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FINAL

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Prepared by:
U.S. Department of the Interior
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In Cooperation with:

Native Village of Kaktovik
Iñupiat Community of the Arctic Slope
Native Village of Venetie Tribal Government
Venetie Village Council
Arctic Village Council
Environmental Protection Agency
State of Alaska

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
BLM	United States Department of the Interior, Bureau of Land Management
DOI	United States Department of the Interior
EIS	environmental impact statement

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Appendix B. Affected Environment

B.1 INTRODUCTION

This appendix describes the baseline environmental conditions (affected environment) for the resources analyzed in the Leasing SEIS. The environmental consequences of the alternatives being evaluated and a discussion of potential direct, indirect, and cumulative impacts from future oil and gas development under each resource is provided in **Chapter 3**. A description of the alternatives under consideration, including the No Action Alternative (Alternative A) and four action alternatives (Alternatives B, C, D, and D2) is provided in **Chapter 2**. The approach to impact analysis is discussed further in **Appendix G**.

B.2 PHYSICAL ENVIRONMENT

B.2.1 Climate and Meteorology

Affected Environment

Climate is described by the National Oceanic and Atmospheric Administration (NOAA 2016) as the average weather patterns in a location over a period of time, typically 30 years or more. Climate change refers to changes in average weather conditions that persist for multiple decades or longer (U.S. Global Change Research Program (USGCRP) 2023). Climate change can be driven by natural forces, such as volcanic eruptions and solar cycles, or by human activity, such as land use changes or the release of greenhouse gases (GHGs). In its Sixth Assessment Report (AR6), the Intergovernmental Panel on Climate Change (IPCC 2021; 2023) concludes that "human activities, principally through emissions of greenhouse gases, have unequivocally caused global warming," and the observed increase in atmospheric concentrations of well-mixed GHGs since around 1750 is the result of anthropogenic activities. The IPCC (2023) concludes that the likely range of the human-caused global surface temperature increase between the periods of 1850-1900 and 2010-2019 is 0.8 to 1.3°C (IPCC 2023).

GHGs can persist for decades or centuries in the atmosphere and warm the atmosphere by absorbing infrared terrestrial radiation emitted by the earth's surface. This section analyzes the three main GHGs associated with the production, transportation, and downstream combustion of oil and gas: carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). GHG emissions are also summarized as carbon dioxide equivalents (CO_2e) using the global warming potential (GWP) of each GHG from AR6 (IPCC 2021). More information on GWPs and how they are applied is provided in **Section 2.1.2** of **Appendix R**, Air Resources Technical Support Document.

Black carbon, a byproduct of incomplete combustion, is also discussed as it affects climate directly by absorbing and scattering solar radiation and indirectly by altering cloud properties (Arctic Monitoring and Assessment Programme (AMAP) 2015; Xu et al. 2017). Black carbon decreases the surface albedo (i.e., reflectivity) when it settles on top of snow or ice, leads to more absorbed solar radiation and increasing snow/ice melt, which causes exposure of land surface and further reduction in albedo (Sedlacek 2021). Black carbon has a strong impact on Arctic regions due to its ability to change the reflective properties of ice and snow. Since black carbon emitted in the Arctic has a higher probability of being deposited onto snow or ice, this "snow- and ice-albedo feedback effect" is stronger when black carbon is emitted in the Arctic than when it is transported from lower latitudes (Sand et al. 2013). The IPCC (2021) reports with

"high confidence" that the deposition of black carbon (and other light absorbing particles) on snow enhances snow melt in the Arctic.

On Alaska's North Slope, black carbon can come from international transportation sources (Matsui et al. 2011; Stohl 2006; Xu et al. 2017), biomass burning (Creamean et al. 2018; Stohl 2006; Xu et al. 2017), shipping (Corbett et al. 2010; Lack and Corbett 2012), oil and gas exploration and production activities (Creamean et al. 2018; Stohl et al. 2013), and residential combustion (Stohl et al. 2013) as noted in the Willow Master Development Final SEIS (BLM 2023). In particular, black carbon emitted from shipping can be deposited directly onto sea ice, and ice breakers can deposit black carbon onto the ice pack itself (Brewer 2015). Black carbon emitted onto ice and snow can increase melting and exacerbate warming as darker and more absorbent land and water surfaces are exposed as a result. Because climate change is a global issue and GHGs are long-lived and well-mixed in the atmosphere, the analysis area cannot be restricted to one region. Thus, the GHG/climate change analysis evaluates GHG emissions and climate trends and impacts globally with a focus on the Coastal Plain, Alaska North Slope, and United States.

Current Conditions

The program area is in the Arctic National Wildlife Refuge in northeast Alaska, along the Beaufort Sea, which is part of the Arctic Ocean. The area is considered an arctic climate zone, with cold winters spanning approximately 8 months of the year (October through May) and cool summers, spanning approximately 4 months of the year (June through September).

Climate summary data for the Kaktovik Airport on Barter Island from late 1947 through mid-2016 are available on the Western Regional Climate Center website (WRCC 2023). More recent (1991-2020) climate data from the Deadhorse Alpine Airport monitor, approximately 50 miles west of the program area, is available on the NOAA U.S. Climate Normals website (NOAA 2023). The period of record climatological data summary for Kaktovik Airport and the recent 30-year climate normals summary for Deadhorse Airport are shown in **Table B-1**. Due to limited snow data available for recent years at the Kaktovik station, monthly average snow depth measured at the USGS Niguanak station from 2000 to 2019 is also provided in **Table B-1** to reflect snow depth patterns in the program area. The USGS Niguanak site was installed in August of 2000 and is located within the Coastal Plain program area (Urban and Clow 2021).

Average monthly precipitation in the area is heaviest in July and August, with approximately an inch in each of these months. The average annual precipitation is approximately 6 inches at both sites. Based on historical snow data from 1947 to 1989 at Kaktovik station, average monthly snowfall is highest in October, at slightly more than nine inches. As seen in the historical snow depth data at the Kaktovik and Niguanak stations, snow is usually on the ground for approximately 10 months of the year, with typically only July and August having little or no snow depth. July is the warmest month, with an average maximum temperature of 55°F and an average minimum temperature of approximately 40°F at the Deadhorse site. February is the coldest month, with an average maximum temperature of around -8°F and an average minimum temperature of around -22°F.

Table B-1
Climate summary data for Weather Stations

Kaktovik Airport Monthly Climate Summary 1947-2016[1]													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average max. temperature (F)	-7.7	-13.9	-8.8	6.7	26.3	38.4	45.4	43.8	35.4	20.3	5.1	-5.8	15.4
Average min. temperature (F)	-20.3	-26.3	-22.5	-9.3	15.7	30.4	34.8	34.4	27.9	10.1	-6.7	-18.3	4.1
Average total precipitation (in.)	0.48	0.23	0.21	0.19	0.31	0.53	1.03	1.10	0.68	0.77	0.41	0.26	6.19
Average total snowfall (in.)[2]	5.0	2.7	2.6	2.4	3.0	1.6	0.5	1.5	4.9	9.2	5.0	3.4	41.8
Average snow depth (in.)[2]	12	14	15	15	10	2	0	0	1	5	8	10	8
Deadhorse Alpine Airport Monthly Climate Normals 1991-2020													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average max. temperature (F)	-8.0	-7.7	-6.6	10.2	28.5	46.2	55.0	49.7	39.3	23.8	8.3	-2.8	19.7
Average min. temperature (F)	-21.7	-21.8	-21.0	-4.5	18.7	33.6	39.7	37.4	30.0	12.8	-4.9	-15.7	6.9
Average temperature (F)	-14.9	-14.8	-13.8	2.8	23.6	39.9	47.3	43.5	34.6	18.3	1.7	-9.2	13.2
Average Precipitation (in.)	0.25	0.13	0.14	0.21	0.30	0.57	1.00	1.37	0.64	0.40	0.33	0.36	5.70
Niguanak Monthly Average Snow Depth 2000-2019													
Parameter	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Annual**
Average snow depth (in.)	6.0	6.1	6.5	6.9	6.1	2.0	N/A	N/A	2.1	4.6	6.3	6.3	5.3

Sources: WRCC 2023, NOAA 2023, Urban and Clow 2021
Notes:
[1] Percent of possible observations from September 23, 1947, to June 7, 2016: maximum temperature: 98.6 percent; minimum temperature: 99.7 percent; precipitation: 99.7 percent snowfall: 95.7 percent snow depth: 98.5 percent
[2] Snowfall data at the Kaktovik Barter Island Airport was only available from 1947 to 1989.

Wind speed and direction are measured at the Kaktovik Airport, as part of the automated weather observing system (AWOS) network. The Kaktovik AWOS station is near the coast, next to the program area. A wind rose showing average windspeed and wind direction measured at Kaktovik Airport from 2013 to 2019 is shown in **Figure 3-1** in **Appendix A** (adapted from the BLM 2020c). The wind rose shows a very strong predominance of winds from the east and the west, with easterly winds being the most common. Winds from northerly and southerly directions are infrequent in this area. Average wind speed is also relatively high, typically ranging from 6 to 8 meters per second (13.4 to 17.9 miles per hour). Winds are typically stronger in the program area than in the NPR-A and other areas to the west (Sturm et al. 2019). Calm winds occurred less than 2 percent of the time between 2013 and 2019 (BLM 2020c). Meteorological monitoring began at the BLM Kaktovik Ambient Air Monitoring Project (KAAMP) station in October 2021 (Air Sciences Inc. and Pinyon Environmental 2022). A wind rose for KAAMP for the period of October 2021 – September 2022 is provided in **Figure 2-1** of **Appendix R**. The annual wind rose from KAAMP station shows similar wind patterns as the Kaktovik Airport site with predominant easterly and westerly winds and infrequent northerly and southerly winds.

Farther inland, near the Brooks Range, monthly mean wind speeds are slightly lower (9.4 miles per hour; Olsson et al. 2002), but strong winds from the south, readily exceeding 45 miles per hour, can originate as

katabatic[1] flows down the many north-oriented valleys of the Brooks Range (Sturm and Stuefer 2013). In general, snow depth and snow water equivalent decrease from inland to the coast (snow water equivalent values of 6 to 8 inches near the foothills to 2 to 5 inches near the coast; Liston and Sturm 1998), while bulk snow density and the prevalence of wind slabs increase (Sturm and Liston 2003).

Wind speed and direction are important to the dilution and transport of air pollutants; wind direction determines where the air pollutants emitted in the area are transported. Based on the Kaktovik AWOS station and KAAMP station wind roses shown in **Figure 3-1** in **Appendix A** and in **Figure 2-1** in **Appendix R**, respectively, air pollutants are most often transported either in a westerly or easterly direction. Wind speed affects the concentration of air pollutants. This is because dispersion and turbulence increase with increasing wind speeds, thereby decreasing air pollutant concentrations resulting from an emitted plume of pollutants.

The degree of stability in the atmosphere is also a key factor in the dispersion of emitted pollutants. During stable conditions, vertical movement in the atmosphere is limited, and the dispersion of pollutants is inhibited. Conversely, during unstable conditions, upward and downward movement in the atmosphere is enhanced, and dispersion of pollutants in the atmosphere increases. Conditions where temperatures increase with height, known as temperature inversions, can result in very stable conditions, with virtually no vertical air motion. The program area typically experiences more large-scale temperature inversions in the winter than in the summer due to colder stable air masses settling closer to the ground during winter. Summer periods in the program area typically have greater instability, due to warming and solar-induced vertical (convective) air currents.

In addition to weather data discussed above, the USGS operates a 16-station, permafrost monitoring network in the NPR-A (13 stations) and the Arctic National Wildlife Refuge (4 stations) to help detect changes in meteorological conditions and soil temperatures. This network, known as the DOI/Global Terrestrial Network for Permafrost Observing System, began operations at some sites as early as 1998, and now has over 10 years of data from each site. The four Arctic National Wildlife Refuge stations include three in the program area: Marsh Creek, Camden Bay, and Niguanak. Data for 1998-2019 are available from this monitoring network (Urban and Clow 2021) at the following website: https://pubs.usgs.gov/ds/1092/ds1092.pdf.

Observed Climate Trends and Impacts in the Arctic, Alaska, and North Slope

The IPCC (2021) reports with "high confidence" that Arctic surface air temperatures have increased by more than double the global average over the past two decades, and annual minimum temperatures have increased at about three times the rate of global surface temperatures since the 1960s; some studies indicate Arctic warming observations at an even higher rate (for example Rantanen et. al. 2022). Average surface air temperatures in the Arctic from October 2021 to September 2022 were the sixth warmest since 1900, and October 2015 to September 2022 is the warmest seven-year period on record (Druckenmiller et al. 2022). The average temperatures over land in the Arctic in 2022 were 2.36 ºF (1.31 ºC) above the 1991-2020 mean, the fifth warmest since 1900 (Druckenmiller et al. 2022).

The June snow cover extent in 2022 was the second lowest in the 56-year record over the North American Arctic (Druckenmiller et al. 2022). Large decreases in the extent and thickness of sea ice have also been observed in both summer and winter (IPCC 2021; Meier et al. 2022). IPCC (2021) reports with "high

[1]Caused by local downward motion of cool air

confidence" that the annual average sea ice extent in the Arctic from 2011 to 2020 was the lowest since at least 1850 and with "medium confidence" that the late summer sea ice extent was the lowest in the past 1000 years. The Arctic Sea ice extent in 2022 was higher than many recent years but still much lower than the long-term average (Meier et al. 2022).

Declines in the extent of snow and sea ice cover has reduced the surface albedo of the Arctic, leading to increased absorption of solar radiation and more warming (IPCC 2019, 2021; Meier et al. 2022). Recent studies suggest that the rapid warming of the Arctic appears to have significant impacts on the jet streams and other weather patterns in mid-latitude regions, leading to severe flooding and drought and other impacts (Moon et al. 2022). Warming temperatures also result in permafrost thawing (Druckenmiller et al. 2022; Jones et al. 2020a). Permafrost thawing releases CO_2 and CH_4 into the atmosphere (Schaefer et al. 2014) and leads to nitrogen release from the previously frozen soil, enabling chemical transformations from nitrogen to N_2O by microbial community within permafrost soil (Butterbach-Bahl et al. 2013; Voigt et al. 2017).

Annual average temperatures across Alaska increased at a rate of approximately 0.7 ºF (0.39 ºC) per decade between the late 1970s and 2016 (USGCRP 2018) and have increased by about 3 ºF (1.67 ºC) since 1925 (NOAA 2022). NOAA (2022) reports that most of the observed warming across the state since 1925 has occurred in the winter and spring with the least amount of warming in the summer and fall. Statewide average temperatures in Alaska have been increasing at an accelerated rate since 2013 with the warmest year on record and the second warmest year on record being 2019 and 2016, respectively (NOAA 2022). Temperatures in Arctic Alaska have been increasing at a higher rate than in the southern part of the state (USGCRP 2018).

Though comprising only about 18 percent of the United States' land area, the state of Alaska contains more than half (53 percent) of the nation's total carbon stock. More than 91 percent of the Alaska total carbon stock resides in soils and permafrost (USGS 2016a, 2016b). The soils of the boreal and arctic regions of Alaska are estimated to hold 31 to 72 billion metric tons of carbon (USGS 2016a). These regions have experienced rapid permafrost warming and thawing since the 1970s (USGCRP 2018).

Temperatures across Alaska's North Slope have been warming at approximately 2.6 times of the rate of the continental U.S. (USGCRP 2018) and have increased by about 4 ºF (2.2 ºC) since 1925 (NOAA 2022). From 1982 to 2022, satellite data indicates that the North Slope has experienced strong tundra greening (i.e., an increase in the productivity of tundra vegetation) (Frost et al. 2022), and it has also experienced widespread permafrost thawing due to increasing temperatures (NOAA 2022; Richter-Menge, Druckenmiller, and Thoman 2020).

Projected Climate Trends and Impacts in the Arctic, Alaska, and North Slope

IPCC (2021) concludes that "it is virtually certain that the Arctic will continue to warm more than global surface temperature, with high confidence above two times the rate of global warming." Temperatures on the coldest days are projected to increase at a rate of about three times the rate of global warming (IPCC 2021). There is also "high confidence" that permafrost thawing, the loss of seasonal snow cover, and decreases in land ice and sea ice cover in the Arctic will be amplified due to additional surface warming (IPCC 2021). The IPCC (2021) report that the Arctic is projected to be "practically ice-free" (i.e., less than 1 million square kilometers) in September (the month of minimum ice extent) at least once before 2050, and this is projected to be the norm for late summer by the end of the 21st century under high GHG emission

scenarios (IPCC 2021). The global volume of perennially frozen ground located 3 meters below land surface is projected (with "medium" confidence) to decrease by 25 percent for each additional 1.8 ºF (1ºC) of warming (IPCC 2021). IPCC (2021) stated with "high confidence" that permafrost thawing will result in the emission of GHGs, but reports low confidence in the timing, magnitude, and the relative roles of CO_2 versus CH_4 as feedback processes. Abrupt permafrost thaw could result in higher emission rates and amplify warming impacts (Turetsky et al. 2019).

By mid-century, Alaska is projected to see an increase of 4 °F to 8 °F in the highest daily maximum temperatures and an increase of more than 12 °F in the lowest daily minimum temperatures compared to the 1981-2000 average under a high GHG emissions scenario (BLM 2022b; USGCRP 2018). A decreasing number of nights below freezing is also projected, with a decrease of more than 20 nights per year statewide and more than 45 nights per year in coastal areas of the Alaska North Slope by mid-century compared to the 1981-2000 average (BLM 2022b; USGCRP 2018). Northern and interior areas of Alaska are projected to experience more warming than the southern areas of the state (BLM 2022b). Due to projected warming, near-surface permafrost in the Arctic and boreal regions of Alaska is projected to disappear on 16 to 24 percent of the landscape by 2100 (USGCRP 2018). Precipitation is projected to increase across the state in all seasons but with greater increases during winter and spring (BLM 2022b). Annual precipitation is projected to increase by more than 10 percent by 2050 over the majority of the state, with larger increases in the Arctic and interior areas (BLM 2022b).

By the end of century, the North Slope is projected to see an increase in average annual temperatures of about 16°F compared to 1950-2009 averages under a high emissions scenario (SNAP 2023). Winter temperatures on the North Slope are projected to increase by 8.5 °F - 12.3 °F by mid-century and 12.8 °F - 22.5 °F by the end of the century depending on the GHG emission scenario (SNAP 2023). The smallest increases are projected for summer temperatures with an increase of 4.6 °F – 5.9 °F by mid-century and 5.2°F - 10.0 °F by the end of the century (SNAP 2023). Precipitation in North Slope is projected to increase with the largest increases in summer and the smallest increases in spring, although there is high uncertainty in the precipitation projections (SNAP 2023). Progressive deep thawing of permafrost is anticipated to begin in the next 30-40 years in the North Slope due to increasing temperatures (Richter-Menge, Druckenmiller, and Thoman 2020).

Baseline Greenhouse Gas Emissions

An inventory of recent GHG emissions, expressed as CO_2e, at various geographic scales is provided in **Table B-2**, in units of million metric tons (MMT) per year. Emissions are provided for 2020, the latest year for which the EPA's national and state emission inventories have been finalized (EPA 2022a, 2022b); emissions for 2019 are also provided as the 2020 emissions were impacted by the COVID-19 pandemic. Note that the GHG emissions shown in the table do not include sources and sinks associated with land use, land use change, or forestry (LULUCF). Also, oil and gas methane emissions in the EPA inventories have been found to be underestimated likely due to not fully accounting for emissions released during abnormal operating conditions (Alvarez et al. 2018). A recent similar study estimated that the carbon intensity (including emissions of CO_2 and CH_4) for oil and gas production in the US Gulf of Mexico is more than twice the amount reported in the EPA inventories (Negron et al. 2023).

Table B-2
GHG Emissions at Various Geographic Scales in year 2019 and 2020

Geographic Area	Data Source	2019 CO_2e Emissions (MMT/year)	2020 CO_2e Emissions (MMT/year)
Alaska	EPA 2022a, ADEC 2023	33.7	35.8
US	EPA 2022b	6,571.7	5,981.4
Global	UNEP 2022	52,600	50,800

Sources: EPA 2022a, 2022b; UNEP 2022; ADEC 2023
Notes:
EPA 2022a and 2022b use the 100-year Global Warming Potentials (GWPs) from the IPCC Fourth Assessment Report to convert GHGs emissions to CO_2e, where the GWP is 1 for CO_2, 25 for CH_4, and 298 for N_2O. UNEP 2022 uses the 100-year GWPs from the IPCC Sixth Assessment Report to convert GHGs emissions to CO_2e, where the GWP is 1 for CO_2, 29.8 and 27.2 for fossil and non-fossil origin CH_4, and 273 for N_2O.

The Alaska Department of Environmental Conservation (ADEC 2023) published a GHG emissions inventory report for the state of Alaska that provides annual emissions for the period 1990 to 2020. Emissions in 2019 and 2020 are presented in **Table B-2**. Total Alaska GHG emissions peaked in 2005 and have generally decreased since then. Oil and gas and power plants are the largest sources of GHG emissions in the state. In 2019, approximately 67.3 percent of total GHG emission from the state were from the oil and gas industry and other industrial activities and 21 percent were from power plants. Emissions from oil and gas have decreased mainly due to the decline in crude oil production and refining in the state, while the electrical generation emissions increased by approximately 3 percent between 1990 and 2019 (ADEC 2023). Using data and projections from USGS, ADEC (2023) concludes that the sequestration of GHGs from land use, land-use change, and forestry from lands in the state has been significantly higher than the state's total anthropogenic GHG emissions since 1990, with annual average emissions of approximately 46.96 MMT of CO_2e and average yearly sequestration capacity of approximately 3.778 billion metric tons between 1990 and 2020 (ADEC 2023). Note that the ADEC emissions and sinks calculations did not include carbon flux from natural sources such as GHG emissions from permafrost carbon feedback. These types of actions would likely increase in the future due to climate change.

EPA requires all large emitters (facilities emitting more than 25,000 metric tons or more of CO_2e per year) to report their annual GHG emissions as part of the Greenhouse Gas Reporting Program (GHGRP). Annual emissions reported under the GHGRP are provided in the EPA Facility Level Information on Greenhouse Gases Tool (EPA 2022c). The total CO_2e emissions from all major sources on the North Slope in 2019, 2020, and 2021 (the most recent three years of data) are listed in **Table B-3**. The industrial sector, including oil and gas, is the major contributor to GHG emissions in Alaska's North Slope and in the entire state of Alaska (EPA 2022a).

Table B-3
Greenhouse Gas Emissions from Major Facilities in the North Slope (in metric tons of CO_2e[1]) for years 2019, 2020, and 2021

Facility Name	2019	2020	2021
Alyeska Pipeline Se/Taps Pump Station 01	56,022	63,920	72,700
Barrow Utilities & Electric	42,777	43,489	43,017
Hilcorp Alaska, LLC Central Compressor Plant	2,890,691	3,004,082	3,024,876
Hilcorp Alaska, LLC Central Gas Facility	2,026,974	1,979,598	2,053,953
Hilcorp Alaska, LLC Central Power Station	771,315	781,717	801,343
Crude Oil Topping Unit, Prudhoe Bay Operations Center, Tarmac Camp	20,413	20,636	21,447
ConocoPhillips Alaska Inc – KRU CPF1	548,907	490,729	511,828

Facility Name	2019	2020	2021
ConocoPhillips Alaska Inc – KRU CPF2	411,758	356,150	330,118
ConocoPhillips Alaska Inc – KRU CPF3	311,368	300,759	317,111
ConocoPhillips Alaska Inc – KRU STP	90,838	93,755	86,475
Hilcorp Alaska, LLC Endicott Production Facility	610,769	637,114	598,796
Hilcorp Alaska, LLC Lisburne Production Center	634,439	669,976	691,820
Hilcorp Alaska, LLC Seawater Injection Plant	148,964	187,588	215,447
Hilcorp Alaska, LLC Seawater Treatment Plant	131,849	178,738	158,976
Trans Alaska Pipeline System Pump Station 3	53,045	57,585	29,636
Trans Alaska Pipeline System Pump Station 4	55,131	54,268	55,129
Trans Alaska Pipeline System Pump Station 7	11,251	8,913	-
Total	**8,816,511**	**8,929,017**	**9,012,672**

Source: EPA 2022c
Notes:

[1] EPA (2022c) reports CO_2e (carbon dioxide equivalent) using 100-year time horizon global warming potential (GWP) values from IPCC AR4, where the GWP is 1 for CO_2, 25 for CH_4, and 298 for N_2O.

Under Paris Agreement, the United States has established an economy-wide target of reducing its net GHG emissions by 50 percent to 52 percent below 2005 level by 2030 (UNFCCC 2021). The 2005 U.S. net emissions (including sinks) were 6,635 MMT CO_2e (UNFCCC 2021). Therefore, the 2030 U.S. net emissions target is estimated to be between 3,185 and 3,318 MMT CO_2e.

B.2.2 Air Quality

Affected Environment

Air quality is measured by the concentration of air pollutants in a geographic area. Wind, temperature, humidity, and geographic features, in addition to natural and anthropogenic emissions sources, are factors that have the potential to affect the resource. Indicators of impacts on air quality are the inability to meet NAAQS or AAAQS and a degradation of AQRVs, such as visibility and deposition.

Air Quality

The federal Clean Air Act provides the framework for protecting air quality at the national, state, and local level. The act designates the EPA as the chief governing body of air resources in the US; however, it provides states with the management authority to implement their own air quality legislation, monitoring, and control measures. With EPA approval, state and local air districts can implement their own permitting and emissions control regulations to implement federal requirements, and the state and local requirements cannot be less stringent than the federal requirements. In Alaska, the ADEC has the authority to implement and enforce the Alaska Air Quality Control Regulations under 18 Alaska Administrative Code 50 (18 AAC 50) through an EPA-approved State Implementation Plan.

Criteria Air Pollutants

Under the authority of the Clean Air Act, the EPA has set time-averaged NAAQS for six criteria air pollutants considered to be key indicators of air quality: carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), and two categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]) (EPA 2023a). Note that Pb is also a hazardous air pollutant. These standards may be updated periodically based on peer-reviewed scientific data. The EPA updated the primary annual $PM_{2.5}$ NAAQS in February 2024, lowering the value from 12.0 $\mu g/m^3$ to 9.0 $\mu g/m^3$ (89 FR 16202). States may set their own ambient air quality standards for criteria pollutants and other pollutants, but their criteria pollutant standards must be at least as stringent as the

federal standards. The AAAQS were promulgated in 18 AAC 50. The NAAQS and AAAQS are provided in **Table 2-1** in **Appendix R**.

The EPA designates areas as attainment or nonattainment based on compliance with the NAAQS, or unclassifiable if there is insufficient data to make an attainment/nonattainment determination. The program area is in attainment or unclassifiable (treated as attainment for regulatory purposes) for each of the NAAQS (EPA 2023d). The nearest nonattainment area is in Fairbanks, approximately 350 miles southwest of the Coastal Plain, which is in nonattainment for the 24-hour averaged $PM_{2.5}$ NAAQS (EPA 2023d).

The Clean Air Act requires each state to identify areas that have ambient air quality in violation of federal standards using monitoring data collected through state and federal monitoring networks. There is one BLM monitoring station located within the program area near Kaktovik which began collecting data in October 2021 (AirSci 2022). There are no other state or federal air quality monitoring stations in the program area. Industry monitoring that conforms to EPA guidance is an available quantitative indicator of air quality on the North Slope. The Nuiqsut station, operated by ConocoPhillips, Alaska Inc. (CPAI) and located approximately 110 miles west of the Coastal Plain boundary, has operated since 1999 and reports complete, multiyear data. Kaktovik and Nuiqsut are the only two monitors within approximately 100 miles of the Coastal Plain that have current data through 2022. In addition, ADEC shares monitoring values for short-term, project-specific air quality monitors used in the air permitting process. There are no Pb measurements in the analysis area; however, emissions of Pb from developments (apart from some Pb emissions from aircraft) are expected to be small.

Table 2-2 through **Table 2-6** in **Appendix R** show the measured pollutant concentrations at the stations in the North Slope that are located within approximately 100 miles of the Coastal Plain and have verified data in the last 5 years or at least 3 years of verified data within the past 10 years. These include the Kaktovik, Point Thomson, Nuiqsut, A-Pad, and CCP monitoring stations, which are shown in **Figure 2-1** in **Appendix R**. Three years of data are shown where possible since the form of some NAAQS typically requires an average over three years (see **Table 2-1** in **Appendix R**). The monitored concentrations are all well below the NAAQS and AAAQS.

Hazardous Air Pollutants

In addition to criteria pollutants, the Clean Air Act regulates toxic air pollutants, or hazardous air pollutants (HAPs), that are known or suspected to cause cancer or other serious health effects or adverse environmental impacts. The HAP regulatory process identifies specific chemical substances that are potentially hazardous to human health. It sets emission standards to regulate the amount of those substances that can be released by individual facilities or by specific types of equipment. Controls can be required at the source, either through manufacturer requirements or via add-on control devices, to limit the release of these air toxics into the atmosphere. The HAPs most relevant to oil and gas operations are formaldehyde, n-hexane, benzene, toluene, ethylbenzene, and xylenes.

There are two active monitoring stations on the North Slope, Nuiqsut and CD1/CD4, that report multi-year measurements of volatile organic compounds (VOCs), including HAPs. Measurements of five select HAPs (n-hexane, benzene, toluene, ethylbenzene, and xylenes) commonly emitted during oil and gas development are reported for these stations in **Table 2-7** and **Table 2-8** in **Appendix R**. Formaldehyde is not measured by either sampling program. Data for additional VOCs is included in SLR (2022). In general, there have been very few VOCs measured above the detection limit between 2014 and 2022, and reported

concentrations are well below the corresponding Reference Exposure Level (RELs) and Acute Exposure Guideline Levels (AEGLs) (EPA 2021). More information can be found in SLR (2022).

Air Quality Related Values

AQRVs are resources that may be affected by a change in air quality. The Clean Air Act gives federal land managers the responsibility for protecting these values in Class I areas from the adverse impacts of air pollution (40 CFR 51.166). The Class I area nearest to the program area is Denali National Park, which lies about 425 miles southwest. Federally managed national parks, monuments, wilderness areas, and wildlife refuges that were not designated as Class I areas are classified as Class II areas. The nearest Class II areas are the Arctic National Wildlife Refuge, in which the Coastal Plain is located, and Gates of the Arctic National Park, approximately 125 miles southwest of the Coastal Plain. The Federal Land Managers' Air Quality Related Values Work Group report (FLAG 2010) provides guidance for evaluating AQRVs. AQRVs for visibility impairment and atmospheric deposition are discussed below.

Visibility

Haze is a form of air pollution that occurs from refraction of sunlight on particles and gases in the atmosphere. The result of haze is impaired visibility. In 1999, the EPA published the Regional Haze Rule, implementing a visibility protection program for Class I areas. The closest Class I area to the program area is Denali National Park, more than 400 miles away. Visibility is monitored through the Interagency Monitoring for the Protection of Visual Environments (IMPROVE) at sites in or near Class I and Class II areas and is described by two units of measure: haze index in deciviews (dv) and standard visual range. Each dv change corresponds to a small but perceptible change in visibility conditions.

The closest monitor to the program area is Toolik Field Station, located approximately 110 miles southwest of the Coastal Plain. Note that this monitor will be discontinued at the end of 2023. Visibility is also monitored at Bettles Field Station (near Gates of the Arctic National Park) and Denali National Park. Data from these three monitors, including the haze index in dv on the 20 percent haziest and 20 percent clearest days, is shown in **Figures 2-1** through **Figure 2-3** in **Appendix R**. The 20 percent haziest days include both anthropogenic and natural influences following the EPA algorithm (EPA 2003) as revised by IMPROVE in December 2019. Data for the 20 percent most impaired days, which includes only anthropogenic influences, is also shown in **Figure 1-4** in **Appendix R** for Denali National Park but is unavailable at the other two sites.

Three years of data (2019 through 2021) are available at Toolik Field Station; visibility conditions have remained relatively constant with a slight decrease in the haze index on both the haziest and clearest days from 2019 to 2021. The 3 dv measure on the clearest days in 2021 corresponds to a visual range of about 180 miles; the approximately 10 dv on the haziest days in 2021 corresponds to a visual range of about 90 miles (IMPROVE 2023). Estimated natural visibility conditions range from 2.7 dv (visual range of approximately 219 miles) and 9.3 dv (approximately 109 miles) on the 20 percent clearest and 20 percent haziest days, respectively (IMPROVE 2023).

Data was collected at the Bettles Field Station (Gates of the Arctic National Park) from 2010 to 2014 and showed an improvement in conditions on the haziest days and essentially constant visibility conditions for the clearest days over that period. The 4 dv measure on the clearest days corresponds to a visual range of about 160 miles; the approximately 13 to 9 dv on the haziest days corresponds to a visual range of 65 to 100 miles (IMPROVE 2023). Estimated natural visibility conditions range from 2.8 dv (visual range of

approximately 222 miles) to 7.7 dv (approximately 130 miles) on the 20 percent clearest and 20 percent haziest days, respectively (IMPROVE 2023).

Denali National Park has the longest visibility data from 1989 through 2021. The haze index at Denali National Park on the haziest days generally shows a downward trend from 1989 to 2021, with the maximum value of approximately 22 dv (visual range of about 27 miles) occurring in 2004. This high value in 2004 is an outlier and is most likely due to wildfires. On the clearest days, the haze index in Denali National Park has consistently been slightly higher than natural conditions since 2000, ranging from approximately 2 to 3 dv (visible range of 180 to 200 miles) (IMPROVE 2023). The haze index on the most impaired days generally shows a downward trend from 1989 to 2021. The increase in 2009 has been attributed to local wildfire and volcano activity (ADEC 2022a). Estimated natural visibility conditions range from 1.8 dv (visual range of approximately 219 miles) to 7.3 dv (approximately 109 miles) on the 20 percent clearest and 20 percent haziest days, respectively (IMPROVE 2023).

Deposition

Atmospheric deposition is the transfer of air pollutants from the atmosphere to aquatic and land-based ecosystems. This can occur through precipitation (wet deposition) or through the dry gravitational settling of particles onto soil, water, and vegetation (dry deposition). A primary issue of atmospheric deposition is the potential formation of acids, particularly nitrogen and sulfur species. In areas of heavy emissions, this can lead to acid rain and snow and the subsequent deterioration of lakes, streams, soils, nutrient cycling, and biological diversity. Additional compounds that can accumulate from atmospheric deposition are air toxins, heavy metals such as mercury, and nutrients such as nitrates and ammonium.

There are currently no federal standards for deposition and Federal Land Managers instead use critical loads and deposition analysis thresholds to assess cumulative and project-specific impacts. Critical loads are levels of deposition below which no harmful effects to an ecosystem are expected. Deposition analysis thresholds are applicable only to individual projects and are therefore not relevant to the current analysis for the program area. In the Alaska tundra ecoregion, critical loads of atmospheric nitrogen deposition range from 1.0 to 3.0 kilograms nitrogen per hectare per year (kg N/ha-yr) (Pardo et al. 2011, Sullivan 2016).

The National Trends Network (NTN) of the National Atmospheric Deposition Program (NADP) measures concentrations and deposition rates of constituents removed from the atmosphere by wet deposition. It focuses on those that affect rainfall acidity and those that may cause adverse ecological effects. The Clean Air Status and Trends Network (CASTNET) measures air quality and deposition trends in rural areas. CASTNET and NTN data are used to estimate total (wet and dry) sulfur and nitrogen deposition for critical load analysis and other ecological studies. A hybrid approach with modeled and modeling data is used for these total deposition estimates (NADP 2014).

The closest active monitoring stations to the program area are Toolik Field Station (NTN Site AK96), Gates of the Arctic National Park (NTN Site AK06), Poker Creek (NTN Site AK01), and Denali National Park (NTN Site AK03). As noted previously, the Toolik Field Station monitor will be discontinued at the end of 2023. Trends for ammonium (NH_4^-), nitrate (NO_3^-), and sulfate (SO_4^{-2}) for each station are shown in **Figure 2-4** through **Figure 2-7** in **Appendix R**. Most of the annual wet deposition fluxes of NH_4^-, NO_3^-, and SO_4^{2-} are below 1.0 kg/ha-yr with no apparent trend at most monitoring stations. The wet deposition fluxes of NO_3^- at Poker Creek have shown an upward trend over the last decade and 2019 and 2020 had the two

highest measurements in over two decades. However, these values are still below 1.0 kg/ha-yr and Poker Creek is located more than 250 miles from the program area.

The estimated total deposition flux of nitrogen and sulfur for Denali National Park for 1999 through 2020 is provided in **Figure 2-8** in **Appendix R**. The highest monitored total deposition fluxes of nitrogen and sulfur occurred in 2002 and were 0.741 kg N/ha-yr and 0.601 kg S/ha-yr, respectively. The mean deposition fluxes of nitrogen and sulfur from 1999 through 2020 are 0.297 kg N/ha-yr and 0.287 kg S/ha-yr, respectively. The total deposition flux of nitrogen was well below the critical load for nitrogen deposition defined by the Federal Land Managers for the tundra ecoregion of Alaska (1.0 to 3.0 kg N/ha-yr) in all years.

Mercury (Hg) deposition has been measured at the Toolik Field Station by the NADP's Mercury Deposition Network (MDN) since 2017. There are only two years with available data that meet data completeness requirements. In 2018, Hg deposition was 2.5 $\mu g/m^2$ and in 2020, Hg deposition was 2.3 $\mu g/m^2$ (NADP 2023). There are currently no federal or state standards for Hg deposition.

Air Pollutant Sources

There are currently few sources of air pollutants in the Coastal Plain. The primary pollutant sources are residential and commercial heating sources and mobile sources such as snowmachines, vehicles, and aircraft. Additional emission sources on the wider region of the North Slope outside the program area are dominated by onshore sources (e.g., oil and gas production and exploration, airports, pipelines, and non-oil and gas related stationary and mobile sources). Oil and gas facilities are the greatest source of all criteria air pollutants except PM_{10} and $PM_{2.5}$, which are dominated by dust from unpaved roads (Fields Simms et al. 2014; BLM 2020b). PM emissions are highly uncertain however (Fields Simms et al. 2014; BLM 2020b). HAP emissions are greatest from onshore oil and gas activity, other nonroad vehicles and equipment, on-road gasoline-powered trucks, waste incineration, landfills, and other combustion sources (Fields Simms et al. 2014). Emissions of criteria and hazardous air pollutants from offshore sources (drilling rigs, survey/drilling vessels and aircraft, and commercial vessels) are minor compared to onshore sources (Fields Simms et al. 2014; BLM 2020b).

The nearest oil and gas facilities occur in the Point Thomson, Badami, Liberty, and Duck Island oil and gas units, west of the Coastal Plain (ADNR DOG 2022). As of April 2023, there were approximately 1.9 million acres of active leases on Alaska's North Slope (ADNR DOG 2023). There are currently no active oil or gas wells in the Coastal Plain.

Alaska is affected by international long-range transport of pollutants that affect visibility conditions (Stohl 2006; Matsui et al. 2011). International transport of pollutants into Alaska has been documented through a variety of research studies. Storm activity in arid desert regions of Asia typically affects Alaska from March to May. Arctic haze has been attributed to anthropogenic aerosols from Northern Europe and Russia that reach Alaska from November to May. Human caused and natural fires from Siberia, Asia, Europe and North America can also affect Alaska from April to August (Huff 2017).

B.2.3 Acoustic Environment

Affected Environment

This section incorporates by reference the overview of acoustical principles in the acoustical environment section from the GMT2 Final SEIS (BLM 2018a, Section 3.2.3.6). Because the greater Nuiqsut area, the

focus of the GMT2 Final SEIS, has a different acoustical setting than the Coastal Plain, the 2010 background acoustic monitoring done by the US Army Corps of Engineers (USACE) at Point Thomson, next to the western Coastal Plain boundary, is used as a comparable description of existing acoustic environment in the program area (USACE 2012, Appendix O).

Terrestrial Acoustic Environment

The terrestrial acoustic environment includes sounds caused by wildlife and natural features of the landscape, as well as unwanted human-caused sounds. As previously stated, such sounds are considered noise because they have the potential to affect the natural acoustical environment and noise-sensitive resources and values. In the context of a leasing program, noise-sensitive resources, along with wildlife, are people engaged in subsistence pursuits, recreation, and other activities.

The degree to which noise may disturb wildlife and human receptors depends on many factors, such as the following (Francis and Barber 2013):

- Wildlife responses to noise are known to vary by species
- Acoustical factors, such as the frequency, intensity (loudness), and duration of noise
- Non-acoustical factors, such as life-history stage, environmental or behavioral context, and degree of past exposure

Noise that is abrupt and unpredictable may be perceived as a threat, potentially triggering a startle response or antipredator behavior (Fred and Dill 2002; Francis and Barber 2013). Chronic noise may affect sensory capabilities via masking of biologically important natural sounds, such as those used for communication or detection of predators or prey (Francis and Barber 2013). Similarly, human responses to noise also are contingent both on acoustical and non-acoustical factors. Examples of the latter are social context and perceived ability to exert control over the noise source (Kroesen et al. 2008; Stallen 1999).

Existing noise sources in the Coastal Plain area are the following:

- On-road and off-road vehicles and snowmobiles and community noise, such as generators and other small equipment motors, in the village of Kaktovik
- Aircraft and boats for village access, tourism, recreation access to remote sites, and scientific research

Disturbance of subsistence resources (particularly caribou) and subsistence activities by low-flying aircraft, including helicopters, associated with oil and gas development has long been an issue of concern to North Slope residents. The level of 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 (USFWS and BLM 2018). Stinchcomb et al. (2020) demonstrate that there is direct correlation between aircraft noise and subsistence. Subsistence harvesters report that aircraft startle caribou and that they prefer to avoid aircraft themselves. As such, the harvesters are required to travel farther for a successful harvest, increasing fuels costs, equipment, and effort (Stinchcomb et al. 2020).

According to a recent soundscape study (Perra 2022), Caribou's auditory system is capable of picking up on all types of anthropogenic sounds, including low frequency noises related to oil and gas exploration. Caribou can detect sounds as low as 30 hertz (Hz) with acute sensitivity, making it possible for them to

perceive sounds of seismic exploration, gravel mine blasting, and other anthropogenic sounds associated with resource extraction from afar (Perra 2022).

As reported in Stinchcomb (2017), sound levels perceived as unwanted or annoying by humans correspond with the range of sound levels emitted by low-flying aircraft. Aircraft sound is concentrated at low frequencies, which lose little energy over long distances and produce vibrations that elicit feelings of discomfort and annoyance.

Sound Propagation Through Air

The propagation of sound in outdoor settings is affected by many variables: distance from the source; meteorological conditions, such as temperature, wind, and humidity; and landscape features and surface characteristics that may interfere with sound through absorption, reflection, or diffraction (Attenborough 2014).

Among these, distance is the most significant factor. For a point source producing a constant sound, sound levels are expressed as dB and generally decrease by approximately 6 dB for each doubling of distance from the source. The same 6 dB reduction with doubling distance holds for the maximum sound level produced by a single moving source, such as an aircraft in flight, when the source is at its closest point of approach to the receptor (Attenborough 2014). For a line of moving sources, such as vehicle traffic on a road, sound levels decrease by approximately 3 dB with doubling distance.

When wind is present, sound diminishes with distance less than expected in the downwind direction—downwind propagation is enhanced—and greater than expected in the upwind direction. Temperature inversions reduce decreases and enhance propagation. In general, meteorological conditions tend to enhance sound levels to a lesser degree, such as 1 to 5 dB, than decrease sound levels, such as 5 to 20 dB (Attenborough 2014).

Noise-Related Health Effects

The results from multiple scientific studies highlight the detrimental effects of noise exposure on human health, especially from road traffic noise. A meta-analysis reveals that higher noise exposure correlates with an increased risk of incidence and mortality from myocardial infarction (MI), tissue death of the heart muscle, with each 10 dBA rise in noise contributing to a 4 percent higher MI incidence and a 2 percent higher MI mortality rate (Liu et al. 2022). Additionally, road traffic noise has been linked to several other mental and physical illnesses including hypertension, cardiovascular diseases, anxiety, negative mental health, type 2 diabetes, behavioral problems in children, auditory system damage, and potentially altered BMI trajectories in children exposed during pregnancy (Babisch et al. 2014a; Babisch et al. 2014b; Lan et al. 2020; Li et al. 2022; Stansfeld et al. 2021; Thacher et al. 2021; Tiesler et al. 2013; Wang et al. 2021; Weyde et al. 2018)

Terrestrial Acoustic Monitoring

No long-term acoustic monitoring has been established in the program area for detecting future changes in acoustic conditions and attributing such changes to particular activities, including those associated with oil and gas exploration and development (USFWS and BLM 2018); however, in 2010, the USACE conducted short-term baseline acoustical monitoring in the extreme northwest corner of the program area for the Point Thomson EIS. In this area, approximately 9 miles inland from the coast and 3 miles west of the Canning River, noise from human activities was generally absent (USACE 2012). Those conducting the baseline

monitoring recorded hourly median sound levels of 23 to 28 A-weighted decibels (dBA) during winter conditions (April 27–June 8) and 24 to 26 dBA during summer conditions (July 12–August 12). This baseline dBA reflects a "natural quiet" condition and represents the benchmark target condition for attempts to maintain natural quiet in the program area.

The program area is expected to have an acoustic environment similar to that described by the USACE (2012). In that study, the USACE noted that the low levels of sound recorded across all hours of the day, and across different seasons of the year, show loud events are rare. Natural sources, such as wildlife and wind, were the dominant sound of the sampling areas in the soundscape in both winter and summer. The USACE observed that human-caused noise, dominated by aircraft, ranged from zero to one event per hour (see also **Section B.4.9**, Transportation).

Marine Acoustic Environment

The underwater and terrestrial acoustic environment is particularly important to marine mammals since they use noise to navigate, find prey, communicate, and detect disturbances or threats. While cetaceans typically rely on underwater acoustics, pinnipeds[2] and polar bears perceive noises in and out of the water, such as when individuals are hauled out, spy-hopping, or traveling across the sea ice as is the case with polar bears (BOEM 2018b).

In the Beaufort Sea, natural sources of marine sound include wind stirring the surface of the ocean, storms, ice movements, and animal vocalizations and noises (including whale calls and echolocation clicks). The frequency and magnitude of noise from each of these producers can differ dramatically, as a result of variation in the seasonal presence of the sound sources. Existing human sources of sound in the Beaufort Sea include vessels (such as motorboats used for subsistence and local transportation, commercial shipping, and research vessels); navigation and scientific research equipment (such as benthic trawls); airplanes and helicopters; human settlements; military activities; and offshore industrial activities.

Sound Propagation Through Water and Ice

The propagation of sound and sound pressure levels through water and ice is an important consideration. This is because such activities as seismic surveys, pile driving, and vessel traffic have the potential to affect fish and other aquatic species, birds, and marine mammals that use aquatic environments.

Propagation of sound produced underwater depends highly on environmental characteristics, such as bathymetry, bottom type, water depth, temperature, and salinity. The sound received at a particular location would be different from that near the source due to the interaction of many factors, such as propagation loss, how the sound is reflected, refracted, or scattered, the potential for reverberation, and interference due to multi-path propagation. In addition, absorption greatly affects the distance over which higher frequency sounds propagate (US Navy 2019).

Sound propagation in the Arctic differs from nonpolar regions. High-frequency sound waves that hit the underside of sea ice tend to attenuate by scattering caused by repeated reflection. Sound waves travelling near the surface of the water column in ice-covered water would therefore not propagate as far as sound waves travelling deeper in the water column or as far as sound waves travelling near the surface in ice-free water. Arctic waters also exhibit a very different sound speed profile than in nonpolar regions, which is

[2]Seals, walruses, and sea lions

caused by a layer of freshwater near the surface or by layers with different temperatures. As a result, sound waves tend to get trapped within a certain layer of the water column (100 to 300 meters) and to propagate farther than if they were not trapped in this channel (Au and Hastings 2008, cited in PAME 2019).

No long-term underwater acoustic monitoring has been undertaken in the program area.

Underwater Noise

Existing and ongoing underwater noise in and around the program area is primarily emitted from shipping boats, icebreaking, and offshore construction. Shipping activities involve the continuous operation of vessels, including cargo ships, tankers, and cruise liners, which emit engine and propeller noise as they navigate through the water. Additionally, the cavitation phenomenon, caused by the pressure drop around ship propellers, generates intense bursts of low-frequency noise (WWF 2023). Icebreaking, essential for maintaining navigable waterways in colder regions, produces significant noise due to the powerful propulsion systems required to break through ice sheets. Furthermore, offshore construction activities, such as pile driving, dredging, and the installation of offshore oil platforms, involve heavy machinery and equipment that generate substantial noise both above and below the water's surface. Noise from these activities can travel long distances underwater, leading to increases and changes in levels of oceanic noise across numerous coastal and offshore habitats (NOAA 2023). This can have detrimental effects on marine life, including disruption of communication, navigation, feeding, and mating behaviors.

Climate Change

Northern environments, including the program area, have experienced warming over the last half-century (SNAP 2023). This trend is expected to continue as climate models predict that high northern latitude regions will experience the greatest warming temperatures of the globe (IPCC 2014). The Arctic Coastal Plain Province, dominated by features and processes driven by permafrost, has the potential to change greatly with the anticipated degradation and thaw of permafrost. Through this process, climate change could affect Arctic sound propagation due to thawing permafrost and increases in water or swampy conditions that allow sound to propagate differently across the landscape. In addition, with warming temperatures, ice degradation and related changes in sound-attenuating conditions are anticipated.

B.2.4 Physiography

Affected Environment

Physiography describes the physical features of an area, including landforms and topography. The Coastal Plain[3] of the Arctic Refuge occupies about 1,563,500 acres in the northeast corner of Alaska. It stretches about 100 miles from the Staines River, the westernmost distributary of the Canning River, on the west to the Aichilik River on the east. From the coast of the Beaufort Sea, the Coastal Plain extends south about 40 miles at its widest point. Elevations range from sea level along the coast to about 2,000 feet at the southern boundary. The Coastal Plain is drained by braided channel rivers, which have their headwaters in highlands to the south. These sediment-laden rivers form deltas where they flow into the sea. **Map 3-1** in **Appendix A** depicts the topography of the Coastal Plain.

[3]In this EIS, "Coastal Plain" describes the program area and is consistent with the language in PL 115-97, Section 20001. It should not be confused with the Arctic Coastal Plain physiographic province, which extends across all of northern Alaska and into Canada, or the general physiographic term "coastal plain," which refers to a flat, low-lying area next to an ocean.

Table B-4 describes the primary types of terrain found in the Coastal Plain, based on the mapping of Walker et al. (1982).

Table B-4
Terrain Types in the Coastal Plain

Terrain Type	Percent of Study Area[1]	Description
Foothills	44.7	The hills typically have rounded, north-trending interfluves between the major drainages. Elevations of the hilltops range from about 300 feet at the coastward boundary to over 1,200 feet at the southern limits of the study area.
River floodplains and deltas	24.6	Includes present channels, braided drainages, and adjacent abandoned channels and deltas. Also includes active and relict steep river bluffs that are subject to mudflows and solifluction.[2]
Hilly coastal plains	22.4	Complex region of gently undulating tundra, with small thaw lakes and pond complexes stretching inland between the Hulahula and Jago Rivers. Drainages are better defined than on flat coastal plains, and large expanses of well-drained terrain border many of the streams.
Flat thaw-lake plains	3.1	The proximity of the Brooks Range to the coast results in a much narrower coastal plain than areas to the west. Typical coastal plain topography, with large thaw lakes, drained lake basins, and low-centered, ice-wedge polygons, is found only in a few small areas, including the Canning River delta, the adjacent coastal area 40 to 50 miles eastward, and a small area southwest of Barter Island.
Mountainous terrain	<0.1	Mountainous terrain underlain by quartzite occurs in the area of Sadlerochit Spring. Elevations are mostly over 1,900 feet.

Source: Walker et al. 1982
[1]The study area for Walker et al. (1982) was defined as the 1.4-million-acre area that was being considered for seismic oil exploration at the time. "Ocean" comprises an additional 5.2 percent of the study area.
[2] See *Geologic Hazards* in **Section B.2.5**, Geology and Minerals.

Physiographic Provinces

A physiographic province is a region of similar topography and climate that has had a unified geomorphic history. The Coastal Plain encompasses parts of three physiographic provinces, as defined by Wahrhaftig (1965). These provinces, shown on **Map 3-2** in **Appendix A**, consist of the Arctic Coastal Plain, the Arctic Foothills, and the Arctic Mountains.

Ecoregions have also been defined for the State of Alaska, including the Coastal Plain (Nowacki et al. 2001). Besides climate and topography, ecoregions are based on additional characteristics such as soils and vegetation data. Ecoregions are described in **Section B.3.1**, Vegetation and Wetlands.

Ninety percent of the Coastal Plain is in the Arctic Coastal Plain physiographic province. The Arctic Coastal Plain physiographic province is divided into the Teshekpuk and White Hills sections. The Teshekpuk section makes up roughly the western two-thirds of the Arctic Coastal Plain province, including the areas that have been previously developed for oil and gas resources, such as Prudhoe Bay and the NPR-A. The Teshekpuk section is generally characterized as a smooth plain rising gradually from the Beaufort Sea to a maximum elevation of 600 feet above sea level (asl). It is covered with elongated thaw lakes having a similar orientation. The coastline has low relief and the shore is typically only 1 to 10 feet asl. The White Hills section is characterized by scattered groups of low hills rising above the plain.

The topography in the White Hills section is much more varied than the Teshekpuk section. The northwest corner of the Coastal Plain is part of the Teshekpuk section and the remainder of the Arctic Coastal Plain physiographic province in the Coastal Plain belongs to the White Hills section (Wahrhaftig 1965). The White Hills section is hillier in the western half than the eastern half.

The Arctic Coastal Plain features a series of large alluvial fans (USFWS 2015a, p. 4-17); these are deposits occurring where the carrying capacity of the stream lessens, resulting in deposition. This often occurs where stream gradient decreases, and the deposits spread out downslope. The alluvial fans create upland terrain with moderate slopes that can extend to the coast, especially south of Camden Bay (Jorgenson et al. 2015).

Most of the southern edge of the Coastal Plain is in the Arctic Foothills physiographic province, as shown on **Map 3-2** in **Appendix A**. This province consists of rolling plateaus and low, east-west trending linear mountains.

About 28,000 acres, or less than 2 percent, of the Coastal Plain along the southern border is in the Central and Eastern Brooks Range section of the Arctic Mountains physiographic province (Wahrhaftig 1965) (see **Map 3-2** in **Appendix A**). The Central and Eastern Brooks Range consists of rugged east-west trending ridges, reaching elevations of 7,000 to 8,000 feet asl in areas outside the Coastal Plain.

Beaufort Sea Coast

The Coastal Plain extends outward from the coastline to the Arctic Refuge boundary, which includes tidally influenced areas of the Beaufort Sea. The Beaufort Sea coastline is irregular, with narrow beaches and small tides. It is characterized by numerous deltas, peninsulas, offshore shoals, mudflats, spits, bars, low-lying barrier islands, and shallow lagoons. The most pronounced deltas are associated with the Canning, Hulahula-Okpilak, Jago, and Aichilik Rivers (Clough et al. 1987). Rivers of the Coastal Plain are discussed in **Section B.2.10**, Water Resources.

Coastal bluffs are typically 4 to 5 feet high but, as noted above, can be as high as 25 feet. The highest elevation along the coast is at 3-mile-wide Barter Island, which is more than 50 feet. Lagoons and bays are generally only 3 to 12 feet deep, except for Camden Bay where depths are greater than 15 feet (Clough et al. 1987, p. 9). Camden Bay extends across more than half of the Coastal Plain coastline and is the largest single feature. The Beaufort Sea coastline is gradually receding. Coastal erosion, one factor that can contribute to a receding coastline, is discussed under geologic hazards in **Section B.2.5**, Geology and Minerals.

Permafrost Features

The Coastal Plain is underlain by permafrost that extends to depths of over 2,000 feet (Collett et al. 1989). Although permafrost generally occurs in materials where the temperature is below 32°F, in areas of elevated salinity or liquid hydrocarbons, materials may not be frozen because the freezing point is lower.

Permafrost is covered by a surface "active layer," which freezes and thaws annually. The active layer in the Coastal Plain is generally 1 to 4 feet thick (USFWS 2015a). A year-round thawed layer, termed a thaw bulb, may be beneath lakes, 7 feet deep or greater, and beneath some parts of deeper rivers, such as the Canning. Based on studies of seawater and borehole temperatures, the permafrost layer in the nearshore area of the Beaufort Sea probably extends out to water depths of 500 feet (Brewer 1987).

A number of topographic features are associated with permafrost, the most prominent of which are ice-wedge polygons. These are vertical wedge-shaped veins of ice that develop in thermal-contraction cracks. These cracks form in a pattern of interconnected polygons that can vary in size. Most range from 30 to 200 feet in diameter and are visible at the surface, although some in the southern part of the Coastal Plain are masked by tussock-type tundra (Brewer 1987).

Other features associated with permafrost that can be found in the Coastal Plain are as follows (USFWS 2015a):

- Beaded streams—series of small ponds connected by small streams
- Frost boils—upwellings of mud that result in barren and partially vegetated areas
- Pingos—low, ice-cored mounds formed as soil-covered water freezes and expands upward
- Gelifluction lobes—tongue-shaped deposits formed from slow flows of the active layer on slopes of 5 to 20 degrees
- Stone stripes—lines of stones that form through frost heaves

Permafrost is described in greater detail in **Section B.2.8**, Soil Resources.

Climate Change

Changes to the coast and overall topography in the Coastal Plain could occur as a result of climate warming. The general warming of the Arctic appears to have lengthened the open-water period in the Beaufort Sea (USACE 2012, Chapter 5). A longer open-water period allows for longer exposure of beaches to coastal processes and increases the fetch[4] for generating larger sea waves. These factors combine to produce more rapid coastal erosion and shoreline retreat, especially at locations not protected by barrier islands.

B.2.5 Geology and Minerals

Affected Environment

Geology

The Coastal Plain is in the eastern part of the North Slope geologic province and has greater geologic complexity than that found elsewhere in northern Alaska. The North Slope geologic province is part of a tectonic feature referred to as the Arctic Alaska microplate. The geologic history for this continental microplate includes three primary tectonic settings: a south-facing passive continental margin during the Devonian to Triassic, a northern rifted margin in the Jurassic to Early Cretaceous, and a southern orogenic[5] margin, with a related foreland basin and fold-and-thrust belt from the Jurassic to recent time (Bird 1999).

A thin layer of surficial deposits covers the bedrock geology in most of the Coastal Plain; therefore, information and understanding of the bedrock geology has been obtained primarily from geophysical remote sensing, observations in the mountains south of the area, and wells drilled west and north of the area (Bird 1999).

Four tectono-stratigraphic sequences characterize the Northern Alaska geologic province (see **Figure 3-4**, Stratigraphy of the Coastal Plain, in **Appendix A**) (USGS 1998a). The oldest sequence is the Franklinian, which consists of a thick succession of metamorphosed sedimentary, volcanic, and igneous rocks of

[4]The area of water over which the wind blows in an essentially constant direction, thus generating waves.
[5]Mountain building

Proterozoic to Early Devonian age. The overlying Ellesmerian sequence of Middle Devonian to Triassic age rocks represents the south-facing passive margin referred to above. The Beaufortian sequence records the Jurassic and Cretaceous rifting, which severed the continental connection of northern Alaska and opened the Canada basin. The Brookian sequence, Cretaceous to recent age, consists of sediments originating from the ancestral and modern Brooks Range and deposited in foreland basin and passive margin settings (Bird 1999). Information regarding the oil and gas potential for these sequences is provided in **Section B.2.6**, Petroleum Resources.

Geologic structures in the Coastal Plain consist of closely spaced folds and faults in rocks that were deposited in the foreland basin setting and broad, domed faulted structures in the pre-foreland basin and basement rocks. These structures formed in one or more episodes of Brooks Range-related deformation during Cenozoic time. Devonian and possibly older structures are also present in the Coastal Plain, and these structures have controlled the orientation of some younger Cenozoic structures (Bird 1999).

A major structural feature of the Coastal Plain is the east-northeast trending Marsh Creek anticline, which formed during the Oligocene (Bird 1999). Rather than being a simple anticline, the Marsh Creek anticline is interpreted to be either a triangle zone or an anticlinorium[6] (Bird and Magoon 1987). The Marsh Creek anticline divides the Coastal Plain into two areas having different structural characteristics. Rocks northwest of the Marsh Creek anticline are in the "undeformed area" and have remained nearly undeformed since their deposition. Rocks to the southeast of the Marsh Creek anticline, the "deformed area," have been thrust faulted, folded, and uplifted (Magoon et al. 1987). The deformed area is about twice the size of the undeformed area.

Map 3-3 in **Appendix A** is a surficial geologic map of the Coastal Plain. The Coastal Plain is largely covered by a thin mantle of Quaternary unconsolidated sediments that range in thickness from a few feet to about 100 feet (Clough et al. 1987). These include river deposits (alluvium), beach deposits, colluvium, alluvial fans, terrace deposits, marine terrace deposits, glacial deposits, glaciofluvial deposits, and landslides (Marshall et al. 1998). **Map 3-3** in **Appendix A** includes further details of the surficial geology, particularly related to depositional environment. For a more detailed map of surficial geology, refer to Carter et al. 1986.

During the Pleistocene, portions of the Coastal Plain near the Sadlerochit Mountains were glaciated. Tills believed to be from either or both the Anaktuvuk River and Sagavanirktok River glaciations are present along the Canning, Tamayariak, Sadlerochit, Hulahula, and Jago River drainages (Rawlinson 1993, Figure 32). The glacial tills occur as isolated outcrops and well-defined moraines. Glaciofluvial deposits and eolian[7] materials are widespread, even in unglaciated areas (Clough et al. 1987).

As shown in **Map 3-3** in **Appendix A**, two general types of surficial deposits predominate in the Coastal Plain: gravel and sand and silt and very fine sand over gravel. Gravel and sand include deposits associated with river floodplains and terraces and upland terraces that lack a silt cover. Silt and very fine sand over gravel comprise a fine-grained cover, generally more than 6.6 to 10 feet thick and ice rich, and commonly containing fine-grained organic debris. These deposits include ice-rich, Pleistocene eolian silts (**Map 3-10**). Morainal deposits composed of compact, silty, bouldery till are present in the previously glaciated areas along the southern border of the Coastal Plain, described above. Near the coast, surficial unconsolidated

[6]An intensely deformed series of anticlines and synclines that together form a general arch
[7]Windblown

deposits typically consist of alluvial sediments (silt, sand, and gravel) overlying finer-grained marine sediments. Surficial sediments and soils are described further in **Section B.2.8**, Soils.

The cover of unconsolidated sediments is broken up by outcrops of Tertiary-Cretaceous sedimentary rocks. The largest of these outcrop areas occurs along the Marsh Creek anticline and upper Jago River. Outcrops in the Marsh Creek anticline area include the Sagavanirktok and Canning Formations (Marshall et al. 1998). The Sagavanirktok Formation, which overlies the Canning Formation, consists of poorly consolidated gray siltstone, mudstone, sandstone, and lesser amounts of conglomerate that were deposited in non-marine and shallow marine environments. This rock unit is as much as 4,900 feet thick on the north flank of the Marsh Creek anticline and 7,500 feet thick in wells near the mouth of Canning River. The Canning Formation consists of gray shale and siltstone containing interbeds of mostly thin-bedded, very fine to fine-grained lithic sandstone; they represent turbidites deposited in a deep-water marine environment by a sediment gravity flow. The Canning Formation was measured at 4,900 to 5,000 feet thick in wells west of Canning River (Molenaar et al. 1987).

The Jago River Formation crops out in the upper Jago River area (Marshall et al. 1998). This formation consists of well hardened, thick-bedded, fine- to coarse-grained, lithic sandstone and conglomerate. There are also minor amounts of coal and carbonaceous shale deposited in a primarily nonmarine environment with minor shallow marine influence. The Jago River Formation is 9,800 feet thick in its type section along Igilatvik (Sabbath) Creek (Buckingham 1987).

Smaller bedrock outcrops occur around the Sadlerochit Mountains and in the east-central part of the Coastal Plain. In addition to the Canning Formation, these outcrops expose the Cretaceous Hue Shale, Pebble Shale unit, and Kemik Sandstone; Cretaceous-Jurassic Kingak Shale; Triassic Karen Creek Sandstone; Permian and Triassic Sadlerochit Group; and Pennsylvanian-Mississippian Lisburne Group (Marshall et al. 1998).

For more detailed information regarding the rock units and geologic structure of the Coastal Plain, refer to Bird and Magoon (1987) and Bird (1999).

Geologic Hazards

Geologic hazards are natural physical conditions that could damage land or structures and injure humans. Potential geologic hazards in the Coastal Plain are earthquakes, surface faults, landslides, land subsidence, flooding, sea ice ride-up and override, coastal erosion, and storm surge.

Earthquakes and Surface Faults

The USGS has prepared seismic hazard maps for Alaska that portray the probability of ground motion (peak ground acceleration) due to an earthquake (Wesson et al. 2007). For the Coastal Plain, the USGS estimates that peak ground accelerations of up to 0.2 g (where g equals the acceleration due to gravity); there is a 5 percent probability that this acceleration would be exceeded in 50 years; thus, the Coastal Plain is in an area of relatively low seismic risk. This risk may be revised in the future, based on August 2018 seismic activity, described below.

Historically the level of earthquake activity in the Coastal Plain has been low. Earthquakes of magnitude (M) 6 and larger on the Richter scale of intensity are potentially destructive; earthquakes of M 5 could cause local damage (Clough et al. 1987). Prior to August 2018, epicenters of five earthquakes with M 4.5 to M 5.0 had been recorded in or within 15 miles of the Coastal Plain (USGS 2018a). Of these, three were

centered in the Coastal Plain: A M 4.7 earthquake in February 2006 and M 4.5 and M 4.9 earthquakes in April 2007. Three earthquakes above M 5.0 had been recorded in the northeast corner of Alaska, the closest of which was an M 5.2 earthquake centered about 30 miles southwest of the Coastal Plain in August 1995. The largest of the three was an M 5.5 earthquake in August 2003 about 80 miles from the southwest corner of the Coastal Plain (USGS 2018a).

On August 12, 2018, an M 6.4 earthquake occurred 52 miles southwest of Kaktovik (and less than 10 miles south of the Coastal Plain) in the Sadlerochit Mountains. It was felt widely across the eastern NSB, and was, by a wide margin, the largest earthquake ever recorded north of the Brooks Range in Alaska (Alaska Earthquake Center 2018). This earthquake was followed by a number of aftershocks on the same day, including an M 6.0 earthquake about 20 miles east of the M 6.4 event. From August 13 to September 2, 2018, 13 earthquakes between M 4.0 and M 4.8 were recorded in the same area. The Alaska Earthquake Center indicated that this seismic activity is consistent with natural earthquake activity. Aftershocks are expected to slowly decline but remain active for many weeks or months. According to the University of Alaska Fairbanks Earthquake Center, as of March 31, 2019, numerous earthquakes less than M 4.0 and several between M 4.0 and 5.0 have continued to occur in the seismically active area about 50 miles south-southwest of Kaktovik (Alaska Earthquake Center 2019).

The USGS's Quaternary fault and fold database (USGS and ADNR 2006) contains information on faults and associated folds in the US that are believed to be sources of earthquakes greater than M 6 during the Quaternary (i.e., the past 1.6 million years). This database indicates the presence of one Quaternary surface feature in the Coastal Plain, which is the Marsh Creek anticline (described above and depicted on **Map C-1** in **Appendix C**). The main tectonic feature mapped in the northeastern Brooks Ranges is the Canning displacement zone (CDZ) (Gaudreau et al. 2019). Based on Interferometric Synthetic Aperture Radar (InSAR) slip modeling, Gaudreau et al, 2019 presents the M 6.4 and M 6.0 Kaktovik earthquakes occurred on previously unknown active fault systems conjugate to the CDZ. These newly identified active faults present right-lateral displacement accommodating overall left-lateral motion of the CDZ by rotation about a vertical axis. Other areas have been identified to have potential for similar right-lateral displacement, and the Kaktovik earthquakes highlight the potential magnitude of earthquakes in the area.

Slope Failure

Slope failure in the Coastal Plain can occur in the form of solifluction[8] and creep or slump along coastal bluffs, terrace escarpments, lake margins, and ridge slopes. Locally along a stretch of the Katakturuk River and near Marsh and Carter Creeks, landslides have occurred in weathered and soft Tertiary shale, siltstone, and sandstone. In all areas having any appreciable slope and exposed mineral soil, the soil migrates gradually downslope because of seasonal frost heaving of individual soil grains (Clough et al. 1987).

Retrogressive thaw slumps are slope failures resulting from thawing, ice-rich permafrost. They develop along streams or coastlines and expand inland to form landslide-like U-shaped scars (Lantuit et al. 2013).

Subsidence

The volume of ice in permafrost soils, particularly in the first few tens of feet below the ground surface, can be several times the volume of the mineral components (Brewer 1987). In one study of 65 field sites along the Beaufort Sea coast (Kanevskiy et al. 2013), t. Natural and human-induced thawing of this near-

[8]Very slow deformation of the seasonally thawed surface, forming elongated shallow lobes

surface ice generally results in uneven lowering of the ground surface, which may lead to water ponding or preferential erosion or both (Rawlinson 1993). Because of the presence of ice-rich permafrost, about one-third of the Coastal Plain has the potential for thaw settlement of 16 to 98 feet (Jorgenson et al. 2015).

Flooding and River Ice Jams

Most streams in the Coastal Plain have swift, braided courses across broad gravel flats that typically freeze to the bottom in the winter. In addition, groundwater from seeps and springs that flow throughout the winter freezes and forms thick, layered sheets of ice, called aufeis.[9] During spring when meltwater begins to flow, the presence of ice in the stream channels causes the streams to flood. As meltwater runs over the top of river ice, the ice breaks into pieces. As the ice flows downstream, it may lodge in constricted parts of the channel, creating jams and forcing more water out of the stream channel (USACE 2012, p. 3-61). Streams draining the Brooks Range also have the potential to produce significant summer precipitation-driven flood discharges (USACE 2012, p. 3-47). Flooding is discussed further in **Section B.2.10**.

Sea Ice Ride-up and Override

On shorelines exposed to the open ocean, onshore winds can push sea ice 100 feet or more onshore and 10 to 20 feet high, in a process called sea ice ride-up and override (USACE 2012, p. 3-42). Any natural or human-made features exposed to this sea ice push are susceptible to damage, including shoreline and seabed scouring. Lagoon areas are not generally subject to this phenomenon.

Coastal Erosion and Storm Surge

Beach erosion varies greatly from place to place and year to year along the entire Beaufort coast, depending on storm intensities and the nearness of pack ice. Erosion and deposition of eroded sands and gravel also produce barrier island or spit migration, especially where established vegetation is absent (Brewer 1987). Gibbs and Richmond (2017) have calculated average and maximum shoreline change rates for two regions of the Coastal Plain. Region 1 is the shoreline from the US-Canada border to the Hulahula River, and Region 2 is the shoreline from the Hulahula River to the Staines River. For both Regions 1 and 2, the average rate of shoreline change is -3.0 feet per year over the short term and long term. The negative value indicates that, overall, erosion is greater than accretion. The maximum long-term and short-term rates of erosion observed in Region 1 are -48.6 and -64.3 feet per year; the maximum long-term and short-term rates of erosion in Region 2 are both -22.3 feet per year. In this study, erosion indicates landward movement or retreat of the shoreline and does not distinguish between physical erosion and flooding of the coast, due to land subsidence or sea level rise.

Erosion along the coast can also be caused by wind. Wind erosion is generally confined to exposed spits and barrier islands and the Canning, Hulahula, Okpilak, and Jago River deltas, where active dunes are found along their western banks (Clough et al. 1987).

Although outside the program area, studies of coastal erosion at Kaktovik and the US Air Force's Defense Early Warning (DEW) Line site on Barter Island provide insight into the potential for impacts on coastal structures in the program area. Along the coastal permafrost bluffs that front the village and DEW Line site, an average erosion rate of 4.3 feet per year was measured during 2014 and 2015 by Gibbs et al. (2019).

[9]A mass of layered ice that forms from successive flows of groundwater during freezing temperatures

Higher erosion rates have been observed along the Barter Island coast during some years, including 65 feet of retreat in a single year (Gibbs et al. 2019).

According to USACE (2009), a timber crib wall was installed in the 1990s to protect the lagoon area of Kaktovik. The runway at the Kaktovik Airport has been stabilized with erosion protection measures; however, flooding due to storm surges is an ongoing problem during the open-water season. A gravel bag revetment was installed to provide erosion protection at the DEW Line site in 1999 (USACE 2009).

Abnormally high rises in sea level, referred to as storm surges, are caused by strong westerly winds and can be 4 to 6 feet above the elevation of sea level, or even greater with winds at 50 to 60 knots (USACE 2012, p. 3-31). Storm surges can cause coastal flooding, particularly along low-profile beaches common in the Coastal Plain.

Additional details regarding shoreline erosion and storm surge along the Beaufort Sea coast can be found in Barnes et al. (1992), Jones et al. (2009), USACE (2012, Chapter 3), and Gibbs and Richmond (2017).

Minerals

In the 1970s, before ANILCA, the USGS and former US Bureau of Mines conducted limited reconnaissance geological and mineral investigations in northeast Alaska. Limited mineral industry work was also conducted in the 1970s (USFWS 2015a, p. 4-37). Under ANILCA, the Arctic Refuge was closed to all forms of appropriation under the public land laws, including the mineral leasing and mining laws (USFWS 2015a, p. 4-1).

The BLM classifies mineral resources it manages as salable, leasable, or locatable. Salable minerals are subject to the Materials Act of 1947, as amended, and include common construction materials, such as sand, gravel, decorative rock, and building stone. Salable minerals relevant to the Coastal Plain (sand and gravel) are addressed in **Section B.2.9**.

Leasable minerals generally include energy minerals, such as petroleum, geothermal, and coal resources, as well as potash, sodium, and phosphate; petroleum resources are addressed in **Section B.2.6**. Geothermal resources in Alaska are associated with the Aleutian volcanic arc or thermal springs in the interior or southeastern Alaska and have not been identified around the Coastal Plain (Miller 1994).

Coal occurs in isolated areas throughout Alaska, referred to as provinces. The North Slope coal province has the largest coal deposits in Alaska, and the eastern edge of the province extends into the Coastal Plain (Flores et al. 2004; Stricker et al. 2011). The most important Cretaceous coal-bearing rocks in the province are in the Colville and Nanushuk groups west of Prudhoe Bay (Flores et al. 2004). Coal deposits in the eastern North Slope coal province primarily occur in the Tertiary Sagavanirktok Formation in two separate zones and are characterized as sub-bituminous (Stricker et al. 2011).

Locatable minerals are subject to the General Mining Law of 1872 and include metallic minerals, such as gold, silver, copper, lead, zinc, and uranium; nonmetallic minerals, such as alunite, asbestos, barite, gypsum, and mica; and certain varieties of stone. These are also referred to as hardrock minerals. The following discussion addresses locatable minerals and phosphate (a leasable mineral).

The USGS maintains a database with descriptions of mines, prospects, and mineral occurrences in Alaska. The records in the database are generally for metallic mineral commodities only but also may include certain

high value industrial minerals, such as barite and rare earth elements. No mineral occurrences are documented in the Coastal Plain; however, seven mineral occurrences are documented within 15 miles (see **Table B-5**; **Map 3-4** in **Appendix A**). These minerals are copper, rare-earth elements, phosphorus, uranium, and phosphates.

Table B-5
Documented Mineral Occurrences within 15 Miles of the Coastal Plain

Site	Latitude	Longitude	Location Description	Commodities	Ore Minerals	Geologic Description
Unnamed	69.47	-142.82	Accurate to within 5,000 feet	Copper	Chalcopyrite	Mafic volcanic rocks
Aichilik River	69.53	-143.15	Deposit along the Aichilik River; accurate to within 5,000 feet	Rare earth elements	Ytterbium, yttrium	Efflorescent salts coat outcrops of Kingak shale and accumulate along the margins of ephemeral pools at the foot of cut banks.
Itkilyariak Creek	69.63	-144.75	Accurate to within 4,000 feet	Copper	Native copper	Greenstone, probably Proterozoic
Katakturuk River	69.59	-145.6	1,890-foot hill at the confluence of two forks of the Katakturuk River, in the headwaters of the Katakturuk River, near the south flank of the Sadlerochit Mountains; accurate to within 1,500 feet	Phosphorus, uranium	Phosphate, uranium	Shublik Formation
Fire Creek	69.53	-145.2	Within 1 mile	Phosphate	—	Shublik Formation
Hulahula River	69.48	-144.38	Not provided	Phosphate	—	Shublik Formation
Unnamed	69.63	-144.42	Accurate to within 1 mile	Phosphate	—	Shublik Formation

Source: USGS 2018b
Note:
— = not applicable

Hartman (1973) assessed mineral potential in the Arctic Refuge and identified granitic intrusions with metallic mineral deposits in the Romanof Mountains and along the southern edge of the Brooks Range. Closer to the Coastal Plain, Hartman identified abundant low-grade phosphate deposits in the Shublik Formation that crops out along the northern edge of the Brooks Range.

A 1978 report of the mineral resource potential for the Brooks Range included all but the northwest corner of the Coastal Plain (Grybeck and DeYoung 1978). This assessment indicates that most of the Coastal Plain has uranium potential. Just to the south are areas with copper and phosphate potential. The phosphate areas are described as deposits of marine phosphate beds with minor uranium, vanadium, and fluorite content. No information is provided regarding the areas of copper potential.

The Geochemical Atlas of Alaska (Lee et al. 2016) provides maps of the distribution of 68 elements for the state, including the Coastal Plain. The maps are based on compilation and modeling of sediment and soil samples. These maps indicate, in part, that portions of the Coastal Plain have relatively higher

concentrations of gold, uranium, phosphorus, and copper. The maps can be viewed online at https://pubs.er.usgs.gov/publication/ds908.

Climate Change

Climate change produces changes in several geologic hazards, including subsidence, flooding, and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence. Climate change is also expected to affect the frequency and severity of extreme storms and floods. Storms with surges would be stronger and more frequent, which, combined with rising sea levels, could lead to greater coastal erosion (BLM 2012). The Arctic Refuge Revised CCP (USFWS 2015a, Section 1.10.1) predicts that climate change would result in earlier breakup and delayed freeze-up. These changes could affect flooding conditions in the program area.

B.2.6 Petroleum Resources

Affected Environment

Regulatory Information

Section 20001 of PL 115-97 directs the BLM to undertake an oil and gas leasing program in the Coastal Plain of the Arctic Refuge. Under the ANILCA, the Coastal Plain was not designated wilderness, and Congress reserved the area for potential future oil and gas development. The USFWS Revised CCP (2015a) recommended the area for wilderness designation and the area has been managed for wilderness characteristics. PL 115-97 opened all federal lands in the Coastal Plain to leasing, however, Alaska Native selected lands within the program area boundary remain segregated from mineral leasing due to their selected status. PL 115-97 limited surface development from oil and gas production and support facilities to a maximum of 2,000 acres.

Oil and Gas Resources

The Coastal Plain encompasses approximately 1,563,500 acres. It is estimated that approximately 427,700 acres of the program area are projected to have high potential for petroleum resources, 658,500 acres are projected to have moderate potential, and 477,200 acres are projected to have low potential. Estimates are based on best available information, primarily 1,400 miles of seismic survey data collected in 1984 and 1985 that has been reprocessed and reinterpreted using improved technology, but due to the limited amount of exploration that has occurred in the area, petroleum development potential and acreages should be considered rough estimates. The one exploration well drilled in the Coastal Plain is held as confidential information, so exact formation compositions and oil and gas percentages are not well established across the entire region. Existing oil and gas wells are shown in **Map 3-5** in **Appendix A**. See the hypothetical development scenario (**Appendix C**) for more information on development potential, assumptions behind potential estimates, and estimates for the baseline future development scenario for petroleum.

Approximately 80 percent of petroleum resources are estimated to be in the undeformed western portion of the program area (USGS 1998b). As shown in **Table B-6**, the identified potential plays in the undeformed area are the Topset play, Thompson play, Turbidite play, Wedge, Kemik, and Undeformed Franklinian. Potential plays in the deformed area are the Thin-Skinned Thrust Belt, Ellesmerian Thrust Belt, Deformed Franklinian, and Niguanak/Aurora (Attanasi 2005).

Table B-6
Estimated Mean Undiscovered Petroleum Resources in the Coastal Plain

Area	Play Name	Oil (BBO)	Gas (TCF)	Natural Gas Liquids (Billion Barrels of Liquid)
Undeformed	Topset	4.325	1.193	0.010
	Turbidite	1.279	1.120	0.065
	Wedge	0.438	0.226	0.005
	Thompson	0.246	0.470	0.039
	Kemik	0.047	0.116	0.010
	Undeformed Franklinian	0.085	0.30	0.029
	Undeformed subtotal	*6.420*	*3.424*	*0.159*
Deformed	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
	Deformed subtotal	*1.267*	*3.617*	*0.096*
Total	**-**	**7.687**	**7.041**	**0.225**

Source: Attanasi 2005
Note: Totals are technically recoverable amounts; oil associated gas and oil associated natural gas liquid estimates were combined with non-oil associated gas and natural gas liquid estimates respectively.

All oil and gas volumes represent the mean estimated technically recoverable volumes unless otherwise noted. The Topset is expected to be the primary play in the Coastal Plain, with an estimated technically recoverable 4.325 BBO and 1.193 TCF of gas. The Turbidite play is the second most productive, with an estimated technically recoverable 1.279 BBO and 1.120 TCF of gas. In the deformed area, the Thin-Skinned Thrust Belt is the primary play, with an estimated technically recoverable 1.038 BBO and 1.608 TCF of gas (Attanasi 2005). In total, the undeformed area is estimated to contain a technically recoverable total of 6.420 BBO and 3.424 TCF of gas, and the deformed area is estimated to contain a technically recoverable total of 1.267 BBO and 3.617 TCF of gas. Natural gas liquids would also be produced as part of the oil and gas production process. Additional exploration would take place to refine knowledge of the geology and petroleum resources of the area should one of the action alternatives be implemented.

Trends

Due to the prior prohibition on leasing, there has been no development of oil and gas resources in the Coastal Plain to date. Section 1002 of ANILCA identified the Coastal Plain for studying the potential oil and gas leasing and development, and there has been interest from some ANCSA corporations in developing the Coastal Plain ever since 1980 (Doyon Limited 2018; Rexford 2017). The area has had limited exploration; as further exploration occurs an improved understanding of the size and characteristics of petroleum resources would be gained.

Ninety percent of technically recoverable resources were estimated to be economically recoverable at $55/barrel (2005 dollars, approximately $85/barrel in 2023 dollars; Attanasi 2005). The threshold price to initiate exploration was estimated to be from $20 to $21/barrel in 2005 dollars (approximately $30 to $32 in 2023 dollars). However, the economics of oil exploration may have changed significantly since that study was published. Alaska North Slope crude was priced around $81 per barrel in December 2022, down from a high of $112 in July of 2022 but up from $68 per barrel one year earlier (EIA 2023). The most recent projections by the EIA predict that crude oil prices will follow a declining trend until 2025, after which they will rise steadily through 2050 (EIA 2023), however crude oil prices may increase or decrease depending on multiple factors and EIA projections are regularly modified as conditions change.

B.2.7 Paleontological Resources

Affected Environment

Paleontological resources include any physical evidence of past life, including fossilized flora and fauna, imprints, and traces of plants and animals. The program area, and all the North Slope, are widely regarded as fossiliferous.[10] It has borne evidence of past habitation that has expanded the scientific community's understanding of the geologic and paleontological record worldwide (BLM 2012).

As discussed in **Section B.2.5**, various geologic units have been identified in the program area. This includes ten bedrock geologic units, with unconsolidated surficial deposits, covering more than 80 percent of the surface area. Eight of these ten units have potential or documented fossils, though the presence of paleontological features has not been specifically noted in outcrops in the program area. Program area bedrock geologic units and their approximate acreage in the program area are shown on **Map 3-10**, Paleontological Resources, in **Appendix A**, and are noted below.

The Potential Fossil Yield Classification (PFYC) system is a tool used to assess potential occurrences of paleontological resources in mapped geologic units. It provides classifications that may be used to assist in determining the need for further assessment or actions. The PFYC system 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 values range from Class 1, Very Low, to Class 5, Very High, which indicate both the probability for the mapped unit to contain significant paleontological resources and the degree of management concern for the resource. Geologic units without enough information associated with them to assign a PFYC value may be assigned Class U, Unknown Potential. Characteristics of PFYC values are included in **Appendix H**.

The PFYC model for Alaska is in development. Preliminary PFYC values have been assigned to the mapped geologic units in the program area and are included in **Table B-7**. Excerpts from the in-progress PFYC model regarding preliminary rankings and unit descriptions are included in **Appendix H**. These PFYC assignments are maintained and updated by the BLM as additional data is available. In keeping with current practice, the use of ranges to describe the PFYC classification has been updated to only designate the higher, more sensitive class in the range. The PFYC model in development relies on the geologic mapping presented in Wilson et al. 2015; some of the mapped units are characterized differently than those presented in **Section B.2.5**.

Pleistocene, or ice age, fossils from between 2.59 million and 11,700 years ago have been identified across the North Slope in surficial quaternary deposits. These are the same deposits that cover approximately 1.4 million acres of the program area. Most of the recorded fossils exposed in North Slope surficial deposits are a result of stream bank erosion. These fossils include remains of animals that existed at the same time as human habitation of the area: horses, mammoths, antelope, bison, bears, lions, muskoxen, caribou, and moose (BLM 2018a).

[10]Rich in fossils or fossil potential

Table B-7
PFYC Values of Program Area Geologic Bedrock Units

Geologic Unit	Acres in Program Area (Approximate)	Age (Millions of Years Ago [mya])	PFYC Value	Noted Fossil Presence in Unit	Alaska Paleontological Database Samples
Sagavanirktok Formation	16,900	Tertiary (65–2.8)	4	Floral, microfauna, and mollusk fossils	1 sample, Late Miocene-Pliocene snails, bivalves, brachiopods
Seabee Formation and Hue Shale	1,200	Cretaceous (145–66)	4	Ammonites, pelecypods, fish remains, bird trace fossil (footprint)	5 samples, Cretaceous and Jurassic bivalves, forams, plants
Jago River Formation	25,300	Upper Cretaceous, (100.5–66)	3	Palynomorphs, plant fossils	
Sadlerochit Formation	2,800	Lower Triassic to Permian (289.9–247.2)	3	Ammonites, pelecypods, and brachiopods	1 sample, Permian bivalves and brachiopods
Lisburne Group, undivided	500	Carboniferous (358.9–298.9)	3	Group noted as generally fossiliferous; contains corals, brachiopods, ammonites, nautiloids, and plants	
Kingak Shale	200	Jurassic (201.3–145)	3	Marine mollusks and crinoids; pelecypods and ammonites	9 samples, Jurassic and Cretaceous ammonoids, annelida, bivalves, brachiopods, crinoids, forams
Surficial Quaternary Deposits	1,421,700	Quaternary, Pleistocene, and upper Tertiary (2.59–present)	3	Flora, fauna	
Kemik Sandstone	200	Lower Cretaceous (146–100)	3	Trace fossils (footprints)	
Kongakut Formation	200	Lower Cretaceous (146–100)	3	Pelecypods and abundant worm borings	
Canning Formation	8,500	Cretaceous to Tertiary (145–2.8)	3	Palynomorphs	

Sources: Alaska Paleontological Database 2023; BLM and USFWS GIS 2022; personal communication [11].

Most paleontological resources identified on the North Slope have been identified in areas west of the program area. A description of the history of fossil discovery on the North Slope and conclusions regarding the fossil record is in BLM 2012, Section 3.2.7, and BLM 2018a, Section 3.2.1.6.

The Alaska Paleontological Database (2023) is a compilation of information on reported fossil localities across the state of Alaska that is searchable by USGS quadrangle and sub-quadrangle (1:63,000-scale) map sheets. The database was searched by the sub-quadrangles which include the Program Area and samples located within the Program Area that could be verified by longitude and latitude or Public Land Survey System coordinates were compiled. These include portions of Barter Island, Demarcation Point, Flaxman

[11]Anna Kohl, HDR, personal communication with Brent Breithaupt, BLM Regional Paleontologist, on July 30, 2018, regarding preliminary PFYC rankings and unit descriptions for the program area

Island, and Mt. Michelson quadrangles. The search identified 316 fossil occurrences in 60 samples drawn largely from reports generated in the 1970s. Cenozoic-era (66 million years ago to the present) samples are most prevalent along the northern coastline and in the western half of the Program Area. Earlier Mesozoic-era (252 – 66 million years ago) samples are most prevalent in the eastern half of the Program Area. Where geologic formations were provided in the database, those samples are listed in **Table B-7**. The most common species identified among the samples were forams, bivalves (mollusks), snails, ammonoids, and brachiopods (Alaska Paleontological Database 2023).

Climate Change

Changing climate conditions would not directly affect paleontological resources but could cause several geologic hazards, including thawing permafrost and coastal erosion. An increase in the active layer expected from a warming climate could result in greater areas of land subsidence, which may expose geologic units with paleontological resources to weathering action. Similarly, organic paleontological remains that have been preserved for millennia in permafrost would rapidly decompose once incorporated into the active layer. Coastal erosion could also expose previously protected units to weathering, which may expose and damage resources. Increased exposure of geologic units with paleontological resources as a result of climate change could lead to increased unauthorized collecting. Given the surficial context of these actions, the geologic unit with the greatest risk is the unconsolidated and poorly consolidated surficial Quaternary deposits, which may contain Pleistocene fossils.

B.2.8 Soil Resources

Affected Environment

The Coastal Plain is in the Coastal Plain physiographic sub-province and portions of the Arctic Foothills physiographic sub-province (see **Section B.2.5**). The soils in the Coastal Plain sub-province are composed of poorly drained, unconsolidated sediments bisected by fluvial deposits of rivers and streams flowing northward from the rolling foothills to the south (Wahrhaftig 1965). Most uplands in the program area are in the western half and extend from the foothills of the Sadlerochit Mountains southern boundary to near the coastline. Upland soils consist of loess (eolian silt), colluvium, and morainal deposits. Lowland Coastal Plain deposits east of the Hulahula River are interbedded marine and alluvial deposits associated with past marine transgressions. These soils generally include fluvial sands and gravels, silty sand, and organic silt over marine silts and clays. The eolian silts and marine silts and clay soils are generally ice rich and contain ice wedges (**Map 3-11**, Soils, and **Map 3-12**, Permafrost, in **Appendix A**; Jorgenson et al. 2015).

Eolian silt deposits (yedoma) comprise nearly 40 percent of the surficial soil deposits in the program area and can range from 3 to 100 feet thick (Jorgenson et al. 2015; Rawlinson 1993). Yedoma deposits typically occur in flat lowland areas are normally frozen, with a high ice content; hillslopes generally have a thin eolian silt deposit cover, less than 15 inches thick. Alluvial and fluvial deposits, including active braided channels, terraces, and deltaic deposits, consist of sands and gravels in steeper gradients near the foothills. They transition to finer grained soils in floodplains and inactive channels (Jorgenson et al. 2015).

The ice-rich yedoma is more susceptible to thermokarst than more thaw-stable eolian sands and alluvial/fluvial deposits. Thaw strain measurements of Coastal Plain eolian silts indicate that settlement due to thawing frozen silts can be as much as 33 to 98 feet and is generally greater than thaw settlement of frozen eolian sand deposits (Pullman et al. 2007). The yedoma is more prevalent in the western portion of the program area.

The Sadlerochit Mountains bordering the southwestern edge of the program area are composed of Tertiary sandstone and conglomerate noncarbonate sedimentary rocks. Colluvium deposits drape the northern slopes of the Sadlerochit Mountains and are composed of loose, silty to rubbly, unsorted deposits derived directly from weathering bedrock deposits upslope. Colluvium deposits are usually vegetated (Jorgenson et al. 2015). At the southern border of the program area, the Canning River and Hulahula River drainages are capped by glacial moraine deposits, consisting of silty sands and gravels, with some cobbles and boulders (Rawlinson 1993).

The entire program area is underlain by permafrost with isolated areas of thaw near deep lakes, springs, and rivers (Bird and Magoon 1987). Depending on their depth and size, lakes and rivers influence the presence of permafrost; deeper lakes and rivers, such as the Canning River, often form a thaw bulb below the water body (Rawlinson 1993). Permafrost and ground ice characteristics are variable, due to differences in climate, topography, soil properties, cryogenic processes, and environmental history (Jorgenson et al. 2015). Massive ice occurs in the form of ice wedges, buried glacial ice in glacial deposits, and intrusive ice (Jorgenson 2008). Permafrost in the Coastal Plain is generally between 650 and 1,300 feet thick (USFWS 2015a). Polygonal patterned ground is created when ice wedges form in the upper few feet of the ground surface and is indicative of ice-rich soils. Polygonal ground is a common surface feature in the program area, especially in lowland areas; polygons may be less apparent in drained upland areas, where vegetation can mask these surface features (Rawlinson 1993).

The top layer of the soil surface that typically thaws and refreezes annually is known as the active layer. In the Coastal Plain, the active layer is generally between 1 and 4 feet thick (USFWS 2015a). Active layer thickness can vary from year to year and depends on such factors as ambient air temperature, aspect, gradient, vegetation, drainage, snow cover, water content, and soil type. Long-term permafrost temperature monitoring shows a warming trend over the past 25 years, with the greatest warming near the coast. Soil temperatures increased 3 to 5°F between 1985 and 2004 (USFWS 2015a). At the approximately 4-foot depth at three USGS monitoring stations in the program area, average subsurface temperatures showed an increase in temperature between 2000 and 2014 from 32.9 to almost 35.6°F (Urban and Clow 2017).

Degradation of permafrost can be affected by ice type and content, soil or vegetation removal, and ground disturbances, with ice-rich and thaw-unstable soils and hillsides being the most sensitive to degradation from thawing (ADNR 2018a). Thawing, ice-rich, permafrost soils, such as yedoma create thermokarst features that transform the landscape by subsidence, erosion, and changes in drainages, including channelization and ponding (Section 4.2.5 USFWS 2015a).

Alternatively, eolian sand lacks sufficient ice for thermokarst lake formation; however, thawing wedge ice can lead to thermokarst pits and troughs (Jorgenson et al. 2015). Changes in the landforms due to erosion and thermokarst, such as slumping and channelization, affect the vegetation and water characteristics of the area (USFWS 2015a). Additionally, carbon, mercury, metals, and other naturally occurring contaminants may be released as permafrost thaws and be introduced into plant and animal habitats (**Section B.3.1**).

The vulnerability of permafrost to degradation depends on a complex interaction of surface changes and soil and permafrost characteristics (Jorgenson et al. 2015). Changes to soils and permafrost on the North Slope resulting from a changing climate are more fully described in BLM (2018a). They include an increase in the active layer thickness and the potential for increased settlement due to thermokarst and ice wedge degradation as warming temperatures increase.

B.2.9 Sand and Gravel Resources

Affected Environment

Sand and gravel are most commonly present in the Coastal Plain in the valleys of larger rivers and streams (Bird and Magoon 1987); the valleys of larger streams are underlain by coarse sand and gravel. These include the Canning, Sadlerochit, Hulahula, and Aichilik Rivers, which are heavily braided and have extensive gravel bars generally free of vegetation. Sediments in the Coastal Plain in the western half of the program area are dominated by outwash sediments covered by younger fluvial sands and gravels within approximately 10 miles of the coastline; the outwash sediments are either directly below the fluvium or have been eroded and replaced by the fluvium (Rawlinson 1993). The eastern half of the program area is also composed of fluvial sediments overlying outwash sediments; however, the fluvial and outwash sediments extend farther inland into the Sadlerochit Mountains than the western side of the program area, about 24 miles.

The Canning River valley on the western border of the program area was formed by a large valley glacier. It formed a piedmont lobe along the Canning and Tamayariak Rivers, depositing glaciofluvial soils (Bird and Magoon 1987). These soils are composed of outwash sediments deposited in multiple terraces, formed by glacial outwash washed downstream and are capped by younger alluvial deposits. The outwash deposits near the northern boundaries of the program area are covered by eolian sand and overlain by lacustrine silt and peat, exposed at stream cuts, and bank exposures (Rawlinson 1993).

Sediments in the program area are dominated by outwash sediments covered by younger fluvial sands and gravels. The outwash sediments are either directly below the fluvium or have been eroded and replaced by it (Rawlinson 1993). Sands and gravels are often found in elevated terrain between river valleys and alluvial fans originating from the foothills to the south (Rawlinson 1993). Soils downstream and closer to the coastline become progressively fine grained, transitioning to deltaic and marine deposits (Bird and Magoon 1987).

Existing material sources in the Coastal Plain and west and outside of the program area are in similar geological environments and next to streams. These sites are reportedly excavated to depths of approximately 45 feet below the surface and are in similar glaciofluvial and fluvial deposits. These deposits have been observed to contain ice wedges and thin discontinuous beds of fine-grained material with abundant detrital wood debris (Rawlinson 1993).

Climate Change

Changes in climate may affect access to those sand and gravel resources. Developers of sand and gravel resources in the program area would use ice roads for access to the material sites. Depending on the excavation methods to mine sand and gravel resources, climate change could make the excavation easier, due to thawing permafrost, or more difficult, due to increased water or swampy conditions (BLM 2018a).

B.2.10 Water Resources

Affected Environment

Water resources on the North Slope consist mainly of rivers, shallow discontinuous streams, lakes, and ponds **(Map 3-14** in **Appendix A**). The climate, topography, and permafrost of the Arctic Refuge Coastal

Plain (ARCP)[12] are the controlling physical forces of the hydrologic cycle and are characterized by low precipitation and below-freezing average temperatures during 8 months of the year (Lyons and Trawicki 1994).

ARCP climate (precipitation, temperature, snowfall, and wind speed) is summarized in **Section B.2.1**. Average annual precipitation as measured from 1947 to 2016 at the Kaktovik Airport is 6 inches and heaviest in July and August (Table 3.1, WRCC 2023, NOAA 2023).

Average temperatures during the same period range between 40°F to 55 °F in July and -8 °F to -22 °F in February, which correspond to the warmest and coldest months (Table 3.1, WRCC 2023, NOAA 2023). A comparison of average monthly temperatures at Barter Island on the coast and farther south in the Coastal Plain and northern Brooks Range foothills (represented by Kuparuk and Toolik Lake, respectively) are provided in **Table I-1** in **Appendix I**.

Topography and permafrost are described in **Section B.2.4**, Physiography. The topography of the program area ranges from the steep Brooks Range foothills in the southern portion of the study area to relatively flat and poorly drained tundra underlain with continuous permafrost closer to the Beaufort Sea coast, with foothills being the most prevalent topographic feature. The program area consists of 45 percent foothills, 22 percent hilly coastal plains, 25 percent river floodplains and deltas, and 3 percent flat thaw-lake plains (Raynolds et al. 2020). The majority of the topography in the program area is Arctic Coastal Plain. **Map 3-1** in **Appendix A** depicts the topography of the study area and **Table B-4** summarizes the terrain found in the Coastal Plain. The topography and permafrost provide indications of the hydrologic response.

Hydrology: Watersheds, Rivers, and Streams

Ten major rivers, 2,860 miles of perennial streams, and numerous smaller channels flow north from the mountain foothills and tundra watersheds that traverse the program area before flowing into the Arctic Ocean. **Table I-4** in **Appendix I** provides a list of the major drainage basins and water bodies in the program area, their drainage areas, other characteristics, and stream lengths.

Streams on the North Slope are generally divided into three types, based on the physiographic province of their origin: those that originate in (1) the Coastal Plain of the North Slope (a broader area than the program area), (2) the Arctic foothills, or (3) the Brooks Range (Gallant et al. 1995). Streams and rivers in the program area share flow characteristics that are typical of the region (Brabets 1996). Flooding of North Slope rivers is influenced by the type of physiographic region drained, the size of the drainage area, and the air temperatures during breakup. Snowmelt is the main cause of annual flooding in all North Slope rivers, and it may be heavy during rapid temperature rises in late May or may occur to a lesser extent over a prolonged period of weeks. Snowmelt flooding nearly always produces the annual peak discharge on rivers in the study area. **Table I-5** in **Appendix I** provides historic data of measured discharge for several rivers in the program area, and climate monitoring stream-gage locations are provided in **Map 3-13**, Agency Monitoring Stations, in **Appendix A**. After spring breakup, the summer flows in the Jago Okpilak, Hulahula, and Sadlerochit Rivers are dominated by glacier meltwater (Nolan et al. 2011)

Streams on the North Slope typically complete the breakup process in June, although there are variations from year to year in timing due to meteorological conditions. Spring breakup can inundate extremely large

[12]Lands in the Arctic Refuge, including the program area, that are part of the larger Arctic Coastal Plain that stretches east into Canada.

areas in a matter of days. More than half of the annual discharge for a stream can occur over several days to a few weeks (Clough et al. 1987; Sloan 1987). The spring season brings about major shifts in hydrology that recharge aquatic habitats and support fish migration. Snowmelt starts earliest in the foothills and then proceeds to the coastal plain. During this time, sheets of snowmelt water flow over frozen ground. Sheetflow can be a significant surface water event in the program area, especially in the Arctic foothills. Extensive fields of aufeis that develop over the winter due to springs play an important role, both in directing river flow paths over land and into new channels and by augmenting summer discharge. Snowmelt and flood waters create ephemeral connections between aquatic habitats and recharge floodplain lakes and wet meadow zones. On the North Slope, up to 40 percent of snowmelt recharges the evaporation deficit from the previous summer; immediately following snowmelt, surface waters are at their maximum extent (Bowling et al. 2003). Within two weeks of snowmelt, overland flow ceases and many hydrologic systems become disconnected (Bowling et al. 2003).

The open water season is generally limited to June through September. Most streams continue to flow throughout the summer but at substantially lower discharges. Streams that originate in the Coastal Plain or Arctic foothills often flow intermittently during summer (Burnkart et al. 2022). ARCP streams with active perennial springs may stay open longer in the fall or may develop significant aufeis accumulations, which persist later in the summer, providing additional runoff. Rainstorms can increase stream flow, but they are seldom sufficient to cause flooding in the ARCP. Runoff from summer rainfall is generally contained in the river channels. Rivers in the program area are more responsive to rain events than those in NPR-A due to higher gradients and fewer lakes and ponds (Arp et al. 2018). Peak stream flow events occur throughout the summer and fall, occasionally exceeding the snowmelt peak (**Table I-5** in **Appendix I**).

Stream flow rapidly declines in most streams shortly after the onset of freeze-up in September and ceases in most rivers by December. During winter, some rivers may freeze to the bed while others have small pockets of unfrozen water beneath ice hummocks and along spring-fed reaches or exhibit flow sub-bed in unfrozen gravels. At locations where water is forced to the surface, extensive fields of aufeis may be generated and persist and melt during the summer, providing a continued source of flow.

Hydrology: Lakes and Wetlands

Most of the program area is considered wetland; however, lakes are very scarce (less than 2 percent of the land surface area), compared with the eastern NPR-A, where lakes cover approximately 20 percent of the land surface area, and where using water from lakes for ice road building is common practice. There are over four thousand lakes and ponds covering 37,000 acres in the North Slope Coastal Plain (Burkart et al. 2022). Lakes are not evenly distributed across the program area but are concentrated near the mouth of the Canning River and in the region of the Sadlerochit and Jago Rivers, with very few lakes occupying the central Katakturuk River region (Trawicki et al. 1991). The low number of lakes is a function of a variety of factors, including precipitation, geology, soil type, permafrost, and topography. Lakes vary in surface area, from 1,500 acres to less than an acre and 90 percent are less than 12 acres. A study of 119 of the largest lakes indicated most are shallow and freeze to the bottom during winter (Trawicki et al. 1991). The estimated volume of liquid water in these lakes is 18.1 billion gallons in summer and 1.1 billion gallons by the end of the winter season, resulting in a 94 percent reduction in available liquid water by the end of the winter season. Eighty percent of this volume is concentrated in seven lakes in the Canning River Delta.

Some lakes in the program area have been measured for lake volume (Trawicki et al. 1991), with some characteristics listed in **Table I-6** in **Appendix I**.

During winter, most water bodies on the ARCP freeze solid as they are typically not as deep as the depth of freeze, reported to be 6 to 7 feet (Trawicki et al. 1991; Lyons and Trawicki 1994). Small pockets of unfrozen water occur in lakes with depths that exceed ice growth. By the end of the winter season, the volume of liquid water in these lakes has been estimated to be reduced by 98 percent (Craig 1989). Consistent with Trawicki et al. (1991) findings, this indicates that the majority of lakes freeze solid or near solid. There is an ice thinning trend in the western Coastal Plain (1.5 cm/yr) that suggests more lakes are no longer freezing to the bed and contain unfrozen pockets of water which is increasing winter water availability and also degrading surrounding permafrost (Arp et al. 2012, Arp et al. 2015).

Arp (2015) notes that lakes in the Arctic Coastal Plain that are completely frozen to the bed with no liquid water tend to become ice free earlier in summer, up to one month earlier, when evaporation is greatest, while lakes that do not completely freeze and contain liquid water tend to have ice cover longer and experience less evaporative loss, 28 percent less evaporation on average. Meltwater ponds on top of the ice when lakes have ice that is anchored to the bed. The meltwater ponds absorb solar radiation and accelerate melting. Meltwater on lakes with floating ice tends to drain to the perimeter of the lake and the floating ice reflects solar radiation and melts more slowly (Arp 2015). The difference in the two regimes poses a divergence in hydrologic responses. Lakes that completely freeze in winter tend to shrink in surface area in years with low summer rainfall due to greater evaporative loss, while nearby lakes with floating ice do not (Jones et al 2009). The recharge capacity of many lakes is generally limited to snowmelt and direct precipitation near the lake. Based on the Bowling et al. 2003 study to the west of ARCP, a significant portion of snowmelt likely serves to recharge the evaporation deficit from the previous summer (Arp et al. 2012).

Deep lakes also have a larger thermal mass; thus, the deeper lakes may remain covered by ice into early July, much later than the shallow lakes (BLM 2014).

Snowfall measurements date back to 1949 on Barter Island, but the monitoring site was taken out of service in 1989, resulting in a discontinuous record of snow climatology. In 2000, three meteorological stations were established (Urban and Clow 2017) as part of the DOI/Global Terrestrial Network for Permafrost Observing System in remote parts of the ARCP. Locations of the three climate monitoring gaging stations can be seen in **Map 3-13**, Agency Monitoring Stations, in **Appendix A**. The limited data available from these stations are the only modern continuous record of snow accumulation in this region of Alaska. The available average annual water equivalent of monthly precipitation is provided in **Table H-2** in **Appendix I** and monthly snowfall is provided in **Table I-3** in **Appendix I**, and as well as summarized in **Section B.2.1** "Current Conditions".

The accumulation and distribution of snow cover in the ARCP is different from NPR-A. Snow cover typically has large spatial variations in depth, with deep drifts occurring along river channels and large scour areas. Snow cover is generally composed of hard wind slab over friable depth hoar and basal facets. (Sturm et al. 2019). Tundra travel is not currently permitted and a minimum standard for snow travel in ARCP has not been established. Average monthly snow depth in the winter is 5 inches. (Leonard 2023).

Freshwater Springs, Aufeis, and Groundwater

The perennial freshwater springs in the ARCP are unique to the eastern Arctic and don't occur in the Prudhoe Bay oilfields or the NPRA. The Sagavanirktok River marks the western extent of perennial freshwater springs across the North Slope. The source of groundwater feeding the perennial springs is

thought to be limestone formations of the southern face of the Brooks Range (Kane et al. 2013). The springs are generally at an elevation of 656 to 2,953 feet asl. At elevations higher than 2,953 feet asl, groundwater lacks the piezometric head to express above the ground surface. At elevations below 656 feet asl, thick Quaternary sediments (permafrost) act as an impermeable layer to upwelling. There appears to be a correlation between the location of the springs and known mapped faults.

Spring-fed reaches maintain relatively stable flows and temperatures year-round, have relatively large productive stands of riparian vegetation, and produce extensive fields of aufeis. Aufeis formations near springs can be 20 feet high and more than 1 mile wide by the end of the winter. Aufeis persists throughout much of the summer season and represents at least a third of the cumulative annual base flow (Yoshikawa et al. 2007; **Map 3-14** in **Appendix A**); some spring-fed reaches stay ice-free during the winter and provide critical overwintering habitat for high concentrations of macroinvertebrates and Dolly Varden (Craig 1989).

The most prolific springs in the program area are the Canning, Hulahula, Sadlerochit, Itkilyariak, and Katakturak, Tamayariak, and Okerokovik springs. While the majority of aufeis in the program area is the result of perennial springs, aufeis can form in any case that water flow beneath the snow or ground is constricted and forces to the surface at subfreezing temperatures (Yoshikawa et al. 2007; Harden et al. 1977). Other factors which contribute to naturally induced aufeis include topography, subsurface stratigraphy, and geomorphology (Sloan et al. 1976). Shur et al. (2016) indicate that freeze back of streambeds can result in intra-gravel flows rising to the surface. Freeze back of streambeds is, in part, due to severe winter temperatures, lack of snowfall, or other flow restrictions and results in aufeis accumulations. Other known flow restrictions are glacial moraine deposits and bedrock outcrops. Locations of aufeis accumulations are fairly consistent and form each winter, but their extent, thickness, and persistence varies with winter temperature and precipitation. Pavelsky and Zarnetske (2017) used satellite imagery to identify aufeis accumulations in Arctic Alaska and to determine how their extent and persistence has changed from 2000 to 2015 (Pavelsky and Zarnetske 2017). While aufeis locations are fairly consistent, changes in climatic conditions have resulted in aufeis disappearing earlier in the summer within the Arctic Refuge. Analysis of available Landsat imagery collecting between 1985 and 2021 found that aufeis melted at a significantly faster rate between 2010 and 2021 compared to between 1985 and 2009 (Dann 2023). Aufeis can also be induced by the construction of roads, trails, and other mechanisms which constrict natural flow pathways (Brown et al. 1983). Shur et al. (2016) indicate that seismic survey tracks across the Sagavanirktok delta area may have compressed snow and accelerated freeze back of the streambed, inducing aufeis growth. Aufeis can pose a hazard as the ice may cause damage to vegetation and infrastructure (as shown in Brown et al. 1983 Figure 57). Flooding that may occur as aufeis melts can cause further damage. However, aufeis also sustains summer stream flows and provides insect relief for wildlife (Burkart et al., 2022).

Outside of the springs, usable groundwater is limited to distinct and unconnected shallow zones in the thaw bulbs of rivers and lakes, due to the presence of permafrost, which is continuous across the North Slope (Jorgenson et al. 2008). The frozen state of the soils, combined with their fine-grained characteristics and saturated conditions, form a confining layer that prevents percolation and recharge from surface water sources and prohibits the movement of groundwater. Because percolation and recharge are restricted, the formation of usable subsurface water resources is limited to unfrozen material on top of the permafrost or taliks (thawed zones) beneath relatively deep lakes, or zones in thawed sediments below major rivers and streams. In general, while these shallow groundwater zones do exist, they are typically very small and are likely to have similar water quality as the rivers and lakes nearby (BLM 2004, Section 3.2.2.1). Shallow

supra-permafrost water also occurs seasonally in the active zone above the impervious permafrost; the thickness of the active layer is typically 1.5 feet but can range from 1 to 4 feet (Gryc 1985). The USFWS (2015a) reported that several of the streams leading from the springs can disappear into the bed and become intra-gravel flow during low discharge periods.

Hydrology: Nearshore Marine

There is a narrow continental shelf that extends offshore 31 to 62 miles into the Beaufort Sea. Surficial sediments of the shelf consist primarily of mud, with coarser material. The Beaufort shelf is most influenced by river input, but it is also affected by processes offshore in the deep basin, such as currents. During the open water season, surface currents are primarily wind driven close to shore. Ice covers the sea for up to 9 months, generally from September to July.

The nearshore marine environment is a mix of open coast and lagoons bounded by barrier islands. In summer, water along the coast becomes brackish and water temperatures can rise due to flow from the Mackenzie River and other rivers along the eastern Arctic coastline into the oftentimes still ice-covered nearshore environment (Craig 1984; Hale 1990; Dunton et al. 2006). The lagoons are relatively shallow, the amplitude of the tides is very small (11.5 inches or less) and the currents are weak, allowing for wind to be a factor in mixing; waters can vary in temperatures (28°F to 57°F) and salinity (0 to >45 percent) throughout the year (Harris et al. 2017). Potential natural hazards include beach erosion, flooding, storm tides, ice override, and subsidence due to permafrost melting.

Water Quantity

Water quantity of lakes in the program area is limited and has been calculated and documented by the USFWS (Lyons and Trawicki 1994). Lake drainages may occur over time due to bank overtopping, headward stream erosion and snow dam accumulation. These events are more common in the Western ARCP and lake drainage studies identify a decrease in occurrence between 1955 and 2017 (Jones et al. 2020b). A study of 119 of the largest lakes in ARCP found an annual ice-free volume of 55,382 acre-feet, as summarized in **Table I-6** in **Appendix I** (Trawicki et al. 1991); this volume is reduced to 3,366 acre-feet in April, when there is approximately 7 feet of ice. These values do not account for all lakes present in the program area and do not represent the total available quantity nor indicate suitable uses of the water, such as for ice road construction or potable uses.

Table I-5 in **Appendix I** provides the discharge statistics for many of the rivers and streams in the program area for June, July, and August for several years. The statistics include the mean, minimum, and maximum average daily values of discharge and also the calculated 7-day minimum flow and information on total runoff in acre-feet and inches of precipitation over the basin. The USGS also maintains gage 15980000 "Hulahula River near Kaktovik, AK" with discharge records from May 2011 to the present.

Water Rights

The Alaska Department of Natural Resources (ADNR) water rights records indicate there are two water right permits issued to North Slope Public Works for water supply. The City of Kaktovik is permitted to use surface water in Navarakpuk Lake on Barter Island as its drinking water source. There are identified drinking water protection areas surrounding the lake (ADNR 2023).

The USFWS has applied for 154 instream flow reservations in the Arctic Refuge and program area to ensure the protection of aquatic habitats and wildlife. The application includes 140 lake water reservations, a total

of 44,330,000 lake acres, and 12 stream reservations, including 116.7 river miles. Instream flow reservations occur on several branches on the Tamayariak, Itkilyariak, Sadlerochit and Akutoktak rivers as shown in **Map 3-21** in **Appendix A**. These reservations have been pending ADNR adjudication since 1994 and have seniority over any new application for water use (ADNR 2023).

Water Quality

Most freshwater systems in the program area are pristine; however, fecal contamination above State of Alaska water quality standards may occur in areas with dense avian, caribou, and lemming populations. Cold water temperatures tend to prolong the viability of fecal coliform. No water bodies in the program area have been assessed by ADEC for water quality or listed as impaired, which is defined as "persistently exceeding state water quality standards" (ADEC 2022). Impairment can derive from levels of pollutants, dissolved oxygen, pH, temperature, turbidity, and other water qualities.

Most freshwater bodies in the program area have low turbidity and dissolved oxygen near saturation, except during spring breakup. The pH of ponds and lakes in the ARCP typically range between 7.2 and 7.6. Specific conductivity measurements of ponds and lakes in the ARCP ranges from 80 to 7,130 µS/cm. (Snyder-Conn and Lubinski 1993). Specific Conductivity is controlled primarily by geology, precipitation, and evaporation. In general, specific conductivity increases in proximity to the coast and within a lake over the course of the summer (Burkart et al., 2022).

Lakes and ponds have a low buffering capacity. Total alkalinity measured in 36 lakes and ponds during the summer of 1988 and 1989 was low (20 to 60 mg per liter) and hardness was low to moderate (20 to 90 mg per liter). Total alkalinity and hardness doubled over the course of the summer (Snyder-Conn and Lubinski 1993).

Winter freeze and summer recharge cycles cause contrasting effects in water quality. During winter freezing, major ions of calcium, magnesium, sodium, potassium, chloride, sulfate, and nitrate and other impurities are excluded from downward-freezing ice and forced into the underlying sediment and in pockets of water under the ice in both streams and lakes. As the winter continues, dissolved oxygen concentrations in these pockets decrease, due to demands of decomposing organic matter (Prentki et al. 1980).

Spring snowmelt and resulting water flowing across the surface of the ice removes the cover from lakes, allowing the wind to mix the water column throughout the summer. Recharge of lakes through sheet flow during spring counteracts the effects of water loss and ion concentration caused by evaporation in the summer. The net result of the input of snowmelt waters and spring sheet flow in deeper lakes is to refresh their existing water chemistry. Lakes in the program area generally have lower pH and alkalinity values that slowly increase in the winter; this reflects the ice exclusion process, which occurs during freeze-up (Trawicki et al. 1991).

Spring breakup in streams typically increases turbidity as sediments, plant material, and other organic materials are flushed into the water system. During the peak discharge, Alaskan Arctic streams can transport more than 80 percent of the total suspended sediments for the year (Rember and Trefry 2004). The suspended solids and sediments transport on their surfaces trace metals and organic carbon downstream during this important part of the hydrological cycle in this region (Trefry et al. 2009). This period of high sediment load can temporarily decrease dissolved oxygen concentrations. The sediments and organic

carbon reach the still ice-covered lagoons of the Beaufort Sea, trapping terrestrial debris in the nearshore environment (Dunton et al. 2012).

Climate Change

The following climate predictions are based on two modeled scenarios of the ARCP using five climate models to map the Representative Concentration Pathways (RCP) relative to 1970-1999. RCP 4.5 scenario is consistent with moderate warming and RCP 8.5 is consistent with higher ranges of warming. Climate change projections and climatology that impacts water resources, such as precipitation and temperature, are discussed in **Section B.2.1** "Projected Climate Trends and Impacts in the Arctic, Alaska, and North Slope."

Climate variability would affect water resources by a longer open water season in the nearshore environment. Average annual temperatures within the study area are expected to increase 16°F compared to 1950-2009 averages under a high emissions scenario with higher increases in the winter (SNAP 2023). The winter warming trend is larger than the summer warming trend and suggests that air temperature season variation will decrease over the next century (Cai 2018). A seasonal breakdown of average historical and projected temperature and precipitation is shown in **Table B-8**. Snow would melt earlier in the season, and spring precipitation is predicted to increase by 14.7 to 21.1 percent which could lead to a shortened melt period, a more intense runoff event, and accelerated bank erosion. A 41-year record (1949-1990) of measured snow depths shows a downward trend in snow depth (Strum, 2019). This trend suggests it will become more challenging to rely on wind-blown snow to protect tundra and construct snow roads. Summer precipitation is expected to increase 22.9 to 25.5 percent by the 2050; however, higher temperatures and increased evapotranspiration may lead to lower base flows while flood frequency and severity could increase (Littell 2021). Increasing rainfall events are well documented in the western Artic coastal plain, these late season rainfall events may increase erosion in permafrost river channels. High lake levels and saturated soils would likely contribute to and potentially accelerate degrading permafrost landforms (Arp et al. 2020). Flows in glacier-fed streams in the ARCP would likely increase due to glacier recession. Annual runoff would vary widely from year to year (Stuefer et al. 2017).

Table B-8
Historical and Projected Average Temperature and Precipitation at Kaktovik under the High Emission Scenario

Season	Historical 1901-2015	Early Century 2030-2039	Mid Century 2060-2069	Late Century 2090-2099
Winter Precipitation in inches (October - May)	0.55	0.66	0.77	0.86
Change from Historical Period (inches)	-	0.11	0.23	0.31
Change from Historical Period (percent)	-	21%	41%	58%
Summer Precipitation in inches (June - Sep)	1.12	1.30	1.48	1.75
Change from Historical Period (inches)	-	0.2	0.4	0.6
Change from Historical Period (percent)	-	16%	32%	56%
Winter Temperature in degrees F (October - May)	-7.73	2.41	9.32	14.90
Change from Historical Period (degrees F)	-	10.1	17.0	22.6
Change from Historical Period (percent)	-	131%	221%	293%
Summer Temperature in degrees F (June - Sep)	36.77	41.09	44.65	48.34
Change from Historical Period (degrees F)	-	4.3	7.9	11.6
Change from Historical Period (percent)	-	12%	21%	31%

Source: SNAP 2023

Mean annual ground temperature forecast models have varied results. Predicted ground temperatures at 3.3 feet range from 10.4 °F to 33.8 °F by the next century (Littell 2021). Ground temperatures that rise above freezing will cause permafrost and ice wedge degradation with hydrological changes that would likely result in differential ground subsidence and would expand and amplify in rapidly warming permafrost regions (Liljedahl et al. 2016). Climate-change related permafrost thawing also changes groundwater flow paths. The deeper flow paths in permafrost-free areas buffer seasonal temperature extremes, so that summer groundwater discharge temperatures are lower in areas with discontinuous permafrost. Permafrost thawing can lead to a decrease in summer stream temperatures and a decline of evapotranspiration in headwater catchments (Sjöberg, 2021). See **Section B.2.8**, Soil Resources for more information on permafrost degradation.

The climate change effects on water resources are described in more detail in the GMT2 Final SEIS (BLM 2018a, Section 3.2.4) and the Willow Master Development Plan Final SEIS (BLM 2023, Section 3.8.1).

B.2.11 Solid and Hazardous Waste

Affected Environment

The Coastal Plain has had limited human or industrial activity that could result in solid or hazardous wastes being introduced into the environment. Kaktovik is the only community in the Coastal Plain; however, it is excluded from the program area boundary under PL 115-97. Solid and hazardous wastes identified in the Coastal Plain are typically along the coast and related to industrial activities or community development.

Past industrial activity consists of Department of Defense (DOD) Distant Early Warning (DEW) line facilities and Long-Range Radar Sites (LRRS) at Brownlow Point, Collinson Point, Barter Island, Griffin Point, and Nuvagapak Point. Construction of these facilities began as early as 1947, with the main installations built in 1952 and 1953. Brownlow Point was abandoned in 1958. Collinson Point and Nuvagapak Point were active between 1953 and 1962. Griffin Point was active between 1953 and 1957. Barter Island White Alice Communications System was deactivated in 1979 and replaced with a minimally attended radar in the mid-1980s. Most of DOD's cleanup and building demolition occurred in 1994, 2000, and 2006.

Community development is associated with public facilities in Kaktovik. Facilities within the community which store or dispose of solid or hazardous materials include the Kaktovik 1.9 SE Landfill (Class III landfill) and the community tank farm (six diesel and gasoline tanks holding a total of 107,814 gallons). See **Section B.4.1**, Landownership and Use, for a further discussion of Kaktovik facilities and activities.

Appendix J identifies facilities near the program area required to be registered with the EPA or ADEC for discharges associated with the Clean Air Act or the Clean Water Act. **Appendix J** also identifies ADEC-authorized solid waste facilities closest to the program area and lists the number of spills near Kaktovik and on the North Slope. **Map 3-16**, Hazardous Waste Sites in **Appendix A** identifies 37 ADEC-documented contaminated sites within 0.25 miles of the Coastal Plain, and the 15 sites within the program area (11 are active sites, 2 are cleanup complete sites, and 2 are informational sites). EPA's RCRA program regulates the generation, transportation, treatment, storage, and disposal of hazardous waste. There are 14 registered RCRA facilities in the vicinity of the Coastal Plain and three facilities located within 0.25 mile of the Coastal Plain.

B.3 BIOLOGICAL RESOURCES

B.3.1 Vegetation and Wetlands

Affected Environment

The program area encompasses much of the broad, treeless ARCP, including portions of the northern foothills of the Brooks Range and the Beaufort Sea coast, between the Canning and Staines Rivers to the west and the Aichilik River to the east (**Map 1-1** in **Appendix A**). This area includes portions of two broad ecoregions, the Beaufort coastal plain and the Brooks foothills (Nowacki et al. 2003; Jorgenson and Grunblatt 2013, **Map 3-17**, Terrestrial Ecoregions, in **Appendix A**). The Beaufort coastal plain generally is characterized by flat and very gently sloping tundra and the Brooks foothills by increasingly undulating terrain inland toward the Brooks Range. Within these two ecoregions are four subregions or eco-subsections: coastal lagoons, lowland peatlands (wet tundra), well-drained colluvium (upland moist tundra), and broad floodplains (shrub thickets) (Jorgenson and Grunblatt 2013; USFWS 2015a).

In addition to existing literature on the effects of oil and gas disturbance throughout the entire North Slope coastal plain of Alaska, two current mapping resources have been used to describe and quantify vegetation and wetlands in the program area. The vegetation mapping chosen to describe the affected environment and analyze potential impacts is "Land Cover Mapping, North Slope of the Arctic National Wildlife Refuge, Alaska, 2019" (**Map 3-18**, Vegetation, in **Appendix A**) prepared by ABR, Inc.—Environmental Research & Services (ABR; Macander et al. 2020). This raster-based vegetation map (1:63,360) was developed through a machine learning process trained using field data and expert image interpretation and includes all landcover types across the program area including unvegetated and upland areas. The wetland mapping used is an updated National Wetland Inventory (NWI) vector-based map (1:24,000) which includes marine, estuarine, palustrine, and riverine waters, and adjacent wetlands but not upland areas. The two mapping resources are not easily comparable due to the difference in scale and therefore, were used separately to characterize vegetation and wetlands for the purposes of this analysis.

Vegetation

Estimates of the area covered by each vegetation type (land cover class) in the program area are provided in **Table B-9**. **Table K-1** in **Appendix K** provides a description of each land cover class.

The most widespread vegetation types in the program area are moist and wet tundra communities including tussock tundra, shrub tussock tundra, moist sedge-shrub tundra with wet inclusions, and wet sedge meadow tundra. Each of these 4 types comprises at least 10 percent of the program area (64.8 percent combined). Less abundant, but moderately common vegetation types (4.1–6.5 percent) are also moist and wet tundra communities: moist sedge-willow tundra, sedge-willow tundra in drainage tracks, and wet sedge meadow tundra with moist inclusions.

Table B-9
Vegetation and Land Cover Classes Mapped in the Arctic Refuge Program Area

Land Cover Class	Area (Acres)	Percent of Program Area
Water	107,700	6.9
Freshwater marsh	300	0.0
Salt marsh	1,700	0.1
Wet sedge meadow tundra	175,400	11.2
Wet sedge meadow tundra with moist inclusions	63,500	4.1
Moist sedge-shrub tundra with wet inclusions	292,200	18.7

Land Cover Class	Area (Acres)	Percent of Program Area
Sedge-willow tundra in drainage tracks	68,400	4.4
Moist sedge-willow tundra	102,100	6.5
Tussock tundra	342,700	21.9
Shrub tussock tundra	203,800	13.0
Moist sedge-dryas tundra	66,300	4.2
Dryas dwarf shrub	13,300	0.9
Ericaceous dwarf shrub	2,600	0.2
Snowbed	5,700	0.4
Low and dwarf birch shrub	45,500	2.9
Low and tall riverine willow shrub	15,400	1.0
Poplar forest	0	0.0
Partially vegetated	43,900	2.8
Barrens	12,800	0.8
Snow/ice	400	0.0
Total	**1,563,700**	**100.0**

Mercander et al. 2020. Acres may vary slightly due to rounding.

Rare Plants

No federally listed, threatened, or endangered plant species are known to occur in the program area (USFWS and NMFS 2014); however, extensive surveys for rare, listed, threatened, or endangered species have not yet occurred for the program area and they may yet be present. The Alaska Center for Conservation Science (ACCS) maintains a listing of ranked, rare vascular plant species in Alaska, provides updates to a rare plant field guide, and manages a database of rare plant occurrences (ACCS 2018a, 2018b). Based on information obtained from the ACCS rare plant occurrence database, records were found in the program area for 10 vascular plant species with Alaska state rankings (**Table K-2** in **Appendix K**). These included 4 BLM sensitive species (BLM 2019b) and 1–2 BLM watchlist species (see footnote to **Table K-2** in **Appendix K**). It is important to note that this large area has not been extensively surveyed for rare plants; the most recent collections documented in the ACCS database were made in 1985.

Cortés-Burns et al. (2009) identified 31 rare vascular plant species with known occurrences on the North Slope, which includes the program area. Only 5 of the 10 species currently documented to occur in the program area are included in this 2009 list, possibly because rarity status of some taxa has changed in the past 14 years. Thus, 26 of the rare species listed by Cortés-Burns et al. (2009) as occurring on the North Slope have not been recorded in the program area. Some of these species may have rarity status since 2009 and no longer be considered rare. Several species are limited to alpine habitats and therefore are unlikely to be found in the program area. However, most of the species on 2009 list are associated with habitats that do occur in the program area, including riverbanks and terraces, coastal beaches, and polygonal tundra. Thus, it is likely that additional rare plant species are present in the program area but have not been documented.

Nonnative and Invasive Plants

The spread of nonnative plants is limited on Alaska's North Slope due to the short growing season, low summer temperatures, and the relative rarity of disturbed areas (Carlson et al. 2015). Historically, the region has been thought of as a low-risk area for invasive plant infestations (Wascowicz et al. 2019), but the potential for invasive species to become established in the program area may increase in the future (Lassuy and Lewis 2013). Disturbance vectors for transporting seeds or other propagules[13] to remote locations on the North Slope are limited but are expected to increase with industrial development in remote areas, such

[13]Any structure that can propagate a new plant, such as a shoot, root mass, or seed.

as the program area. Vector pathways for invasive plants are closely tied to human disturbance, primarily at regional airport hubs, along road and highway corridors, and in areas with foot traffic (Carlson et al. 2015; ACCS 2018c). With a warming climate and an increase in North Slope commercial activity, damage caused by invasive plants is expected to increase in the coming decades (Carlson and Shephard 2007; Carlson et al. 2015).

A review of Alaska's statewide invasive plant database, the Alaska Exotic Plants Information Clearinghouse (AKEPIC; AKEPIC 2023), revealed no documented occurrences of nonnative plant species in the program area. The search area was then expanded to the broader ARCP and Brooks Range foothills, where infestations were documented along the Dalton Highway and at Umiat (AKEPIC 2023). Nonnative species with recorded occurrences in the broader search area were Canada thistle (*Cirsium arvense*), narrowleaf hawksbeard (*Crepis tectorum*), herb Sophia (*Descurainia sophia*), white sweetclover (*Melilotus albus*), common dandelion (*Taraxacum officinale*), and foxtail barley (*Hordeum jubatum*). These infestations were associated primarily with disturbance activities such as fill importation or extraction associated with the construction of gravel roads and pads.

All these species have the potential for establishing in the program area during exploration, construction, and operation activities, which could adversely affect native vegetation and wetlands. According to the BLM Rapid Ecological Assessment (REA) (Carlson et al. 2015) the two invasive species with the highest potential for invasion in the near future are *H. jubatum* and *T. officinale*. According to the species fact sheets provided by AKEPIC, both species have moderate invasiveness rankings (64 and 59, respectively) and can grow on a variety of soil types. Both species are widespread in North America, including Alaska, but were not known to occur on the North Slope prior to industrial development. *M. alba* is ranked as highly invasive (81) by AKEPIC and has spread rapidly along roadsides and riparian gravel bars in southern and central Alaska, but Carlson et al. (2015) did not consider this species sufficiently cold tolerant to establish north of the Brooks Range under current climate conditions.

An additional species of possible concern is the submerged aquatic vascular plant, *Elodea canadensis*. It has a high invasiveness ranking (79) from AKEPIC and has colonized lakes in many parts of Alaska in recent years, primarily via boats and floatplanes. Although no occurrences have been recorded within the program area or the expanded search area described above, *E. canadensis* could be transported to Arctic lakes by floatplanes. The species can overwinter under ice and is established in the Fairbanks area, suggesting it might be able to persist in the Arctic where winter conditions under the ice are likely similar.

Wetlands

The BLM and USFWS used National Wetland Inventory (NWI) mapping for the North Slope of Alaska (Knopf 2022) to assess the extent of wetland resources in the program area. NWI is mapped at a scale of 1:24,000, which depicts wetlands at a broad scale relative to requirements for project specific wetland permitting. Broad scale maps are suitable for analysis in this Supplemental EIS because most of the program area is assumed to be jurisdictional Waters of the U.S. (WOTUS) and would likely be subject to permitting under Section 404 of the Clean Water Act (CWA) for disturbances (e.g., fill placement).[14] The jurisdictional WOTUS designation includes subtidal, intertidal, and freshwater aquatic resources that are covered in

[14]The U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers (USACE) have reverted to pre-2015 definition of WOTUS after the U.S. Supreme Court's decision in *Sackett v. Environmental Protection Agency*. Under 2015 standards the majority of wetlands in the program area are likely to be jurisdictional.

Section B.2.10, Water Resources. In this section, the open waters classes are shown in summary tables but not included in the analysis which is focused primarily on wetlands as a subset of jurisdictional WOTUS.

The Knopf (2022) NWI wetland map includes 119 individual WOTUS types within the program area; for the purposes of this analysis, those NWI wetland types were combined into 24 broader wetland classes as listed in **Table B-10**. Each broad-scale class includes numerous specific wetland types classified according to Cowardin et al. (1979). The 24 broad wetland classes are also presented in **Table K-5** in **Appendix K**, along with individual aggregated NWI types and characteristics and distribution in the program area.

Table B-10
Wetland Classes Mapped in the Arctic Refuge Program Area by the National Wetland Inventory Program

Wetland Class	Area (Acres)	Percent of Program Area
Nearshore waters	5,000	<1
Estuarine open water	61,800	4
Tidal influenced palustrine waters	300	<1
Lentic freshwater	12,700	<1
Palustrine waters	5,800	<1
Tidal influenced lotic freshwater	2,500	<1
Lotic freshwater	43,300	3
Estuarine mud flat	13,700	1
Estuarine salt marsh	2,100	<1
Tidal influenced emergent meadow	7,500	<1
Tidal influenced shrub scrub	400	<1
Littoral mud flat	200	<1
Littoral wetlands	1,500	<1
Flooded emergent meadow	274,800	18
Seasonally flooded emergent meadow	466,700	30
Saturated emergent meadow	317,900	20
Flooded shrub scrub	10,100	<1
Seasonally flooded shrub scrub	153,000	10
Saturated shrub scrub	128,500	8
Partially vegetated barrens	100	<1
Tidal influenced riverine wetlands	<50	<1
Freshwater riverine wetlands	5,200	<1
Riverine barrens	19,200	<1
Seasonally flooded barrens	100	<1
Total wetlands and waters	1,532,400	98
Uplands	31,000	2
Total	1,563,400	**100**

Source: Knopf 2022

Wetland hydrogeomorphology[15] in the region is primarily driven by a continuous permafrost layer which impedes drainage and contributes to extensive riverine and tidal flooding. The flat or gently sloping or undulating landscape contributes to maintenance of a perched water table and wetlands extend across most of the landscape. Isolated and possibly non-jurisdictional wetlands may be present in specific and limited geomorphic locations. Approximately 2 percent of the program area is comprised of non-jurisdictional and non-wetland areas, which largely occur in the southern portion of the program area where the foothills of the Brooks Range extend into the Coastal Plain terrain.

[15]The interaction and linkage of hydrologic processes with landforms in temporal and spatial dimensions.

The most common wetland types in the program area are seasonally flooded emergent meadow, saturated emergent meadow, and flooded emergent meadow, comprising 30, 20, and 18 percent of the program area respectively. These 3 most common types occur in broad continuous wetland mosaics on the gentle sloping terrain between major riverine drainages. Numerous large riparian corridors drain northward from the Brooks Range foothills to the Beaufort Sea, which supports riparian wetland mosaics and most of the seasonally flooded shrub scrub wetland class, comprising 10 percent of the program area. An additional 8 percent of the program area includes saturated shrub scrub wetlands which are dominant wetland types in riparian headwaters at the base of the foothills (**Table B-10**).

Open water waters classes encompass an additional 8 percent of the program area and include marine, estuarine, tidal influenced palustrine waters, lentic freshwater, and lotic freshwater resources. The most common class of open water in the program area is estuarine open water which comprises 4 percent of the program area and occurs along the length of the Beaufort Sea coast between barrier islands and the mainland. Lotic freshwater accounts for 3 percent of the program area and includes upper and lower perennial rivers and intermittent headwater streams for numerous riparian corridors. Open freshwater bodies include lentic freshwater and palustrine waters, which combined comprise approximately 1 percent of the program area and are relatively rare in comparison to occurrence of similar types in the Coastal Plain to the east. Lentic waters in the program area are generally concentrated in the Canning and Jago River Deltas.

The program area is largely undisturbed, and wetland structure and function are intact. Climate change poses the most significant threat to the stability of wetlands in the program area (BLM 2018a; USFWS 2015a). As described below in the *Climate Change* section, climate change is generating a drying trend on the North Slope for lake, pond, and wetland habitats, and this is predicted to continue in the program area.

Wetland Functions and Values

Wetland functions are the chemical, physical, and biological processes that occur within wetlands that provide value to the overall ecosystem. Wetland functions and functional loss after disturbance is often quantified and used in a debit-credit formula to determine compensatory mitigation requirements for USACE Section 404 permits. Debits are calculated for the net functional loss of a specific project and credits are calculated using a similar functional or condition assessment to assign credits to a proposed mitigation project or purchase of compensatory mitigation credits from a USACE-approved in-lieu fee program or mitigation bank. Mitigation may include avoidance or minimization of impacts which often focuses on avoidance of higher value wetlands, permittee responsible mitigation projects that improve wetlands within the project area, or the purchase of compensatory mitigation credits from an in-lieu fee program or wetland mitigation bank. Section 404 of the CWA, ROP management objectives, and the Ramsar Convention (Ramsar Convention Secretariat 2010) prioritize maintaining wetland health and function, while considering opportunities for developing undisturbed areas. The programs require regionally specific and standardized functional assessment methods to assess baseline conditions. Statewide, Alaska has very few formally developed and regionally specific methods to systematically quantify wetland functions. Recently USACE developed a wetland conditional assessment method for the North Slope (Berkowitz et al. 2017). This method may rely on field data or be conducted remotely using off-site data. The method assesses three functional groups: habitat, hydrology, and biogeochemical cycling along a gradient of anthropogenic disturbance and it was developed to standardize the calculation of compensatory mitigation for the North Slope. It is most suitable in areas where development has already occurred and may be useful to assess functional degradation in areas where some development already

exists. Existing suitable methods for assessing baseline conditions of undisturbed wetlands would have to be modified to address specific regional characteristics of wetlands in the program area. A functional or conditional assessment would be prepared during the permitting process for a specific development project and no formal assessment was prepared for wetlands within the program area. Higher value wetlands typical to the North Slope and their functions are discussed below based on existing literature.

Wetlands in the program area are largely undisturbed by human development; thus, they remain in the reference standard condition where they are functioning normally, according to individual wetland characteristics. In general, the freshwater wetland classes within the program area provide important functions but they are limited in large part by the presence of underlying permafrost. Cold and frozen soils limit many of the biogeochemical and hydrologic function typical to wetlands without permafrost, however, most wetlands provide significant fish and wildlife habitat support. The most important for wildlife habitat functions for the program area may include nesting, brood-rearing, and migration staging habitat for avian species.

Depressional wetlands including lentic freshwater and palustrine freshwater classes are also typically most important for habitat function, providing both avian and fish habitat but also important hydrologic functions, such as floodwater storage. Estuarine and palustrine wetlands influenced by tidal fluctuation provide important coastal erosion protection function as well as habitat support for saltwater-tolerant wildlife species (Berkowitz et al. 2017).

Riparian wetlands and barrens comprise approximately 2 percent of the program area and include tidal influenced riverine wetlands, freshwater riverine wetlands, and riverine barrens, which are directly influenced through the flow of lotic waters. However, seasonal overbank flooding due to snowmelt or storm surge is not limited to the narrow riparian corridors and affects wetland composition and function of palustrine wetlands, which in turn contributes to fish and wildlife habitat support function, groundwater discharge and recharge, floodwater attenuation, and erosion protection.

Uplands

Upland areas that do not have the hydrology, vegetation, and soils to be classified as a wetland (Environmental Laboratory 1987; USACE 2007) comprise approximately 2 percent of the program area. Uplands are typically rare on the North Slope and are limited to well-drained ridge crests and other exposed areas that are typically blown free of snow in the winter or barrens where bedrock is close to the surface; these areas accumulate little moisture throughout the year. Uplands in the program area are mostly limited to higher elevations in the foothills where landcover types include shrub tussock tundra, tussock tundra, ericaceous dwarf shrub, moist sedge dryas tundra, and barrens (see descriptions in **Appendix K, Table K-1**). The dry dwarf shrub types and rocky barrens are most commonly non-wetlands whereas the tussock dominated types are more typically within a saturated wetland class throughout most of the program area. Tussock tundra uplands in the program area are limited to well drained ridge crests or steeply sloping upper and middle slopes.

Climate Change

In the reasonably foreseeable future, climate change is expected to alter vegetation and wetlands on the North Slope in the direction of more well-drained and drier habitat types, characterized by a greater dominance of shrubs and dwarf trees in protected areas. Despite projections for increased precipitation, the longer growing season and increased temperatures due to climate change are predicted to result in greater

evapotranspiration rates, which in turn are expected to produce landscape-scale drying; by mid-century, the landscape may be 10 to 12 percent drier in the Coastal Plain (USFWS 2015a). This drying would alter vegetation and shallow-water systems, such as palustrine wetlands, ponds, and lakes directly, and these wetlands and waterbodies are likely to be reduced in number and extent. These transitions may result in substantial changes in wildlife species assemblages, depending on the extent of habitat change (see **Chapter 3, Section 3.3.3**, Birds, and **Section 3.3.4**, Terrestrial Mammals). Coastal erosion would result in the continued loss of coastal vegetation and wetlands, and gradual reductions in the extent of the barrier island-lagoon system on the North Slope are also likely.

The longer growing season and increased summer temperatures are expected to promote the expansion of shrub vegetation in the program area, as has been found elsewhere on the North Slope (Tape et al. 2006) and throughout Alaska. Warming and a longer growing season is also expected to promote the northward expansion of the ranges of some plant species more typically associated with the boreal forest, such as balsam poplar (*Populus balsamifera*) (USFWS 2015a).

Additionally, increasing soil temperatures could melt permafrost and release stored carbon and greenhouse gases (e.g., methane) to the atmosphere, thus exacerbating warming (Sturm et al. 2001a; Farquharson et al. 2019) and further promoting the direct and indirect changes to vegetation and wetlands described above. The degradation of permafrost could release persistent organic contaminants and mercury to aquatic ecosystems and wetlands (Schiedek et al. 2007). The combined effects of the drying of wetlands and waterbodies and an increase in shrub plant cover would reduce the extent of sedge-dominated wetlands and lacustrine waterbodies that are used for nesting and brood-rearing by many waterbird and shorebird species.

Coastal erosion and the direct loss of coastal vegetation and wetlands on the North Slope also has increased due to climate change. Increasing ocean temperatures, sea level rise, and an increase in wind-driven storm surges of water or sea ice has resulted in a substantial increase in coastal erosion rates (Jorgenson and Brown 2005). It is expected that increasing water temperatures, reduced sea ice, sea level rise, permafrost degradation, increased storm surges, and changes in river discharge and sediment transport rates (see drying trend noted above) would continue to alter coastal habitats. A recent analysis of data for the North Slope coastline from the Canadian border to Icy Cape indicates that although some areas show accretion, the mean values across the region and a substantial majority of the shoreline transects analyzed, including barrier islands, have been eroding between the 1940s and 2010s (Gibbs and Richmond 2017). Erosion rates along the Beaufort Sea coast also were substantially greater than along the Chukchi Sea coast.

B.3.2 Fish and Aquatic Species

Affected Environment

There are three primary aquatic habitats available to marine, anadromous, and freshwater species in and next to the program area: the lagoon and nearshore brackish waters of the Beaufort Sea; the rivers, streams, and springs emanating from the Brooks Range or Arctic Coastal Plain[16] (ACP) tundra; and lakes or ponds that are concentrated mostly near the Beaufort Sea coast. The quantity and distribution of these habitats throughout the program area are summarized in **Table B-11**, **Map 3-19**, Fish Habitat and Distribution, and **Map 3-20**, Essential Fish Habitat, in **Appendix A**.

[16]The Arctic Coastal Plain is a physiographic province that includes all of the North Slope of the Brooks Range north of the Foothills province. It extends across all of northern Alaska from the Chukchi Sea to the BS. (Wahrhaftig **GIS 1965)**

Table B-11
Anadromous Fish Habitat in Streams of the Program Area and Surrounding Area

Freshwater Streams	Streams in the Program Area (Miles) [b]	Anadromous Fish Habitat in the Program Area (Miles) [a]
Aichilik River	–	1
Akutoktak River	18	13
Angun River	33	8
Canning River	41	46
Carter Creek	22	13
Hulahula River	25	27
Jago River	36	26
Katakturuk River	22	20
Kimikpaurauk River	5	4
Kogotpak River	20	12
Marsh Creek	20	1
Nataroarok Creek	21	8
Nularvik River	3	3
Okpilak River	30	30
Sadlerochit River [d]	29	0
Sikrelurak River	21	11
Siksik River	7	5
Staines River	18	18
Tamayariak River	29	26
West Canning River [b]	–	15
Other Streams Total	3171	26
Total Streams	**3571**	**313**

Other Waters	Length (Miles)	Area (Acres)
Total Lake Area [b]	–	18,400
Unfrozen Lake Area [e]	–	6,200
Coastline [f]	593	–

Notes:
[a] ADFG GIS 2023. Data do not exist to quantify overwintering habitat by stream; the locations of overwintering habitat in the program area are depicted in **Map 3-20** in **Appendix A**.
[b] USGS GIS 2023. Data may conflict with ADFG 2023; some streams may show fewer miles of stream than anadromous waters in the stream. These are the best available data for stream miles and anadromous fish habitat miles.
[c] Includes Marsh Fork Canning River
[d] The Sadlerochit River has been identified as providing habitat for anadromous Dolly Varden (see **Map 3-20** in **Appendix A**), but the ADFG AWC has not been updated to reflect its addition to the catalog; thus, there are no AWC miles in this table.
[e] Grunblatt and Attwood 2014. Dataset indicates the presence of liquid water, but not depth of water; thus, this data set overestimates potential fish overwintering habitat (unfrozen water may be range from a few inches to over 7 feet), though it is the best available information for this topic. Numbers are surface area of lakes with any portion unfrozen.
[f] NOAA GIS 2018; USFWS 2015a

As described in **Section B.2.10**, Water Resources, freshwater fish habitat (such as lakes, ponds) is limited in the program area; this is the case especially during the winter, when aquatic habitat is reduced to approximately 5 percent of that available during summer as most rivers freeze to the bottom and the only known liquid water is contained in isolated pockets beneath ice hummocks and along spring-fed reaches. This reduction in habitat results in fewer freshwater and anadromous fish species in the program area, relative to other parts of the ACP along the Beaufort and Chukchi Seas (USFWS 2015a) (**Map 3-20** in **Appendix A**).

Lagoons and Nearshore Brackish Waters

Lagoons and shallow, brackish coastal waters are well understood to provide refuge/nursery habitat for juvenile fishes and for providing significant invertebrate prey for juvenile and adult fishes alike (Craig et al. 1982; Craig 1984; Dunton et al. 2006; Dunton et al. 2012). The nearshore brackish and marine waters

within the boundary of the Arctic Refuge, including the program area, are composed of a mix of open coastline, bays, and lagoons, bounded on the north by barrier islands. There are 16 bays and lagoons along the program area coastline, representing 593 miles of coastline and nearshore aquatic habitat potentially home to aquatic species (USFWS 2015a) (**Map 3-20** in **Appendix A**). These productive, shallow nearshore waters provide ample foraging and refuge opportunity for smaller fish and rich feeding grounds for larger migratory fish. During summer, these waters become brackish due to freshwater input from rivers along the ACP (Dunton et al. 2006; USFWS 2015a). Many of the inside barrier island lagoons are shallow and experience reduced currents and a small tidal flux of less than or equal to 1 foot, resulting in waters that are warmer and fresher than those outside the barrier islands.

Summertime mixing of marine waters with freshwaters produces conditions favorable to many marine and anadromous fishes,[17] as well as invertebrates (USFWS 2015a); however, by late fall the lagoons become saline again as freshwater input declines. As ice forms on the lagoons the water below becomes hypersaline and very cold, the result of ion exclusion during ice formation, restricted flow between the lagoons and the open sea beyond, and freezing point depression with greater salinity. These cold, hypersaline lagoon environments become unsuitable habitats for both anadromous and marine fishes during winter (USFWS 2015a).

Rivers, Streams, and Springs

The program area is underlain by continuous permafrost, which limits infiltration of surface water, resulting in a high ratio of stored water at the surface, rather than in the ground (USFWS 2015a). Data on these water resources are limited, with few datasets going back more than 5 years. There is speculation that groundwater flow sources south of the Brooks Range may play an important role in surface water recharge (Kane et al. 2013).

All flowing surface waters in the program area drain to the Beaufort Sea. There are at least 10 major rivers and many smaller streams in the program area, though most flow only during summer, because of snowmelt, rainfall, perennial springs, and, in some cases, glacier melt (McCart 1980; Lyons and Trawicki 1994; Rabus and Echelmeyer 1998; Kane et al. 2013; USFWS 2015a) (**Table B-11** and **Map 3-20** in **Appendix A**). During winter, most streams cease flowing by October or November due to freezing and remain uninhabitable by fish until May or June (Lyons and Trawicki 1994). The exception to this rule is in areas with perennial spring flow, which offer the only available overwintering fish habitat outside of summer (Craig 1989; Brown et al. 2014; Kane et al. 2013; USFWS 2015a) (**Map 3-20** in **Appendix A**). The temperature of these springs ranges from 0 to 33 °C, with many hovering just above freezing. Spring discharge in and near the program area is approximately 20,000 liters per second requiring a groundwater recharge area of 3,150 square kilometers. Groundwater recharge likely occurs on the south side of the Brooks Range where extensive limestone outcrops are found (Kane et al. 2013). Though there are 392 miles of streams in the program area (**Table B-11**), only 5 percent (roughly 20 miles) are habitable in winter. Although perennial springs are considered high-quality overwintering habitat, mass mortality events have been observed (Glass et al. 2023). A USFWS survey of unfrozen river water in late winter determined that rivers were unlikely to be sufficient sources of water to support ice road development (Elliott and Lyons 1990).

[17]Fish species that inhabit the ocean mostly but return to inland waters to spawn

A large portion (approximately 99 percent) of the program area is classified as wetlands, but lakes constitute very little of the total surface area of water for the region (Trawicki et al. 1991). Lake density from the Staines and Canning Rivers to the Aichilik River (which mark the western and eastern bounds of the program area) is lower than the ACP west of the Arctic Refuge (White et al. 2008; Arp and Jones 2009; USFWS 2015a). The central portion of the program area has very few lakes. Most program area lakes are near the delta areas of the Canning, Sadlerochit, and Jago rivers (**Map 3-20** in **Appendix A**) (USFWS 2015a). As noted in **Section B.2.10**, Water Resources (Lakes and Rivers), as much as 80 percent of the estimated volume of liquid water during winter is concentrated in just seven lakes in the Canning River delta.

These lakes vary in surface area from less than 1 acre to approximately 1,500 acres, though most are less than 12 acres (USFWS 2015a). Most are shallow and freeze solid during winter (Lyons and Trawicki 1994). Only 33.7 percent of the program area lakes) have some small volume of unfrozen water in winter. All lakes that are shallower than 7 feet deep freeze to the substrate in the winter (Clough et al. 1987; USFWS 2015a). The few lakes with remaining liquid water at the end of winter (lakes deeper than 7 feet) occur mostly in the Canning River delta area; thus, fish overwintering habitat is extremely limited in program area lakes (**Map 3-22** in **Appendix A**). The total lake surface area is 18,400 acres, with only 6,200 acres available as potentially deep, overwintering water (**Table B-11**; overwintering acres are likely overestimated). Of 119 lakes in the program area surveyed by USFWS in the late 1980s and early 1990s, just nine lakes represent 90 percent of the available unfrozen water in April when ice thickness reaches its maximum depth (Trawicki et al. 1991). Trawicki et al. (1991) estimated a total of 55,379 acre-feet of liquid water in program area lakes prior to freezup in October. By late April, when ice thickness had reached 7-feet, liquid water volume was estimated at 3,366 acre-feet, or 6 percent of ice-free season liquid water volume (**Appendix K, Table K-8**). While subsistence fishes are uncommon in most of these lakes, the same study found that the ninespine stickleback, a hardy forage fish, was found in 34 of 52 lakes surveyed for fish.

Fish Species

There are approximately 17 to 21 species of fish that use the program area regularly on a seasonal basis (**Table B-12**); however, only Dolly Varden, round whitefish, burbot, ninespine stickleback, and arctic grayling overwinter in freshwater habitats in the program area (**Table L-1** in **Appendix L**). Some species are described as overwintering in other parts of the Arctic Refuge (USFWS 2015a), but they have not been confirmed in studies in the program area (USFWS 2015a); thus, a range of likely species is presented in this SEIS, based on the best available information. It is also likely that additional marine species, which are not listed in **Table B-12**, may use waters north of the program area (USFWS 2015a; BLM 2012).

Round whitefish and burbot are present in the Canning River at the western boundary but not elsewhere in the program area (Fruge and Palmer 1994; USFWS 2015a). Dolly Varden are present in three resident populations—dwarf populations that occupy perennial springs, residual males from otherwise anadromous populations, and populations that occupy isolated lakes—and several anadromous populations (McCart and Craig 1973; USFWS 2015a).

Arctic grayling occur in some lakes and in rivers with perennial springs (Fruge and Palmer 1994; USFWS 2015a). Most of the anadromous species described in **Table B-12** use the nearshore marine area for migration or rearing (Craig 1989). Various marine species also use the nearshore marine area, but only four are present in large numbers next to the program area (USFWS 2015a): four horn sculpin, arctic flounder, saffron cod, and arctic cod. Additional information on the life history attributes for fish of the program area are provided in **Appendix L**.

Table B-12
Fish Species that Have Been Identified in the Program Area

FAMILY Common Name		Scientific Name	Freshwater	Anadromous	Marine
Cottidae: sculpins	Fourhorn Sculpin	*Myoxocephalus quadricornis*	-	-	+
Gadidae: cods	Arctic Cod	*Boreogadus saida*	-	-	+*
	Burbot	*Lota lota*	+	-	-
	Saffron Cod	*Eleginus gracilis*	-	-	+*
Gasterosteidae: sticklebacks	Ninespine Stickleback	*Pungitius pungitius*	+	+ brackish	-
Osmeridae: smelts	Rainbow Smelt	*Osmerus mordax*	-	+	-
Pleuronectidae	Arctic Flounder	*Pleuronectes glacialis*	-	-	+
Salmonidae: salmonids	Arctic Cisco [b]	*Coregonus autumnalis*	-	+	-
	Arctic Grayling	*Thymallus arcticus*	+		-
	Broad Whitefish	*Coregonus nasus*	+	+	-
	Chinook Salmon	*Oncorhynchus tshawytscha*	-	+*	-
	Chum Salmon	*Oncorhynchus. keta*	-	+*	-
	Dolly Varden	*Salvelinus malma*	+	+	-
	Humpback Whitefish	*Coregonus pidschian*	+	+	-
	Least Cisco	*Coregonus sardinella*	+	+	-
	Pink Salmon	*Oncorhynchus gorbuscha*	-	+*	-
	Round Whitefish	*Prosopium cylindraceum*	+	-	-

Source: BLM 2012; USFWS 2015a
- = not applicable
* Species with designated EFH in the program area
[a] Species that may be extremely rare or unconfirmed as present in program area waters.
[b] Some subsistence users have reported harvest take of Bering cisco (*Coregonus laurettae*), though this has not been confirmed, based on taxonomic features, such as gill raker count.

Aquatic Invertebrates

Though data for aquatic invertebrates in the program area are limited, it is well understood that invertebrates provide the bulk of food resources for both fish and bird communities of the ACP (Howard et al. 2000). The distribution and density of invertebrates depend on the types and quantities of habitats, including sediment and vegetation types (Dunton and Schonberg 2000). The most productive waters for invertebrates are in coastal marine environments, where benthic and pelagic organisms are plentiful and diverse. Fauna in nearshore brackish and marine waters are primarily omnivorous detritovores strongly dependent on microbial processing of terrestrial sources of carbon (Dunton et al. 2012). Epibenthic fauna (such as polychaetes, mysids, and amphipods) that proliferate in the relatively warm summer waters of coastal bays and lagoons, are the main food source for fish in these ecosystems (Craig et al. 1984). In freshwater habitats, benthic invertebrates and zooplankton are most prevalent, with the former dominating food sources for fish (Howard et al. 2000); key freshwater macroinvertebrates include Anostraca, Chironomidae, Cladocera, Limnephilidae, and Physidae (Gurney et al. 2022). Terrestrial insects likely contribute to freshwater

invertebrate food resources for fishes. For a more complete understanding of aquatic invertebrate communities in the program area and the ACP, refer to *The Natural History of an Arctic Oil Field* (Truett and Johnson 2000). However, surface freshwaters are a limited resource throughout the program area, so aquatic macroinvertebrate assemblages in freshwater would be reduced and perhaps less diverse by comparison to flowing or lacustrine waters of the ACP west of the Canning River.

Aquatic Invasive Species

An "invasive species" is defined as "a species whose introduction does or is likely to cause economic or environmental harm or harm to human health where it is introduced" (EO 13112 of February 3, 1999: Invasive Species). EO 13112 requires federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. Potential vectors for introducing aquatic invasive species include ballast-water discharge, fouled ship hulls, and equipment placed overboard (e.g., anchors, seismic airguns, hydrophone arrays). The USCG developed regulations (33 CFR 151) that implement provisions of the National Invasive Species Act of 1996. Vessels brought into the State of Alaska or federal waters are subject to these USCG regulations, which are intended to reduce the transfer of invasive species. The regulations require operators to remove "fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations" (33 CFR 151.2035(a)(6)).

An additional concern is the potential invasion by the submerged aquatic vascular plant, *Elodea canadensis*, which has recently started to colonize lakes throughout Alaska (ACCS 2018c) (see **Section B.3.1**). This invasive aquatic plant species has spread throughout sub-Arctic freshwaters of Alaska, often transported from previously colonized lakes to new waterbodies via float plane or boat propellers. *Elodea* has the potential to disrupt fish populations by creating abiotic conditions (i.e., reduced dissolved oxygen), changing aquatic habitat structure, altering predator-prey interactions, and potentially impacting including whole ecosystems (Carey et al. 2016, 2023)

Saprolegnia parasitica, a water mold, is not truly an invasive species but may be expanding its range in the north and increasing in density. *Saprolegnia* is common throughout temperate regions and is often noted in Pacific salmon in freshwater as they return to spawn. The disease is uncommon in brackish waters and in marine fishes. It is commonly observed in stressed or injured fish in freshwater (Sformo et al 2021). *Saprolegnia* was first detected in Broad Whitefish on the Colville River in 2013, and in Humpback Whitefish in 2016 (Sformo et al. 2017). Severe *Saprolegnia* infection can lead to osmoregulatory dysfunction and subsequently death by haemolysis (Van West 2006). This infection has been previously found in salmonids from the nearby Northwest Arctic Borough: Noatak Chum Salmon (*Oncorhynchus keta*, ADFG Fish Pathology Database Acc. No, Year: 84–0234, 1984), Kotzebue/Ambler River Chum Salmon (02–0027, 2001), Kotzebue/Ambler River Sheefish (*Stenodus leucichthys*, 02–0026, 2001), and Wulik River/Kivalina Dolly Varden (03–0041, 2002). It has been speculated that this emerging disease in the Colville River is related to changes in the aquatic environment, specifically increasing temperatures (Sformo et al 2021).

Essential Fish Habitat

The 1996 Sustainable Fisheries Act enacted additional management measures to protect commercially harvested fish species from overfishing. Measures were added to the Magnuson-Stevens Fishery Conservation and Management Act Reauthorization (16 USC 1801–1882), including one to describe,

identify, and minimize adverse effects on EFH. Pacific salmon are found in the program area in both marine water and freshwater, though at this time NMFS officially lists Pacific salmon in only freshwater.

Freshwater EFH consists of the lower reaches of some larger rivers in the western portion of the program area (**Map 3-10** in **Appendix A**). Because there is no identified spawning habitat for these species, EFH does not extend to the upstream reaches of these rivers. Pacific salmon (particularly pink and chum salmon) are found in marine waters along the entirety of the Beaufort Sea coastline; however, recent data indicate that EFH for these species on the ACP could be refined to just freshwater habitats (Echave et al. 2012; Simpson et al. 2017). Arctic cod EFH includes the marine, nearshore, and coastal lagoon waters in and next to the program area, but they may also extend into the lower, brackish reaches of larger rivers during summer.

Saffron cod are not officially listed under NMFS guidelines for EFH in the program area but are a common species in nearshore and offshore marine waters of the Beaufort Sea. It is likely that a future review of EFH would include the entirety of the Arctic Alaska coastlines as saffron cod EFH. Snow crab EFH is found in nearshore coastal marine habitats throughout the Beaufort Sea coastline to Canada, including the program area. See **Appendix Q** for a more complete analysis of program area EFH relative to lease stipulations and ROPs found in **Table 2-3**. Additional relevant information on EFH for the Arctic, including the Beaufort Sea coastline, can be found in the NPR-A IAP/EIS (BLM 2012).

Climate Change

As discussed in BLM 2018a, climate change is affecting many variables that then affect aquatic species and habitats; such variables are precipitation, timing of ice formation, permafrost degradation, macroinvertebrate abundance, and changes to hydrologic functions and water quality, such as temperature and dissolved oxygen, longer open-water periods and increased fetch leading to coastal erosion, which in turn could impact fishes and invertebrate communities. Increasing temperature is expected to change climate patterns and lengthen the ice-free season, degrade permafrost, and increase evaporation, processes that contribute to surface water hydrology and may reduce (Laske et al. 2016) or increase (Stueffer et al. 2017) surface water connectivity. Over time, temperature increases in terrestrial and aquatic environments may influence the ice-free period for greater durations, resulting in changes to the delivery of dissolved organic matter to area streams and lakes (Creed et al. 2017). Water quality and food availability may be altered by liberation of essential nutrients nitrogen (N) and phosphorus (P) from terrestrial sources to aquatic environments in increased concentrations (Kendrick et al. 2018). Resultant changes in nutrient cycling may significantly alter food webs from the bottom up by impacting the availability or quality of microbial and invertebrate food resources for fish. Reductions in connectivity from, for example drying of channels or ponds, may in turn reduce colonization opportunities for fishes by limiting dispersal pathways and movement between habitats (Laske et al. 2016). This could change local species assemblages or species richness. Additionally, climate change may result in expansion or contraction of species ranges, the timing of the spawning run, and susceptibility to disease or competition for many species, including Pacific salmon (Logerwell et al. 2015; Crozier 2016). Recent surveys of fish assemblages in two lagoons in the Arctic Refuge suggest that moderate to rapid warming in the last two decades is resulting in borealization[18] of fish communities (von Biela et al. 2022). This trend is exemplified by profound decreases in Arctic specialist fishes like fourhorn sculpin and increases in generalists like saffron cod or even changes in habitat use for

[18]Community reorganization where Arctic species are replaced by species with more boreal distributions in response to climatic warming.

species like Dolly Varden. BLM (2019) describes the potential impacts of GHG emissions that could result from post-lease oil and gas activities from combustion of fossil fuels (mainly natural gas, diesel fuel and gasoline) for construction, drilling, production, processing, and transport of the petroleum products. Smaller amounts of emissions would occur through permafrost degradation from surface-disturbing activities. Additional GHG emissions would result from combustion of the products themselves in the global marketplace.

B.3.3 Birds

Affected Environment

According to the USFWS (USFWS 2015a, Appendix F), 157 bird species have been recorded in the Arctic Refuge on the northern foothills of the Brooks Range, in the ACP (an area inclusive of the program area), and in adjacent marine waters (**Table K-9** in **Appendix K**). Sixty-nine of those species (44 percent) are confirmed breeders or permanent residents, or both; 11 are possible breeders, 40 species use the ARCP during staging or migration (29 of which are breeders or possible breeders), and 65 species occur as casual, accidental, or rare visitors.

With some exceptions described below, birds in the program area are migratory and are only present May to September (Young et al. 1995; Kuletz et al. 2015; Kuletz and Labunski 2017). Winter residents include small numbers of ravens and ptarmigan, American dippers near open running water, and occasional gyrfalcons. The migration routes and wintering areas of ARCP birds encompass much of the North American and South American continents and central and southern Pacific islands; some species may winter in southern Africa, Australasia, east and southeast Asia, and coastal Antarctica.

Shorebirds and passerines[19] are the most abundant guilds of nesting birds on the ARCP (Bart et al. 2012). Waterfowl, loons, larids (gulls, terns), and jaegers also occur at higher densities in some parts of the ARCP (Amundson et al. 2019). Raptors and other seabirds are less abundant but important components of the bird community.

Of the species considered likely to occur on the ARCP, 39 are classified as common, fairly common, or abundant in one or more seasons, and all are breeders or possible breeders on the ARCP. Most of the 53 species considered casual and accidental visitors were seen outside the normal range of the species, as were many of the species listed as uncommon or rare; however, 40 of the 65 species listed as uncommon or rare are breeders or possible breeders in the ARCP, and many of these are species of conservation concern (Pearce et al. 2018; **Table K-9** in **Appendix K**).

As treated in this EIS, waterbirds on the ARCP are waterfowl (ducks, geese, and swans), loons, grebes, and cranes. Seventy-eight species of waterbirds, shorebirds, larids, and other seabirds occur along the marine vessel transit route to Dutch Harbor, Alaska, including Steller's and spectacled eiders, which are discussed under *Special Status Species*, below (see **Table K-11** in **Appendix K**). Many bird species are present where there is open water in these marine habitats during all seasons of the year; however, concentration areas are particularly important during the fall open water season (Kuletz and Labunski 2017). A number of species, including eiders and brant, rely on marine habitats and freshwater wetlands along the Beaufort, Chukchi, and Bering Sea coastlines during migration, molting, and/or wintering.

[19]Perching birds.

The ARCP represents a substantial portion of the Beaufort Sea coastline in Alaska. Accordingly, it also supports a large number of birds during the important pre-breeding, nesting, rearing, and migration staging periods. For these reasons, the ARCP and adjacent marine waters are recognized as important bird areas by the American Bird Conservancy, Audubon, the Sea Duck Joint Venture, and Birdlife International. Prior studies (summarized in USFWS 2015a; Pearce et al. 2018; and USFWS and BLM 2018) have demonstrated that at least several hundred thousand breeding and nonbreeding birds use the ARCP and program area during spring migration, summer breeding, and fall staging and migration. As migratory birds continue to face habitat changes and loss along migratory routes and wintering grounds (see Alaska Shorebird Group 2019 and Boreal Partners in Flight 2021 for detailed descriptions of global population threats), the availability high-quality breeding habitat such the ARCP is even more important for these species. The USFWS has recognized this and designated Arctic Refuge's coastal lagoons and wetlands, freshwater spring systems, open freshwater habitats, and moist and wet sedge-shrug habitats as Resources of Concern for the Arctic Refuge in part because of their importance to birds (USFWS 2021a).

Even for species that have been relatively well studied, such as golden eagles and fall-staging snow geese, recent data are lacking (summarized in USFWS 2015a). Although there are historical survey data for the ARCP, as described in USFWS and BLM (2018), detailed distribution and abundance data for the program area are lacking for many species, and contemporary data are lacking for most bird species. In addition, much of the contemporary data were collected for only 1 or 2 years, cover only a small portion of the program area, or were collected at low survey intensity. The program area contains far fewer waterbodies, compared with sites farther west, such as Prudhoe Bay and the NPR-A. Because of this, many waterbirds and shorebirds are patchily distributed, which increases the difficulty in estimating numbers with precision. Information about the various bird species and species groups found in the program area is summarized below.

Special Status Species

The Migratory Bird Treaty Act and the corresponding Migratory Bird Convention Act and Canada Wildlife Act in Canada protect all migratory birds. The Bald and Golden Eagle Protection Act provides additional protections for eagles. The ESA and the Species at Risk Act in Canada protect threatened and endangered bird species (**Table K-10** in **Appendix K**).

Of the 157 species known to occur in the program area, 12 are recognized as BLM sensitive species (BLM 2019b), 18 are USFWS birds of conservation concern (USFWS 2021b), and 45 are recognized as at-risk species by the ADFG (**Table K-9** in **Appendix K**). ADFG at-risk species are those with a small population size or range, a declining population, or a population facing documented threats. ADFG at-risk rankings also incorporate the conservation concern listings prepared by other agencies and specialist groups focused on the conservation of Alaska birds (ADFG 2015). Listings by the US Shorebird Conservation Plan Partnership, Partners in Flight, the International Union for Conservation of Nature Red List of Threatened Species (IUCN 2018), and Audubon Alaska (Warnock 2017a and 2017b) are also included in **Table K-9** in **Appendix K**.

Steller's eiders, the smallest of the four eider species, are tundra-nesting sea ducks. Their primary present-day breeding range is in eastern Siberia, where they nest in wet tundra near freshwater ponds with and without emergents[20] (Fredrickson 2001; Safine 2013, 2015; Graff 2016). The Alaska-breeding Steller's

[20]A water plant whose leaves and flowers appear above the surface

eider, which belongs to a larger Pacific population, was listed under the ESA as a threatened species in 1997 (62 FR 31748–31757). Critical habitat was designated for Steller's eiders in western Alaska (including Kuskokwim Shoals, Sea Islands, Nelson Lagoon, and Izembek Lagoon, all of which are next to the marine transportation route), but no critical habitat was designated on the North Slope. Although the nesting distribution on the North Slope once extended eastward to Demarcation Bay, most Steller's eiders in the listed population nest in the Utqiaġvik area (Quakenbush et al. 2002). Steller's eiders are considered to occur only as rare visitors in the program area (**Table K-9** in **Appendix K**) and are not expected to nest that far east on the ACP. As with other eiders, they spend the entire non-breeding season in coastal marine waters. In the winter, most of the world's Pacific Steller's eiders are located along the Alaska Peninsula and Aleutian Island chain.

The spectacled eider is a medium-sized eider, breeding on tundra in arctic and western Alaska and eastern Siberia and spending the rest of the year at sea, after young can fly (Petersen et al. 2000). The spectacled eider was listed as threatened under the ESA in 1993, after a severe decline of the species on the Yukon-Kuskokwim Delta (58 FR 27474–27480). Critical habitat was designated in 2001 in Ledyard Bay in the Chukchi Sea and in other areas of western Alaska next to the marine transportation route (66 FR 9146–9185). No critical habitat occurs in the program area. The spectacled eider breeds primarily on the Arctic coast from Point Lay and Utqiaġvik to the Sagavanirktok River (USFWS 1996). The program area is in the breeding range, but in the lowest density class for breeding spectacled eiders as measured by ACP aerial surveys (Wilson et al. 2018; Amundson et al. 2019). Between 1992 and 2016, densities of breeding spectacled eiders were low (0.253 birds per 0.39 square mile; range: 0.233–0.278) (**Map 3-23**, Nest Sites, Observations, and Density of Pre-Nesting Spectacled Eider, in **Appendix A**). The spectacled eider is an uncommon breeder in the program area (USFWS 2015a). Nests have been documented on the Canning River delta as recently as 2017 (USFWS unpublished data; Lamoreaux 2017), but contemporary systematic ground surveys have not been conducted. Low numbers of spectacled eiders are expected to occur in the program area during the pre-nesting and nesting periods, where suitable habitat is available.

Waterbirds

Thirty-seven species of waterbirds have been observed on the ARCP, 20 of which are confirmed breeders and 4 are possible breeders; 19 species occur as migrants (14 of which are also breeders), and an additional 9 species are visitors (**Table K-9** in **Appendix K**). Most of the 9 species of waterbirds that are casual or accidental visitors and several of the 15 uncommon and rare species are outside their historical ranges; however, 9 of 15 uncommon or rare species breed on the ARCP, and several of these are species of conservation concern. Of the 24 waterbird species considered breeders and possible breeders on the ARCP, there are 14 species of ducks, 3 geese, 3 loons, 2 swans, 1 grebe, and 1 crane.

Of the 37 species of waterbirds known to occur on the ARCP, five species are included on at least one of four agency conservations lists. Two are listed as threatened under the ESA (Steller's and spectacled eiders); another 2 are listed as sensitive species by the BLM (red-throated and yellow-billed loons; BLM 2019b), one of which (yellow-billed loon) is also a USFWS bird of conservation concern (USFWS 2021b); and ADFG lists these plus a fifth species (black scoter) as an at-risk species (ADFG 2015) (**Table K-9** in **Appendix K**). Five waterbird species considered game species are listed by the USFWS Migratory Bird Program as Focal Species: brant, greater scaup, lesser scaup, common eider, and white-winged scoter (USFWS 2011). The USFWS also considers tundra nesting waterbirds to be a Resource of Concern for the Arctic Refuge (USFWS 2021a).

The Seaduck Joint Venture designated 16 key sites for seaducks in Alaska, nine of which are in proximity of the MTR (Bowman et al. 2022). The MTR would cross the Beaufort Sea Coastal Lagoons Key Site which has been designated a key habitat for seaducks based on its importance as a molting area, particularly for long-tailed ducks (Bowman et al. 2022). Additionally, the MTR would be within a 20 mile to 425 mile proximity of Ledyard Bay, Northern Bering Sea, Norton Sound, Yukon-Kuskokwim Delta, Kuskokwim Shoals, Nushagak and Kvichak bays, Seal Islands, Nelson Lagoon, and Izembek Lagoon key sites which were designated as key sites primarily for their importance to eiders as critical, molting, or breeding habitat (Bowman et al. 2022).

Waterbirds, especially ducks and geese, are an important subsistence resource for residents in Kaktovik (summarized in USFWS 2015a). Thirteen waterbird species that occur in the program area are harvested by Kaktovik residents; an average of 11 waterbird species (range: 8–12) were reported as harvested during 2007–2012 (Harcharek et al. 2018). Black brant, cackling, and Canada geese represented the largest proportion of the waterbird subsistence harvest during all years.

Thirteen waterbird species are fairly common to abundant seasonally in the program area: greater white-fronted goose, snow goose, brant, Canada goose, cackling goose, tundra swan, northern pintail, king eider, common eider, white-winged scoter, long-tailed duck, red-breasted merganser, red-throated loon, and Pacific loon (Pearce et al. 2018). All occur as breeders or possible breeders. The North American Waterfowl Management Plan (USFWS 2012) and updates (USFWS 2018a) outline the population status and abundance objectives of agency wildlife managers for waterfowl (ducks, geese, and swans).

Using aerial-survey breeding waterbird data collected across the ACP from 1992–2016 for 20 species, Amundson et al. (2019) found that density on the ARCP was greater than average for tundra swan, red-throated loon, and Canada/cackling geese, and lower than average for greater white-fronted geese, Pacific loon, Steller's eider, white-winged scoter, and yellow-billed loon. There was no difference in density between areas surveyed in NPR-A and the ARCP for snow geese, black brant, northern pintail, scaup, spectacled eider, king eider, long-tailed duck, and red-breasted merganser. However, due to lower sampling intensity in Arctic Refuge than in other parts of the Arctic Coastal Plain, there is greater uncertainty in these density estimates and lower power to detect small differences in densities of breeding birds (Amundson et al. 2019).

Breeding waterbirds generally arrive in the Coastal Plain of the North Slope in late May and June and begin nesting from late May through June (Johnson and Herter 1989). Most waterbird species nest at highest densities in wet and moist tundra habitats, often on waterbody shorelines, islands, and peninsulas, but some species primarily nest in drier habitats. The distribution of high-value waterbird nesting habitats in the ARCP is roughly represented by the areas included in annual USFWS waterfowl breeding population surveys (Larned et al. 2011; see **Map 3-3**).

In July and August, most waterbirds occupy lakes and ponds to rear their young, although geese and cranes graze in tundra wetlands. In the late summer, large numbers of post-breeding and molting (temporarily flightless) sea ducks, primarily long-tailed ducks, and other waterfowl and loons use coastal lagoons behind the barrier islands. In aerial surveys conducted in late June/early July 1999–2011, surf scoters were the most abundant species in the ARCP barrier island/lagoon system (mean 2,857 birds, range 544 to 8,855 birds), followed by long-tailed ducks (mean 1,445 birds, range 220 to 3,199) and white-winged scoters (mean 1,340, range 31 to 4,192) (Dau and Bollinger 2012, USFWS unpublished data).

Common eiders and red-breasted mergansers were abundant, and loons and swans were common in the lagoon systems in late June/early July. By late July/early August, long-tailed ducks become the dominant species in the lagoons, where they spend the molting period flightless. In surveys conducted in the ARCP lagoons in 2002 and 2003, 12,000 and 27,965 long-tailed ducks were counted, making up 92 and 95 percent of birds observed (Lysne et al. 2004).

The peak in numbers of long-tailed ducks in the lagoons are in late July or early August. This is followed by a decline into mid-September, by which time the flightless molt has ended (Garner and Reynolds 1986; Johnson and Gazey 1992). Other species present in much lower numbers (fewer than 450 birds) during the late July/early August surveys were common and king eiders, surf scoters, scaup, northern pintails, and all three species of loons.

Waterbirds use both inland and coastal habitats as they stage for the southward migration. Sea ducks and other waterbirds continue to forage in the lagoons. Migratory waterbirds may be present in the marine environment through October and into November, leaving with advancing sea ice (Kuletz et al. 2015).

Various migration routes and wintering areas are used by different species of waterbirds. Most geese and dabbling ducks migrate through the Pacific and Central Flyways but are also found in the Mississippi and Atlantic Flyways during winter. Tundra swans cross the continent to winter on the Atlantic coast, largely in Chesapeake Bay. Primary migration routes of brant, eiders, and loons from the ARCP are coastal across northern Alaska and along the coasts of the Chukchi and Bering seas. Eiders winter primarily in the Bering Sea, with some species also occurring in coastal areas of southern Alaska. Brant, Pacific loons, and yellow-billed loons from the ARCP winter primarily along the Pacific coast of North America, while red-throated loons from the ARCP winter in East Asia (McCloskey at al. 2018).

Common Eider and King Eider

Common and king eiders are an important subsistence resource for North Slope residents. The USFWS conducted 12 years of aerial surveys during the nesting period of common eiders (1999–2009, 2011) and estimated the number, distribution, and population trend of common eiders in coastal habitats on the North Slope, including Arctic Refuge lands (Dau and Bollinger 2012, summarized in USFWS 2015a) (**Map 3-24** top panel, Common Eider Locations in Late June/Early July, in **Appendix A**). During that period, USFWS estimated between 75 and 445 breeding pairs annually, suggesting that common eiders have increased in abundance on their barrier island breeding grounds in the Arctic Refuge since 1976, although the reasons are uncertain (USFWS 2015a). In a 2015 ground-based survey conducted across most Arctic Refuge barrier islands, over 800 common eider nests were found (USFWS, unpublished data).

Common eiders that breed in the Arctic Refuge primarily winter in the Bering Sea, apparently using the closest available ice-free habitats (Petersen and Flint 2002). Common eiders use the lagoon system into late July/early August prior to migration (**Map 3-24** bottom panel, Common Eider Locations in Late July/early August, in **Appendix A**). Migration routes of common eiders in the Beaufort Sea are generally within 30 miles of shore, and routes are affected by the occurrence of open water leads in spring. Common eiders undertake spectacular spring migrations of several hundred thousand birds between the Beaufort Sea and coastal areas in western Alaska, along the coast of the Chukchi Sea. Common eiders undertake a molt migration between June and September from the breeding grounds to the molting areas (Goudie et al. 2020). The true fall migration from the molting areas to the wintering areas is typically in October-December (Goudie et al. 2020). Fine-scale data on molting areas for common eiders is not available.

From systematic observations of the spring and fall migrations past Point Barrow, common eider numbers declined by 53 percent between 1976 and 1996 (Suydam et al. 2000). The common eider population that migrates past Point Barrow increased by a rate of 2.26 percent annually between 1994 and 2004. During that time, numbers of common eiders observed during spring migration increased from 74,651 in 1994 and 72,606 in 1996 to 114,996 in 2003 and 110,561 in 2004 (Quakenbush et al. 2009). Westward fall migration of eiders is protracted compared to spring migration, and common eiders move out of the Beaufort Sea between July and October, after molting. They use a corridor paralleling the northern coast of the Yukon Territory and Alaska, past Point Barrow and southwest across the Chukchi Sea to wintering areas in the Bering Sea south to the Aleutian Islands.

King eiders are abundant in the Beaufort Sea area, including the program area (Johnson and Herter 1989). They nest primarily in tundra wetlands, and low densities (0.3–0.8 nests/0.39 square mile) have been documented in the Arctic Refuge (Johnson and Herter 1989) (**Map 3-25**, King Eider, in **Appendix A**). Spring migrating king eiders come close to land only as they pass specific points, including Point Barrow and sites primarily in the Northwest Territories of Canada; offshore lead systems in pack ice are the primary determinant of routing and timing. Similar to common eiders, spring migrations of king eiders past Point Barrow in May can be spectacular, with king eiders typically first and closely followed by common eiders.

King eiders undertake a molt migration between July and September leaving the breeding grounds and the Beaufort Sea for staging areas in the Chukchi Sea and then to molting and wintering areas in the Bering Sea (Phillips et al. 2006). As in spring, much of this migration occurs offshore and is most conspicuous at Point Barrow and Cape Bathurst in the eastern Beaufort Sea, and less conspicuous along much of the intervening coast (Johnson and Richardson 1982). King eiders are not abundant during fall surveys of coastal lagoons in the Arctic Refuge (Lysne et al. 2004).

Barry (1974) estimated that about a million king eiders migrated into and through the Beaufort Sea area in the early 1970s; however, estimated numbers from systematic observations at Point Barrow in spring and fall declined for unknown reasons by more than 50 percent between 1976 and 1996, to about 350,835 birds (Suydam et al. 2000). In 2003 and 2004, 304,966 and 591,961 king eiders, respectively, were estimated (Quakenbush et al. 2009). King eider populations were stable, and possibly increasing, between 1996 and 2016 (McGuire et al. 2019).

Waterbird Use of Coastal Lagoons

Many waterbirds in the post-breeding period use the coastal lagoons between the barrier islands and the program area's coast (see **Appendix A**, **Map 3-24**, Common Eider, **Map 3-25**, King Eider, **Map 3-26**, Surf Scoter, **Map 3-27**, Long Tailed Duck, and **Map 3-28**, Yellow-Billed Loon). The Beaufort Sea coastal lagoon and barrier island ecosystem has been designated a key habitat for seaducks based on its importance as a molting area, particularly for long-tailed ducks (Bowman et al. 2022), and the Arctic Refuge considers this ecosystem and the waterbirds that use it to be Resources of Concern (USFWS 2021d).

In aerial surveys of nearshore waters and barrier islands conducted 1999–2009 and 2011 during late June and early July (early incubation for common eiders and the early post-breeding period for most other species surveyed), 17 waterbird species were recorded regularly (Dau and Bollinger 2009, 2012). The most abundant species recorded was surf scoter (average of 2,173 individuals), followed by long-tailed duck (average of 819 individuals), common eider (average of 593 individuals), and glaucous gull (average of 553 individuals). In aerial surveys conducted later in the season (late July and early August 2002 and 2003),

thousands more long-tailed ducks were observed, with over 28,000 birds recorded in one year (Lysne et al. 2004). These numbers likely far exceed the number breeding in the Arctic Refuge, indicating that long-tailed ducks from a larger geographic area move to coastal lagoons in the Arctic Refuge to molt in late summer and fall (Lysne et al. 2004; USFWS 2015a). Additionally, aerial surveys conducted in the 1980s showed that the greatest concentrations of waterbirds in the Arctic Refuge were in coastal lagoons, which provide important staging and molting habitats for waterfowl and shorebirds (USFWS 1986).

During those same aerial surveys conducted in fall 2002 and 2003, up to 20 percent of yellow-billed loons, 28 percent of red-throated loons, 29 percent of long-tailed ducks, 33 percent of scaup, and 41 percent of Pacific loons counted across the entire North Slope survey area were in the lagoons and nearshore areas along the Arctic Refuge coast (Lysne et al. 2004).

Snow Goose

The entire western Arctic population of snow geese assembles for fall migration in the Coastal Plain of Alaska and Canada during late August and early September (Garner and Reynolds 1986; USFWS 2015a). In post-breeding surveys conducted between 1973 and 2004, as many as 325,760 snow geese were recorded on the ARCP (**Map 3-29**, Frequency of Occurrence of Snow Goose Flocks with >500 Birds observed During Aerial Surveys, 1982–2004, in **Appendix A**). During 1992–2016, snow geese had an annual growth rate of 13.8 percent (range: 9.0–18.4 percent) across the ACP (Amundson et al. 2019). They come primarily from the large nesting colony on Banks Island (Canada) and from much smaller nesting colonies on the North Slope and in western Canada to graze in upland and coastal tundra habitats (Hupp et al. 2002).

The ARCP east to the Canada border is part of a larger assembly area that extends east another 310.7 miles to the Bathurst Peninsula in Canada (Pearce et al. 2018). The breeding population of snow geese on Banks Island more than doubled, from 200,000 in the early 1990s to 500,000 in 2013 (Pacific Flyway Council 2013). The population breeding across the entire Coastal Plain of the North Slope also increased dramatically in that time (Burgess et al. 2017; Hupp et al. 2017). Although snow geese were not historically known to breed on the Arctic Refuge (USFWS 2015), the species was observed breeding near the Canning River Delta in 2018 and 2019 (USFWS unpublished data). Because systematic surveys have not been conducted, it is unknown whether snow geese still breed at the sites they were observed in 2018 and 2019, or also now breed at other sites on the ARCP.

The numbers of birds on the ARCP during the 1973 to 2004 USFWS surveys were highly variable, with the proportion of the population staging in Alaska ranging from 0 to 49 percent. In some years, no staging snow geese were recorded as far west as the ARCP; numbers in Alaska may depend on weather conditions (wind and the timing of onset of snow cover) and may be affected by changes in food availability caused by foraging (Kendall 2006). In the last complete survey of staging snow geese on the ARCP conducted in 2004, 189,636 individuals were recorded (USFWS 2015a). Most recently, a survey was attempted in 2022, but weather prevented its completion. Preliminary results suggest higher use of the western portion of the ARCP by staging snow geese in 2022 than during surveys conducted in the early 2000s, but more data is needed before drawing conclusions. If trends in staging reflect population trends in breeding areas, the number of geese staging in the program area was likely much higher now than the 189,636 observed in 2004.

Snow geese depend on this staging period to build energy reserves for their southward migration (Brackney and Hupp 1993). Snow geese forage in inland habitats in the program area for two to four weeks prior to

autumn migration, targeting graminoid species such as *Eriophorum angustifolium* and *E. russeolum* (Hupp et al. 1998). Feeding probability and quality forage availability for this species are highest in flooded soils along the ecotone of flooded and upland habitats, and the distribution of staging snow geese is largely determined by the availability of suitable foraging habitat (Hupp et al. 1998; Robertson et al. 1997). During staging, snow geese frequently use the central Coastal Plain between the Okpilak and Aichilik rivers, which consists of low, rolling ridges, high densities of thermokarst pits (Robertson et al. 1997). Following staging in the coastal plains of northeastern Alaska and northwestern Canada, snow geese migration takes birds south through Alberta and Manitoba and to wintering areas primarily in central California (Mowbray et al. 2020).

Red-throated Loon

Red-throated loons have been identified as a sensitive species by the BLM (BLM 2019b) and an at-risk species by ADFG (ADFG 2015). On average, red-throated loons are found in higher densities in the Arctic Refuge than they are on the rest of the ACP, and their population exhibited a significant decline of 3.4 percent (range: 5.6 –1.3 percent decline) across the ACP during 1992–2016 (Amundson et al. 2019). Preliminary data from a 2022 aerial survey of red-throated loon breeding occupancy in the Arctic Coastal Plain ecoregion support this finding (Rizzolo et al. 2022). Previous analyses of red-throated loon population trends using survey data from 1977–1993 showed a decline of 53 percent ($r^2 = 0.65$, $p < 0.001$) across all of Alaska (Groves et al. 1996).

Red-throated loons nest in lacustrine habitats and rely on marine fish as their primary food source (Uher-Koch et al. 2021). The highest densities of red-throated loons in the program area occur in the Coastal Plain and adjacent marine areas (USFWS 2015a).

Shorebirds

Thirty-three shorebird species have been recorded on the ARCP, 19 of which are confirmed breeders and 3 are possible breeders. Fourteen shorebird species are migrants, 12 of which also breed or possibly breed on the ARCP, and an additional 9 species are rare or casual visitors (**Table K-9** in **Appendix K**). The group of 22 breeders and possible breeders includes 17 sandpiper species, 3 plovers, and 2 phalaropes.

As a group, shorebirds are of increasing conservation concern, as many species have been undergoing population declines over the past several decades (US Shorebird Conservation Plan Partnership 2016; Alaska Shorebird Group 2019). Rosenberg et al. (2019) reported a 37 percent decrease in the abundance of shorebirds across North America during 1970–2017, with 68 percent of shorebird species ($n = 44$) experiencing population declines. Of the 23 shorebird species not considered accidental, rare, or casual visitors, 11 are listed as species of conservation concern by at least one of four agencies: 6 BLM sensitive species (BLM 2019b), 5 of which are also USFWS birds of conservation concern (USFWS 2021b), and an additional 6 shorebirds are listed as at-risk species by ADFG (ADFG 2015) (**Table K-9** in **Appendix K**). Fourteen of 22 species (64 percent) that breed or possibly breed on the ARCP are considered shorebirds of conservation concern (US Conservation Plan Partnership 2016), including 7 species of moderate concern, 6 species of high concern, and 1 species of greatest concern (**Table K-9** in **Appendix K**). Of the 9 shorebird species that could occur along the marine vessel transit route, 3 are USFWS birds of conservation concern and one (rock sandpiper) is also a BLM sensitive species (**Table K-11** in **Appendix K**). In addition, the USFWS considers tundra nesting shorebirds to be a Resource of Concern for the refuge (USFWS 2021).

Eight shorebird species are fairly common to abundant in the program area as both breeders and migrants: American golden-plover, semipalmated plover, ruddy turnstone, pectoral sandpiper, semipalmated sandpiper, long-billed dowitcher, red-necked phalarope, and red phalarope (Pearce et al. 2018). Upland sandpipers are listed in **Table K-9** in **Appendix K** as "fairly common (inland)" and are typically found more in the foothills, which are primarily outside the program area. The 9 rare or casual visitors and several of the rare or uncommon breeders/migrants are outside the normal ranges of those species; however, 13 of 16 species considered rare or uncommon are confirmed or likely breeders on the ARCP, as follows: black-bellied plover, whimbrel, bar-tailed godwit, stilt sandpiper, sanderling, dunlin, Baird's sandpiper, white-rumped sandpiper, buff-breasted sandpiper, western sandpiper, Wilson's snipe, spotted sandpiper, and wandering tattler.

Shorebirds arrive on the North Slope in mid-May through June. Most begin nesting in June, though a small number begin laying eggs in late May and into early July (Saalfeld and Lanctot 2015). In surveys of breeding shorebirds in June 2002 and 2004, Brown et al. (2007) recorded 14 shorebird species and estimated that 230,000 shorebirds (95 percent confidence interval (CI) of 104,000 to 363,000) occupied the program area during the breeding season. For the five most abundant shorebird species on the ARCP (pectoral sandpiper, semipalmated sandpiper, red-necked phalarope, red phalarope, and American golden-plover), numbers breeding in the program area were estimated to comprise between 1.4 percent (semipalmated sandpiper) and 13.2 percent (pectoral sandpiper) of global populations.

Shorebirds use a wide range of tundra habitats for nesting. Most species nest in wet and moist habitats, but some prefer drier uplands and riverine habitats. Wetland and riparian habitats, particularly deltas and coastal areas, have higher shorebird density and diversity, and shorebird density appears to be highest in wetland areas in the Canning River delta region (Brown et al. 2007).

Across the ACP, shorebirds are generally more abundant near the coast than farther inland, though the American golden-plover and long-billed dowitcher are more evenly distributed (Saalfeld et al. 2013). Species richness was highest to the west, in the NPR-A (Johnson et al. 2007; Saalfeld et al. 2013). However, several species were more common in the east (Johnson et al. 2007), reflecting differences in distribution among individual species across the Coastal Plain of the North Slope.

After hatching, most shorebirds use open tundra and shorelines to rear their young; as the young become flight capable, they begin to forage on the coast. In late July through September, shorebirds stage on river deltas across northern Alaska, including in the ARCP, for the fall migration to wintering areas in the Americas and Asia. Shorebird abundance on river deltas varies among sites and years (Taylor et al. 2010; Brown et al. 2012) and individuals move among multiple sites during the year (Taylor et al. 2011). Up to 4,000 shorebirds were counted on daily surveys at the Jago River and Okpilak River deltas in 2011 (Churchwell 2015). Most of the deltas on the North Slope are used by large numbers of foraging shorebirds, with the Jago River and Hulahula River deltas being among the most heavily used areas in the ARCP (summarized in USFWS 2015a and Pearce et al. 2018). These deltas are among an interconnected network of post-breeding sites, all of which are important to multiple species of shorebirds (Taylor et al. 2011). Most of the shorebirds foraging in the river deltas in late summer and fall are juveniles hatched earlier in the summer. After staging, shorebirds continue migrating to coastal wintering areas in Central and South America (e.g., semipalmated sandpipers) and Asia (e.g., dunlin), using various flyways and migration routes, with both eastward and westward movements along the Alaska coast (Taylor et al. 2011; Brown et al. 2017b).

Larids

Sixteen larid species (gulls, jaegers, and terns) have been recorded on the ARCP, 7 of which are confirmed breeders (**Table K-9** in **Appendix K**). Three larid species (ivory gull, Ross's gull, and herring gull) occur only as rare migrants, and 6 larid species occur as rare, casual, or accidental visitors.

None of the larids that occur on the ARCP are BLM sensitive species (BLM 2019b), USFWS birds of conservation concern (USFWS 2021b), or ADFG at-risk species (ADFG 2015) (**Table K-14** in **Appendix K**). Jaegers (pomarine, parasitic, and long-tailed combined) averaged higher than average densities in the ARCP compared to the rest of the ACP, and their population trend appeared to be stable across the ACP during 1992–2016 (Amundson et al. 2019) and in Prudhoe Bay during 2003–2019 (McGuire et al. 2023). Sabine's gulls occur at lower densities in the program area than in the NPR-A, while glaucous gulls and arctic terns occur at about the same densities as they do in the NPR-A (Amundson et al. 2019). At-sea surveys have recorded glaucous gulls, black-legged kittiwakes, Ross's gulls, and Sabine's gulls in waters next to the ARCP (Kuletz et al. 2015). At least 17 larid species occur along the marine vessel transit route to Dutch Harbor, including 4 listed as USFWS species of conservation concern (red-legged kittiwake, Aleutian tern, Caspian tern, and arctic tern; **Table K-11** in **Appendix K**).

Larids arrive on the North Slope roughly at the same time as shorebirds, in mid-May through June (Johnson and Herter 1989). They breed across the ARCP in a range of habitats, including open tundra (primarily jaegers), shores and islands on tundra lakes, and on the barrier islands (primarily gulls and terns). During the breeding season, the smaller gulls and terns generally feed on aquatic invertebrates and small fish, whereas jaegers largely prey on small mammals, birds, and eggs.

The single larger gull species (glaucous gull) is omnivorous and can prey on small birds and eggs. Local residents report that glaucous gull populations on the ARCP have been increasing, and there is some evidence of increases in gull populations in the Arctic generally (NRC 2003). Numbers of gulls increased in Prudhoe Bay during 2003–2019 (McGuire et al. 2023) and across the entire ACP during 1992–2019 (Amundson et al. 2019). These increases could be due to global changes in their populations or increased human development in the area (Weiser and Powell 2010). There are numerous accounts of glaucous gulls foraging in North Slope landfills. Distribution maps from aerial surveys indicate that gulls tend to concentrate in the vicinity of human development in the Coastal Plain of the North Slope, including Kaktovik on the Arctic Refuge (summarized in USFWS 2015a).

Raptors

As treated in this EIS, raptors on the ARCP include eagles, hawks, falcons, and owls. Thirteen raptor species have been recorded on the ARCP, 6 of which are confirmed breeders and 2 are possible breeders (**Table K-9** in **Appendix K**). Five species occur as casual visitors, including the bald eagle. Only 3 raptor species are considered abundant (golden eagle, snowy owl, and short-eared owl), and the other 5 breeding or possibly breeding species are uncommon or rare (northern harrier, rough-legged hawk, merlin, gyrfalcon, and peregrine falcon).

Two raptor species (snowy owl and short-eared owl) are listed as USFWS birds of conservation concern (USFWS 2021b), and none are listed as sensitive species by the BLM (BLM 2019b). Two more species (northern harrier and American kestrel) are listed by ADFG as at-risk species (ADFG 2015); however, American kestrels are only known to occur in the ARCP as casual visitors (**Table K-9** in **Appendix K**). The arctic peregrine falcon subspecies, which breeds on the ARCP, was previously listed as endangered

under the ESA, but it was delisted in 1994 (59 FR 50796; USFWS and NMFS 2014). It still retains special concern status under Canada's Species at Risk Act (**Table K-10 in Appendix K**).

Raptor species use multiple habitat types present in the program area. Several raptors on the ARCP are cliff-nesting, occurring primarily in mountainous terrain or on steep river bluffs: golden eagle, rough-legged hawk, gyrfalcon, and peregrine falcon. Ground-nesting species are northern harriers, snowy owls, and short-eared owls.

In the Arctic Refuge, nesting of raptors begins from late March to early May (Young et al. 1995). Some snowy owls winter on Arctic breeding grounds, but most arrive on the North Slope during April and May, with most egg laying in mid-May (summarized in Holt et al. 2015). The remaining raptors arrive and begin nesting in May and early June (Johnson and Herter 1989).

Golden eagles nest almost exclusively in cliff habitats, and in the program area, they nest primarily in the Brooks Range foothills, as cliff habitat appropriate for eagles is rare elsewhere on the ARCP. Breeding golden eagles return to Alaska, presumably including the Arctic Refuge, from late February to mid-April, with nonbreeders arriving later (summarized in Kochert et al. 2002). Golden eagles are commonly observed on the ARCP in late June and early July, when calving and post-calving caribou herds are present; these are primarily subadult birds that are preying on or scavenging caribou calves (summarized in USFWS 2015a). In a 1983–1985 study, golden eagles were the main predators of caribou calves on the calving grounds (Whitten et al. 1992; Griffith et al. 2002). It also appears that golden eagles from other regions in the state use northern Alaska, including the Brooks Range and ARCP. Eagles that hatched in the Alaska Range were found in the Arctic Refuge during at least two subsequent summers (summarized in USFWS 2015a).

In the program area, cliff nest habitats occur primarily in river corridors; outside of these areas, the overall abundance of nesting raptors is low. Surveys on the ARCP were conducted on the Canning, Hulahula, and Kongakut rivers in the 1990s and early 2000s to monitor cliff-nesting raptors (summarized in USFWS 2015a). Raptors nesting on cliffs along these rivers are golden eagles, peregrine falcons, gyrfalcons, and rough-legged hawks.

The two owl species that breed on the ARCP, snowy owl and short-eared owl, are variable in abundance among years. As in other regions on the North Slope, both species are substantially more common as breeders in years of high vole or lemming abundance (Johnson and Herter 1989).

Landbirds

As treated in this EIS, landbirds on the ARCP include a diversity of species that are strongly dominated in abundance by passerines[21] (primarily Lapland longspurs) and two species of ptarmigan. Of the 50 landbird species occurring on the ARCP, 18 are confirmed breeders and 2 are possible breeders (**Table K-9** in **Appendix K**). None of these 20 breeding or possibly breeding landbird species are listed as BLM sensitive species or USFWS birds of conservation concern (BLM 2019b; USFWS 2021b), but the USFWS identified one landbird species, the gray-headed chickadee, as an Arctic Refuge Resource of Concern (USFWS 2021). Eight landbird species are listed by ADFG as at-risk species (ADFG 2015) (**Table K-9** in **Appendix K**). Thirty landbird species occur only as rare, casual, or accidental visitors, and two of these (rufous hummingbird and varied thrush) are listed as USFWS birds of conservation concern (USFWS 2021b). All

[21]Perching birds

7 accidental landbird species and many of the rare and casual visitors have been observed outside of their historical ranges.

Most landbirds in the Coastal Plain of the North Slope are migratory species that arrive in mid-May through June and begin nesting shortly thereafter (Johnson and Herter 1989). The American dipper, willow ptarmigan, rock ptarmigan, and common raven are year-round residents. By far the most abundant landbird species on the ARCP is Lapland longspur, which nests throughout the area in wet and moist tundra habitats (**Table K-13** in **Appendix K**). Other relatively common species on the ARCP are rock ptarmigan (found throughout the area), willow ptarmigan (more common inland), common raven (found throughout the area), eastern yellow wagtail (most common in riparian areas), common and hoary redpoll (found throughout the area), snow bunting (more common on the coast), savannah sparrow (more common inland), and American tree sparrow and white-crowned sparrow (more common inland) (Pearce et al. 2018).

Lapland longspurs are the most abundant landbird species on the ARCP; however, their nest survival (the probability of hatching one egg) declined from 59 percent to 34 percent between 2003 and 2019 (McGuire et al. 2023). McGuire et al. (2023) also found that longspur nest density varied between 11 and 27 nests/square kilometer during 2003–2019, but there was no obvious trend across time. The reasons for this decline are not understood, but there is some speculation that increases in avian predator populations in Prudhoe Bay during the same period may have disproportionally affected longspurs, and climate change may also play a role (see *Climate Change* section below).

Other Seabirds

Eight seabird species (fulmars, shearwaters, and alcids) have been recorded in marine waters off the ARCP, but 6 of these species are rare or casual visitors. One seabird species (black guillemot) is known to breed on barrier islands off the ARCP and one species (thick-billed murre) is a rare migrant (**Table K-9** in **Appendix K**). Two species (Kittlitz's murrelet and tufted puffin), considered to be visitors, are listed as birds of conservation concern by USFWS (USFWS 2021b) (**Table K-9** in **Appendix K**).

Thirteen additional seabird species are present along the marine vessel transit route to Dutch Harbor, including alcids (auklets, murres, and puffins), cormorants, and albatrosses (Audubon Alaska 2017) (**Table K-11** in **Appendix K**). Short-tailed, black-footed, and Laysan albatrosses all have increased in abundance and shifted their ranges northward in the Bering Sea in recent decades (Kuletz et al. 2015). The short-tailed albatross is federally listed as endangered, and individuals have been found as far north as the southern Chukchi Sea in recent years (Day et al. 2013). Of the 13species, 10 are listed by the USFWS as birds of conservation concern (USFWS 2021b); 2 of these are also listed as sensitive species by the BLM (BLM 2019b).

Climate Change

Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section B.2.1**). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Warmer temperatures and earlier snowmelt would likely change the timing of seasonal events on the North Slope, but it is unclear how bird populations would respond; impacts would depend on how quickly and dramatically the vegetation and hydrology change. Some bird species could benefit from longer breeding seasons and expansion of shrub and coastal habitats, while others could lose habitat, food, or prey and could experience seasonal mismatches in breeding and plant/insect phenology (seasonal timing of events) (i.e., trophic mismatches; see Doiron et al. 2015). It is possible that birds are unable to adapt to

trophic mismatch (Dawson 2008; Kumar et al. 2010). The historically dominant landbirds and waterbird species may be displaced northward or into shrinking remnant habitats. Kubelka et al. (2018) suggested predation is increasing in the Arctic and is linked to climate-induced shifts in predator-prey relationships, which could adversely affect both numbers and productivity of nesting birds. However, Bulla et al. (2019) reanalyzed the same data set and did not find that predation rates in the Arctic were increasing any faster than elsewhere. Long-term data from Prudhoe Bay indicates that numbers of two avian egg predator species (glaucous gulls and common ravens) increased during 2003–2019 (McGuire et al. 2023). Amundson et al. (2019) also found a long-term increase in glaucous gull numbers.

A species may experience both beneficial and adverse effects, as outlined below, with outcomes uncertain; however, many species that nest on the ARCP already are experiencing decreasing populations, and many could suffer catastrophic consequences from the effects of global climate change in one or more of their seasonal continental or even global habitats. These effects combined with development-related impacts across the ranges of many bird species may result in extinction during the 85-year scope of this analysis (IPBES 2019). This is particularly the case for the 74 of 157 total bird species on the ARCP (44 percent) that are listed as species of conservation concern by at least one of eight major government or conservation entities (see **Table K-9** in **Appendix K**).

Earlier and warmer spring and fall temperatures may have positive effects on some species. The density of nesting geese has increased across the ARCP since 1992, both on a broad scale (Wilson et al. 2018; Amundson et al. 2019) and locally in Prudhoe Bay (McGuire et al. 2023). Geese are known to initiate nests as soon as snow-free sites are available, and they may benefit from earlier and longer breeding seasons (Dickey et al. 2008). Common eiders may benefit from earlier ice-melt around barrier islands, which has been correlated with earlier laying and larger clutch sizes (Love et al. 2010; Chaulk and Mahoney 2012). Delayed freeze-up in fall may be advantageous to the slow-growing young of such species as loons and swans, which are not always flight capable by the time of freeze-up (Johnson and Herter 1989; Ritchie and King 2000). Shorebirds at three sites across the ACP (Utqiagvik, Colville River delta, and Prudhoe Bay) nested earlier and in higher numbers in early, warm springs, relative to historical levels (n = 3,789 nests; 2005–2014); however, there was no relationship between early, warm springs and increased nest survival (McGuire et al. 2020). Shorebirds and passerines have been shown to have altered their breeding phenology, initiating nests up to 0.80 days earlier each year over 9 years, 2002–2011 (Liebezeit et al. 2014). Many of the 65 species considered visitors and many historically rare or uncommon breeders on the ARCP are at the northern edge of their typical range, and some, particularly landbirds and waterbirds, may expand their ranges, potentially increasing species richness or displacing currently abundant species.

With earlier thaws and snowmelt, insect populations may hatch earlier (McKinnon et al. 2012). Some insect-feeders (shorebirds and passerines) can initiate nests earlier with early snowmelt; however, it is unclear if birds relying on insects to feed their young (songbirds and shorebirds) could adapt to arrive at the appropriate time to initiate nesting and hatch eggs at the optimum time as insect hatch continues to advance (McKinnon et al. 2012; Grabowski et al. 2013). Saalfeld et al. (2019) noted that long-term climatic changes resulting in earlier snowmelt have the potential to greatly affect shorebird populations, especially if shorebirds are unable to initiate nests sufficiently to keep pace with seasonal advancement of their insect prey. McGuire et al. (2020) found that early springs resulted in more broods hatching after peak food (insect) availability. Shorebird chicks in northern Alaska are particularly dependent on synchronous hatching with large hatches of craneflies and may experience reduced growth and survival if phenological

events are decoupled. Red knots breeding in the Russian high Arctic have been shown to produce smaller offspring with shorter bills in summers with early snowmelt (van Gils et al. 2016).

Warmer temperatures may have more subtle effects on nesting birds and their incubation behaviors such as recess frequency (number of times a bird leaves a nest unattended). Parrett et al. (2023) found that yellow-billed loon incubation constancy declined on warm days with calm winds, and camera-monitored birds exhibited signs of heat stress and entered the water more often, leaving their nests unattended and vulnerable to predation. Shorebird species also will reduce incubation periods in response to heat stress and were sometimes unable to incubate their nests continuously in the face of prolonged heat waves (Amat and Masero 2004).

Plant biomass is predicted to increase with warmer temperatures, but forage quality is seasonal. Mismatches in forage quality with timing of bird reproduction may have adverse effects on growth rates of young of plant-eating species, particularly geese (Dickey et al. 2008; Doiron et al. 2015). Models suggest that increasing dominance of shrubs in tussock tundra habitats may result in northward shift of white-crowned sparrows and a reduction in habitat for Lapland longspurs (Boelman et al. 2014), which is currently the most common songbird in the ARCP. Waterbodies in the program area may shrink or disappear, depending on the balance of precipitation, evapotranspiration, and drainage from thermokarsting and a deeper active layer in soils (Smith et al. 2005). Melting permafrost would result in widespread thermokarst in the ARCP, because of large volumes of ground ice present (Walker et al. 2019). Ice-wedge degradation and consequent surface subsidence already has resulted in widespread drying of tundra, significantly altering the water balance of lowland tundra by reducing inundation, increasing runoff, and changing snow distribution (Liljedahl et al. 2016). With the drying of tundra habitats, some shorebirds (particularly phalaropes), waterfowl, and loons could face reduced availability or quality of nesting and brood-rearing habitats (Martin et al. 2009).

Thermokarst may also mobilize contaminants, including heavy metals, such as mercury, into surface waters from the thawed sediments. Such contaminants could pose health risks to birds, particularly to shorebirds that feed on aquatic invertebrates.

Increases in shrubs and trees have been documented (Sturm et al. 2001b; Tape et al. 2006) and are expected to continue with increasing summer temperatures. If available wet sedge and graminoid meadows are reduced by invading shrubs and decreasing moisture, it may result in shifts in the breeding bird community. Shrub- and tree-nesting birds (passerines, such as redpolls, sparrows, and thrushes) may become more numerous, and tundra nesting birds (longspurs, savannah sparrows, shorebirds, geese, and eiders) may decline (Marcot et al. 2015). With a longer breeding season and increases in shrub and tree cover, breeding species more typical of boreal forest areas to the south may extend their ranges northward and possibly compete with current tundra breeders for resources.

Shrubification (the expansion of shrubs across the Arctic) of tundra habitats is likely to increase gradually with climate change, but coastal areas may change rapidly in response to erosion and deposition. Coastal areas are historically dynamic in the Arctic, and some areas, such as river deltas and barrier islands, would be increasingly dynamic. River deltas may shift in size from deposition of sediment, while barrier islands, which form the lagoon areas important to post-breeding birds, may be losing area to increasing storm surges, while accreting less material from ice-push events in the future. Erosion of coastal shorelines could increase inundation of tundra by salt water; the resulting salt-killed tundra may be colonized by salt-tolerant species and develop into salt marsh, a rare but important post-breeding habitat for geese (Flint et al. 2003). Glaciers

in the Arctic Refuge are receding and may disappear within a few decades with potential drying of late summer delta habitats of shorebirds (Kendall et al. 2011).

Coastal habitats are likely to change quickly with increased water temperature, reduced sea ice, rising sea level, and increasing storm surges and wave action (Gibbs and Richmond 2017). Erosion of barrier islands and ice-rich coastlines from mechanical process and thawing can happen rapidly; current rates of loss along the Beaufort Sea coastline are 6.5 to 59 feet per year (see Martin et al. 2009 for review).

Some species nesting on barrier islands, such as common eiders, could be adversely affected by predicted sea level rise and increasing storm surges that could flood nests and decrease productivity (Liebezeit et al. 2012). Climate-mediated changes in the Beaufort Sea nearshore environment may result in changes in benthic prey[22] communities and increasing sea level, along with reductions in sea ice. These conditions may dramatically alter coastal physiography, possibly eliminating the barrier island-lagoon systems across the entire Arctic coast (see **Section B.2.4**, Physiography).

Offshore, the increasing water temperatures and loss of sea ice in the Beaufort Sea are associated with increased primary production (Moline et al. 2008; Arrigo and van Dijken 2011) and range expansion of seabird species from the Pacific and Atlantic Ocean basins into the Beaufort Sea (Bluhm et al. 2011; Day et al. 2013; McKeon et al. 2016). The reduction in sea ice removes physical barriers to movement and access to prey, possibly increasing opportunities for seabirds to use waters offshore of the program area. Most notable has been an increase in the abundance and diversity of zooplankton-eating species, including ancient murrelets and short-tailed shearwaters (Day et al. 2013). Conversely, there is concern that the reduction in sea ice would result in larger waves and more swell (Thomson and Rogers 2014), which could disrupt seabird foraging behavior in the Beaufort and Chukchi Seas.

Along the marine route, climate change has resulted in unusually warm water. This has been associated with seabird die-offs, which previously have been rare in the Bering Strait region (USFWS 2017a, 2018b; Jones et al. 2019).

B.3.4 Terrestrial Mammals

Affected Environment

Thirty-nine species of terrestrial mammals are known or expected to occur in the Arctic Refuge, 18 of which occur regularly in the Coastal Plain physiographic province in the Arctic Refuge (MacDonald and Cook 2009; USFWS 2015a; **Table K-19** in **Appendix K**). The occurrence and distribution of terrestrial mammals in the program area have been described in detail previously (Clough et al. 1987; Douglas et al. 2002; USFWS 2015a; Pearce et al. 2018); those discussions are incorporated here by reference, and relevant information is summarized below, and supplemented with updates from more recent research. Some species such as American beaver, common muskrat, moose, Canada lynx, and snowshoe hare are expanding their range on the ACP (Tape et al. 2015, 2016, 2018; BLM 2023) and could become more common in the program area in the future. Dall sheep are unlikely to occur in the project area (USFWS 2018c) but do occur in the Brooks Range to the south. Suitable habitat occurs in the Sadlerochit Mountains to the south of the project area and Dall sheep have occasionally been observed in that area (USFWS 2018c).

[22]Bottom-dwelling species

Special Status Species

None of the terrestrial mammals in the program area are listed under the federal ESA or the BLM list of sensitive species (BLM 2019b). (Polar bears do occur on land in the program area, but they are discussed in **Section B.3.5,** Marine Mammals). The Alaska tiny shrew[23] was on the previous BLM list of sensitive species (BLM 2010).

Caribou

Caribou are the most abundant large mammals in the program area and are an important subsistence and cultural resource for Iñupiaq, Inuvialuit, Gwich'in, and other groups who hunt the Porcupine Caribou Herd and Central Arctic Herd in Alaska and Canada. They also are an important species for other hunters who do not live in the Porcupine Caribou Herd range and for nonconsumptive uses, such as tourism and wildlife viewing. Because caribou exhibit high fidelity to calving grounds, the ADFG defines herds based on their use of calving grounds.

Four herds of barren-ground caribou occur in Arctic Alaska: (proceeding from west to east) the Western Arctic Herd (WAH), the Teshekpuk Herd (TCH), the Central Arctic Herd, and the Porcupine Caribou Herd. These four herds differ in their use of seasonal ranges, especially during the calving, insect-relief, and winter seasons (Russell et al. 1993; Murphy and Lawhead 2000). The program area is primarily used by the Porcupine Caribou Herd and the Central Arctic Herd and is outside the range of the WAH (Dau 2015; Joly and Cameron 2017; Prichard et al. 2020b). The program area is also outside the primary range of the TCH (Prichard et al. 2020b), although an estimated 5,000–10,000 TCH caribou moved into the northern portion of the Arctic Refuge in the fall of 2003 (Carroll 2005; Person et al. 2007; USFWS 2015a), following a large rain-on-snow event in the TCH winter range in October 2003 (Bieniek et al. 2018). That unprecedented movement was highly unusual, has not been repeated, and resulted in high mortality of TCH caribou wintering near the program area (Carroll 2005).

Many caribou of the Porcupine Caribou Herd give birth in the program area during most years, although the amount of calving in the area depends on spring conditions, including May snow depth (Russell and Gunn 2019; Severson et al. 2021). Porcupine Caribou Herd caribou use the coastal areas and ridges in the adjacent foothills and mountains for relief from insect harassment during summer, a period when some Central Arctic Herd caribou also use the program area. For these reasons, this discussion focuses on the Porcupine Caribou Herd and Central Arctic Herd.

Herd Sizes and Trends

The Porcupine Caribou Herd was estimated to number about 100,000 animals in 1972 and increased to 178,000 in 1989, before declining to 123,000 animals in 2001 (Caikoski 2020). Due to unsuitable conditions of weather and herd distribution, another census could not be conducted until 2010, when the herd was estimated at 169,000 animals. It increased to 197,000 animals by 2013 and reached a herd size of 218,000 animals in July 2017 (**Figure 3-6**, Population Size of Three Caribou Herds in Arctic Alaska, 1977-2017, in **Appendix A**; ADFG 2018a; Caikoski 2020). Although caribou populations are naturally cyclical and population dynamics are complex, population growth of the Porcupine Caribou Herd has been correlated

[23] *Sorex yukonicus* has since been reclassified as the holarctic least shrew, *S. minutissimus* (Hope et al. 2010; Bradley et al. 2014).

with phases of the arctic oscillation (an index of oceanic temperature and sea level pressure over the Arctic Ocean), which may affect snowfall and summer growing conditions (Joly et al. 2011).

The Central Arctic Herd was estimated at approximately 5,000 animals when it was first described as a separate herd in the mid-1970s. The herd grew to its estimated peak of 68,000 animals by July 2010, then declined steeply to 23,000 by July 2016, it then increased to 28,000 individuals in 2017 and 34,642 in 2022 (**Figure 3-6** in **Appendix A**; Lenart 2015b, 2018, 2021a; M. Nelson pers. comm[24]). The herd decline between 2010 and 2016 was thought to be due to high adult mortality and to the emigration of some Central Arctic Herd caribou to the Porcupine Caribou Herd and TCH (ADFG 2017; Prichard et al. 2020b). Some level of herd interchange occurs among the four Arctic herds in Alaska, but the larger herds, WAH and Porcupine Caribou Herd, tend to have higher herd fidelity than the two smaller herds, TCH and Central Arctic Herd (Prichard 2020b).

Life History and Habitat Use

Caribou behavior and habitat use in northern Alaska vary substantially on a seasonal basis (Russell et al. 1993; Murphy and Lawhead 2000; Russell and Gunn 2019; Prichard et al. 2020a). Caribou can efficiently travel long distances with little energetic costs (Fancy and White 1987) to maximize access to areas of nutritious forage plants, to minimize the risk of predation, and to limit their exposure to insect harassment.

Caribou of the Porcupine Caribou Herd and Central Arctic Herd generally spend the winter in or south of the Brooks Range (Griffith et al. 2002; Nicholson et al. 2016; Caikoski 2020; Lenart 2021a; Pedersen et al. 2021), where the winter ranges of the two herds overlap in some years (Caikoski 2015; Lenart 2015b; Prichard et al. 2020b), although some Central Arctic Herd caribou winter north of the Brooks Range in some years (Nicholson et al. 2016; Lenart 2021a). The proportion of animals wintering north of the Brooks Range may be related to fall snow depth as well as long-term trends (Pedersen et al. 2021). Many Porcupine Caribou Herd animals migrate to winter range in the Yukon. During winter, the availability of lichens and other winter forage is influenced strongly by snow depth, snow hardness, and ice (Collins and Smith 1991). Winter snow depth is negatively related to population growth (Aanes et al. 2000), calf birth mass (Adams 2005), and birth rate (Ferguson and Mahoney 1991). Deep winter snow may delay the timing of births and reduce birth rates for a year (Adams and Dale 1998a, 1998b).

In spring, pregnant females migrate northward to calving grounds ahead of non-pregnant females, with males arriving later, after most calving is complete (Russell et al. 1993; Murphy and Lawhead 2000). Spring migration tends to coincide with snowmelt, and caribou often calve farther south when snowmelt is delayed (Carroll et al. 2005) or, in the case of the Porcupine Caribou Herd, farther east (Griffith et al. 2002; Russell and Gunn 2019; Severson et al. 2021). In northern Alaska, most adult females older than 2 years of age give birth to a single calf in late May or early June. Caribou calving grounds in Arctic Alaska are in areas with few predators and with abundant, early emerging forage plants (especially tussock cotton grass, *Eriophorum vaginatum*), which are high in protein, are highly digestible (Kuropat 1984; Griffith et al. 2002; Johnstone et al. 2002; Johnson et al. 2018) and have high levels of some trace minerals (Oster et al. 2018). Because of the delayed plant phenology, use of the Coastal Plain during summer appears to extend the period when caribou can find forage with adequate digestible nitrogen (Barboza et al. 2018; Johnson et al. 2021). Forage plants on the ACP have higher digestible concentrations of nitrogen than in inland areas and the period that usable nitrogen is available is more extended (Barboza et al. 2018; Johnson et al. 2021). The

[24]Mark Nelson, ADFG, personal communication with Alex Prichard, ABR Inc., regarding 2022 herd size estimates of the Central Arctic Herd.

highest forage nitrogen concentrations occur during the post-calving period when peak lactation occurs (Johnson et al. 2018) and nutritional demands of parturient caribou are greatest (Parker et al. 1990).

The calving grounds of the Porcupine Caribou Herd and Central Arctic Herd are near coastal mosquito-relief habitat, requiring relatively short movements once mosquitoes become active (Walsh et al. 1992; Murphy and Lawhead 2000; Nicholson et al. 2016). During the summer insect season (late June to mid-August), caribou are harassed heavily by mosquitos (*Aedes* spp.) and parasitic oestrid flies (warble fly, *Hypoderma tarandi*; nose-bot fly, *Cephenemyia trompe*). The longest distances traveled per day throughout the entire year typically occur in July, when mosquito harassment peaks (Fancy et al. 1989; Prichard et al. 2014; Dau 2015). In response to severe mosquito harassment, caribou form large groups and move to relief habitat near the coast or to remnant snowfields, patches of aufeis, and mountain ridges farther inland, where temperatures are lower and wind speeds are higher (Downes et al. 1986; Walsh et al. 1992; Murphy and Lawhead 2000; Yokel et al. 2009; Wilson et al. 2012). Due to the proximity of the Brooks Range to the coast in the summer range of the Porcupine Caribou Herd, the herd can use either coastal areas or mountain ridges for mosquito relief habitat (Walsh et al. 1992; Russell et al. 1993).

Oestrid flies emerge in July and exert strong effects on caribou behavior and body condition (Murphy and Lawhead 2000; Hughes et al. 2009). In response to fly harassment, large caribou groups break up and disperse widely in small groups, seeking relief in unvegetated habitats, such as river bars, dunes, drained-lake basins, pingos,[25] and ridgetops. In areas of northern Alaska with industrial development, caribou sometimes use elevated sites on gravel roads and pads and in shaded areas under buildings and pipelines when flies are active (White et al. 1975; Pollard et al. 1996; Murphy and Lawhead 2000; Prichard et al. 2020a), although caribou tend to avoid these areas in the period leading up to mosquito season until the drive to avoid insects becomes the dominant factor influencing their behavior (Johnson et al 2020, Prichard et al 2020a). Hot summers with severe insect harassment can substantially decrease caribou conditions in fall, causing them to enter the winter in poor condition (Helle and Tarvainen 1984; Colman et al. 2003; Weladji et al. 2003; Couturier et al. 2009) and potentially leading to lower productivity and survival (Cameron and Ver Hoef 1994; Johnson et al. 2022).

During late summer and fall, caribou feed heavily to restore body reserves before the onset of winter (Haskell and Ballard 2004; Gustine et al. 2017). The birth rate for female caribou in spring is strongly related to body mass in the previous autumn (Cameron and Ver Hoef 1994; Cameron et al. 2000). On the range of the Central Arctic Herd, the length of the growing season has increased by 15 to 21 days as the climate warmed between 1970 and 2013 (Gustine et al. 2017); despite a 9- to 10-day increase in the fall growing season during that period, no significant change in seasonal forage quality was evident. Caribou migration to winter ranges in the fall coincides with the breeding season (rut) in October, a period when male caribou experience high energy demands. In one study, adult males lost 23 percent of body protein and 78 percent of body fat during the rut (Barboza et al. 2004).

Compared with the conditions experienced by other arctic migratory herds, the range of the Porcupine Caribou Herd has warm spring conditions and cool moist summers, which likely result in longer periods of high plant quality and lower mosquito harassment (Russell and Gunn 2017). The winter range has relatively high snow depths, but diverse terrain provides a wide range of wintering locations. Porcupine Caribou Herd animals accumulate less back fat and get pregnant at higher fall body weights (indicating lower

[25]A dome-shaped hill formed in a permafrost area when the pressure of freezing groundwater pushes up a layer of frozen ground

productivity) than other herds, but pregnancy rates change less dramatically with changing fall body weights (indicating lower vulnerability). The Porcupine Caribou Herd has had a more stable population size than other herds in recent decades (Fauchald et al. 2017; Russell and Gunn 2017).

Porcupine Caribou Herd Use of the Program Area

Caribou may have used the area for 400,000 years, and subsistence hunting of caribou has occurred in the program area for millennia (Nuttall et al. 2005; USFWS 2015a; Miller et al. 2023). Caribou use of the program area varies greatly throughout the year. The principal use by the Porcupine Caribou Herd occurs in the spring and summer, during spring migration and the calving, post-calving, and insect seasons (**Map 3-31**, Seasonal Distribution of the Porcupine Caribou Herd, in **Appendix A**). The Porcupine Caribou Herd give birth from the northern portion of the Arctic Refuge into northern Yukon, an area of 8.9 million acres (Griffith et al. 2002), but the extent of use of those areas varies substantially among years (Map 4-9 in USFWS 2015a; **Maps 3-31**, **3-32**, and **3-33** in **Appendix A**).

Four terms that have been previously used to describe the use of calving grounds by Porcupine Caribou Herd caribou, as follows (Griffith et al. 2002):

- Annual calving ground—the calving ground for a particular year
- Extent of calving—the outer perimeter of all known annual calving grounds
- Annual concentrated calving area—the area of higher than average calving density in an annual calving ground
- Extent of concentrated calving—the outer perimeter of all known annual concentrated calving areas

Both the Gwich'in and Inuvialuit consider protecting the program area to be critical to the survival of the Porcupine Caribou Herd as described in **Section B.4.3**, Subsistence Uses and Resources. The Gwich'in, particularly those residing in Arctic Village and Venetie, identify the Coastal Plain as *Iizhik Gwats'an Gwandaii Goodlit*, "The Sacred Place Where Life Begins" (Gwich'in Steering Committee 2004), in part due to its importance for caribou calving as described in **Section B.4.2**, Cultural Resources. Early descriptions of range use of the Porcupine Caribou Herd are complicated by the lack of telemetry data and the unknown status of the Central Arctic Herd (Central Arctic Herd movements could have been attributed to the Porcupine Caribou Herd); nevertheless, the available historical information shows the entire program area has been used for calving at times but with large inter-annual, and perhaps decadal, variability in distribution. Skoog et al. (1963) surveyed the area in 1961 and estimated that 60,000 caribou were between the Canning and Kongakut Rivers during calving; approximately one-third were between the Canning and Katakturuk Rivers. Hemming (1971) describes the calving range as between the Katakturuk and Kongakut Rivers. Severson et al. (2021) used models of the current distribution of Porcupine Caribou Herd caribou during calving and post-calving seasons to predict the extent of future caribou distributions during calving and post-calving distributions as a result of a warming climate (**Maps 3-34 and 3-35 in Appendix A)**.

Between 1983 and 2001, the annual percentage of Porcupine Caribou Herd females calving in the ANILCA program area averaged 42.7 percent (a portion of the concentrated calving area was in Alaska each year from 1983 to 1999; **Maps 3-32** and **3-33** in **Appendix A**). The percent calving occurring in the area was highest in years with early spring conditions (as measured by the Normalized Difference Vegetation Index [NDVI] calculated from satellite imagery during calving; Griffith et al. 2002). In 8 of the 12 years from 2000 to 2011, the annual concentrated calving areas occurred in the Yukon or near the Yukon-Alaska border, largely outside the program area (USFWS 2015a). The Porcupine Caribou Herd calved

predominantly in the Yukon in 2012/2013 (**Map 3-33** in **Appendix A**) but predominantly in Alaska between 2014 and 2017, and calving was widely dispersed in 2018. In 2017, much of the Porcupine Caribou Herd concentrated calving area was west of the Sadlerochit River. From 2019 to 2023, the concentrated calving area was generally in the program area, or near the southern border. (**Maps 3-32** and **3-33** in **Appendix A**;). Russell and Gunn (2019) found that use of the program area for calving is higher in years with shallower snow in mid-May. Severson et al. (2021) found that during calving, Porcupine Caribou Herd caribou selected calving areas that were still brown or snow-covered, but within that area, caribou selected locations at a fine scale where the snow had melted, and vegetation was greening (**Map 3-34** in A**ppendix A**).

The annual calving grounds were in areas with higher rates of increase in NDVI, which is thought to indicate higher quality forage. The annual concentrated calving areas in those annual calving grounds were characterized by higher forage biomass, as measured by NDVI (Griffith et al. 2002). Porcupine Caribou Herd caribou feed primarily on immature flowers of tussock cottongrass early in June, in wet sedge meadows, herbaceous tussock tundra, and riparian vegetation types; then later in June they forage primarily on willows and herbaceous plants (Griffith et al. 2002; Johnstone et al. 2002). Gagnon et al. (2020) used Porcupine Caribou Herd caribou body condition scores recorded by Indigenous hunters to determine that body condition improved between 2000 and 2010 and body condition was related to snow conditions, insect harassment, temperatures in May, and icing levels.

Between 1983 and 1985, Porcupine Caribou Herd calf mortality during June averaged 29 percent, and 61 percent of that mortality was due to predation, primarily by golden eagles, grizzly bears, and wolves. Predation rates and predator densities were higher in the foothills south of the program area (Whitten et al. 1992; Young and McCabe 1997), and calf survival was lower for calves born in the foothills (Griffith et al. 2002). Mean annual calf survival was higher when the forage biomass at peak lactation (estimated by NDVI on June 21) was higher (Griffith et al. 2002); hence, calving grounds for the Porcupine Caribou Herd varied annually, at least in part due to spring weather and vegetation growing conditions; calving location and vegetation growing conditions appear to affect calf survival. The USFWS (2015a) concluded that, due to the annual variability in the calving area, the Porcupine Caribou Herd needs a large region from which to select the best conditions for calving each year. Severson et al. (2021) used models of current caribou selection and predictions of future snowmelt and vegetation phenology to predict how the calving and post-calving distributions of Porcupine Caribou Herd caribou would change in future decades (**Map 3-34** in **Appendix A**). These models used 6 years of GPS collar data and weather and environmental data to determine factors useful for describing the current distribution of caribou using a machine learning model. Those results were then used to predict future caribou distributions under modeled weather conditions based on output from climate change models. Because these predictions are based on modeled distributions applied to modeled climate data, the uncertainty in the predictions is unknown. Future changes in different factors, such as the plant composition in the area, as a result of climate change could also add additional uncertainty to model projections.

During the post-calving season (mid to late June), most locations of Porcupine Caribou Herd caribou were in the program area; even if they calved outside of it, as Porcupine Caribou Herd caribou moved west toward the program area (Griffith et al. 2002; **Map 3-35** in **Appendix A**). Sixty-seven percent of all caribou outfitted with radio collars (1985-2017) spent time in the program area in a year (Russell and Gunn 2019). Of those caribou, the ones that calved in the program area spent an average 26.5 days there, while caribou

that calved outside the program area spent an average of 9.8 days in the program area. Five percent of caribou using the program area remained there for more than 5 weeks (Russell and Gunn 2019).

Porcupine Caribou Herd caribou may use both coastal areas and inland ridgetops for insect relief (Walsh et al. 1992; USFWS 2015a). Most Porcupine Caribou Herd caribou move out of the program area by mid to late summer. During the summer insect season (July 7–August 14) in the years before 2000, caribou spread out across the Coastal Plain and in the Brooks Range in Alaska and Yukon, with few remaining in the program area (**Map 3-35** in **Appendix A**; Russell et al. 1992; Griffith et al. 2002). From 2000 to 2014, Porcupine Caribou Herd caribou generally left the Coastal Plain by the end of June (USFWS 2015a), but between 2015 and 2018 caribou used the program area later in the summer (see comments in **Appendix U**).

Central Arctic Herd Use of the Program Area

Roby (1978) and Shideler (1986) describe the observations of biologists working in the area of the Central Arctic Herd range before the advent of telemetry collars. Since construction of the Alaska North Slope oil fields, the Central Arctic Herd has been exposed to some level of development for about 50 years (White et al. 1975; NRC 2003; Cameron et al. 2005). Females in the Central Arctic Herd calve in two areas west of the Arctic Refuge: the western area is south and southwest of the Kuparuk oil field, between the Colville and Kuparuk Rivers, and the eastern area is between the Sagavanirktok and Canning Rivers in an area with little development (**Map 3-36 and Map 3-37**, Seasonal Distribution of the Central Arctic Herd and Seasonal Movement of the Central Arctic Herd, in **Appendix A**). By late June, caribou move to the coast for mosquito-relief and move back inland when mosquito harassment abates. Coastal movements by large groups of caribou occur during periods of mosquito harassment, with caribou typically moving into the wind (which tends to be easterly in the program area); however, those groups tend to break up and disperse when oestrid flies become the dominant insect pests (Murphy and Lawhead 2000). The Canning River delta can receive high use by Central Arctic Herd in some years. The program area is the only portion of the primary Central Arctic Herd mosquito-relief habitat that does not currently contain some development.

After oilfield construction and prior to 2003, Central Arctic Herd caribou calving in the western area typically remained west of the Sagavanirktok River during mid-summer. Beginning in 2003, a new mid-summer movement pattern was evident (Lawhead and Prichard 2003). In that year, the western calving segment of the Central Arctic Herd moved east past the Prudhoe Bay Oilfield and joined the eastern calving portion of the herd and then both segments of the herd often continued east into the program area during the summer insect seasons (**Map 3-36** in **Appendix A**; Lawhead and Prichard 2003; Lenart 2015b; Nicholson et al. 2016; Prichard et al. 2017). After approximately 2014, this movement pattern ended, and Central Arctic Herd caribou generally remained in two separate groups during mid-summer, similar to the movement pattern observed prior to 2003 (Prichard and Welch 2024). In addition, the proportion of Central Arctic Herd females calving in the western area near the Kuparuk Oilfield increased starting in about 2014 (Lenart 2021a; Prichard and Welch 2024). The result of these two changes, more calving occurring in the western calving area and fewer caribou making long easterly movements during mid-summer, was a decline in the use of the program area by the Central Arctic Herd in recent years. The proportion of collared Central Arctic Herd females using the program area at some point during the summer (June–August) has varied annually between 16 and 100 percent (2003–2022), and the average proportion of days in the program area for individual collared caribou varied between 4 and 25 percent during that period (**Table K-26** in **Appendix K**). Since 2015, Central Arctic Herd females have spent 3 percent or less of all collar-days (one animal collared for one day equals one collar-day) in the program area during June–August (**Table K-26**

in **Appendix K**). It is unclear why the summer movement patterns of the Central Arctic Herd shifted; the period of highest use of the program area by Central Arctic Herd caribou corresponded with the peak population of the herd, so the change in movement patterns could be related to herd size or, because caribou tend to move into the wind during periods of insect harassment, it could be related to high levels of east winds during the period between 2003–2014.

Muskox

This native species became extinct in Alaska in the nineteenth century; the history, distribution, and habitat preferences of muskoxen were described previously (BLM 2012, Section 3.3.6.2, page 293; USFWS 2015a). The current population in northeastern Alaska was reestablished by translocation when 64 animals from Greenland stock were released at Barter Island and the Kavik River in 1969 and 1970 (USFWS 2015a). As their numbers increased, they expanded westward on the ACP to the Colville River drainage and eastward across the international border to the Babbage River in northern Yukon.

The population in northeastern Alaska and northwestern Canada was estimated at 700–800 animals in the mid-1990s, but it subsequently declined to approximately 300 animals from 2007 to 2014; about 200 were located west of the Arctic Refuge and 100 were located east of it in northern Yukon (Lenart 2015c; Arthur and Del Vecchio 2017). The population was estimated to be 297 animals in 2019 (Lenart 2021b). The decline was especially steep in the Arctic Refuge, where only one muskox was observed in 2006. A group of fewer than 25 animals, moved back and forth across the Canning River into the program area (Lenart 2015c, 2021b). The current population is approximately 350 animals (Prichard and Welch 2024).

Another group of approximately 24 muskoxen inhabits the northwestern Yukon Territory. It is commonly found near the Alaska-Yukon border and frequently accesses the refuge (USFWS, see **Appendix U**). Predation by grizzly bears accounted for 58 percent of calf mortality and 62 percent of adult mortality from 2007 to 2011 (Arthur and Del Vecchio 2017), although pathogens and mineral deficiencies may have been contributing factors (Afema et al. 2017). Two mixed-age, mixed sex groups of muskoxen have been present in the Kuparuk oilfields for over two decades, with one group typically located near the Kuparuk River and one along the Colville River (Hicks 1999; Lenart 2021b; Prichard and Welch 2024).

Moose

The program area is near the northern extent of moose range, but moose are found in low numbers on the ACP where suitable forage plants occur, primarily in riverine habitats dominated by willow shrubs (**Map 3-38** in **Appendix A**; Lenart 2014; USFWS 2015a). Late-winter aerial surveys in 2014 found only 22 moose in a series of drainages that included the program area, a sharp decrease from the fairly stable number of 47–61 moose found in the same survey area from 2002 to 2010 (Lenart 2014 2018). Moose exhibit large fluctuations in population size on the North Slope but appear to be expanding their range farther north in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2016).

Moose are an important resource for local subsistence hunters. Moose numbers east of the Canning River watershed are currently low, but numbers in tributaries of the Canning River, on both its east and west sides, are larger; some of these could be in the program area, and other moose just outside the area to the west

could be affected by activity in the area. Moose aggregate in tall shrub riparian areas during winter, but they disperse more widely across the ACP during summer, particularly pregnant cows.[26]

Carnivores

Three large- to medium-sized terrestrial carnivores— Brown (grizzly) bear, wolf, and wolverine—inhabit the program area, occurring in lower densities in the Coastal Plain of the North Slope than father inland in the foothills and mountains (Young et al. 2002). The USFWS (2015a) summarized information on these species.

Grizzly bears and wolves are important predators of caribou and other ungulates. Grizzly bears occupy dens during winter dormancy, whereas wolves and wolverines remain active year-round. Grizzly bear density in Game Management Unit (GMU) 26C, which covers much of the program area, was estimated to be 3.8 bears per 100 square miles in 1993 (Lenart 2015a, 2021c). Due to the distribution of suitable landforms and substrates, wolf den sites are more common in the foothills and mountains than in the Coastal Plain of the North Slope (Young et al. 2002; USFWS 2015a). Wolf density in GMU 26C was estimated to be 5.7–8.3 per 1,000 square miles in the 1980s (Garner and Reynolds 1986; Caikoski 2012). Wolverines have large home ranges and feed on a variety of prey species, but ungulates are often an important component of their diet (Glass et al. 2022b). Wolverines often consume caribou as carrion, but they may also hunt live caribou by following them for up to 39 miles (62 kilometers) (Magoun et al. 2018). Wolverines will dig burrows in the snow for reproductive dens, resting, and caching food (Glass et al. 2022b). Reproductive dens are often associated with snowdrift forming terrain features including streambeds, cutbanks on lake edges, thermokarst caves, and boulders (Glass et al. 2022a).

Two species of foxes and two species of weasels inhabit the program area, all which feed on small mammals year-round and on birds and their eggs when available during summer. Arctic foxes inhabit the Coastal Plain during the summer denning season to rear pups but move long distances to forage extensively on sea ice during winter (Pamperin et al. 2008), although arctic foxes may have a significantly reduced winter range and higher survival rates in areas with access to human food sources near development (Pamperin et al. 2008; Lehner 2012). Red foxes do not generally inhabit sea ice and are increasing in numbers on the ACP, in concert with climate warming and increased availability of human food sources in industrial areas (Savory et al. 2014; Elmhagen et al. 2017; Parrett et al. 2023). Red foxes are aggressive toward arctic foxes and can kill or otherwise displace them from den sites (Pamperin et al. 2006; Stickney et al. 2014).

All species of terrestrial carnivores can be attracted to areas of human activity if food or rotting waste are improperly handled or disposed of. This can lead to habituation and food-conditioning, thus increasing the risk of injury or mortality to humans or the carnivores themselves (Burgess 2000; Shideler and Hechtel 2000; Pedersen 2019). Increasing predator populations, with the associated higher predation rates on prey populations (especially nesting birds), has been a perennial concern around the North Slope oil fields (Day 1998; Parrett et al. 2023).

Small Mammals

Small mammals provide important prey resources for predatory mammals and birds in the region, and arctic ground squirrels are especially important prey for grizzly bears and foxes (Babcock 1986). Arctic ground squirrels hibernate during winter, whereas lemmings, voles, and shrews remain active under the snow cover.

[26]Stephen Arthur, USFWS, personal communication with Alex Prichard, ABR Inc., on February 5, 2019, regarding distribution of moose during calving.

Most species of small mammals exhibit cyclical population fluctuations, which have pronounced effects on local ecological systems (USFWS 2015a). Snowshoe hares appear to be expanding their range farther onto the ACP in response to climate warming and corresponding northward expansion of tall shrubs (Tape et al. 2015). Beavers also are expanding their range into parts of Arctic Alaska and the northern Yukon (Tape et al. 2018). Common muskrats have expanded their range and are now common near the Colville River delta west of the program area (BLM 2023).

Climate Change

The Arctic Coastal Plain experienced some of the largest temperature increases per decade in Alaska from 1957–2021 (Ballinger et al. 2023). Climate change is likely to result in a northward expansion of some mammal species, such as moose, beaver, lynx, muskrat, red fox, and snowshoe hare (Tape et al. 2015, 2016, 2018) as well as a change in plant communities. Changes in species composition could have multiple effects on the ecosystem and predator-prey dynamics (Parrett et al. 2023). A continuing increase in red foxes due to warming and availability of human food could cause a decline in arctic foxes. Some species with low reproductive output in the Arctic, such as grizzly bears, may benefit from increased productivity and a more diverse prey base. If Pacific salmon start spawning on in North Slope rivers and streams in high numbers, it could lead to increased grizzly bear density, change predator-prey dynamics, and bring in an influx of marine-derived nutrients to the terrestrial ecosystem (Levi et al. 2020). Wolverine reproductive dens could be affected by changes in the depth and distribution of snow (McElvey et al. 2011; Glass et al. 2022a, 2022b). Muskoxen and other herbivores may be adversely affected by increasing frequency of ice formation or rain-on-snow events (Berger et al. 2018) and the spread of pathogens (Kutz et al. 2015). The current circumpolar status of muskoxen and potential impacts of climate change are summarized by Cuyler et al. (2019).

Climate change in the Arctic is predicted to have multiple, sometimes counteracting, effects on barren-ground caribou (Martin et al. 2009; Albon et al. 2016; Mallory and Boyce 2017). Because climate change could involve both adverse and beneficial effects on caribou, it is difficult to predict the impacts on the Porcupine Caribou Herd and Central Arctic Herd; however, climate change may have been a factor in a 56 percent decline in populations of migratory caribou and wild reindeer across the Arctic over the last 2 decades (Russell et al. 2019) suggesting that the magnitude of the negative impacts could be very large. Caribou body condition and population fluctuations have been found to be influenced by large-scale climate oscillations, such as the Arctic Oscillation (Griffith et al. 2002; Joly et al. 2011; Mallory et al. 2018). Climate change is expected to increase temperatures, increase precipitation, and lengthen the snow-free season (see **Section B.2.1**). Summer temperatures above freezing could occur for 6 weeks longer by 2099 (SNAP 2011). Vegetative biomass in the Arctic has generally increased since 1984, although the increase in Alaska has been lower than the increase in eastern Canada (Ju and Masek 2016). An increase in shrub cover and a decline in lichens growing on soil has been documented in the western Canadian Arctic (Fraser et al. 2014).

A longer snow-free season can increase access to forage (Cebrian et al. 2008; Tveraa et al. 2013), but warmer summers could increase insect harassment (Weladji et al. 2003), increase the incidence of parasites, and result in an increased risk of disease (Mysterud et al. 2023) with the potential for large mortality events. Warm summers can also speed the annual decline in forage quality (Gustine et al. 2017) resulting in an earlier decline in forage nitrogen, which may already be limiting for parturient caribou (Barboza et al. 2018; Johnson et al. 2018). Changes in vegetation composition could result in increased abundance of shrubs and deterioration of caribou forage quality (Fauchald et al. 2017), but could increase forage quality for other

species, for example moose, hare, beaver. Increased moose densities could increase predator densities and alter predator distributions. Increases in wildfire could lower lichen availability on the winter range (Joly et al. 2010).

Changes in winter precipitation could change access to forage and energetic demands for cratering through snow. Rain-on-snow events could have dramatic impacts on caribou body condition, survival, and winter distribution by decreasing access to winter forage (Hansen et al. 2011; Albon et al. 2016; Loe et al. 2016) and increasing mortality (Forbes et al. 2016); these events are expected to increase dramatically on the ACP (Bieniek et al. 2018). Earlier melting of snow patches and aufeis could lower the amount of insect relief habitat present during mid-summer.

Changes in timing of snowmelt and vegetation growth could create a phenological mismatch[27] between timing of calving and the emergence of highly nutritious forage (Post and Forchhammer 2008). Gustine et al. (2017) found no evidence of a spring nourishment mismatch for caribou in Alaska but suggested that one may occur in fall with increased warming and Veiberg et al. (2016) found that calf survival and recruitment was correlated with late winter female body mass but not with spring vegetation or snowmelt. If mosquitos emerge closer to the calving period, it could result in a higher rate of separation of calves, poorer body quality of maternal caribou, and higher calf mortality. Earlier melting of ice and snow and earlier river breakup could alter the timing or difficulty of caribou migrations (Sharma et al. 2009; Leblond et al. 2016).

Russell and Gunn (2019) summarized climatic conditions for the Porcupine Caribou Herd and Central Arctic Herd and identified correlations among climate variables and Porcupine Caribou Herd demographic parameters. The Porcupine Caribou Herd appears to be especially sensitive to freezing rain and rain-on-snow events (negative correlation with parturition, spring condition, and June calf survival), July temperatures (positive correlation with body condition the following spring), fall temperatures (positive correlation with parturition, although longer oestrid fly seasons had a negative correlation with parturition), spring temperatures (positive correlation with June calf survival), and snow depth (negative correlation with late June calf:cow ratio).

The Porcupine Caribou Herd calving distribution varies with the onset of spring seasonal changes and is typically farther west during warmer springs (Griffith et al. 2002; Russell and Gunn 2019; Severson et al. 2021); hence, climate warming could result in a western shift in concentrated calving areas and more frequent calving in the program area. Severson et al. (2021) estimated that the median date of snowmelt in the area would advance by 8 days between 2012–2018 and the 2050s and the median onset greenness date would advance by 15 days over that time period resulting in a prediction of greater use of the program area (**Map 3-34 in Appendix A**). In addition to impacting calving and post-calving distributions for the Porcupine Caribou Herd, these changes could change the protein content of Porcupine Caribou Herd diets and the timing of the onset of mosquito harassment (Johnson et al. 2018; Severson et al. 2021). The potentially large negative impacts of climate change on caribou introduces additional uncertainty into projections of impacts due to development; therefore, alternatives that limit development to a smaller footprint and a smaller portion of the Porcupine Caribou Herd calving and post-calving grounds would allow caribou greater flexibility to adapt to changing conditions.

[27]The phenomenon of food and habitat being available at different times than those to which the species was formerly cued.

B.3.5 Marine Mammals

Affected Environment

All marine mammals found in US waters are protected under the MMPA, as amended (16 USC 1631 et seq.). Some species receive additional protection under the ESA (16 USC 1531 et seq.). Of marine mammal species that occur in the program area, whales, seals, and porpoises are managed by NMFS, whereas polar bears, and walruses are managed by the USFWS. The NMFS and USFWS stock assessment reports (SARs) contain detailed information on the status, seasonal distribution, abundance, and life history of marine mammals in the Beaufort Sea. NMFS publishes current SARs for whales, seals, and sea lions (Young et al. 2022; https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock) and the USFWS publishes current SARs for Pacific walrus and polar bear (www.fws.gov/alaska/pages/marine-mammals).

The USFWS implements the provisions of the MMPA and ESA as they relate to polar bears. The MMPA and its implementing regulations contain provisions governing when USFWS may authorize unintentional, incidental take of polar bears. Per 50 CFR 17.40(q), activities that are authorized or exempted under the MMPA are not subject to ESA prohibitions on take of polar bears. To the west of the Arctic Refuge, oil and gas operators and other parties routinely request incidental take authorizations pursuant to the MMPA. There are two mechanisms for authorizing incidental take under the MMPA. The first is incidental take regulations (ITRs) and associated letters of authorization (LOAs). The second is incidental harassment authorizations (IHAs). Pursuant to each of these mechanisms, USFWS authorizes, upon request, the incidental take of small numbers of marine mammals where such taking would have a negligible impact to the species or stock and would not have an unmitigable adverse impact on the availability of the species for subsistence use by Alaska Natives. Prior to authorizing incidental take under the MMPA, USFWS conducts intra-Service consultation under ESA Section 7. Additional information on polar bears and Pacific walruses can be found in the Beaufort Sea ITR Final Rule (86 FR 42982, 43001-43007). Further, the Final EIS on Effects of Oil and Gas Activities in the Arctic (NMFS 2016a) provides detailed descriptions of marine mammal population status and trends, distribution, seasonal migration and movements, habitat use, reproduction and growth, survival, and mortality. These materials are incorporated into this EIS by reference.

Nine species of marine mammals have been recorded in marine waters within 5 nautical miles of the program area (**Table B-13**). The bowhead whale is listed as endangered under the ESA, and the polar bear, bearded seal, and ringed seal are listed as threatened.

Table B-14 lists additional species of marine mammals that may be encountered in the Bering and Chukchi Seas by oil and gas activity vessel traffic from Dutch Harbor to the program area (**Map 3-30**, Critical Habitat Along the Marine Transport Route, in **Appendix A**). Species currently listed as threatened or endangered under the ESA are fin, humpback, and right whales, Steller sea lions, and sea otters. The discussion below focuses on the ESA-listed species and the beluga whale, which occurs commonly near shore and is of interest for subsistence harvest. Narwhals (*Monodon monoceros*) and hooded seals (*Cystophora cristata*) are considered extralimital to the program area and are not discussed in this EIS.

Table B-13
Marine Mammal Species Occurring within 5 Nautical Miles of the Arctic Refuge Coastline and Their Status in the Program Area

Common Name	Scientific Name	Status	Occurrence[3]
Bowhead whale	*Balaena mysticetus*	Endangered[1]	Common
Beluga	*Delphinapterus leucas*	Protected[2]	Common
Gray whale	*Eschrichtius robustus*	Protected[2]	Casual
Harbor porpoise	*Phocoena phocoena*	Protected[2]	Casual
Bearded seal	*Erignathus barbatus*	Threatened[1]	Fairly common
Ringed seal	*Phoca (Pusa) hispida*	Threatened[1]	Common
Spotted seal	*P. largha*	Protected[4]	Fairly common
Pacific walrus	*Odobenus rosmarus*	Protected[2]	Casual
Polar bear	*Ursus maritimus*	Threatened[1]	Common

Source: ASAMM GIS 2021; Young et al. 2022
[1] Under the ESA (ESA-listed species are considered depleted under the MMPA).
[2] Under the MMPA.
[3] Common = recorded in every year; fairly common = recorded in most years; uncommon = recorded once every 3–5 years; rare = in its normal range but recorded less than every 5 years; casual = beyond its normal range, further observations unlikely. Occurrence is based primarily on data from the Aerial Surveys of Arctic Marine Mammals Program funded by BOEM and National Oceanic and Atmospheric Administration (NOAA).
[4] The Bering distinct population segment (DPS) uses the program area and is not listed under the ESA (the Southern DPS is listed as threatened but does not occur in the program area).

Table B-14
Additional Marine Mammal Species Occurring Along Vessel Transit Routes in the Bering and Chukchi Seas

Common Name	Scientific Name	Status
Steller's sea lion (Western DPS)	*Eumetopias jubatus*	Endangered[2]
Ribbon seal	*Histriophoca fasciata*	Protected[1]
Northern sea otter (Southwest Alaska DPS)	*Enhydra lutris*	Threatened[2]
North Pacific right whale	*Eubalaena japonica*	Endangered[2]
Minke whale	*Balaenoptera acutorostrata*	Protected[1]
Blue whale	*B. musculus*	Endangered[2]
Fin whale	*B. physalus*	Endangered[2]
Humpback whale (Western North Pacific DPS)	*Megaptera novaeangliae*	Endangered[2]
Gray whale (Western North Pacific DPS)	*Eschrichtius robustus*	Endangered[2]
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	Protected[1]
Killer whale	*Orcinus orca*	Protected[1]
Harbor porpoise	*Phocoena phocoena*	Protected[1]
Dall's porpoise	*Phocoenoides dalli*	Protected[1]
Sperm whale	*Physeter catodon*	Endangered[2]
Baird's beaked whale	*Berardius bairdii*	Protected[1]
Stejneger's beaked whale	*Mesoplodon stejnegeri*	Protected[1]
Cuvier's beaked whale	*Ziphius cavirostris*	Protected[1]

Source: NOAA 2018; Young et al. 2022
[1]Under the MMPA
[2]Under the ESA; listed species are considered depleted under the MMPA

Polar Bear

Distribution

Polar bears have a circumpolar distribution in the Northern Hemisphere. In Alaska, they occur most commonly within 200 miles of the coast of the Arctic Ocean (Amstrup and DeMaster 1988). Nineteen subpopulations (stocks) of polar bears have been identified throughout their range, ranging from several hundred to several thousand animals each and, in the latest estimate, totaling approximately 26,000 individuals range wide (95 percent Confidence Interval [CI] = 22,000–31,000; Wiig et al. 2015; Durner et al. 2018).

Bears from three stocks occur in US waters off Alaska, the Northern Beaufort Sea stock, the SBS stock, and the Chukchi Sea stock (Bethke et al. 1996; Amstrup 2003a; Amstrup et al. 2004a; Schliebe et al. 2006; Obbard et al. 2010; Durner et al. 2018). The SBS stock is the subpopulation most likely to occur in the program area, so the analyses below focus on this stock. Based on the distribution and characteristics of sea ice and corresponding population movements (Amstrup et al. 2007), SBS bears either move with the retreating ice or abandon it to spend the summer on land (Durner et al. 2009).

The SBS stock ranges over an expansive area, extending from Icy Cape and Point Hope on the Chukchi Sea coast of Alaska eastward to Cape Bathurst in the Northwest Territories of Canada, and seaward at least 185 miles from the coast (Bethke et al. 1996; Amstrup 2000, 2002; Brower et al. 2002; Schliebe et al. 2006). The core activity area of the SBS stock encompasses a considerably smaller region, from Herschel Island, Yukon, to Point Barrow, Alaska (including the existing oil fields in northern Alaska), and seaward about 85 miles (Amstrup 2000); thus, the program area is within the core activity area of the SBS.

Species Status

The USFWS listed the polar bear as a threatened species under the ESA in May 2008 (73 FR 28212). The ESA listing decision was based on the rapidly diminishing sea ice cover and thickness in the Arctic Ocean due to climate change, primarily during summer (73 FR 28212; Durner et al. 2009). In addition, the polar bear was listed in 2011 as a species of special concern in Canada under the Species at Risk Act (Species At Risk Committee 2012). The special concern designation is used for species that may become threatened or endangered in Canada as a result of a combination of biological characteristics and identified threats. The SBS stock of polar bears is a shared resource and is managed by both the US and Canada (USFWS 2016; Joint Secretariat 2017), and polar bear management is subject to international agreements with other Arctic nations (described in **Appendix E**).

When polar bears were listed under the ESA, the continuing loss of sea ice was judged to put them at risk of becoming endangered throughout their range in the foreseeable future. Subsequent modeling analyses predicted that declining sea ice cover risks significant declines in polar bear populations within three generations (35–41 years; Regehr et al. 2016). Considerable research has focused on changes in population status and survival because of diminishing sea ice habitat. Regehr et al. (2010) documented decreases in vital rates of the SBS stock, including survival and breeding rates, corresponding to increases in the number of ice-free days per year in waters over the Beaufort Sea continental shelf (including waters adjoining the program area).

Sea ice conditions, affected by rising global temperatures, are by far the most influential determinant of population outcomes for polar bears, with continued increases in GHG emissions being the dominant influence leading to worsening population outcomes (Atwood et al. 2016a; USFWS 2016). Atwood et al. (2016a) also evaluated other factors affecting population outcomes, listed in decreasing order of importance: marine prey availability (second only to sea ice), reduced mortality from hunting and defense of life and property interactions (modest influences), and trans-Arctic shipping, oil and gas exploration, and contaminants (negligible influences).

The most recent analyses suggest that the SBS stock declined substantially from 2003 to 2009 and was stable at lower levels from 2006 to 2015 (Obbard et al. 2010; Bromaghin et al. 2015; USFWS 2019; Bromaghin et al. 2021). The estimated population size of the entire SBS stock was approximately 900 bears in 2010 (90 percent CI = 606–1,212; Bromaghin et al. 2015; USFWS 2019). This estimate is significantly

reduced from previous estimates of approximately 1,800 bears in 1986 (Amstrup et al. 1986) and 1,526 bears in 2006 (Regehr et al. 2006). Furthermore, analyses of over 20 years of data on the size and body condition of bears in the SBS stock demonstrated declines for most sex and age classes and significant negative relationships between annual sea ice availability and body condition (Rode et al. 2010). Although the authors of the 2010 population estimate noted that suspected biases may have affected the bears' abundance estimate, the estimate of approximately 900 bears for the entire SBS stock is currently used for management purposes (USFWS 2019). An updated analysis estimated the Alaska portion of the SBS stock to be 573 bears in 2015 (95 percent Bayesian credible interval [232, 1,140]; Bromaghin et al 2021).

Many oil and gas projects to the west of the program area (central Beaufort Sea) are operating under LOAs issued pursuant to a set of ITRs (in effect from August 2021 to August 2026; 86 FR 42982). These ITRs minimize industry disturbance of polar bears by imposing mitigation, monitoring, and reporting requirements (86 FR 43074; 50 CFR 18.128); however, they do not include the program area because the Arctic Refuge was specifically excluded (50 CFR 18.120(b)). Therefore, oil and gas operators seeking MMPA incidental take authorization for activities in the program area would need to request new ITRs and/or IHAs.

The MMPA incidental take authorization process allows USFWS an opportunity to impose important mitigation, monitoring, and reporting requirements that provide significant conservation benefits to polar bears. Such measures have been implemented by the USFWS for over 20 years in the geographic region of the Beaufort Sea ITRs (centered on Prudhoe Bay) and have minimize disturbance and take of polar bears. A variety of design features and operational procedures typically are used to mitigate the potential impacts of petroleum activities on polar bears.

The BLM and USFWS understand that mitigation measures associated with the current ITRs and IHAs managed outside the program area are among the best available mechanism to manage industry impacts on polar bears and that such measures are continually being revised or updated to incorporate new or more effective techniques.

The MMPA and its implementing regulations also allow for intentional take of marine mammals in certain instances (for example, 16 USC 1371(a)(4)(A), 1371(c), 1371(d). USFWS has developed best practices for safely and nonlethally deterring polar bears from damaging property and endangering human life. These measures serve to reduce the frequency and severity of intentional take of polar bears (75 FR 61631). These are focused on passive measures intended to prevent bears from gaining access to property or people, such as fencing, gates, skirting, exclusion cages, and bear-proof garbage containers. They also include preventive measures to discourage bears from interacting with property or people, such as acoustic devices for auditory deterrence using vehicles or boats.

Polar bear harvesting is legal in the US for certain Alaska Natives under the MMPA (16 USC 1371(b)). Polar bear harvests in the SBS are managed through the Inuvialuit-Iñupiat Agreement, a Native-to-Native (First Nations) agreement between Native peoples of the US and Canada; the agreement is voluntary in the US but mandatory in Canada (Nageak et al. 1991; Brower et al. 2002). Under this agreement, the current annual harvest quota for the SBS stock is 56 bears, or 35 for Iñupiaq hunters in Alaska and 21 for Inuvialuit hunters in Canada (Miller et al. 2018).

From 2008 through 2017, total human-caused removals of polar bears in Alaska (including both the SBS and Chukchi Sea stocks) numbered 420 bears, ranging from 17 to 88 per year and averaging 42 bears,

comprising 62 percent males, 19 percent females, and 19 percent sex unknown or unreported (Miller et al. 2018). The subsistence harvest of polar bears in Alaska from 2008 to 2017 (both stocks, including "struck and lost" animals) ranged from 14 to 82 annually, averaging 38 bears (Miller et al. 2018).

Other human-caused removals during that 10-year period totaled 29 in defense of human life, 3 related to industry activities, 1 research-related, 1 by euthanasia, 3 of unknown causes, and 2 orphaned cubs placed with zoos (Miller et al. 2018). The proportional representation of the SBS stock for these mortalities was not reported, but the SBS harvest is lower than that of the Chukchi Sea stock. For example, from 2006 through 2015, the SBS harvest in Alaska averaged 19 bears per year, comprising 50 percent males, 27 percent females, and 23 percent unreported sex (USFWS 2017b). During the same period in Canada, the SBS harvest averaged 14.2 bears per year, comprising 56 percent males and 44 percent females.

Population Movements

Polar bears of the SBS stock range over large areas, with annual activity areas of collared individuals ranging from 2,805 to 230,426 square miles (Amstrup et al. 2000). They are transient throughout the nearshore areas of the Beaufort Sea coast, including the program area. The largest monthly movements occur during early winter and the smallest in early spring; females with cubs move less and cover smaller areas than do males and other age classes.

Movements are increasing as sea ice cover diminishes (Pagano et al. 2021). From 1979 to 2006, collared female polar bears moving from the pack ice to denning areas onshore experienced an average increase in travel distance of 3.7 miles per year, and future increases of greater than 10 miles per year have been estimated out to 2060, based on ocean circulation models (Bergen et al. 2007). As the rate of westward and northward drift of sea ice has increased with decreasing thickness and extent in the Beaufort Sea (at least 30 percent over 26 years), polar bears have shown corresponding increases in the amount of time spent active and in travel speed and distance, resulting in increased energy expenditure and food requirements (Durner et al. 2017).

Polar bears typically use land only during late summer, autumn, and the maternal denning season in winter; besides denning females, adult females with and without cubs, subadults, and adult males all come ashore (Johnson and Derocher 2020). Polar bears begin to appear on the mainland and barrier islands in July and August, during the open-water period (Miller et al. 2006; Schliebe et al. 2008). As seasonal and multiyear pack-ice cover spreads southward in the late fall and winter, polar bears move with it, appearing along the Beaufort Sea coast (Amstrup et al. 2000), although some may remain on pack ice all year, if there is continuous access to prey (Stirling 2009).

The number of bears on land in the summer and fall is significantly related to the distance of pack ice from shore (Schliebe et al. 2008; Wilson et al. 2017; Rode et al. 2022). Except for pregnant females that remain to den, bears using land begin to leave when sea ice develops, usually by late October (Schliebe et al. 2001; Kalxdorff et al. 2002). Rapid environmental changes from lengthening of the ice-melt season and diminished sea ice cover have increased the bears' use of terrestrial habitats: the percentage of collared female SBS bears coming ashore tripled over 15 years since the late 1990s, with bears arriving onshore earlier, staying longer, and departing later (Atwood et al. 2016b; Rode et al. 2022). The mean duration of the open-water period increased by 36 days in that period, and the mean length of stay increased by 31 days.

It has been known for a long time, as stated by Indigenous hunters (USFWS 1995; Joint Secretariat 2015; Rode et al. 2021), that polar bears become increasingly abundant on the mainland and barrier islands during the open-water season in late summer and the fall subsistence whaling season. USFWS biologists flew 53 aerial surveys along the entire Beaufort Sea coast between Point Barrow and the Canada border in fall 2000 to 2014, averaging 64 bears per survey and recording a maximum of 156 bears on a single survey in August 2012 (Wilson et al. 2017). On average, 4 to 8 percent of the bears in the SBS stock were observed on land per survey (Schliebe et al. 2008). Most sightings on those coastal surveys (82 percent) were recorded on barrier islands, with 11 percent on the mainland and 6 percent on landfast ice (74 FR 56068).

Peak numbers of polar bears observed on land generally occurred in late September and early October (USFWS 1995; Schliebe et al. 2001, 2008; Kalxdorff et al. 2002). The number of polar bears on shore is related to sea ice dynamics, although the distribution of bears on shore was influenced most strongly by the availability of food from subsistence whaling (Wilson et al. 2017). Bear numbers on shore have increased in late summer and autumn, with the greatest concentrations occurring at Barter Island, Cross Island, and Point Barrow, where bears feed on bone piles of butchered bowhead whales taken during the autumn subsistence hunt (Miller et al. 2006; Schliebe et al. 2008; Atwood et al. 2016b; Lillie 2018).

Polar bears using terrestrial habitats near the program area have shown increases in the amount of bowhead whale consumed in their diets in recent years. This reflects increased foraging on the Kaktovik whale-bone pile, with bowhead whale constituting 50–70 percent of the fall diet of those bears that spent more time on and near the coast than bears farther offshore (Rogers et al. 2015; McKinney et al. 2017). Increased consumption of bowhead whale was associated with better body condition.

Genetic analysis of hair-snare samples estimated that as many as 146 individuals (standard error = 21), representing approximately 16 percent of the most recent SBS stock estimate, visited the whalebone pile in Kaktovik in 2012 (Lillie 2018). In one recent study, the percentage of collared SBS bears spending time along the coast of northeast Alaska ranged from 22 to 33 percent annually, averaging 27 percent, with the area near Kaktovik receiving the most use (Pongracz and Derocher 2017).

Life History

Polar bears are large, long-lived (29–32 years), opportunistic hunters that feed primarily on ringed and bearded seals but also on beached carcasses of marine mammals (whales and walruses) (Smith 1980; Amstrup 2003a; Schliebe et al. 2006; Miller et al. 2006). Adult males, non-pregnant adult females, and subadults are active all year. Mating occurs from March to late May. Pregnant females construct and enter snowdrift natal dens in November (Amstrup and Gardner 1994; Joint Secretariat 2015, Rode et al. 2018) and give birth in late December or early January.

Litter size ranges from one to three cubs, averaging 1.63; litters of two cubs are most common (Amstrup 2003a). Mothers and cubs emerge from natal dens in March, when the cubs are 3 to 4 months old (Amstrup and Gardner 1994; Smith et al. 2007; Joint Secretariat 2015, Rode et al. 2018). The cubs remain near the dens for up to 2 weeks (Smith et al. 2007) as they adapt to outside temperatures and gain the strength to travel over land and ice.

Young cubs are vulnerable to predation during the brief period after den emergence and before moving onto sea ice (Richardson and Andriashak 2006). Cubs usually stay with their mothers until they are 2 to 3 years old (Stirling et al. 1975, Derocher and Stirling 1996). Females breed again at about the same time

they separate from their young, resulting in a breeding interval of females that successfully wean cubs of 3 years or longer.

Critical Habitat

The USFWS designated critical habitat for polar bears in Alaska in 2011 (75 FR 76086). Three units of critical habitat (all of which occur in the program area; **Map 3-41**, Polar Bear Habitat, in **Appendix A**) were designated, corresponding to the following primary constituent elements of critical habitat described in the final rule:

- Sea ice habitat, used for feeding, breeding, denning, and movements, in US territorial waters;
- Terrestrial denning habitat, on land along the northern coast of Alaska, with characteristics suitable for capturing and retaining snow drifts of sufficient depth to sustain maternal dens through winter, occurring within 20 miles of the coast between the US-Canada border on the east and the Shaviovik and Kavik Rivers on the west (including the program area), and within 5 miles of the coast from the Shaviovik and Kavik Rivers west to Point Barrow; and,
- Barrier island habitat, used for denning, refuge from human disturbance, and movements along the coast for access to denning and feeding habitats, comprising barrier islands and associated mainland spits, along with the water, ice, and terrestrial habitat within 1 mile of those features, designated as a no-disturbance zone.

Critical habitat excludes human-made structures and the land on which they are located, as well as seven specific areas consisting of the communities of Utqiaġvik and Kaktovik and five US Air Force radar sites (Point Barrow, Point Lonely, Oliktok Point, Bullen Point, and Barter Island). The acreages and percentages of each critical habitat unit in the program area are described in *Impacts Common to All Alternatives* (**Chapter 3**).

Habitat Use

Polar bears rely principally on the availability of sea ice habitats to roam, hunt, breed, and rest. Although most of the SBS bears remain on sea ice during summer (Pongracz and Derocher 2017), their use of terrestrial habitats has been increasing as sea ice cover has declined. Between 2000 and 2014, the percentage of collared adult female bears coming ashore tripled (averaging 20 percent and ranging up to 37 percent). The average length of stay ashore increased to 56 days, from 20 days in the 1990s (Atwood et al. 2016b). Although adult males cannot be collared to track their movements, observations indicate that adult males and subadults also use land in the summer and autumn (Miller et al. 2015; Johnson and Derocher 2020).

Preferred habitats are in the active seasonal ice zone that overlies the continental shelf and associated islands and in areas of heavy offshore pack ice (Stirling 1988; Durner et al. 2004, 2009; Joint Secretariat 2015; Pongracz and Derocher 2017). Adult males usually remain there, rarely coming ashore (Amstrup and DeMaster 1988). Habitat use changes seasonally with the formation, advance, movement, retreat, and melt of sea ice (Amstrup et al. 2000; Ferguson et al. 2000; Durner et al. 2004, 2009; Schliebe et al. 2008; Joint Secretariat 2015).

During winter and spring, polar bears tend to concentrate in areas of ice with pressure ridges, at floe edges, and on drifting seasonal ice at least 8 inches thick (Stirling et al. 1975, 1981; Schliebe et al. 2006); the greatest densities occur in the latter two categories, presumably because those habitats provide greater access to seals. Use of shallow water is greatest in winter, in areas of active ice with shear zones and leads

(Durner et al. 2004). Females with new cubs and subadult males are consistent in selecting nearshore areas along the edge of the landfast ice in winter (Johnson and Derocher 2020). Use of landfast ice increases in spring during the pupping season of ringed seals. Adult males, females subadults, solitary females, and females with older cubs all tend to remain in the remnant multiyear pack ice in summer and autumn as it retreats to its minimal extent (Ferguson et al. 2000; Durner et al. 2004; Durner et al. 2017; Johnson and Derocher 2020).

In comparison with core denning areas known to support relatively high concentrations of maternal females of other population stocks, such as those on Wrangel Island in the Chukchi Sea and Svalbard in the North Atlantic, the SBS is an area of widespread, low-density denning by maternal polar bears (Amstrup 2003b; Schliebe et al. 2006; USFWS 2017c). Nonetheless, the highest density of maternal dens in Alaska 2000–2015 (2.06–2.32 dens per 100 km^2) was located in the northwestern corner of the project area (Patil et al. 2022). The total number of maternal dens occupied annually by females of the SBS stock has been estimated at a median of 123 dens (95 percent posterior credible interval 69–199; Patil et al. 2022) (see **Appendix K**).

The distribution of maternal dens in northern Alaska has shifted landward over the past three decades as sea ice has become less available and stable (Fischbach et al. 2007; Olson et al. 2017). In a study of 287 dens located by telemetry observations, the average probability of denning on land was 23 percent lower in 1982–1999 (posterior median = 0.32 [0.2, 0.48]) compared to 2000–2015 (0.56 [0.5, 0.71]; Patil et al. 2022). Although female polar bears do not show fidelity to specific den locations, they tend to den on the same substrate (sea ice or land) from year to year and may return to the same general area to den (Amstrup and Gardner 1994; Amstrup 2003b; Schliebe et al. 2006; Fischbach et al. 2007). The use of denning substrate (sea ice or land) is significantly related to where bears occur in autumn. Pregnant polar bears in the SBS stock that spent 25 days or more on land in autumn all subsequently denned on land (Olson et al. 2017), and between 1985 and 2013, the percentage of SBS females denning on land increased from 34 to 55 percent, linked to sea ice declines.

The distribution of land dens within the SBS range generally and within the program area specifically shifted westward between 1982–1999 and 2000–2015, with the largest increases in land denning and the highest abundance of land dens occurring between the Colville and Canning Rivers (Patil et al. 2022). Despite the recent decline in the probability of land dens occurring within the eastern half of the program area, the region continues to support between 5 and 30 land dens annually (Wilson and Durner 2020; Patil et al. 2022). Terrestrial denning critical habitat composes 76.3 percent of the program area and fall snow depth has remained consistent since the 1980s, providing the necessary substrate for snowdrift den habitat. An estimated 21 percent of terrestrial dens of the SBS stock occur in the program area annually (see **Appendix K**); thus, the program area is known to be an important area for maternal denning and would likely remain important as the percentage of bears denning on land increases with continuing sea ice loss (Olson et al. 2017; Patil et al. 2022).

Because of bears' greater proximity to settlements, industrial sites, and other coastal areas of human activity, dens on land and land-fast ice are more vulnerable to disturbance by human activity than are dens on sea ice. A few records of female polar bears denning successfully in snow drifts near oil infrastructure have been recorded since development began in the oil fields along the central Beaufort Sea coast. Maternal polar bear dens have also been disrupted as a result of human disturbance, leading to possible cub mortality (Woodruff et al. 2022a).

Pregnant polar bears denning in terrestrial habitats excavate maternal dens in compacted snow drifts next to coastal banks of barrier islands and mainland bluffs, river, stream, and lake banks, and other areas with suitable topographic relief (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). In the program area, 46 maternal dens have been documented in terrestrial habitats, 18 of which were located between the Katakturuk and Sadlerochit River drainages in the central portion of the program area; 12 additional dens were found on sea ice within 5 miles of the program area and in the Arctic Refuge south of the program area (**Map 3-41** in **Appendix A**). The dens in this sample were found using a variety of methods; most were found by radio-tracking bears collared with very high frequency radio collars or satellite transmitters from 1989 to 2010, whereas others were found through opportunistic encounters or dedicated searches from as early as 1913 to as recently as 2010 (Durner et al. 2020).

Using the best available data on the estimated population of the SBS stock, the proportion of adult females in the population, the breeding probability of adult females, the proportion of dens on land, and the proportion of historical dens in the program area, the USFWS estimates that approximately 14 female bears may den in the program area annually (see **Appendix K**). For this estimate, Patil et al. (2022) relied on previous data that included only dens detected using satellite or very-high-frequency radio tags deployed on bears within the SBS boundary. This dataset controlled for spatial bias associated with opportunistic observations and localized surveys (Patil et al. 2022).

The most important characteristic of maternal denning habitat is the presence of topographic features of sufficient height and slope to catch blowing snow and form persistent drifts in early winter, with at least 4.3 feet of vertical topographic relief and steep slopes (mean 40°, range 15.5–50°) (Amstrup and DeMaster 1988; Durner et al. 2001, 2003, 2006). Initial efforts used manual interpretation of high-resolution aerial photographs to sections of stream banks suitable for maternal denning (Durner et al. 2001). Biologists now use an algorithm to map denning habitat identified on a digital terrain model derived from interferometric synthetic aperture radar (IfSAR; Durner and Atwood 2018; **Map 3-41** in **Appendix A**). Based on the IfSAR-derived map, approximately 79.6 square kilometers of suitable bank habitat was identified in the program area (**Table 3-28**).

Other researchers recently developed a three-dimensional (3D) spatial model, integrating snow physics, weather data, and a high-resolution digital elevation model, to predict the occurrence of potential denning habitat along the Beaufort Sea coast (Liston et al. 2015). All of these techniques can provide fine-scale results to focus aerial surveys of denning habitat using thermal imaging equipment (forward-looking infrared radiometry [airborne FLIR; Amstrup et al. 2004b], also known as aerial infrared [AIR; Owyhee Air Research 2018]). This method is the most suitable for searching large areas for maternal dens in advance of seismic exploration or other potentially disturbing activities (Amstrup et al. 2004b; York et al. 2004; Owyhee Air Research 2018).

Bowhead Whale

Bowhead whales transit past the program area during spring (April–June), although they leave the continental shelf to travel over deep water towards feeding areas in the Canadian Beaufort Sea (Olnes et al. 2020). During the fall migration (September and October), whales travel along the shelf break and come close to shore to feed (Quakenbush et al. 2010; Citta et al. 2015; Olnes et al. 2020; **Map 3-42**, Bowhead and Beluga Whale Sightings, in **Appendix A**). The spring migratory corridor between the Bering Strait and Cape Bathurst in the Amundsen Gulf (Canada) has been relatively distinct and consistent over time (Citta et al. 2015; Olnes et al. 2020).

During the summer, bowhead whales feed throughout the Beaufort Sea and may occur in the program area throughout the open-water season. Historically, they have largely aggregated in the Canadian Beaufort Sea and the western Beaufort Sea shelf near Barrow, likely due to predictable and abundant food resources, although some whales remain in the eastern Chukchi and western Beaufort Seas (Ireland et al. 2009; Ashjian et al. 2010, Quakenbush et al. 2010; Clarke et al. 2011; Olnes et al. 2020; Citta et al. 2021). Whales that visit the Alaskan Beaufort Sea during the summer tend to stay off the shelf (Olnes et al. 2020), although they are occasionally observed in nearshore, shallow areas (Clarke et al. 2015).

Fall migrating whales typically reach Cross Island in September and October, although some might arrive as early as late August (BOEM 2018b) and continue on to Point Barrow, where they spend additional time feeding along the continent shelf (Olnes et al. 2020). After passing Point Barrow, the migration paths of individual bowhead whales fan out across the Chukchi Sea, with some heading toward Wrangel Island (Russia) and then the coastal waters of Chukotka, (Russia); others travel across the Chukchi Sea south of Hanna Shoals toward the Russian coast (Ireland et al. 2009; Quakenbush et al. 2010; Citta et al. 2015). They continue southward through the Bering Strait and overwinter in the Bering Sea (Ireland et al. 2009; Quakenbush et al. 2010; Citta et al. 2015). The distribution of bowhead whales is further described in the Final Environmental Impact Statement for the Liberty Development and Production Plan, incorporated here by reference (BOEM 2018b).

Bowhead whales in the program area and along the shipping corridor belong to the western Arctic stock, also known as the Bering-Chukchi-Beaufort stock and are the only one of the four stocks that inhabit US waters (Muto et al. 2021). Bowhead whales were listed as endangered under the predecessor of the ESA in 1973, but no critical habitat has been designated. The decline in extent and duration of sea ice over the past 40 years has coincided with an increase in harvest by residents of Kaktovik, who harvested 1–2 whales per year from 1973 to 1994 and 2–4 whales per year from 1995 to 2016 (Koski et al. 2005; Suydam and George 2018). The Western Arctic population of bowhead whales increased at a rate of 3.2–3.7 percent from 1978 to 2011 (Schweder et al. 2009; Givens et al. 2013) and the most recent population estimate is 17,175 individuals (95% CI: 10,793-27,330; Ferguson 2022).

Bowhead whales have an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Going by their vocalizations, bowhead whales should be most sensitive to frequencies between 20 Hz and 5 kHz, with maximum sensitivity between 100 and 500 Hz (Erbe 2002). Subsistence hunters note that bowhead whales are sensitive to noise during the spring whaling season (Noongwook et al. 2007).

Beluga Whale

Beluga whales in Arctic Alaska belong to the Beaufort Sea (BS) and the Eastern Chukchi Sea (ECS) stocks (Muto et al. 2018). They use waters in the eastern Beaufort Sea but stay farther offshore than bowhead whales, typically beyond the shelf break (Hauser et al. 2014). Spring migration eastward through the Beaufort Sea is stock-specific, with BS stock migrating in spring (April and May) and ECS stock migrating in summer (June and July; Suydam et al. 2001, The BS stock continues on to Canadian waters, spending the summer in the eastern Beaufort Sea, Mackenzie River Estuary, Amundsen Gulf, M'Clure Strait, and Viscount Melville Sound (Hauser et al. 2014, 2017). The ECS stock spends the summer primarily restricted to the continental shelf and slope north of Alaska in the northeastern Chukchi and western Beaufort Seas (Suydam 2009; Hauser et al. 2014; Stafford et al. 2016). The BS stock starts moving west and south in September, leading to an overlap of ranges for the two stocks that extends from Prince of Wales Strait in Canada westward to Herald Shoal in the Chukchi Sea (Hauser et al. 2014; Stafford et al. 2017). The main

fall migration corridor of belugas is over 54 nautical miles north of the coast; however, they do occasionally approach shallow water in coastal areas, such as lagoons and river deltas, to molt or feed (Suydam 2009).

Belugas have been recorded within 5 nautical miles of the program area in the lagoons (**Map 3-42** in **Appendix A**, Hauser et al. 2017) and are sometimes harvested by Kaktovik residents. The population estimate for the ECS stock is approximately 20,000 belugas (Lowry et al. 2017). Although the BS stock was estimated to be approximately 39,000 whales, based on 1996 information, there is currently no recent reliable population estimate available for the BS stock (Muto et al. 2020); however, trend data suggest that the stock is at least stable (Harwood and Kingsley 2013).

Beluga whales are the most vocal of the toothed whales and have a wide variety of vocalizations. They have as many as 50 different whistles and calls in frequencies, ranging from 0.1 to 12.0 kHz (BLM 2012). They can detect sounds at frequencies as low as 40 to 125 Hz (Richardson et al. 1995).

Other Whales

Whale species that may be encountered by vessels in transit from Dutch Harbor to the Beaufort Sea are described in the EIS for the Liberty development project (BOEM 2018b), incorporated here by reference. Gray whales are grouped into the Eastern North Pacific stock, which feeds in the Beaufort, Chukchi, and Bering Seas in summer, and the Western North Pacific stock, which is listed as endangered and is found in Russian waters.

The Eastern North Pacific stock migrates south from Alaska in the fall to spend winter in waters off California and Mexico. The most recent population estimate for this stock of 16,650 individuals is based on systematic counts of gray whales migrating south along the central California coast (Eguchi et al. 2022). This population count represents a 38.2 percent decline since the survey conducted in 2016 (Durban et al. 2017), reflecting what NOAA believes was an unusual mortality event that may have peaked in 2019 (Eguchi et al. 2022). Gray whales from the Eastern North Pacific stock regularly occur near Utqiaġvik in both the Chukchi and Beaufort Seas in summer (Moore and DeMaster 1997; Laake et al. 2009). They have been recorded during aerial surveys (ASAMM 2017) and on acoustic recorders (Moore et al. 2000, 2006), rarely ranging past 155.8ºW (Clarke et al. 2015 in BOEM 2018). While no gray whales have been observed within 5 nautical miles of the program area, gray whales have been sighted six times in the Canadian Beaufort Sea (Rugh and Fraker 1981; Quakenbush et al. 2013; Brower et al. 2015; Clark et al. 2015; Yuka et al. 2016). This suggests that a small, casual proportion of gray whales migrates into Canadian waters and could be encountered during Coastal Plain activities. Gray whales have an estimated auditory bandwidth of 7 Hz to 22 kHz, placing them in the low-frequency hearing group for cetaceans. They produce signals from 100 Hz to 4 kHz, with the most common sounds on the feeding grounds being knocks (BLM 2012).

In addition to the species listed in **Table B-13**, sub-arctic whales that could be encountered during vessel transit are blue, fin, humpback, minke, North Pacific right, sperm, and killer whales. Blue whales are present in Alaska waters only during their non-breeding season and would be found in the open waters near the Aleutian Islands and the Bering Sea. Fin whales are present in both the Bering and Chukchi Seas in the summer, with greater numbers in the Bering than the Chukchi Sea (Muto et al. 2021). Individual humpback whales from the Western North Pacific Stock could occur in the Bering Sea and possibly in parts of the Chukchi and Beaufort seas (Muto et al. 2021), although sightings are rare. Minke whales are believed to be migratory summer residents of the Chukchi and Bering Seas and move south of the Bering Sea to overwinter. North Pacific right whales are considered the rarest of all large whale species and among the

rarest of all marine mammal species. Critical habitat was designated for the eastern North Pacific right whale in 2008 (73 FR 19000) in the Bering Sea, based on geographic coordinates where they have been consistently sighted in spring and summer.

Ringed Seal

Population and Life History

Ringed seals (*Phoca* [*Pusa*] *hispida*) have a circumpolar distribution and have five recognized subspecies (Kelly et al. 2010). The Alaska stock consists of a portion of the subspecies *P. h. hispida* found in the US waters of the Beaufort, Chukchi, and Bering Seas (Muto et al. 2021). There is no reliable population estimate for the entire Alaska stock. Surveys conducted from 1996 to 1999 yielded a conservative estimate of at least 300,000 ringed seals in the Alaskan Beaufort and Chukchi Seas (Bengtson et al. 2005; Frost et al. 2004; Kelly et al. 2010). The estimate for the US Beaufort Sea, however, has not been corrected for the number of ringed seals that had not hauled out at the time of the surveys (Kelly et al. 2006; Carretta et al. 2015).

Data from aerial surveys conducted over the Bering Sea in 2010 and 2013 were used to calculate an abundance estimate of 170,000 ringed seals in the US sector of the Bering Sea (Conn et al. 2014). Recent estimates indicate that the Arctic ringed seal population numbers over 1,000,000 (Kelly et al. 2010). The population trends and status of this stock are currently unknown (Muto et al. 2021). The decline in extent and duration of sea ice cover is the primary conservation concern leading to their listing as threatened under the ESA in 2012 (77 FR 76705).

Ringed seals are year-round residents in the Beaufort Sea (Muto et al. 2021). Historically, the population densities of ringed seals have been substantially greater in the eastern Beaufort Sea than in the western Beaufort (Burns and Kelly 1982; Kelly 1988). Ringed seal population densities tend to be greatest in areas of flat ice near the edge of the shore-fast ice zone and decline away from that edge (Frost et al. 2004). They use sea ice as a platform for pupping in the winter and early spring, molting in early summer, and resting throughout the year (Kelly 1988).

Ringed seals can be found in the nearshore areas during the summer and winter (Williams et al. 2002). Optimal wintering areas for ringed seals in the Beaufort Sea are generally in waters 32–115 feet deep; however, under-snow seal structures have been found in waters depths of 5–10 feet in the central Beaufort Sea (Williams et al. 2006), indicating that seals may use portions of the program area in addition to the marine transportation corridor.

During the summer, ringed seals forage along ice edges offshore and in productive open water (Harwood et al. 2015b), including waters within 5 nautical miles of the program area (**Map 3-43**, Seal Sightings, in **Appendix A**). Critical habitat has been proposed for the Arctic ringed seal in US waters; it effectively includes all marine waters within the US Exclusive Economic Zone where sea ice regularly forms during winter (BOEM 2018b). The final determination for ringed seal critical habitat from the NMFS remains pending.

Adult females construct pupping lairs, often on shore-fast ice, and adult males appear to defend their breeding territories around those lairs from other males and subadults (Kelly et al. 2010). Single pups are born in the spring (March to May), with the peak of pupping in early April (Kelly et al. 2010). Mating takes place in April and May while mature females are still lactating (Moulton et al. 2002). Ringed seals molt

between mid-May and mid-July. During this time, they remain hauled out on the edge of the pack ice or on remnant land-fast ice until their old pelt dries out and sheds (Reeves 1998). Because of the need for dry skin during the molt, ringed seals refrain from entering the water and forgo foraging, making the molt a particularly stressful time for them (Ryg et al. 1990).

When not whelping, lactating, breeding, or molting, ringed seals travel widely and may occur in waters of nearly any depth, although their distribution remains strongly correlated with the presence of sea ice and with food availability (Simpkins et al. 2003; Freitas et al. 2008).

Polar bear predation remains the largest source of ringed seal mortality (Stirling and Archibald 1977), followed by subsistence hunting (Muto et al. 2018). Ringed seals are an important resource for subsistence communities across the North Slope, including Kaktovik. The number of seals taken annually varies considerably between years due to ice and wind conditions, which affect hunter access to seals.

The ADFG maintains a subsistence harvest database and, as of August 2000, the mean estimate of ringed seals taken annually is 9,567. Data from 2007 to 2012 indicate a reported annual average harvest of 3.5 ringed seals (range of 0 to 10 individuals) taken by Kaktovik subsistence hunters, mainly during the snow-free months of June to August (Harcharek et al. 2018). Data from 2008 to 2012 show an annual average of 4.12 mortalities of Arctic ringed seals from commercial fishing operations in Alaska (Muto et al. 2018). Other sources of mortality among ringed seals are entanglements and predation from Arctic foxes, walruses, wolves, wolverines, and ravens which also occasionally kill ringed seals, and all of which result in very few losses (Allen and Angliss 2013).

Critical Habitat

In 2022, NMFS designated critical habitat for ringed seals in the Bering, Chukchi, and Beaufort seas within the geographical area presently occupied by ringed seals (87 FR 19232). Critical habitat contains the biological features essential to the conservation and management of the species. For ringed seals, the features considered essential to the conservation of the species include:

1. Snow-covered sea-ice habitat suitable for the formation and maintenance of subnivean birth lairs, defined as waters at least 10 feet (3 meters) deep containing areas of seasonal land fast ice or dense stable pack ice.
2. Sea ice habitat suitable as a platform for basking and molting, defined as areas containing sea ice concentrations of 15 percent or more in waters at least 10 feet (3 meters) deep.
3. Primary prey resources to support ringed seals, defined as small, often schooling fish and small crustaceans.

The movements and habitat use of Arctic ringed seals are strongly influenced by the seasonality of sea ice. The boundaries for critical habitat were therefore delineated to include the sea ice essential features as these presumably also correspond to areas with the necessary prey resources. The southern boundary was determined from the median position of the ice edge for May from 1990 to 2019 because it provides the best estimate of the southern extent of where the birth lair essential feature occurs on a consistent basis. The outer limit of the US exclusive economic zone to the north, west, and east best defined the remaining seaward boundaries of the area containing the sea ice essential features. Finally, the shoreward boundary

was delineated by the 3-meter isobath (relative to mean lower low water[28]), consistent with the 10-foot (3-meter) minimum water depth identified for sea ice features. Critical habitat excludes an area north of the Beaufort Sea shelf that is used by the US Navy. The acreage and percentage of critical habitat in the program area is described in *Impacts Common to All Alternatives* (**Chapter 3**).

Bearded Seal

Population and Life History

Bearded seals are associated with offshore pack ice throughout the year, remaining close to the ice edge for as long as the ice is available. They use ice as a platform for breeding, pupping, molting, and resting. In summer, bearded seals may use nearshore areas of the Beaufort Sea (**Map 3-43** in **Appendix A**), and occasionally haul out on land (Muto et al. 2021). Bearded seals are diving bottom feeders of fish and invertebrates (Crawford et al. 2015). A preliminary analysis of diving behavior indicates that they make proportionately more dives in marginal ice (15 to 80 percent) or open water and during the day than in heavy ice or from midnight to 4:00 a.m. They tend to dive in shallow water (0 to 131 feet-deep) (Quakenbush and Crawford 2019). Young bearded seals use estuary and riverine habitat for foraging and resting, including Dease Inlet and the Colville and Koyuk Rivers (Quakenbush and Crawford 2019). Bearded seals are expected to occur within 5 nautical miles of the program area and along the shipping route.

No reliable population estimate and no reliable data on trends of population abundance are available for the entire Alaska stock of bearded seals (Muto et al. 2018). The most recent abundance estimates for bearded seals in US waters (299,174 individuals; 95 percent CI: 245,476–360,544) applies only to the Bering Sea (Conn et al. 2014). Residents of Kaktovik hunt bearded seals as part of their subsistence activities, but seals are not considered a primary food source (Clough et al. 1987). Harcharek et al. (2018) reported that Kaktovik subsistence hunters harvested an annual average of 3.8 bearded seals (range of 1 to 10 individuals) during the snow-free months of July and August. These seals are important subsistence resources, however, for other communities in the NSB and along the shipping route. The primary conservation concern for this species is the ongoing and projected loss of sea ice cover (Cameron et al. 2010), which led to their listing as threatened under the ESA in 2012 (77 FR 76740).

Critical Habitat

In 2022, NMFS designated critical habitat for the Beringia DPS of the bearded seal in the Bering, Chukchi, and Beaufort seas (87 FR 19180). Critical habitat contains the biological features essential to the conservation and management of the species. For bearded seals, the features considered essential to the conservation of the species include:

1. Sea ice habitat suitable for whelping and nursing, defined as areas with waters no more than 656 feet (200 meters) deep containing pack ice of at least 25 percent concentration and providing bearded seals access to those waters from the ice.
2. Sea ice habitat suitable as a platform for molting, defined as areas with waters no more than 656 feet (200 meters) deep containing pack ice of at least 15 percent concentration and providing bearded seals access to those waters from the ice.

[28]A tidal datum. The average of the lower low water heights during the current national tidal datum epoch.

3. Primary prey resources to support bearded seals, defined as waters no more than 656 feet (200 meters) deep containing benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes.

Bearded seals generally maintain an association with drifting sea ice, and many seals migrate seasonally to maintain access to sea ice. The boundaries for critical habitat were therefore delineated to include the sea ice essential features. The southern boundary is based on a modified contour of the estimated position of the April median ice edge west of Kuskokwim Bay from 1990 to 2019. The northern boundary is defined by the 200-meter isobath over the continental shelf break in the Chukchi and Beaufort seas (i.e., the northern extent of waters 656 feet [200 meters] deep or less in these seas), and the boundaries to the east and west are defined as the limit of the US exclusive economic zone. The shoreward boundary is determined by the edge of landfast ice, which is not considered a feature of critical habitat. In the Beaufort region, the 656-foot (20-meter) isobath is the shoreward boundary because it provides a reasonable approximation of the average stable extent of landfast ice (Mahoney et al. 2007; Mahoney et al. 2014). There is no critical habitat for bearded seals within the program area but any shipping from Dutch Harbor to the program area would transit through critical habitat enroute.

Other Marine Mammals

Pinniped species that may be encountered by vessels in transit from Dutch Harbor to the Beaufort Sea are described in the EIS for the Liberty development project (BOEM 2018b), incorporated here by reference. Steller sea lions typically occur in coastal areas of the North Pacific and Bering Sea and are commonly encountered by vessels traveling in and out of Dutch Harbor and near the Pribilof Islands where large breeding rookeries occur. Spotted seals are widely distributed on the continental shelf of the Bering, Chukchi, and Beaufort seas, with pupping and breeding occurring primarily south of Bering Strait (Boveng et al. 2009).

They rely less on sea ice than ringed or bearded seals, using nearshore areas and coastal haul-outs in summer and fall (Quakenbush and Crawford 2019). While extralimital near the program area, Pacific walruses are common in the Bering and Chukchi seas and occasionally range into the Beaufort Sea (Fay 1982; Garlich-Miller et al. 2011). The Southwest Stock of northern sea otters may be encountered by barges near Dutch Harbor, but probably not in offshore areas.

Climate Change

Climate change is a global issue affecting marine mammals in the program area (see **Section B.2.1**). Climate warming is expected to be most dramatic in the Arctic, with rates of warming nearly twice that experienced globally (ACIA 2005; Wendler et al. 2014). The effects of these global trends are complicated; yet the forecast models—based on current trends—that have been constructed to examine the likely effects on marine mammal habitats point to dramatic declines in the extent and thickness of arctic sea ice cover. This loss of sea ice has serious implications for the future of ice-associated species, such as polar bears, ice-associated whales, and ice seals (Durner et al. 2009; Cameron et al. 2010; Kelly et al. 2010; Species at Risk Committee 2012; Joint Secretariat 2015; Regehr et al. 2016).

Climate change in the Arctic is a rapidly growing concern, especially for the marine environment. Increased air and sea temperatures, longer periods of open water with an earlier onset of melting and later onset of freeze-up, increased rain-on-snow events, warm-water intrusion, and changing atmospheric wind patterns are contributing to overall reduction and changes in sea ice (Kovacs et al. 2011; Chapin et al. 2014; Stroeve

et al. 2014; Joint Secretariat 2015). The greatest concern for marine mammals in the reasonably foreseeable future is the continued arctic warming trend and the resulting deterioration of sea ice conditions that are necessary for ice-dependent species and their prey.

Arctic sea ice is changing in the extent of geographic coverage, thickness, age, and timing of melt and is one of the most pronounced changes currently occurring, at rates higher than previously predicted. Analysis of long-term data sets show substantial decreases in both extent (area of ocean covered by ice) and thickness of sea ice cover during the past 30 years (Post et al. 2013; Wendler et al. 2014). These trends are projected to continue, possibly resulting in loss of summer sea ice by mid-century (Chapin et al. 2014; Stroeve et al. 2014) and suggesting that all ice-dependent species may experience conditions that could result in declines of food availability and foraging and breeding habitat.

In addition to changes in sea ice, ocean acidification is occurring as a consequence of increased carbon dioxide in the atmosphere. Ocean acidification is occurring as a consequence of increasing CO2 in the atmosphere and is predicted to be amplified in the Arctic, resulting in changes in ecosystem processes and increased effects on organisms (AMAP 2013; Meltofte 2013). The primary concern with ocean acidification is its effect on prey populations, particularly on bottom-dwelling and free-swimming invertebrates that form shells. A decrease in ocean pH, concurrent with increases in water temperature, may interfere with the ability to form shells (Fabry et al. 2008; Kroeker et al. 2009; Hofman et al. 2010), compromising survival of invertebrates and reducing prey availability for marine mammals (Doney et al. 2012; 77 FR 76708).

The ongoing declines in the extent and duration of sea ice cover present the greatest source for possible population-level impacts on marine mammals over the next 20–40 years, although the impacts are not entirely clear and may vary among species. Bowhead whales were shown to be in better body condition in years of light ice cover (George et al. 2015), although post-weaning whales had lower body condition after years with abnormally low winter sea-ice concentrations (Citta et al. 2023). It appears that the Western Arctic stock is so far adapting to changes in ice cover, as demonstrated by their consistent population increase (Givens et al. 2013; Muto et al. 2018) and shift to overwintering farther north in years with light sea ice (Insley et al. 2021; Szesciorka and Stafford 2023); however, the long-term effect of reductions of sea ice on bowhead populations is not known (George et al. 2015).

Beluga whales may be sensitive to changes in Arctic weather, sea surface temperatures, and ice extent and the concomitant effect on prey availability. Arctic cod, a major prey item for belugas, are most prevalent at the 656- to 984-foot depth in the western Beaufort Sea; these are the depths that most belugas dive to (Hauser et al. 2015). Recent evidence for declining growth, body condition, and blubber thickness suggests that ecosystem changes may be affecting belugas through reduced availability or quality of prey, primarily ice-associated Arctic cod (Harwood et al. 2014, 2015a).

Laidre et al. (2008) and Heide-Jørgensen (2010) concluded belugas are probably less sensitive to climate change than other Arctic cetaceans, after considering their wide distribution and flexible behaviors. If salmon or whitefish become more prevalent in the Beaufort Sea, the diet composition of belugas could shift, but to what degree remains speculative; thus, the future effects of climate change on belugas and their habitat could result in fewer or more feeding opportunities, depending on how the populations of prey species respond to the new environmental conditions. This in turn would affect the physical and behavioral state of belugas, as well as their population.

Losses in sea ice could allow marine predators, such as killer whales, to penetrate into the Beaufort Sea for longer distances, increasing the risks of predation on belugas (O'Corry-Crowe et al. 2016). Most belugas, however, prefer feeding in deep water near the shelf break, and are capable of diving to 2,950 feet in the Canadian Basin (Hauser et al. 2015); Miller et al. (2010) recorded the maximum dive depth for a killer whale at 833 feet. Loseto et al. (2006) noted that open-water habitat near mainland shore may be selected by females with calves, possibly to reduce predation risk from polar bears or being entrapped in ice. Additionally, shallow open water may provide protection from killer whales because the larger whales' mobility would be hampered in shallow waters (Loseto et al. 2006).

There were indications that ocean conditions in some areas were more favorable for ringed seals in the early part of the last century than in the second half, as ringed seals near Kaktovik were growing and maturing faster and at a younger age than 30 years previously (Quakenbush et al. 2011), however current rates are unknown. The broad distribution, ability to take undertake long movements, diverse diet, and association with widely varying ice conditions suggest that ringed seals may be resilient to changes in sea ice availability (NMFS 2013; Lydersen et al. 2017), at least in the short term. The greatest impacts on ringed seals from climate change, however, would manifest in reductions of sea ice and less snow cover (77 FR 76708). While winter precipitation is forecast to increase in a warming Arctic (Walsh et al. 2011), the duration of ice cover could be reduced. This could lead to lower snow accumulation on ice (Hezel et al. 2012), particularly over their under-snow lairs. According to NMFS's climate model projections, snow cover is expected to be inadequate for the formation and occupation of lairs during this century over the Alaska stock's entire range (Kelly et al. 2010).

Bearded seals are more strongly associated with sea ice available over bottom habitats in shallow water that is suitable for feeding, suggesting they may be less resilient to reduced sea ice cover (NMFS 2013). Reductions of sea ice in the Bering Sea may require that bearded seals shift their nursing, rearing, and molting areas to ice-covered seas north of the Bering Strait, where projections suggest a potential for the ice edge to retreat to deep waters of the Arctic basin.

There is a moderate to high threat that reductions in spring and summer sea ice would result in spatial separation of sea ice resting areas from bottom feeding habitat (77 FR 76740, December 28, 2012). Such an event would force seals into suboptimal conditions and habitats and likely would compromise reproduction and survival. NMFS (77 FR 76740) concluded the Beringia DPS of bearded seals is under no present threat from climate change, but future changes in sea ice could present an increasing threat, leading to the extinction of the Beringia bearded seal DPS by around 2095.

Recent changes in demography, distribution, habitat use, and behavior of polar bears are attributable primarily to loss of sea ice habitat as a result of climate warming (Atwood et al. 2016a; USFWS 2016). The greatest future declines in optimal polar bear habitat are predicted to occur in the divergent ice ecoregion along the Arctic coastlines of Russia and Alaska. Here, reductions in sea ice habitat are predicted to be most likely to reduce polar bear populations (Durner et al. 2009; Regehr et al. 2016). Based on population size, summer ice loss, length of ice-free period, the amount of habitat over the continental shelf, and prey diversity, the SBS stock has been ranked as one of three having the highest vulnerability to the effects of climate change (Hamilton and Derocher 2019).

An analysis from 1979 to 2014 of sea ice conditions in the annual range of the SBS revealed trends of spring ice retreating 9 days earlier per decade and fall ice advancing 8.8 days later per decade, an increase of length in the ice-free season of 17.8 days per decade (Stern and Laidre 2016). That study also calculated a decrease

of 9.3 days per decade in mean sea ice concentration from June to October and a decrease of 17.5 days per decade in the number of days of ice cover. The decreased ability of sea ice to reflect solar radiation (9 percent per decade from 1982 to 2011) has led to significantly increased absorption of solar radiation by ocean waters, especially along the Beaufort Sea coast of Alaska, from May through September. This has lengthened the open-water season and delayed autumn freeze-up (Stroeve et al. 2014).

The increasing difficulty for polar bears dealing with ecological changes, resulting from declining sea ice cover related to climate change, has led in turn to behavioral changes, as follows:

- Increased travel speed and time spent active, and thus energy expenditure, by collared female bears on sea ice as the rate of ice drift has increased due to declining ice thickness and extent (Durner et al. 2017)
- Increased frequency of long-distance swimming, and thus energy expenditure, by collared female bears, peaking during July to September (Durner et al. 2011; Pagano et al. 2012; Pilfold et al. 2017; Pongracz and Derocher 2017)
- Observations of swimming bears and dead bears in open water (Monnett and Gleason 2006; Schliebe et al. 2006)
- Increased percentage of the population coming ashore and spending more time on land, with arrival dates becoming earlier, at a rate of about 5 days per decade, and departure dates becoming later, at a rate of about 7 days per decade (Atwood et al. 2016b; Wilson et al. 2017; Rode et al. 2022)
- Higher activity levels while ashore (some of it associated with foraging on bowhead whale carcasses) and more time spent in marginal habitats (on land and on sea ice off the continental shelf) than in preferred habitat (sea ice over the continental shelf) (Ware et al. 2017)
- Increased use of terrestrial habitats for maternal denning (Fischbach et al. 2007; Olson et al. 2017; Patil et al. 2022)
- Unusual predation behavior (Derocher et al. 2000; Brook and Richardson 2002; Stirling et al. 2008)
- Polar bear predation and cannibalism (Amstrup et al. 2006a)

Polar bears of the SBS stock experienced twice as many days of reduced sea ice from 2008 to 2011 than did those of the Chukchi Sea stock. The increased frequency of female SBS polar bears denning on land now rather than on pack ice has been attributed to reductions in stable old (multi-year) ice, increases in unconsolidated ice, and lengthening of the melt season (Fischbach et al. 2007; Olson et al. 2017).

Another result of climate change is earlier breakup of landfast ice and higher drift rates of pack ice (Durner et al. 2017), forcing more bears to spend more time on land where they have difficulty catching prey and spend longer periods fasting (Rode et al. 2022). Although polar bear locomotion on land is relatively efficient at the slow walking speeds they prefer (mean = 2.1 miles per hour, similar to grizzly bears), it becomes less efficient at unusual speeds above 3.3 miles per hour; (Pagano et al. 2018a), potentially increasing energetic demands if polar bears are disturbed while spending time ashore. More time onshore also increases the chance of human/bear interactions, and consequently the risk of bears being killed in defense of life or property (Amstrup 2000; Species at Risk Committee 2012; Whiteman et al. 2015; Joint Secretariat 2015).

Population-level effects of sea ice loss have been observed in polar bears at the southern edge of their range in western Hudson Bay, and the timing of fluctuations in polar bear survival and abundance in the SBS

suggest a similar relationship. In the SBS subpopulation, reduced body size, cub survival, and recruitment in polar bears have been documented in years when sea ice availability was reduced (Rode et al. 2010). Despite similar diets, SBS bears were smaller and in poorer condition and exhibited lower reproductive rates than bears of the Chukchi Sea stock, and twice as many were fasting in spring (Rode et al. 2014). Models predict decreased survival (including breeding rates and cub litter survival) of polar bears in the SBS population with reduced sea ice coverage (Regehr et al. 2010; Hunter et al. 2010) and low survival in 2012 coincided with the lowest Arctic sea ice extent recorded to date (Bromaghin et al. 2021).

Polar bears using terrestrial habitats near the program area have shown increased use of bowhead whale in their diets in recent years, reflecting increased foraging on the Kaktovik whale bone pile (Rogers et al. 2015; McKinney et al. 2017). Carcasses of large whales can provide fat- and protein-rich food sources for polar bears, enabling them to store large amounts of fat for long periods of fasting; however, the availability of whale carcasses is not likely to provide a sufficient food source to replace ice seals in polar bear diets as sea ice continues to decline (Laidre et al. 2018). Given the high metabolic demands and increased movements of polar bears, cascading adverse effects on polar bear populations are predicted as sea ice declines and the availability of preferred, high-energy prey decreases accordingly (Rode et al. 2015; Pagano et al. 2018b; Whiteman 2018). Congregations of polar bears onshore around Kaktovik also pose an increased risk of disease transmission compared to bears on ice (Atwood et al. 2017; Whiteman et al. 2019).

The warming temperatures and increased precipitation year-round and longer growing seasons that are predicted to occur in the future may have negative implications for the stable conditions required for maternal denning by polar bears, especially if warm temperatures prevent snow cover of sufficient depth from accumulating early in the denning season. Recent research predicts that shorter annual periods of snow cover in the future are likely to result from increased air temperatures, later freeze-up in fall, and earlier snow melt in spring. Although snow cover in northeastern Alaska still is predicted to occur during the maternal denning period of October to April (Littell et al. 2018; Box et al. 2019), snow depth is more difficult to predict.

Range expansion of subarctic and temperate species into the Beaufort and Chukchi Seas has been observed in recent years and is likely to continue with changing arctic conditions. Increased observations of gray whales, humpback whales, and fin whales in the northeastern Chukchi Sea and gray and humpback whales in the western Beaufort Sea is a relatively recent phenomenon (Clarke et al. 2015); thus far, potential range expansion into the Beaufort Sea has been limited, but sightings appear to be increasing slowly. Range expansion by more temperate species raise the possibility of resource competition with arctic species (ACIA 2005). Other risks to arctic marine mammals induced by climate change include increased risk of infection and disease with improved growing conditions for disease vectors and from contact with nonnative species, increased pollution through increased precipitation transporting river borne pollution northward and increased human activity through shipping and offshore development (ACIA 2005; Huntington 2009; Hauser et al. 2018).

B.4 SOCIAL SYSTEMS

B.4.1 Land Ownership and Use

Affected Environment

The affected environment for landownership and use is similar to Section 4.1.2, Land Status, in the Arctic Refuge CCP (USFWS 2015a); however, because the Coastal Plain program area does not include the entire Arctic Refuge, a revised description of the program area is included here. Lands administered by the

USFWS, including submerged lands, account for greater than 99.9 percent (1,562,600 acres) of the 1,563,500-acre program area. The remaining 900 acres of lands are Alaska Native Allotments. These allotments typically support subsistence resources and use. Patented and allotment lands are mostly located along the Beaufort Sea between the Hulahula and Jago Rivers. There are also smaller, isolated allotments along the coast. ANCSA corporation mineral interests are also present in the program area. The ASRC owns subsurface acreage in the program area, while the KIC owns surface acreage. Descriptions of Alaska Native Lands and Allotments are incorporated here by reference from the USFWS CCP (USFWS 2015a).

There are no BLM-administered surface lands in the program area; however, the BLM manages all of the subsurface mineral estate (see **Sections 3.2.5** and **3.2.6**). The BLM would manage federal oil and gas leases, permits, and ROWs associated with fluid mineral development. The BLM would verify subsurface mineral estate ownership at a site-specific level prior to a lease sale.

With the exception of Barter Island, there are no roads, power lines, pipelines, or other permanent facilities or structures in the program area. A single runway airport and the city of Kaktovik, a community of approximately 250 people, are both located on Barter Island.

B.4.2 Cultural Resources

Affected Environment

This section addresses the cultural resources of the program area associated with several Alaskan and Canadian Indigenous groups including Inuit (i.e., Alaskan Iñupiat and Canadian Inuvialuit) and Gwich'in. The Kaktovikmiut (i.e., Iñupiat of Kaktovik) are the current Indigenous inhabitants of the program area. Also addressed are the cultural resources associated with more recent, post-contact Euro-American groups.

This section incorporates information from the following sources:

- ADNR, Office of History and Archaeology (ADNR OHA 2023) Alaska Heritage Resources Survey (AHRS);[29]
- NSB's Iñupiat History, Language, and Cultural (IHLC) Division's repository of Traditional Land Use Inventory (TLUI) sites (IHLC 2023);
- ADNR, Division of Mining, Land and Water (ADNR MLW 2023) Revised Statute (RS) 2477 trail database (e.g., historic public ROWs);
- NOAA Office of Coast Survey (NOAA OCS 2016) wrecks and obstruction database;
- Ethnographic interviews conducted for the previous Coastal Plain EIS effort (Tritt 2018a; Tritt 2018b; James 2018; Gilbert 2018; Frank 2019a; Eric 2019a; Newman 2019; Eric 2019b; Tritt 2019; Frank 2019b; Keeney 2019);
- Placename compilations (Gilbert, Williams, Fields, Williams, Flitt, Savage, Francis, John, Salmon, Salmon, Tritt, Martin, Herbert, Frank, Frank, James, Alexander, and Roberts 2017; Smith 2017; Pedersen, Coffing, and Thompson 1985; Jacobson and Wentworth 1982; Nielson 1977; Caulfield, Peter, and Alexander 1983); and,
- Previous literature and EIS documents near the program area, including the Point Thomson EIS (USACE 2012) and Arctic Refuge CCP (USFWS 2015a).

[29]AHRS data reviewed for this SEIS in March of 2023

The BLM and USFWS reviewed scoping comments for this SEIS for information on cultural resources in the program area, including comments provided by Canadian entities that addressed the cultural ties of the Canadian Inuvialuit and Gwich'in to the program area.

Section 106 of the NHPA (with its implementing regulations in 36 CFR 800) and NEPA require the BLM to evaluate the effects of the Leasing SEIS on cultural resources.[30] Federal agencies are encouraged to coordinate compliance with Section 106 with any steps taken to meet the requirements of NEPA and should consider their Section 106 responsibilities as early as possible in the NEPA process (36 CFR 800.8a). A Programmatic Agreement (PA) for the Section 106 process developed during the initial EIS effort is currently in place. Other relevant legislation or EOs that apply to the management of cultural resources include the Antiquities Act of 1906 (54 USC 320301 et seq.); the Archaeological Resources Protection Act of 1979 (ARPA; 16 USC 470aa et seq.); the Abandoned Shipwreck Act of 1987 (43 USC 2101 et seq.); the American Indian Religious Freedom Act (42 USC 1996); Section 4(f) of the DOT Act (49 USC 303); the Archaeological and Historic Preservation Act of 1974 (the Moss-Bennett Act); EO 13007 (Indian Sacred Sites); and the Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001-3013).

Cultural and Historic Context

The Arctic Refuge Revised CCP (USFWS 2015a, Section 4.4.1.2) and Point Thomson EIS (USACE 2012, Sections 3.21.4 and 3.21.5) describe the cultural themes and periods of the Arctic Refuge, including the program area. **Table B-15**, below, provides a summary of the cultural context of the Arctic Refuge as presented in the CCP (USFWS 2015a) and based on information provided in USACE (2012). **Section B.4.4**, Sociocultural Systems, also provides a cultural overview of the Iñupiat and Gwich'in that is relevant to this section.

Table B-15
Archaeological Traditions, Cultural Themes, and Periods of the Arctic Refuge Area

Tradition/Theme	Period
Paleoindian	13,700 to 9,800 years ago
American Paleo-Arctic	11,800 to 8,000 years ago
Northern Archaic	8,000 to 3,000 years ago
Arctic Small Tool Tradition	5,000 to 2,400 years ago
Athabascan (including Gwich'in)	2,000 years ago, to present
Birnirk Culture	1,600 to 1,000 years ago
Thule	1,000 to 400 years ago
Iñuit (including Iñupiat and Inuvialuit)	400 years ago, to present
Euro-American exploration	1820s to 1900s
Early ethnographic research	1900s to 1920s
Trading posts and reindeer herding	1910s to 1940s
Military presence/DEW Line sites	1950s to 1980s
Land conservation	1950s to present
Oil development	1970s to present

Sources: USACE 2012; USFWS 2015a

Cultural Resources in the Program Area

Previous Archaeological and Historic Resources Surveys

In general, previous survey efforts focused on identifying archaeological and historic resources in the program area have been concentrated primarily along the coastal region, with fewer investigations along

[30]Section 106 of the NHPA requires the BLM to evaluate effects on historic properties, which are a type of cultural resource.

the river systems and little research of the inland areas. A review of the previous surveys module of the AHRS database (which uses section-level[31] spatial coverage for the program area) revealed seven literature reviews, 13 reconnaissance surveys, and two Phase II evaluation level surveys. A similar review of the document repository module of the AHRS returned 33 records for reports associated with those sections.

Past surveys were primarily concentrated in and around the village of Kaktovik, along the coast and barrier islands of the Beaufort Sea, and along several of the major rivers in the area. Of special note is one wide-area survey of the program area conducted by Edwin Hall (1982) over approximately 20 days, using aerial overflights and limited pedestrian investigation of the coastal area and select river systems. This survey represents the only attempt at systematic coverage of the program area guided by targeted surveys at high potential landforms and topographic settings. Overall, vast inland areas of the program area have received little to no systematic investigation for cultural resources; while the coastal region has been the subject of a greater number of survey efforts, dynamic coastal erosion processes are affecting those resources (Grover and Ryder 2011). The Section 106 PA for the program area addresses the additional steps that the BLM and USFWS will take to address the lack of survey coverage and identification efforts to date in the program area.

Previously Documented Sites

The USFWS (2015a, Section 4.4.1.1) identified several site types that could be found in the Arctic Refuge, and the following categories outline the types of sites that are most likely to be found in the program area:

- Coastal settlements, consisting of semi-subterranean driftwood or whalebone houses, in some cases associated with cemeteries or additional structures; post-contact and pre-contact houses are present along the coast of the Beaufort Sea
- Inland settlements, consisting of semi-subterranean driftwood or whalebone houses, also in some cases associated with cemeteries or additional structures; this is the least known type of site on the Arctic Refuge
- Tent ring complexes, consisting of arrangements of stones used to secure skin tents to the ground, often with associated hearths in and outside the ring; these features are found along river corridors on elevated terraces and likely relate to seasonal caribou hunting; in some cases, these complexes are near or next to caribou drive lines or fences
- Lithic (i.e., stone tool) scatters, consisting of surface and subsurface collections of artifacts and debris resulting from the procurement, preparation, and manufacture of stone tools; in many cases, lithic typological and technological comparisons are the only way of assigning an age or cultural affiliation to a site
- Post-contact[32] structures, including sod houses and cabins, built by Indigenous peoples, early explorers, and trappers that offer insights into the early contact period
- Graves and burials are another category of site types that occur in the program area.

As identified in the AHRS database, there are 93 AHRS sites recorded in the program area, including sites of both pre-contact and post-contact origin (**Appendix M**). Five are eligible for listing on the NRHP, two

[31]The finest resolution of the AHRS database for wide-area queries is the section level, which may result in non-program area lands being included in the search.
[32]Refers to the period after contact with European and American people. Pre-contact refers to the period before interaction with European and American people.

are not eligible, two are pending reevaluation for their eligibility, and 84 have not had formal evaluations for their NRHP eligibility.

Approximately one-third of the sites have pre-contact components, including such features as sod houses, lithic scatters, tent rings, and various artifact scatters. Due to the limited research associated with these sites, the cultural affiliations of many of them are unknown. Post-contact sites comprise the remaining two-thirds of sites and include military sites associated with the DEW Line and several types of Iñupiaq structures, such as sod houses, cellars, tent frames, and other buildings.

The NSB's TLUI database documents place names, landmarks, traditional land use sites, travel routes, and important locations remembered by the Iñupiat, particularly the Kaktovikmiut and their ancestors who have occupied the Coastal Plain for thousands of years. Many of the studies that helped inform the TLUI database (e.g., Jacobson and Wentworth 1982), including ongoing TLUI research and database updates,[33] describe in detail the strong cultural ties that the Kaktovikmiut have to the lands in and adjacent to the Coastal Plain.

In essence, the Coastal Plain is the homeland of the Kaktovikmiut. According to the TLUI database, there are 56 recorded TLUI sites in the program area (**Appendix M**). These sites primarily consist of house ruins (both collapsed sod and cabin structures), graves, and important hunting, fishing, camping, and lookout areas. Except for five TLUI sites inland, the remaining 51 sites are located in coastal settings inside the program area.

The following information, summarized from the TLUI and based on the different types of sites, demonstrates how integrally tied the Kaktovikmiut and their ancestors are to the Coastal Plain. The area has been the homeland of the Kaktovikmiut since time immemorial:

- House ruins—Many of the TLUI sites in the program area reflect widespread use by the Kaktovikmiut before centralizing in Kaktovik. Many of the ruins are associated with the names of respected elders living at these locations in the early twentieth century and who were instrumental in the establishment of the current community of Kaktovik.
- Graves—There are burials of past Kaktovikmiut family members also throughout the coastal locations, many near house ruins and old settlements.
- Harvesting areas—These are important places where the Kaktovikmiut could reliably find resources, such as whitefish, grayling, arctic char, Dall sheep, caribou, waterfowl, ptarmigan, and berries.
- Ice cellars—These are locations where food was stored and preserved, also often associated with nearby house ruins.
- Camps—These are places where people stayed or camped during their travels along the coast or between the coast and inland areas.
- Place names and legends—Many places have special names that translate to reference Kaktovikmiut stories about the past, for example where you go to see a long wayoil seeps; farthest

[33]TLUI updates are ongoing, and additional work remains to document the Kaktovikmiut uses of the Coastal Plain; TLUI data in this EIS are current as of April 3, 2023.

north mountains; and a place with a story about a fish swallowing two kids. The latter is also reported in TLUI as having a Dene name of Saluksa[34].

- Reindeer herding— These are locations used during the early twentieth century for herding reindeer.
- Trading Posts—These are post-contact stores for trading between Euro-Americans and Kaktovikmiut.

Other sources of cultural resources information are the RS 2477[35] database, and the NOAA Wrecks and Obstruction database. The RS 2477 trail database identifies three RS trails (914, 1043, and 1649) in the program area. RS 914 is the Poker (Pokok) Lagoon Southeast Trail, a 5.5-mile winter trail near Pokok Lagoon; RS 1043 is the Bullen-Staines River Trail, a 22-mile tractor trail; and RS 1649 is the Tamayariak River-Simpson Cove Trail, a 20-mile tractor trail.[36] The NOAA database identifies two shipwrecks in the program area, one just off the northeast shoreline of Barter Island and a second in Camden Bay next to the POW-DEW Line site.

BOEM (2018) states that submerged pre-contact sites dating from between 20,000 and 3,000 years before present could exist in the offshore environment, depending on regional variation of the seafloor. While the extent of disturbance to submerged landforms is unknown, past research has suggested that areas near barrier islands, such as nearshore locations in the program area, could exhibit less ice gouging and have a greater potential for intact archaeological resources (Darigo et al. 2007). In 2013, although no cultural resources were identified, dated samples from geotechnical cores associated with offshore areas of the Liberty Project revealed moss and gastropod shell that support the suggestion that buried paleo-landforms exist in offshore areas of northern Alaska's continental shelf (Rogers 2014).

Locations of Previously Documented Sites

Due to the confidential and sensitive nature of cultural resource sites, no map is provided in this EIS; however, there are two main locations where cultural resources have been documented in the program area: on barrier islands and protected coasts of the Beaufort Sea and inland on elevated dry ground landforms, such as pingos, river terraces, and bluffs. For example, the river terraces on the Hulahula River have several documented sites, have been described in ethnographic interviews as a historic travel route for Iñupiat and Gwich'in trading and bartering, and have intensive subsistence use by people of Kaktovik today (USFWS 2015a). The combination of these cultural components (known sites, Indigenous trade and travel route, and subsistence uses) is one of the reasons that the USFWS has determined the Hulahula River suitable as a WSR with an outstandingly remarkable cultural value designation (see **Section B.4.7**, Wild and Scenic Rivers for more information). While pingos, bluffs, and river terraces, such as those along the Hulahula River, are the types of landforms on which inland sites have been found, one reason for this is because these

[34]Nielson (1977) identifies this as "Another reference name is Sallute, used by Indians. A legend is connected to this place in which two Indian kids got swallowed by fish."
[35]RS 2477 is found in Section 8 of the Mining Law of 1866 and states, "The ROW for the construction of highways over public lands, not reserved for public uses, is hereby granted." This statute granted states and territories ROWs over federal lands that had no existing reservations or private entries. In Alaska, this law effectively ended in 1969, but due to the time frame in which these ROWs were established (1866–1969), these highways, trails, and other ROWs are considered historical resources and are taken into consideration in this EIS (ADNR MLW 2013).
[36]The RS 2477 trails have been identified and asserted by the State of Alaska, but the validity of all RS 2477 trails must be determined either via a determination of perfection prior to the Federal Land Policy and Management Act or through appropriate judicial proceedings.

were the types of landforms focused on by Hall (1982) when he surveyed in the interior. Sites of greatest antiquity are found inland, as these landforms appear to have long periods of relative stability.

Documented coastal sites mostly date to after contact with Euroamerican and correspond to locations having the highest potential for human activity and where previous surveys have focused. Older sites along former shorelines are rare due to erosion caused by eustatic sea level, the dynamic coastal environment which appears to cause rapid displacement of sediments and soils through erosion, underlying permafrost thawing, and elevated sea levels (CCRS and NLUR 2012). Other undocumented sites are likely present in unsurveyed portions of the program area. Many of the sites in the program area were documented before the use of global positioning systems, so the reported locations of many sites may not be accurate. Based on a report by Reanier (2003) for sites documented along the Trans Alaska Pipeline System, the accuracy of site locations documented prior to the widespread use of GPS technology revealed that the average error in the AHRS locations was in excess of 200 meters and the greatest error for a single site exceeded two kilometers.

Place Names

Place names can provide information about natural and social environments as well as about human populations and their histories. Place names also provide insights into a culture's worldview and its perceptions of features of the environments it inhabits. Place names are a key component for identifying cultural resources in an area, as well as for establishing territorial range and means of travel throughout a traditional territory (Kari 2006).

Iñupiaq and Northern Athabascan place names, which include Gwich'in, have similar analyzable structures in that their place names are generally binomial in structure, consisting of generic and specific terms (Kari 1996; Müller-Wille 1990). Generic terms describe the geographic aspect of the name (*e.g.*, canyon, river, lake, ridge) and specific terms modify the generic term by emphasizing "shape and form" (*e.g.*, small, little, big, large, short) and "character" (*e.g.*, locational, situational) (Müller-Wille 1990; Kari and Fall 2003). Unlike Northern Athabascan place names, Iñupiaq place names can change over time (Burch 1981; Kari and Fall 2003). For the Iñupiat, "[n]ames are given to previously unnamed features, old names fall into disuse and are forgotten, and new names replace earlier ones," whereas for Northern Athabascans "places with forgotten names are left unnamed. New names are never coined by individuals, and Dena'ina [and other Northern Athabascan] places are almost never named after people" (Kari and Fall 2003). In their documentation of Gwich'in place names, Caulfield et al. (1983) state that place names are a source of traditional knowledge in that they can assist in the identification of important environmental resources or habitats (e.g., caribou migration routes, mineral licks, fish spawning areas), and understanding traditional land use patterns can assist in development of locally relevant, sensitive, and acceptable management practices.

Place names are frequently identified on maps as points, even though the place name may represent larger natural features such as creeks, rivers, lakes, ancestral and modern village sites, resource locations, or mountain ranges that extend for some distance. To capture locations with Indigenous place names within the program area, a 5-mile (8-km) buffer was used to identify geographic features and other locations that may intersect the program area but whose identifying points were outside of the program area. In addition to these place names, there are three locations outside of this 5-mile buffer that were specifically noted by the Gwich'in, including the Brooks Range (*Gwashral/Gwazhal*), Herschel Island (*Chuu Choo Vee*), and the Kongakut River (*Ch'ùhnjik*).

Based on place name sources identified for this SEIS, there are 126 Indigenous place names within the program area (**Table M-3**). A total of 122 are of Iñupiaq origin, four are associated with the Gwich'in, and one place has both Iñupiaq and Gwich'in designations. Iñupiaq place names are primarily located along the coastline but also include several inland placenames along the waterways including the following:

- 1st Fish Hole
- Akutoktak River ("food mixture of seal oil, caribou fat, and snow")
- Igilatvik Creek ("place where parts of a house are found")
- Katakturuk River ("a narrow place, many falls")
- Nularvik River ("camping place")
- Okerokovik River ("place where there is a blubber cache")
- Okpilak River ("no willows")
- Okpirourak Creek ("a few willows")
- Sadlerochit Spring / *Salliġutchich*
- *Sallitchit Iqaluitch* ("most northernly fish hole")
- *Sivugaq* ("first")
- *Uqsruqtalik* ("place with some oil")

One inland location represents the Niguanak Ridge which translates as "attempt to see animals."

Gwich'in place names include *Iizhik Gwats'an Gwandaii Goodlit* ("Sacred Place Where Life Begins"), *Łeerideedal* (Barter Island – "we meet" – a place where Gwich'in people traded with Iñupiat), *Chuu Choh Vee' Taii* (Huluhula River - "Shore of Big Water Trail"), *Sallute* (Collinson Point – associated with legend of two Indian kids who got swallowed by fish), and *Vyàhk'it Gwinjik* (Canning River – "Camping Areas Trail"). One Iñupiaq name of Itkilyariak Creek and Valley translates to "Indian's route."

Ethnographic Resources

Cultural aspects of the environment are not limited only to discrete locations where physical remains of past human activities are preserved, but they may also include culturally valued places, cultural use of the biophysical environment, such as religious and subsistence uses, and sociocultural attributes, such as social cohesion, social institutions, lifeways, religious practices, and other cultural institutions (National Preservation Institute 2018). These ethnographic resources are cultural or natural features of a region, where traditionally associated cultures have formed significant connections to the landscape. They are closely linked with their own sense of purpose, existence as a community, development as ethnically distinctive peoples, and survival of their lifeways.

Ethnographic resources are held as traditionally meaningful and may be sites, landscapes, structures, objects, or natural resources, such plants, animals, minerals, and bodies of water, that are assigned traditional legendary, religious, subsistence, or other significance in the cultural system of a group. The significance that cultures assigned to ethnographic resources may encompass both the tangible and the intangible aspects of these special places. These types of sites provide knowledge regarding places important to identity, spirituality, and, in the case of ethnographic landscapes, a broader more holistic way of viewing cultural resources within the natural setting that surround them.

Many terms are used by different groups to describe these ethnographic resources. Although not an exhaustive list, commonly used terms to describe the various types of ethnographic resources include the following:

- Traditional cultural places (TCPs)[37]
- Ethnographic landscapes
- Native American sacred sites
- Intangible cultural resources (e.g., oral traditions, Indigenous knowledge, traditional skills)

Traditional knowledge provided through oral histories and scoping testimonies is one avenue of identifying ethnographic resources. Such knowledge can be derived from oral histories and public testimony and can provide traditional knowledge that is both general, such as testimony on long-standing use of the arctic environment, or very specific, such as testimony about use of a specific family subsistence camp. Besides the NSB's TLUI program and some initial interview efforts associated with the Coastal Plain 2019 FEIS (Tritt 2018a; Tritt 2018b; James 2018; Gilbert 2018; Frank 2019a; Eric 2019a; Newman 2019; Eric 2019b; Tritt 2019; Frank 2019b; Keeney 2019), surveys and research to identify and document potential sacred sites, TCPs, ethnographic landscapes, or intangible resources have not been completed to date in the program area.

Kaktovikmiut have long recognized the area north of the Continental Divide to 62 miles (100 kilometers) offshore, including the entire program area, as *Iñuuniagviat Qaaqtuvigmiut*¸ or "Homeland of the Kaktovik Iñupiat" (City of Kaktovik and Karl E. Francis & Associates 1991). During the Coastal Plain 2019 FEIS process, Kaktovik commenters stressed the importance of residents being able to maintain, if not increase, their access to and management of traditional areas in the program area and broader Arctic Refuge. During initial interview efforts for the Coastal Plain 2019 FEIS, BLM documented traditional areas tied to the program area and broader Arctic Refuge with Kaktovik community members (Keeney 2019). Within the program area, common themes of traditional use that were conveyed to the BLM focused on subsistence, historic land use areas, and important natural features. Traditional subsistence areas include locations for hunting (caribou, waterfowl, moose, ptarmigan, wolverine, seal), fishing, trapping (ground squirrel), and berry picking. Historic locations included a number of old sod houses, cabins, graves, ice cellars, old boats, and camp sites, man of which remain in use today. Natural features that were highlighted during the interviews included hot springs, ice bridges, lookouts, and places with wind breaks or other natural features conducive to shelter and resting. Locations to which Kaktovik residents access through the program area that are located in the Brooks Range include sheep, wolverine, caribou, and wolf hunting areas, trout fishing locations, and several camps and cabins. While not an exhaustive effort to document ethnographic resources, these initial 2019 interviews demonstrated the deep cultural connection that the Kaktovikmiut have to *Iñuuniagviat Qaaqtuvigmiut* within the program area and surrounding locations.

During the scoping process for the SEIS, commenters, particularly the Gwich'in in Arctic Village and Venetie, expressed the importance of investigating TCPs in the program area. They commented that there should be an emphasis on consultation with local tribal governments and organizations, nongovernmental agencies, and other interested parties. Broadly speaking, it is evident that the program area is held as sacred by many of the Gwich'in, particularly for those residing in Arctic Village and Venetie. They identify the

[37]The original National Register Bulletin 38 referred to traditional cultural properties. Recent guidance by the National Park Service in their revised National Register Bulletin 38 has adopted the term traditional cultural places

Coastal Plain as *Iizhik Gwats'an Gwandaii Goodlit,* "The Sacred Place Where Life Begins" (Gwich'in Steering Committee 2004). They hold it sacred because it is where life begins, particularly for its association with caribou calving and bird nesting grounds. It encompasses all aspects of the environment and is integral to the Gwich'in and their sense of self (see **Section B.4.4**, Sociocultural Systems). The Gwich'in have also identified a Sacred Site under Executive Order 13007 that exists within the program area. As the surface manager, USFWS is working with the Gwich'in regarding this Sacred Site within the program area (see below).

During the 2019 EIS public comment period, the Native Village of Venetie Tribal Government, a cooperating agency, identified preliminary landscape characteristics associated with the *Iizhik Gwats'an Gwandaii Goodlit,* and initial interview efforts to document the cultural importance of the *Iizhik Gwats'an Gwandaii Goodlit* during the original EIS effort provided further insight into the characteristics that make this place sacred to the Gwich'in. The following provides the landscape characteristics and example quotes from the interviews that provide further documentation of these characteristics*:*

- Cultural traditions—Gwich'in cultural practices have influenced the development of the *Iizhik Gwats'an Gwandaii Goodlit* in terms of land use, patterns of land division, stylistic preferences, and the use of materials, as follows:
- The cultural identity of the Gwich'in as the "Caribou People," which is intertwined with the Porcupine Caribou Herd calving areas
  - *This land we live on, we have a lot of respect for it. Here in Arctic Village, in Venetie and Fort Yukon, they call us Caribou people.* (Gilbert 2018)
  - *The Sacred Place Where Life Begin, we really need to take care of that place. Our survival depend on it. The caribou come from that area and that's we use and rely on. We want to protect the calving grounds.* (James 2018)
- Ancestral and historic trade with Iñupiat at places along the coast
  - *Yes. Long ago, before any contact with the outside world – the bow and arrow days. The Brooks Range…the other side is Inupiaq and this side is Gwich'in. Our people used to go over the Brooks Range. In our language, it's called Gwashrał. Our people go over the Brooks Range to the Eskimo people. They bring gifts for the Eskimos and bring prayer. They pray when they go up and when they come back. They don't hide their campfire – that way they [Inupiaq] know people are coming. If they hide their campfire, they [Inupiaq] would think the Gwich'in were sneaking up on them intending war. It's the same way with both sides. Once place there is a hill – that's where they trade stuff…its either at Spring Creek or East Fork.* (James 2018)
- Occasional battles and peaceful conflict resolution with Iñupiat
  - *We always give each other gifts. We're always happy to see them but if they sneak over and attack, then we fight back and if we do that to them, they'll do that too. That's gonna create war other than that we always been good friends. One time, they came here, they were having a potlatch for them. All of a sudden, they attacked us. They beat us because we didn't expect it. Our people were busy cooking and caught off guard. The ones that survived followed them back up and got even with them. There's a story about it. They didn't just have war for nothing – they didn't hate each other. They used to say nihdlii – It means if you have a friend on the other side. It can be with Koyukon, Eskimo, Salvii, Shashoni, Cree.* (James 2018)

- Ancestral and historic camping, hunting, and traveling
  - *My grandpa never did talk much about that, Elijah Henry, but in -- about talking to earlier, that Elijah Henry walked from Arctic Village up to Kaktovik, and – and those -- Kaktovik, they got more white man contact at that time, and the only reason he goes Kaktovik is to get some ammo. And ammo, you know, they got to have that -- shells at that time. They -- and they -- he goes way up there in the summertime, come back before fall, and got enough ammo to carry him through the winter.* (Tritt 2019)
- Avoidance of the area in modern times to reduce the chances of disrupting caribou calving and waterfowl nesting and to ensure future successful harvesting and preservation of the Gwich'in culture
  - *Yeah, you're not supposed to….disturb. Disturb animal when they're having a calf, just like, for instance, moose, too. They got certain cliques they having some, like swampy place, you know. Moose always do those thing. Just like -- just like those past elder around here, they always say that -- always protect that animal where they have little one. They always had that little one the same place, too.* (Frank 2019b)
- Circulation—Ancestral Gwich'in followed rivers to facilitate travel in the *Iizhik Gwats'an Gwandaii Goodlit* and to connect the landscape with the larger region. They used some of these travel routes for trade.
  - *The Hoola River. My father [Isaac Tritt], and Grandfather Albert [Tritt] went up there. My dad talk about it when he was young. When they arrive up there, he said he admired the Eskimos. They live a tough life but still they are very happy. There's lots of animals up that way – caribou, sheep, fish, seal, whale…everything. The Eskimos use to come down this way too.* (Tritt 2018b)
- Archaeological sites—Ancestors of the Gwich'in and Iñupiat created these sites as a result of their shared use of the program area. Many of the documented sites are along rivers that ancestral Gwich'in followed to access the program area. The ancestral Gwich'in-derived sites contribute to the significance of the *Iizhik Gwats'an Gwandaii Goodlit.*
  - *They go up this way [motions on map]. This is where they go to get stuff they need. They go down towards Kaktovik. Only the men would make this trip using dogs with dog packs. The women and children stayed behind. They made this trip many times. My grandpa, Gilbert, used to make this trip too.* (Gilbert 2018)

Also evident in the interviews, was the profound respect that Iñupiat and Gwich'in hold for natural resources (e.g., caribou, fish, plants, rivers, views) and their importance to their culture. While the SEIS characterizes natural, cultural, and human use qualities of the program area in different sections, it is clear that the Indigenous perspective is expressed in a manner that braids and intertwines all of these topics. For this SEIS, additional Indigenous knowledge and perspective is included in **Section B.4.3** and **Section B.4.4**. Further efforts to describe the process for consulting, identifying, and documenting these types of ethnographic resources that the Iñupiat and Gwich'in hold as culturally important would be addressed in accordance with the Section 106 process and other relevant cultural resource regulations (e.g., Executive Order 13007 - Indian Sacred Sites).

In September 2023, the USFWS received a letter from the sovereign governments of the Native Village of Venetie Tribal Government, Arctic Village Council, and Venetie Village Council (the Tribes) informing the agency that the Tribes have identified the core Porcupine Caribou Herd calving grounds as a Sacred

Site under Executive Order (EO) 13007 Indian Sacred Sites. This area is also the traditional homelands of the Iñupiat, who have used these lands for generations and consider it as sacred. Due consideration is being given to the significance that the Inupiat and Gwich'in Tribes place on this area.

The Gwich'in Tribes informed the USFWS that the Porcupine Caribou Herd Calving Grounds Sacred Site is one part of the *Iizhik Gwats'an Gwandaii Goodlit* (Sacred Place Where Life Begins). The Tribes identified the Porcupine Caribou Herd Calving Grounds (approximately 1,595,259 acres) using BLM's "Seasonal Distribution of the Porcupine Caribou Herd May 26 – June 10 Calving Period" for cows and calves based on 37 years of data. More specifically the identified sacred site corresponds to federal lands within the area where ≥40-percent of cows and calves are present during a two-week window for calving.

EO 13007 defines a "sacred site" to mean "any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion; provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site."

The USFWS acknowledges the Gwich'in Tribes' sacred site submission concerning the Porcupine Caribou Herd Calving Grounds. The extent to which this area overlaps with areas proposed for leasing is considered for each action alternative in **Section 3.4.2**, Cultural Resources as well as **Sections 3.4.3**, Subsistence Uses and Resources and **3.4.4**, Sociocultural Systems.

Transboundary Cultural Ties

In addition to the cultural ties of the Iñupiat and Gwich'in in Alaska to the program area, traditional knowledge and other forms of documentation have identified the cultural connections and ties of the Inuvialuit and Gwich'in in Canada to the program area. Long before the creation of an arbitrary US/ Canada border, the ancestors of the Inuvialuit used the Arctic Coastal Plain. Many continue to maintain connections with, and have family ties to, the Iñupiat in Alaska. While researchers tend to focus on cultural uses of land in either country, plenty of examples describe cultural and contemporary ties between the Inuvialuit and Iñupiat traveling along the coast between the two countries (e.g., Milton Freeman Research Limited (1976) and the Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee (2018).

In Alaska, SRB&A (2010) also documented these ties during their subsistence mapping project in Kaktovik. The Vuntut Gwich'in in Canada also recognize the ethnographic resource of the *Iizhik Gwats'an Gwandaii Goodlit* as being an important sacred resource for their people (Vuntut Gwich'in Government 2017). Additional details related to sociocultural and subsistence values and connections to the *Iizhik Gwats'an Gwandaii Goodlit* by the Gwich'in are identified in **Section B.4.3** and **Section B.4.4**.

Climate Change

As identified in the GMT2 Final SEIS (BLM 2018a) and 2012 NPR-A Final IAP/EIS (BLM 2012), cultural resources on the North Slope are susceptible to climate change effects of erosion, mass wasting, melting

permafrost, and cryoturbation.[38] These effects result in increased thawing and lack of preservation of frozen artifacts. They can also cause a loss of spatial relationships between cultural levels, leading to disturbances in site integrity and context. Erosion (particularly along the coast) and melting permafrost can worsen the effects of wind erosion, cryoturbation,[39] and solifluction[40]; however, impacts from climate change are not universal across Arctic Alaska, and in some places, cultural resources may not be as affected (e.g., coastal accretion instead of erosion) or experience noticeable changes. A USACE survey of coastal sites that included locations in the program area (Grover and Ryder 2011) found that while coastal erosion is widespread, it is not uniform. Rather it depends on the geomorphological characteristics of the site location and the coastal dynamics at play.

B.4.3 Subsistence Uses and Resources

Affected Environment

This section summarizes the relevant subsistence activities of communities that use the program area or the wildlife that migrates through the program area and are harvested elsewhere. For the purposes of this analysis, there are four primary subsistence study 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 subsistence species that use the program area. In addition, because of the importance of the program area to caribou—particularly the Porcupine Caribou Herd and Central Arctic Herd —this section also includes relevant data on subsistence uses of caribou by 22 Alaskan communities, including the four subsistence study communities listed above, in GMU subunits in the Porcupine Caribou Herd and Central Arctic Herd herd ranges, which have Federal Subsistence Board customary and traditional[41] use determinations for caribou (**Map 3-45**, Coastal Plain SEIS Subsistence Study Communities, in **Appendix A**). In this EIS, these communities are referred to as the caribou study communities. Many of these caribou communities, such as Fort Yukon, Chalkyitsik, Wiseman, Beaver, Circle, Birch Creek, and Stevens Village, have reported geographic and/or cultural ties to the Arctic Refuge as a whole (USFWS 2015a). The primary subsistence study communities and caribou study communities include all nine Alaskan Gwich'in communities (Arctic Village, Beaver, Birch Creek, Canyon Village [see Fort Yukon], Chalkyitsik, Circle, Eagle Village [see Eagle], Fort Yukon, and Venetie). These Alaskan Gwich'in communities have a strong cultural and subsistence connection to the Arctic Refuge because of their high reliance on the Porcupine Caribou Herd, historic uses of the Arctic Refuge, and their view of the Arctic Refuge as sacred ground. See Section B.4.2, Cultural Resources for additional information on a sacred site defined by the Gwich'in per EO 13007.

Additionally, Gwich'in, Inuvialuit, and other user groups in Canada have cultural, historical (i.e., anytime in the past), and subsistence ties to the Arctic Refuge or the Porcupine Caribou Herd or both. According to the Agreement Between the Government of Canada and the Government of the United States of America

[38]Refers to the mixing of materials from various horizons of the soil down to the bedrock due to freezing and thawing. Occurs to varying degrees in permafrost soils.
[39]The mixing of materials from different soil horizons due to periodic freezing and thawing, namely those of active layer sediments that overlie permafrost
[40]The downslope movement of soil as it thaws
[41]Customary and traditional use, based on federal definitions (50 CFR 100.4), means a long-established, consistent pattern of use, incorporating beliefs and customs that have been transmitted from generation to generation. This use plays an important role in the economy of the community. Where the Federal Subsistence Board has made a customary and traditional use determination regarding subsistence use of a specific fish stock or wildlife population (50 CFR 100.24), only those Alaskans who are residents of rural areas or communities designated by the board are eligible for taking of that population or stock on public lands for subsistence uses.

on the Conservation of the Porcupine Caribou Herd, "when evaluating the environmental consequences of a proposed activity, the Parties will consider and analyze potential impacts, including cumulative impacts, to the Porcupine Caribou Herd, its habitat and affected users of Porcupine Caribou" (Section 3(g)). Canadian uses of the Porcupine Caribou Herd and other subsistence species relevant to the program area are addressed under the section below, *Transboundary Subsistence Uses*.

Additional associated information relevant to subsistence is in **Section B.4.4**, Sociocultural Systems, which addresses cultural history, social and political organization, mixed cash/subsistence economy, and belief systems; **Section B.4.2**, Cultural Resources, addresses prehistory/history, archaeological sites, and traditional land use sites.

Subsistence Definition and Relevant Legislation

Subsistence is a central aspect of rural life and culture and is the cornerstone of the traditional relationship of the Indigenous people with their environment. Residents of the study communities rely on subsistence harvests of plants and animals both for nutrition and for their cultural, economic, and social well-being. Activities associated with subsistence—processing, sharing, redistribution networks, cooperative and individual hunting, fishing, and gathering, and ceremonial activities—strengthen community and family social ties, reinforce community and individual cultural identity, and provide a link between contemporary Natives and their ancestors. These activities are guided by traditional knowledge, based on a long-standing relationship with the environment. More than just food, subsistence includes economic, social, cultural/traditional, and nutritional elements. In their *Proclamation to Achieve Subsistence Rights and Protection of Native Cultures,* the Alaska Federation of Natives AFN (2012) describes Native subsistence uses as follows:

> *We are the People of the Land. The essence of our being and our way of life---from the whale hunters of the Arctic to the fishers along the coasts and rivers of our state---is derived from our land and the sea. We are dependent on our hunting, fishing and gathering values and practices. Our ancestors developed distinctive cultures around our subsistence economies that have sustained Alaska Natives for thousands of years. It is a way of life and set of values that we are determined to maintain for our future generations. In the face of changes brought to our world throughout the last century, with and without our consent, Alaska Natives have remained committed to our traditions.*

The study communities participate in a rural economic system called a "mixed, subsistence-market" economy, wherein families invest money into small-scale, efficient technologies to harvest wild foods (Wolfe 2000). The combination of subsistence and commercial-wage activities provides the economic basis for a way of life that is highly valued in rural communities of Alaska, and subsistence harvests are an important source of food (Wolfe and Walker 1987).

The program area is almost entirely on federal lands managed by the USFWS; Alaska Native allotments comprise about 900 surface acres. Subsistence management by federal land managers in Alaska is carried out according to regulations issued (DOI regulations regarding the take of fish and wildlife on public lands are found at 50 CFR Part 100) in accordance with ANILCA Title VIII. One of Congress' primary intents in passing ANILCA included providing the opportunity for rural residents engaged in a subsistence way of life to continue to do so (ANILCA Section 101(c) and Section 303 (2)(B)(iii)). Subsistence uses are defined in ANILCA as:

> *…the customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade.* (ANILCA Section 803)

ANILCA recognizes that the continued opportunity for subsistence uses on public lands is essential to Native physical, economic, traditional, and cultural existence, and to non-Native physical, economic, traditional and social existence (ANILCA Section 801). In recognizing the importance of Native and non-Native rural residents' subsistence needs, ANILCA established a rural priority for the subsistence uses of fish and wildlife over other consumptive users in times of scarcity (ANILCA Section 802).

Subsistence hunting, fishing and trapping in the Refuge is regulated under a dual management system by the Federal government and the State of Alaska. These management systems sometimes overlap, depending on where and when the harvest occurs. Subsistence hunting, fishing and trapping on federal public lands (including the Refuge) is regulated under a dual management system by the Federal government and the State of Alaska, which sometimes overlap, depending on where the harvest occurs. Subsistence activities on all lands in Alaska, including private lands, are subject to state or federal subsistence regulations, with fish and wildlife harvesting on corporation-owned land and Native allotments being managed by the State. See USFWS (2015a) for a more in-depth discussion of subsistence management in the Arctic Refuge.

In addition to state and federal management of subsistence activities, the study communities practice their own form of wildlife management which is based upon generations of Indigenous knowledge. Indigenous communities recognize that protecting the health and abundance of wildlife resources is essential to their cultural survival. Many Indigenous ethics and values are based on this concept and include not harvesting more than one needs; sharing one's harvest and respecting the animals to ensure future success; and waiting for the first of a caribou herd to pass by the community before hunting from the herd.

Overview of Subsistence Uses

The following sections provide a brief overview of subsistence uses for the four study communities, in addition to *Alaskan Subsistence Uses of the Porcupine Caribou Herd and Central Arctic Herd* and *Transboundary Subsistence Uses*, below. Additional subsistence data tables are provided in **Appendix N**, and maps are provided in **Appendix A**. Other sources provide additional descriptions of subsistence or contain data that are relevant to subsistence but are not directly comparable to the information in this section, such as reported versus estimated harvests and Native households versus all households. These sources include the USFWS (2015a, Section 4.4.4), which provides a detailed description of subsistence uses in the Arctic Refuge, and the NSB census reports and community plans (e.g., NSB 2015a, 2015b), which includes subsistence data that focus on Native households and selected resources.

Kaktovik

Kaktovik residents are the primary subsistence users of the program area, which crossed much of the community's traditional and contemporary area of subsistence use (**Map 3-46**, Kaktovik Subsistence Use Areas, in **Appendix A**). Kaktovik use areas from the two previous comprehensive all resources mapping studies show overlap with the program area; for the most recent period (1996 to 2006), the data show the greatest amount of overlapping use areas in the program area occurring along the coast, between Beaufort Lagoon and Brownlow Point, and inland around the Sadlerochit, Hulahula, and Jago Rivers. In addition,

high levels of overlapping subsistence use areas occur offshore from the program area in the Beaufort Sea. All respondents (38 active harvesters) (SRB&A 2010) reported 1996 to 2006 subsistence uses in the program area.

Kaktovik use areas overlap with the program area for the following categories of subsistence species: terrestrial mammals (including caribou, moose, grizzly bear, and Dall sheep), furbearers and small land mammals, fish, birds (including geese and eiders), vegetation, and marine mammals (including bowhead whale, beluga whale, seal, walrus, and polar bear) (**Map 3-47**, Kaktovik Caribou Subsistence Use Areas in Coastal Plain, through **Map 3-57**, Kaktovik Polar Bear Subsistence Use Areas in Coastal Plain, in **Appendix A**). The primary inland subsistence uses for Kaktovik in the program area are caribou, furbearer, and grizzly bear hunting, in addition to limited moose hunting, vegetation gathering, and fishing in select locations along rivers. The primary coastal subsistence uses that overlap the program area are fishing, harvesting vegetation, and hunting for caribou, geese, eider, and bearded and ringed seals in nearshore areas. Offshore areas are used primarily for hunting bowhead whales, with more limited walrus hunting.

The timing of subsistence activities in Kaktovik is depicted in **Table N-4** in **Appendix N**. Subsistence activity, in terms of the number of species categories targeted, is highest during the late summer/fall, when residents hunt bowhead whales in addition to targeting caribou, moose, fish, waterfowl, and plants and berries. April is another busy time, when geese arrive in the area and are harvested along the coast and inland. The fewest species categories are targeted from December through February, although some residents pursue inland resources, such as furbearers, moose, caribou, and freshwater fish during this time, frequently at inland locations.

Kaktovik residents access much of their subsistence use areas along the coast using boats, while inland travel is limited exclusively to four-wheel vehicles along coastal locations in the summer/fall and large overland areas by snowmachine in the winter (**Table N-5** in **Appendix N;** SRB&A 2010). Inland travel during the snow-free months has historically been limited due to USFWS restrictions on off-highway vehicle (i.e., ATV) access in the Arctic Refuge; the USFWS is currently reviewing whether these are established traditional uses by the community of Kaktovik and therefore allowable in the Refuge. The Kaktovik Comprehensive Plan for 2021-2041 lists restrictions on summer hunting activities, including lack of year-round access to the mainland in the Refuge, as current community weaknesses (NSB 2021a). Residents also walk or use vehicles to access subsistence use areas on Barter Island. The program area, which includes coastal, nearshore, and inland subsistence use areas, is accessed using boats and snowmachines, with some inland travel from the coast by four-wheel vehicles.

As shown in **Table B-16**, based on years with available data, Kaktovik residents harvest an annual average of 588 pounds of subsistence foods per capita. Marine mammals are the primary resource harvested in terms of edible weight, contributing over 60 percent toward the community's subsistence diet. Large land mammals are the second-most harvested resource by edible weight, followed by fish other than salmon and migratory birds. During most years, the primary subsistence species harvested by Kaktovik residents (**Table N-3** in **Appendix N**) are bowhead whale, caribou, Dolly Varden, Arctic cisco, beluga whale (during some years), bearded and ringed seal, Dall sheep, geese, and moose.

Table B-16
Selected Kaktovik Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All resources	588	100.0	99	92	83	98
Salmon	1	<1	16	5	6	12
Non-salmon fish	57	10.1	87	70	53	72
Large land mammals	176	24.7	97	68	60	93
Small land mammals	1	<1	45	41	21	22
Marine mammals	318	62.7	93	72	61	91
Marine invertebrates	<1	<1	1	1	0	1
Migratory birds	12	1.9	80	63	45	65
Upland game birds	3	<1	80	60	42	47
Bird eggs	<1	<1	9	6	5	6
Vegetation	1	<1	49	38	15	36

Sources: 1985, 1986 (ADFG 2018c); 1992 (Fuller and George 1999); 1992 (Pedersen 1995a); 1994-95 (Brower et al. 2000); 2000-01, 2001-02 (Pedersen and Linn 2005); 2002-03 Bacon et al. 2009); 2007-2012 (Harcharek et al. 2018); 2010-11 (Kofinas et al. 2016)
Note: See **Tables N-1, N-2,** and **N-3** in **Appendix N** for data by study year.

Over 90 percent of Kaktovik households participate in one or more subsistence harvesting activities, with over two-thirds of households participating in marine mammal hunting, fishing, and large land mammal hunting. Sharing is a central aspect of Kaktovik subsistence. A recent BOEM-funded study on sharing networks documented Kaktovik households giving an average of 3.1 and receiving 4.5 core species (identified by Kofinas et al. [2016] as being harvested in the greatest quantity, having the most cultural importance, and being representative of a range of resources). Specifically, caribou was the second-ranked core species (after bowhead whale), followed by Dolly Varden, both of which are harvested frequently within the program area. Other core species which are harvested in the program area included Dall sheep and geese. Kaktovik is unique among coastal North Slope communities for their regular harvests of Dall sheep, which are facilitated by the closer proximity of the Brooks Range to the coast in this region. In fact, Kaktovik are the only indigenous people to hunt both bowhead whales and Dall sheep (Harcharek 2018).

For caribou, sharing relations extended across the North Slope (Nuiqsut, Anaktuvuk Pass, Atqasuk, and Utqiagvik) in addition to other regions of Alaska and even other countries. Dolly Varden was also shared widely across the state. Other subsistence foods (geese, Dall sheep) were shared primarily within the community during the documented study year (Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016). The sharing networks documented in Kofinas et al. (2016) include flows into and out of the community. While Kaktovik households share widely to other North Slope and Alaskan communities, they also receive subsistence foods from other communities; often, these relationships are reciprocal. In the case of caribou, the primary outside sources were Nuiqsut, Barrow, and Anaktuvuk Pass. Kaktovik households also received marine mammals (for example, bowhead whale, bearded seal) and Dolly Varden from households in other communities. The study found that during a single year, 176,577 pounds of subsistence foods flowed between Kaktovik households. In addition to food, sharing was in the form of labor, money/equipment, and other contributions. Sharing networks extend across nearly all regions of Alaska and to other states (Kofinas et al. 2016). Sharing not only serves to distribute food throughout a community, but "social relations in the form of cooperation and sharing persist and may act as sources of resilience for community households" (Kofinas et al. 2016); thus, sharing is a crucial part of social structure, social ties, and resiliency in Alaska Native communities.

An analysis of resource importance, based on material (percentage of total harvest) and cultural (percentage of households harvesting and percentage of households receiving), is provided in **Table N-6** in **Appendix N** (see USACE [2012] for a description of the method used). Based on this analysis, resources of major importance in Kaktovik are bearded seal, Bering cisco, bowhead whale, caribou, Dall sheep, Dolly Varden/Arctic char, ptarmigan, and wood. In addition, resources of moderate importance in Kaktovik are various species of fish (Arctic cisco, Arctic grayling, broad whitefish, lake trout, saffron cod), waterfowl (Canada geese, common eider, king eider, white-fronted geese, snow geese, and long-tailed duck), marine mammals (beluga, polar bear, walrus), terrestrial mammals (fox, wolf, wolverine, moose, and muskox), and vegetation (cranberries, blueberries, and salmonberries).

Nuiqsut

Nuiqsut is west of the program area, and although Nuiqsut has limited direct subsistence uses of the program area, Nuiqsut residents harvest wildlife that migrates through the area (**Map 3-58**, Nuiqsut Subsistence Use Areas, in **Appendix A**). For the most part, Nuiqsut subsistence users utilize lands west of the Prudhoe Bay area, although many of the lands in the area were traditionally used by Nuiqsut people. In addition, the community's whaling grounds are based out of Cross Island and whaling sometimes extends offshore of the program area. As shown in **Map 3-59**, Nuiqsut Whales Subsistence Use Areas in Coastal Plain, **Map 3-60**, Nuiqsut Seal Subsistence Use Areas in Coastal Plain, and **Map 3-61**, Nuiqsut Wolf and Wolverine Subsistence Use Areas in Coastal Plain, in **Appendix A**, Nuiqsut use areas overlap the program area for marine mammals (bowhead whale and ringed/bearded seal; three mapping studies) and furbearers (wolf and wolverine; one mapping study).

For the most recent period for which information is available (1995 to 2006), bowhead whale and seal use areas overlap the program area in nearshore areas east of Flaxman Island. More recent data for the 2014 time period provide use areas for marine mammals as a whole (Brown, Braem, Mikow, Trainor, Slayton, Runfola, Ikuta, Kostick, McDevitt, Park, and Simon 2016). These use areas occur within the 1995-2006 use areas described above, but not as far east. Cross Island whaling crews travel beyond Flaxman Island during certain years, depending on ice conditions and the availability of whales. During certain years, whaling crews have reported disturbances in their hunting area from vessel traffic and seismic activity. A wolf and wolverine hunting area, likely reported by a single hunter, was documented extending overland from Nuiqsut's core hunting area and crossing the Sadlerochit, Hulahula, and Jago Rivers. Use areas overlapping the program area were reported by four Nuiqsut respondents (12 percent; SRB&A 2010). Nuiqsut residents harvest caribou primarily from the Teshekpuk Herd and the Central Arctic Herd, which sometimes passes through the program area before heading west toward the Colville River delta. Nuiqsut is located on the periphery of the Teshekpuk Herd and Central Arctic Herd ranges, making the community's annual harvest success somewhat vulnerable to changes in herd migration and distribution (SRB&A 2019b). Nuiqsut harvesters have reported a decrease in large caribou migration events within the Colville Delta, and many attribute this to oil and gas development east of the Colville River (SRB&A 2018b).

Data on the timing of Nuiqsut subsistence activities are depicted in **Table N-9** in **Appendix N**. August and September are the peak of hunting and harvesting in Nuiqsut, when residents station whaling crews at Cross Island, hunt moose and caribou, and harvest fish. October/November is a crucial time for subsistence in the community, when residents set nets for Arctic cisco (*qaaktak*) as they run upriver. These *qaaktak* are the same that originate in the Mackenzie River delta and migrate west along the coast, passing by the program area, before arriving at their destination in the Colville River delta.

Winter activities are limited primarily to furbearer and caribou hunting, with some fishing through the ice. Residents travel by snowmachine and boat during the spring to hunt waterfowl and then travel offshore and inland during the summer by boat to hunt seals and caribou, set nets for broad whitefish, fish for grayling and Dolly Varden, and harvest berries. Boats are the most commonly used method of transportation for Nuiqsut subsistence activities, although snowmachines are necessary for inland pursuits, such as wolf and wolverine hunting and geese hunting (**Table N-10** in **Appendix N**). In recent years, all-terrain vehicles and trucks have become more commonly used during the summer and fall, when residents hunt caribou to the west of the community (SRB&A 2017b).

As shown in **Table B-17**, based on years with available data, Nuiqsut residents harvest an annual average of 679 pounds of subsistence foods per capita. Marine mammals, large land mammals, and fish other than salmon contribute nearly equal amounts toward the subsistence harvest, although bowhead whaling success often determines the relative contribution of other species (**Table B-17**, and **Table N-7** in **Appendix N**). During most years, the primary subsistence species harvested by Nuiqsut residents (**Table N-8** in **Appendix N**) are bowhead whale, caribou, Arctic cisco, broad whitefish, bearded and ringed seal, white-fronted geese, and moose.

One hundred percent of Nuiqsut households report using subsistence foods, and 95 percent participate in one or more subsistence harvesting activities, with over two-thirds of households participating in harvests of fish other than salmon, large land mammals, and migratory birds. Household participation in bowhead whale hunting is relatively limited, due to the substantial distance of the whaling site (Cross Island) from the community and the required absence from the community. Nuiqsut residents consider sharing to be central to their identity; the bowhead whale hunt, in particular, centers on sharing, as evidenced by the 97 percent of households who receive bowhead whale meat annually.

Table B-17
Selected Nuiqsut Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All resources	679	100.0	100	95	93	98
Salmon	5	<1	65	43	31	35
Fish other than salmon	209	30.6	97	81	81	79
Large land mammals	224	32.6	96	77	77	78
Small land mammals	<1	<1	45	41	17	12
Marine mammals	226	33.8	97	54	60	97
Migratory birds	13	2.3	85	78	58	52
Upland game birds	2	<1	54	48	36	15
Bird eggs	<1	<1	24	16	8	11
Vegetation	1	<1	61	52	19	33

Sources: 1985 (ADFG 2018c); 1992 (Fuller and George 1999); 1993 (Pedersen 1995b); 1994-95 (Brower and Hepa 1998); 1995-96, 2000-01 (Bacon et al. 2009); 2014 (Brown et al. 2016)
Note: See **Tables N-7** and **M-8** in **Appendix N** for data by study year.

An analysis of resource importance, based on indices of harvest (percentage of total harvest), harvest effort (percentage of households attempting harvests), and sharing (percentage of households receiving), is provided in **Table N-11** in **Appendix N**. Based on this analysis, resources of major importance in Nuiqsut are Arctic cisco, Arctic grayling, bearded seal, bowhead whale, broad whitefish, burbot, caribou, cloudberry, white-fronted geese, and drift wood.

Arctic Village

Arctic Village is south of the program area, on the south side of the Brooks Range, along the East Fork Chandalar River. As shown in **Map 3-62**, Arctic Village and Venetie Subsistence Use Areas, in **Appendix A**, Arctic Village subsistence use areas do not overlap the program area; however, Arctic Village is on the Arctic Refuge boundary, so most subsistence activities do extend into the refuge. Subsistence uses farthest north toward the program area are sheep and caribou hunting and furbearer harvesting.

Caribou is the most important food source for Arctic Village and other northern Gwich'in and they refer to themselves as the "Caribou People" (see **Section B.4.4**). The majority of Arctic Village caribou harvests are from the Porcupine Caribou Herd. Caribou from the Porcupine Caribou Herd calve in the program area, and for this reason, it is considered sacred ground to the Gwich'in (USFWS 2015a) (**Section B.4.2**). The program area is also considered sacred by many Gwich'in because it is a nesting ground for various species of migratory birds which are harvested by Gwich'in residents. Arctic Village residents, in addition to other Gwich'in, therefore view protection of the Coastal Plain as the utmost priority to ensure the survival of their people. Further discussion of the cultural and historic importance of the Arctic Refuge to the Gwich'in is provided in **Section B.4.2** and **Section B.4.4**.

Subsistence harvesting by Arctic Village residents generally occurs on their lands or in the Arctic Refuge south of the program area. Key harvesting locations are Old John Lake, the Chandalar, Sheenjek, Junjik, and Wind rivers, and Red Sheep Creek (USFWS 2015a). The Gwich'in have historic and cultural ties to lands farther north, and a number of Gwich'in place names occur within the Arctic Refuge, including *Iizhik Gwats'an Gwandaii Goodlit* ("Sacred Place Where Life Begins") (**Section B.4.2**). In particular, Arctic Village residents have reported that their elders would periodically travel to the coast or to other areas to hunt or fish, or to meet and trade with the Iñupiaq inhabitants of the Coastal Plain. One Iñupiaq placename within the Arctic Refuge translates to "Indian's route" (**Section B.4.2**).

Data on the timing of Arctic Village subsistence activities are depicted in **Table N-14** in **Appendix N**. In terms of the number of species targeted, the fall and winter are the most active times for subsistence harvesters in Arctic Village. From August through October, residents target a variety of large land mammals, including caribou, moose, and Dall sheep, in addition to fishing and harvesting wood for the upcoming winter. The fall is particularly important for caribou hunting, as residents wait for caribou from the Porcupine Caribou Herd to migrate through their traditional hunting grounds after the Porcupine Caribou Herd has spent the spring and summer on the North Slope, including in the program area (USFWS 2015a). Caribou hunting continues through the winter as caribou are available, and residents also set traps during this time. The spring and summer are primarily dedicated to the harvest of waterfowl and fish.

Harvest data estimated for the community of Arctic Village are somewhat limited. Residents shared that this is associated with a general distrust by Arctic Village residents of outsiders and state and government officials. This is rooted in historic injustices against the Gwich'in, intergenerational trauma associated with centuries of colonialism, and a lack of respect by resource managers (Alliance for a Just Society and Council of Athabascan Tribal Governments n.d.).

While no systematic household surveys were conducted, Caulfield (1983) reports that during the 1981-82 period, Arctic Village residents reported harvesting between 300 and 400 caribou, substantially higher than reported estimates for other nearby communities, such as Venetie and Kaktovik. Based on data collected by the Council of Athabascan Governments (2003), 98.4 percent of Arctic Village households report

receiving and using moose or bear meat, and the same percentage of households report attempting to harvest these animals;[42] thus, participation in large land mammal hunting among Arctic Village households is high.

Forty-four moose were reported harvested by Arctic Village households in 2003. These CATG data (e.g., Council of Athabascan Tribal Governments 2002, 2003, 2005) are not estimated for the entire community or have low response rates. Because of this, they are not comparable to the more comprehensive surveys, which report estimated harvests for the community as a whole; however, the reported percentages demonstrate that moose and caribou are highly important to the subsistence harvest of Arctic Village. The USFWS (2015a) states that, based on reported harvests alone and not community-wide estimates, moose and caribou comprised more than 90 percent of the harvest by weight during harvest years in the 1990s and early 2000s.

Data that estimate harvests for the entire community are limited to less complex studies documenting harvests of migratory birds and fish. As shown in **Table B-18**, based on 3 years of limited data, Arctic Village residents harvested an average of 51 pounds of non-salmon fish per capita, and 6 pounds of migratory birds per capita. Scoters were the most commonly harvested migratory bird, followed by scaup, long-tailed ducks, mallards, and white-fronted geese. Whitefish, particularly humpback whitefish and broad whitefish, contributed the greatest amount to the non-salmon fish harvest, with Arctic grayling and northern pike also contributing substantial amounts (**Table N-13** in **Appendix N**).

An average of 70 percent of households use non-salmon fish (**Table B-18**), and half of Arctic Village households report harvesting fish other than salmon. Forty-six percent reported harvesting migratory birds during the 2000 study year and 87 percent used migratory birds (**Table N-12** in **Appendix N**).

Table B-18
Selected Arctic Village Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
Non-salmon fish	51	—	71	—	23	35
Migratory birds	6	—	—	—	—	—

Sources: 2000 (Andersen and Jennings 2001); 2001, 2002 (ADFG 2018c)
Note: See **Tables N-12 and N-13 in Appendix N** for data by study year.

While data on sharing subsistence foods are limited to fish, the strong sharing relationship between Arctic Village and its sister village of Venetie, with whom it shares ownership of tribal lands, has been documented (Kofinas et al. 2016). This relationship is particularly important because of the more limited availability of certain resources, such as moose in the Arctic Village area, in addition to the relatively limited availability of caribou in the Venetie area. Arctic Village and Venetie commonly share caribou, geese, ducks, salmon, Arctic grayling, moose, and berries (Kofinas et al. 2016).

Data to calculate resources of importance for Arctic Village are not available, as there have been no comprehensive household harvest surveys in that community; however, based on existing literature reviews and statements from community members during public scoping and elsewhere, the assumption is that

[42]Caulfield did not address caribou hunting in the study.

caribou are a resource of primary subsistence, economic, cultural, and spiritual importance for the community of Arctic Village (see **Appendix D** and **Appendix R**).

Venetie

Venetie is south of Arctic Village on the Chandalar River. As shown on **Map 3-62** in **Appendix A**, Venetie subsistence use areas do not overlap the program area. As with Arctic Village and other Gwich'in, Venetie residents consider caribou to be a primary food source and central to their cultural identity (see **Section B.4.4**). Subsistence harvesting by Venetie residents generally occurs on tribal lands surrounding their community and surrounding the Chandalar (including the East and Middle Forks), Yukon, Christian, and Hadweenzic Rivers (Caulfield 1983; Van Lanen et al. 2012). Caribou are primarily available to Venetie and Arctic Village residents along the upper Chandalar River drainage and the foothills of the Brooks Range (Van Lanen et al. 2012). As noted above under Arctic Village, the Gwich'in have strong historic, cultural, and subsistence ties to the Arctic Refuge, particularly due to its importance to the health and survival of the Porcupine Caribou Herd.

Data on the timing of Venetie subsistence activities are listed in **Table N-18** in **Appendix N**. In terms of the number of species targeted, the spring and fall are the most active times for subsistence harvesters in Venetie. Fishing and hunting of waterfowl, black and brown bears, and small land mammals (muskrats and ground squirrels) are common activities during April and May; these activities continue through the summer and into the fall. Berries are harvested also during summer and early fall. Fall is a peak time for harvesting salmon, as fall chum are the primary species targeted by Venetie residents (Brown et al. 2017a). As with Arctic Village, caribou hunting begins in the fall (generally August), when caribou from the Porcupine Caribou Herd begin their annual migration through Gwich'in hunting grounds in the north. Residents also hunt moose during the fall and continue to hunt both moose and caribou through the winter, along with trapping furbearers.

Data on subsistence harvests for Venetie are provided in **Tables N-15** through **N-17** in **Appendix N** and in **Table B-19**, below. Venetie data are limited to one comprehensive study of all subsistence resources for the 2009 study year, in addition to several years of data for migratory birds and land mammals. As shown in **Table B-19**, based on years with available data, Venetie residents harvest an annual average of 274 pounds of subsistence foods per capita. Large land mammals constitute approximately half of the subsistence harvest in terms of edible pounds. Also important are harvests of salmon, fish other than salmon, and migratory birds (Kofinas et al. 2016).

The primary subsistence species for Venetie residents are moose, caribou, chum and chinook salmon, grayling, geese, and whitefish. Ninety-nine percent of Venetie households report using subsistence foods, and 86 percent participate in subsistence activities. Over half of the households participate in harvests of large land mammals, fish other than salmon, and migratory birds. A recent BOEM-funded study documented Venetie sharing networks extending throughout the state, but with a focus on nearby interior communities, such as Arctic Village, Fort Yukon, Eagle, Chalkyitsik, Stevens Village, Beaver, and Birch Creek. Venetie residents also have sharing networks with multiple North Slope communities, including Utqiaġvik, Nuiqsut, and Anaktuvuk Pass (Kofinas et al. 2016). The study notes the importance of the close kinship ties between Venetie and Arctic Village as a source of resiliency, as caribou harvested in Arctic Village are often shared with Venetie, sometimes in exchange for other wild foods, such as salmon, which are less available in Arctic Village (Kofinas et al. 2016). Other commonly traded species include geese,

Table B-19
Selected Venetie Harvest and Participation Data, Average Across Available Study Years

Resource Category	Estimated Pounds Per Capita	Percent of Total Harvest	Percentage of Households			
			Using	Attempting to Harvest	Giving	Receiving
All Resources	274	100.0	99	86	—	—
Salmon	76	27.8	76	37	—	—
Non-Salmon Fish	25	9.0	81	67	—	—
Large Land Mammals	95	49.6	94	63	—	—
Small Land Mammals	12	4.2	56	44	—	—
Marine Mammals	0	0.0	18	0	—	—
Migratory Birds	27	7.4	79	57	—	—
Upland Game Birds	<1	<1	20	31	—	—
Bird Eggs	—	—	—	—	—	—
Vegetation	5	1.8	67	46	—	—

Sources: 2000 (Andersen and Jennings 2001); 2009 (Kofinas et al. 2016); 2008-09, 2009-10 (Van Lanen et al. 2012), 2010-11 (Stevens and Maracle, no date)
Note: See **Tables N-15**, **N-16, N-17** in **Appendix N** for data by study year.

ducks, moose, Arctic grayling, and berries (Kofinas et al. 2016). A study by ADF&G which documented bartering and customary trade networks in Venetie showed the greatest number of transactions for Chinook salmon, caribou, and moose, with Arctic Village a common trading partner (Brown et al. 2017a). Other key recent declines in chum and Chinook salmon returns have resulted in low harvests which may also affect customary trade associated with these species (Brown et al. 2017a). During the study year, Venetie caribou sharing relations occurred heavily between Arctic Village and Venetie, with additional sharing between Venetie and Birch Creek, Fairbanks, and Healy. The importance of caribou in Venetie sharing networks is evidenced by the 22,445 pounds of caribou that flowed between households (nearly half of all subsistence food flows).

An analysis of resource importance, based on harvest (percentage of total harvest), harvest effort (percentage of households attempting harvests), and sharing (percentage of households receiving), is provided in **Table N-19** in **Appendix N**. Based on this analysis, resources of major importance in Venetie are Arctic grayling, caribou, chinook salmon, chum salmon, and moose.

Alaskan Subsistence Uses of the Porcupine Caribou Herd and Central Arctic Herd

Harvest and sharing patterns of 22 Alaskan communities and seven Canadian user groups are relevant if on-the-ground oil and gas activities changes caribou availability or abundance for those users. **Map 3-45** in **Appendix A** shows the location of the 22 caribou study communities and communities associated with the seven Canadian user groups. Canadian uses of the Porcupine Caribou Herd are discussed below in *Transboundary Subsistence Uses*.

Table N-20 in **Appendix N** provides caribou use and harvest data for all of the 22 Alaskan caribou study communities, and **Table B-20** provides data averages for each study community across all available study years. The 22 Alaskan communities have documented customary and traditional uses for caribou in GMU subunits that are in the ranges of the Central Arctic Herd and Porcupine Caribou Herd. Ten of the 22 communities are in GMU subunits that overlap the range of the Porcupine Caribou Herd. They are Arctic Village, Kaktovik, Beaver, Birch Creek, Chalkyitsik, Circle, Eagle, Fort Yukon, Stevens Village, and Venetie. All but two of the 22 study communities (Eagle and Stevens Village) are in GMU subunits overlapping the range of the Central Arctic Herd; thus, for many communities, harvests reflected in

Table B-20
Selected Caribou Harvest and Participation Data, Caribou Study Communities, Average Across Available Study Years

Community	Per Capita Lbs	Percent of Total Harvest	Average Percentage of HHs			
			Using	Attempting to Harvest	Giving	Receiving
Alatna	67	39.3	83	57	34	69
Allakaket	32	-	72	38	21	59
Anaktuvuk Pass	250	84.0	94	66	50	68
Atqasuk	-	-	96	70	71	65
Arctic Village			No Data			
Utqiagvik	90	24.2	86	52	67	68
Beaver	0	0	0	0	0	0
Bettles	33	14.1	52	29	29	30
Birch Creek	0	0.0	27	2	15	23
Chalkyitsik	0	0	0	0	0	0
Circle	4	2.0	54	11	7.5	38
Coldfoot	33	85.3	75	50	50	50
Eagle/Eagle Village	16	6.8	62	56	37	35
Evansville	11	4.9	64	18	17	50
Fort Yukon	11	2.2	37	8	12	32
Kaktovik	118	20.3	96	66	56	87
Nuiqsut	156	29.9	97	76	74	77
Point Lay	169	24.2	94	68	67	75
Stevens Village	0	0.0	3	0	2	5
Venetie	26	19.1	74	21	39	56
Wainwright	193	29.5	97	64	62	84
Wiseman	40	20.9	80	80	60	20

Sources: (ADF&G 2023, SRB&A 2022)
Note: See **Table N-20** in **Appendix N** for data by study year

Table B-20 and **Table N-20** (in **Appendix N**) include some combination of Porcupine Caribou Herd and Central Arctic Herd caribou. In addition, some of these communities (e.g., Central, Eagle) harvest primarily from the Fortymile Caribou Herd (Trainor, McDavid, Park, Cold, and Koster 2020b).

With few exceptions, use of caribou among the 22 Alaskan study communities is high; over 50 percent of households in Bettles, Circle, Eagle, Evansville, Allakaket, Venetie, Coldfoot, Wiseman, Alatna, Utqiaġvik. Anaktuvuk Pass, Point Lay, Kaktovik, Atqasuk, Nuiqsut, and Wainwright use caribou. Less than 5 percent of households in Stevens Village, Beaver, and Chalkyitsik have reported using caribou during years when data are available. The contribution of caribou toward the total subsistence harvest is highest in the communities of Anaktuvuk Pass (84 percent) and Coldfoot (85.3 percent) and lowest in the communities of Fort Yukon (2.5 percent) and Evansville (4.9 percent).

Four communities reported zero harvests of caribou during available study years: Birch Creek, Stevens Village, Beaver, and Chalkyitsik. This is not to say that these communities do not attempt to harvest caribou, or that they do not harvest caribou in some years. In the case of Beaver, during a 2007 study residents indicated that the community once hunted caribou more regularly, but that caribou are rarely available within their hunting area in recent years (SRB&A 2007). Birch Creek residents have also reported a decline in caribou in their area (Park, Trainor, and Cunningham 2020). Some have attributed these changes to forest

fires north of their community, or to increased brush and vegetation. During the mapping study, one Beaver residents reported traveling to Arctic Village to hunt caribou with family in some years (SRB&A 2007).

While communities farther north (e.g., Nuiqsut, Kaktovik) hunt Porcupine Caribou Herd and Central Arctic Herd caribou in the Coastal Plain during the summer and early fall months (e.g., July, August, and September) (SRB&A 2010), communities farther south (e.g., Anaktuvuk Pass, Fort Yukon) generally must wait until the caribou begin their fall migration into their area (August through October, depending on the location of the community) or hunt them during the winter (Trainor, Cold, and Kostick 2020a, SRB&A 2013a). The location and methods used to hunt caribou varies by community. Summer hunting typically occurs by boat along coastal (Kaktovik) or riverine (Nuiqsut) areas. During the fall, caribou hunting continues to occur by boat along river channels (e.g., Fort Yukon, Nuiqsut) or in overland areas by ATV (e.g., Anaktuvuk Pass). During winter, residents travel primarily by snowmachine to access wintering caribou in large overland areas. Hunter success each year is largely dependent on the arrival of caribou at expected times in expected places. If the migration diverts from its normal route, residents' may have difficulty accessing the herds. As an example, Anaktuvuk Pass residents have reported reduced harvest success when the caribou do not travel through the mountain passes where residents traditionally hunt them. Residents have attributed the changes in caribou movement to sport hunters to the north of the community as well as along the Dalton Highway (SRB&A 2013a)

Caribou sharing ranges widely, with 0 percent receiving caribou in Beaver and Chalkyitsik during reported study years; between 5 and 28 percent of households receiving caribou in Stevens Village, Wiseman, Birch Creek, and Fort Yukon; and at least 30 percent of households receiving caribou in the remaining study communities. As discussed above, sharing of caribou between communities and regions is extensive, and some communities rely on these sharing networks as a primary source of caribou. For communities with more limited access to caribou herds, sharing can be particularly important. For example, during a recent harvest study in Fort Yukon, only five percent of households reported harvested caribou; however, 44 percent of households reported using caribou in that year (Trainor et al. 2020a). In Fort Yukon, caribou hunting requires traveling substantial distances and is therefore only feasible for certain households who have the means to do so. As noted above (Arctic Village, Venetie), many Alaskan Gwich'in are highly reliant on the Porcupine Caribou Herd even though some communities are on the periphery of the Porcupine Caribou Herd range. For the Gwich'in, sharing networks are highly centered on exchanges of caribou, and many Gwich'in, regardless of Porcupine Caribou Herd harvest levels, view the Arctic Refuge as sacred due to its importance to the Porcupine Caribou Herd.

Transboundary Subsistence Uses

Transboundary subsistence uses associated with the program area include harvesting of caribou, marine mammals, waterfowl, and fish. Caribou is a primary transboundary concern, as the Porcupine Caribou Herd calves in the Coastal Plain and is harvested elsewhere by Canadian user groups including residents in the Inuvialuit and Gwich'in Settlement Regions. Other transboundary subsistence uses are the Inuvialuit harvests of polar bears, bowhead whales, beluga whales, and other marine mammals and Inuvialuit and Gwich'in uses of waterfowl and fish, which may pass through the program area and be harvested elsewhere. As indicated by historic and contemporary land use documentation studies, Inuvaluit subsistence use areas abut and extend into the Coastal Plain of Alaska and extend throughout the Coastal Plain in Canada (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018; Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). The Inuvialuit-Iñupiat Polar Bear Management Agreement reflects the particular cultural importance of this species to the Iñupiat and Inuvialuit of the

Beaufort Sea, and there are efforts to co-manage this species similar to caribou. Beluga whales are another key subsistence species which are jointly managed through the Inuvialuit-Iñupiat Beaufort Sea Beluga Whale Agreement (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018). In addition, Arctic cisco spawn in the Canadian waters (including the Mackenzie River Delta), after which the young-of-the-year migrate past the program area to overwintering grounds in the Colville River Delta. These fish remain in nearshore Beaufort Sea waters where they feed, returning to Canadian waters once they reach sexual maturity (approximately eight years old). Thus, impacts on Arctic cisco populations could have far reaching consequences for both Alaskan and Canadian subsistence harvesters. Other fish species, including Dolly Varden, migrate along the Alaskan and Canadian coast and are harvested by Inuvialuit residents (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018). During interviews with Inuvialuit Aklavik residents in 2015, a location along the Beaufort Sea coast on the U.S. side of the border was identified as a "safe haven" for travelers (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee).

Arctic cisco are harvested primarily by northern Canadian user groups. Based on data from the Joint Secretariat (N.W.T.) (2003) for the 1988-1997 time period, Tuktoyaktuk and Aklavik are the primary harvesters of cisco (including Arctic and least cisco), with more limited harvests by the communities of Inuvik and Paulatuk. Overall, communities in the Inuvialuit Settlement Region harvested between 7,248 and 46,433 cisco during individual study years. In addition to Arctic cisco, the Inuvialuit are also the closest user group to the Coastal Plain that hunts polar bear. Between 1988 and 1997, communities in the Inuvialuit Settlement Region harvested between 20 and 63 polar bears annually (Joint Secretariat (N.W.T.) 2003). Polar bears are both an important source of food to these communities, in addition to being an important part of local economies. In recent years, guided polar hunts provide income to local Inuvialuit hunters who often use this income to support their subsistence lifestyle (Joint Secretariat 2015). The Coastal Plain is a key habitat for migrating and nesting waterfowl, and Canadian user groups may harvest waterfowl that migrate to or from the program area. Primary species of waterfowl harvested by Gwich'in Settlement Area communities include black ducks, snow geese, mallards, Canada geese, and white-fronted geese (GRRB 2009). In the Inuvialuit Settlement Region, the primary species include snow geese, eiders, white-fronted geese, Canada geese, and brant (Joint Secretariat (N.W.T.) 2003). In both regions, the majority of waterfowl hunting occurs during the spring and early summer (May/June), with some effort also occurring during the fall migration (August/September) (Joint Secretariat (N.W.T.) 2003, GRRB 2009).

Table N-21 in **Appendix N** provides available caribou harvest data for the following seven Canadian user groups of the Porcupine Caribou Herd: Inuvialuit (Aklavik, Inuvik, and Tuktoyaktuk; additional communities from this region include Paulatuk, Sachs Harbor, and Ulukhaktok), Northwest Territory (NWT) Gwich'in (Aklavik, Inuvik, Fort McPherson [*Tetlit Zheh*], and Tsiigehtchic), Vuntut Gwich'in (Old Crow), Tr'ondek Hwech'in (Dawson City), Nacho Nyak Dun (Mayo), and other residents living in the Yukon Territory and the NWT. **Table B-21** provides these data for 2012-2022.

According to recent data on Porcupine Caribou Herd harvests by Canadian user groups (**Table B-21**), the NWT Gwich'in, the Vuntut Gwich'in, and the Inuvialuit are the primary users of the Porcupine Caribou Herd in terms of number of caribou harvested. These data primarily represent a minimum count of actual harvest (whereas the data for Alaska communities are estimated for the community as a whole), and in some cases, such as for the community of Inuvik, harvests may be dramatically underrepresented. Furthermore, variability in herd distribution affects the harvest, and harvests in the 2010s have not been as

Table B-21
Total Annual Harvest Summary of Porcupine Caribou, Available Study Years

Canadian User Group	Estimated Harvest							
	Inuvialuit (NWT)[1]	NWT Gwich'in[2]	Vuntut Gwich'in[3]	Tr'ondek Hwech'in[4]	Nacho Nayak Dun[5]	Yukon licensed[6]	NWT licensed[7]	Total (all user groups)
2012–13	176	615	403	1	0	8	80	1,283
2013–14	368	1,936	473	2	3	81	57	2,920
2014–15	123	451	114	0	0	3	58	749
2015–16	345	2,558	148	12	5	232	67	3,367
2016-17[8]	NA	NA	-	-	-	-	-	1,083
2017-18	314	302	193	0	0	2	34	845
2018-19	-	-	-	-	-	-	-	-
2019-20	-	2,579	222	3	6	239	-	-
2020-21	-	1,743	413	-	-	143	-	-
2021-22	35	43	188	0	0	10	21	297
Average Across Available Study Years	227	1,278	269	3	2	90	53	1,506

Sources: Porcupine Caribou Management Board (PCMB) 2023
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. In some years and for some communities, harvests are likely underreported.
"—" means data not available for that study year. Averages are based only on years where data are available.
[1]Including Inuvialuit in and around Aklavik, Inuvik, and Tuktoyaktuk. Minimum harvest. Due to low sample sizes, accurate Inuvik harvest estimates would likely double the reported harvest amount in the Inuvialuit region (Porcupine Caribou Management Board 2024).
[2]Including Gwich'in in and around Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. Minimum count harvest. NWT Gwich'in Data for the 1995-96, 1996-97, and 1997-98 time periods are for the calendar year 1995, 1996, and 1997. Due to low sample sizes in Inuvik, harvest estimates are likely not representative of Gwich'in harvesters from that community region (Porcupine Caribou Management Board 2024).
[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.
[8] Data for the 2016-17 study year are based on incomplete data and are considered to be low compared to what was actually harvested by all Parties in Canada.

high as they were in the 1990s and 2000s due to migratory variability.[43] Harvests during the 1990s and 2000s were also likely higher among user groups with currently lower harvests, including the Nacho Nyak Dun, Tr'ondek Hwech'in, and licensed Yukon hunters (PCMB 2024). Averages likely underrepresent community harvest and need, as some study years provide minimum counts, and because harvests are based on the availability of caribou in a given year. Residents would likely harvest more caribou in some years if caribou were more widely available in the community's harvesting area. Finally, years with missing data may skew averages. For example, Inuvialuit harvests during the 2020-21 study year was considered to be the largest harvest by Inuvialuit hunters in over a decade; however, the harvest study was paused during

[43]Suitor, Mike. Personal communication. Email from Mike Suitor, Regional Biologist, Environment Yukon to Paul Lawrence, SRB&A on September 27, 2018 regarding Porcupine Caribou Herd harvests in Canada.

that year and therefore no data are available (PCMB 2024). According to the PCMB (2024), the PCH harvest has generally varied between 4,000 and 6,000 caribou during years when the herd is available.

As shown in **Table N-21** in **Appendix N**, Porcupine Caribou Herd harvest data for the Vuntut Gwich'in and Yukon from the 1980s and 1990s show overall higher harvests than in more recent years. Available data show the NWT Gwich'in (Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic) harvested an estimated annual average of 1,278 caribou between 2012 and 2022 of ; the Vuntut Gwich'in (Old Crow) harvested an average of 269 Porcupine Caribou Herd caribou during this same period, and the Inuvialuit of the Northwest Territories (Aklavik, Inuvik, and Tuktoyaktuk) harvested an estimated 227 Porcupine Caribou Herd caribou (**Table B-13**). For the NWT Gwich'in, Vuntut Gwich'in, and Yukon user groups, the average annual caribou harvest for all available years is higher than for the last 10 years. These data generally represent minimum counts and therefore are likely lower than the actual harvests. In terms of individual community averages, Old Crow shows the highest harvest from the Porcupine Caribou Herd.

The most recent data that compare Porcupine Caribou Herd harvests between the US and Canada from 1992 to 1994 (the last time that harvest data were compiled for Porcupine Caribou Herd user groups in Alaska and Canada) indicate that Canadian users accounted for 85 percent of the harvest, and Alaska users were 15 percent of the harvest (**Figure 3-7**, Average Portion of Harvest of Porcupine Caribou Herd Between the US and Canada (1992-1994), in **Appendix A**). The NWT Gwich'in accounted for 45 percent of all Porcupine Caribou Herd harvests, followed by Inuvialuit (20 percent), Yukon Territory First Nations (13 percent), Alaska Native (12 percent), and the remaining 10 percent split among Yukon Territory and Alaska residents/non-residents (**Figure 3-7** in **Appendix A**); thus, most of the Porcupine Caribou Herd harvest occurs in Canada (PCMB 2010).

Information on the timing of caribou hunting is available for some Canadian user groups. Overall, data show the majority of caribou being harvested during the fall, winter, and spring months. The fall and spring migration periods are particularly active times for caribou hunting. On average, residents of the Gwich'in Settlement Region harvested 20 percent of their Porcupine Caribou harvest in October, followed by 17 percent in September, and 15 percent in April (GRRB 2009). Data for the Inuvialuit Settlement Region for the 1998-1997 time period show a somewhat similar timing of harvests, with 16 percent harvested in October, 15 percent in November, and 10 percent in February (Joint Secretariat (N.W.T.) 2003). While some hunting may occur in summer (June/July), residents generally avoid hunting during this time due to the calving season and the relatively poor condition of bulls (Wildlife Management Advisory Council (North Slope) and Aklavik Hunter and Trappers Committee 2009).

Canadian Gwich'in and Inuvialuit consider the Porcupine Caribou Herd to be central to their cultural identity, spirituality, and social and community well-being, and Porcupine Caribou Herd are a key source of nutrition (Wildlife Management Advisory Council (North Slope) and Aklavik Hunter and Trappers Committee 2009, Wildlife Management Advisory Council (North Slope) 1996). Among the Gwich'in, caribou play a particularly important role in traditional belief systems and spirituality (Kritsch, Jerome, and Mitchell 2000). As stated in Benson (2019), "It is impossible to understand caribou or the Giwch'in separately." In Canada, Indigenous communities are heavily involved in the conservation of the Porcupine Caribou Herd through development of management plans. There are eight parties to the Porcupine Caribou Management Agreement (PCMA), under which the Porcupine Caribou Management Board was established (Tr'ondek Hwech'in 2021). A primary goal of the PCMB is cooperative management of the Porcupine Caribou Herd. The PCMB has developed a Harvest Management Plan for the Porcupine Caribou Herd in

Canada (PCMB 2010), which includes a Harvest Management Colour Chart which provides recommendations for hunting regulations based on current herd sizes (Tr'ondek Hwech'in 2024). According to this chart, a Porcupine Caribou Herd population above 115,000 indicates no harvest limit for Indigenous harvesters. The most recent herd estimate for the Porcupine Caribou Herd was 218,000 in 2017, indicating a healthy and sustainable population at present (PCMB 2010).

Both the Gwich'in and Inuvialuit consider protecting the Arctic Coastal Plain—which extends from the North Slope of Alaska into the North Slope of Canada—to be central to the survival of the Porcupine Caribou Herd. The particular importance of this habitat to the Porcupine Caribou Herd, in addition to wildlife such as upland birds, waterfowl, moose, grizzly bear, polar bear, and muskoxen, has been described in numerous traditional knowledge studies among the Gwich'in and Inuvialuit (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018).

Similar to Alaskan Gwich'in and Iñupiat communities, the Gwich'in and Inuvaliuit of Canada rely on subsistence harvesting as a means of nutritional, economic, social, and cultural support. The availability of high-quality subsistence foods is necessary to offsetting high costs in many rural communities, and participation in traditional subsistence harvesting activities strengthens community and kinship ties and helps to maintain cultural identity (Government of Yukon 2018).

As noted in **Section B.4.4** (Sociocultural Systems), Canada's Ivvavik National Park, which is in the Coastal Plain next to the US border, was established under the Inuvialuit Final Agreement, which was established in response to Inuvialuit concerns regarding increased oil and gas development (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018). Its primary purpose is protecting the Canadian calving grounds of the Porcupine Caribou Herd; thus, the Inuvialuit likely view the coastal plain west of the US border with similar concern (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). The area is also identified as being important to key Inuvialuit subsistence species including furbearers, waterfowl, grizzly bear, Dall's sheep, and fish (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018). Similarly, the Vuntut National Park was established as part of the Vuntut Gwich'in First Nation Agreement, to protect traditional and contemporary uses and resources, including the Porcupine Caribou Herd. The Gwich'in and Inuvialuit of Canada also report transboundary subsistence uses, sharing, and kinship ties with their Alaskan counterparts. Many Inuvialuit have ancestors who were born on Barter Island, and many Kaktovik residents have family ties to Inuvialuit communities, and cross-border travel along the coast by boat for visiting and subsistence activities is well documented (IGC,WMAC(NS), WMAC(NWT), and FJMC 2018). Kofinas et al. (2016) shows sharing networks between Kaktovik and Aklavik, two communities with strong kinship ties, to include sharing of beluga and Dolly Varden.

Climate Change

Alaska Native communities have observed numerous changes to the physical and biological environment due to climate change. These include increased temperatures, higher rainfall volumes, melting permafrost, poor air quality due to wildfires, changes in plant communities, invasive species, increased incidence of tundra fires, coastal erosion and sedimentation, decreased sea ice, changes in marine organisms which provide food for marine mammals, and changes in the timing and location of wildlife migrations (NSB 2021a).

Climate change has the potential to affect subsistence uses by affecting the availability of subsistence species, access to hunting and harvesting areas, and harvester safety. The success of subsistence activities

in the Arctic relies on the predictability of weather conditions, such as the timing of freeze-up and breakup, precipitation amounts, storms and prevailing winds, ice conditions, and temperatures, as well as the presence of an adequate number of healthy subsistence species in traditional subsistence use areas at the expected time of year. North Slope hunters have already reported experiencing the effects of climate change on subsistence, including changes in species productivity and distribution, reduced habitat for marine mammals associated with decreased sea ice, changes in the timing of subsistence activities due to later freeze-up or earlier breakup, changes in lakes, rivers, and wetlands, and increased risks to hunters associated with changes in ice thickness, ice movements, and currents (SRB&A 2009a). Subsistence users may experience greater risks to safety when travel conditions are not ideal. They may also experience reduced harvest success if regulated hunting seasons are not adjusted to reflect the impacts of climate change on resource availability and harvester access. In recent years, some Native groups have proposed changes to hunting seasons based on climate change impacts (Tanana Chiefs Conference Inc. 2015). Recently, these have included proposals for extended or later moose hunting seasons (Federal Subsistence Board 2021).

Shrinking sea ice, thawing permafrost, and warmer temperatures could change the migration, distribution, health, and abundance of wildlife, thus affecting their availability to subsistence users who rely on them being in their expected locations at certain times of the year. For example, in recent years, North Slope hunters have observed that the ice pack has retreated more quickly than it used to and is farther from shore. This has resulted in hunters having to travel farther from shore, with increased risks to safety, in order to locate and harvest marine mammals, which tend to follow the ice pack (SRB&A 2009, Callaway 1998). The NSB (2020) noted an increase in household heads who reported a decrease in whaling and other marine mammal hunting activities in the last 5 years. Based on community observations, this could be attributed to poor sea ice conditions in recent years which have affected access to marine mammal hunting grounds and marine mammal availability (NSB 2020). Overland travel has also become more dangerous. Thawing permafrost causes cracking and uneven ground where hunters can get stuck, and a lack of ice and snow in winter increases risks of snowmachines breaking through ice (Schmidt and Kofinas 2018, Brubaker, Bell, Dingman, Evans, Kasak, Itta, and Drake 2014). Residents have also observed that certain animals, such as migratory birds, fish, and marine mammals, are arriving later or earlier than expected. In Nuiqsut, the start date of the 2019 season was one of the latest since monitoring of the fishery began in the 1980s (Forster and Seigle 2021). In addition, an unusual ice melt event in late October interrupted the fishery that year. Events like this may become more common as climate change continues to affect weather patterns.

Erosion and sedimentation along the Beaufort Sea coastline has been observed by Kaktovik and Nuiqsut harvesters. Erosion can affect camp and cabin locations, forcing owners to move the structures or lose them to the sea. Sedimentation along the coast can also affect navigability by boat due to shallow waters. In Kaktovik, the entire coastal bluff has been affected by erosion, with some areas losing over 1,000 feet of shoreline since the 1940s (NSB 2021a).

Climate change is expected to change the survival rates and distribution of terrestrial mammals (including caribou and muskoxen), marine mammals (including bowhead whales, seals, beluga whales, and polar bears), birds (including white-fronted geese, brants, and eiders), and fish (ACIA 2004). The effects on subsistence uses of these animals would depend on the nature of the changes and the degree to which they occur. Changes in species abundance or distribution from climate change can also affect the availability of those species to subsistence users and some subsistence users report traveling farther to access subsistence resources and spending more time and effort on subsistence activities (Brinkman 2016). Warmer temperatures could cause increased growth of woody brush in the program area, which could affect the

distribution and habitats of numerous subsistence species. Woody brush may increase the duration and intensity of tundra fires, which are known to affect caribou migration (NSB 2021a). In addition, an increase in tundra fires could contribute to melting permafrost which can cause erosion, slumping, and unstable travel conditions.

Further, the warming temperatures in the Arctic and their potential impact on soils and permafrost could affect subsistence users' ability to store food gathered by subsistence activities. Many subsistence users have underground cellars that use the frozen ground to keep perishables frozen. The failure of ice cellars due to warming may cause subsistence food to spoil, and users may need to increase their harvest to offset loss due to spoilage or increase their reliance on electric or gas refrigeration.

Overall, climate change affects the location, timing, safety, predictability, and success of many subsistence activities. These ongoing changes compound with other sources of change such as development, regulations, and sport hunting competition to increase the overall effects to subsistence users.

B.4.4 Sociocultural Systems

Affected Environment

This section describes the affected environment for sociocultural systems potentially affected by the leasing program. In particular, the program could affect sociocultural systems among the Iñupiat, Inuvialuit, and Gwich'in who use the program area, who have cultural ties to the program area, who use resources that cross through the program area, or who could experience social or economic changes associated with the leasing program.

This section provides a brief overview of sociocultural systems among the Iñupiat, Inuvialuit and Gwich'in (in both Alaska and Canada), including history, social/political organization, the mixed cash/subsistence economy, and belief systems. The 2012 Point Thomson EIS (USACE 2012, Section 3.21 and 3.22) and 2012 NPR-A IAP/EIS (BLM 2012, Section 3.4.2, 3.4.3, and 3.4.4) are incorporated here by reference. They contain additional relevant details regarding Iñupiat subsistence values, their relationship to the environment, and the history of Kaktovik.

The Iñupiat of Kaktovik (Kaktovikmiut) are the primary users of the program area. They have strong cultural and subsistence ties and consider themselves the stewards of the program area (Native Village of Kaktovik 2019). Because of this, the community of Kaktovik is most likely to experience direct sociocultural impacts associated with development of the program area. In addition to Kaktovik, other North Slope Iñupiaq communities, Gwich'in communities (in both Alaska and Canada), and Inuvialuit communities (in Canada) have the potential for indirect and cumulative impacts on subsistence. Other North Slope Iñupiaq communities may experience impacts due to use of the Coastal Plain or surrounding areas (e.g., Nuiqsut), or because of their kinship and cultural ties to the Coastal Plain and community of Kaktovik (Atqasuk, Utqiaġvik), or because of their use of the Porcupine Caribou Herd (Anaktuvuk Pass). Inuvialuit communities may experience sociocultural impacts due to kinship ties with Kaktovik (e.g., Aklavik) or due to their use of various species, particularly Porcupine Caribou Herd caribou, which migrate through the Coastal Plain. Finally, Gwich'in communities from both Alaska and Canada may experience sociocultural impacts due to their historic and spiritual ties to the Coastal Plain and their high reliance on the Porcupine Caribou Herd for subsistence. Differences in how these sociocultural systems may be affected by development of the program area are described in *Direct and Indirect Impacts* (**Chapter 3**). Additional associated information relevant to sociocultural systems is given in **Sections 3.4.2**, **3.4.3**, **3.4.10**, and **3.4.11**.

History

Iñupiaq

History (both pre- and post-contact) associated with the program area is described in more detail in USFWS (2015a). Kaktovik and Nuiqsut are the two Iñupiaq communities closest to the program area. In addition, other North Slope communities either harvest from the Porcupine Caribou Herd in some years or have kinship and cultural ties to Kaktovik or the Coastal Plain. These include Anaktuvuk Pass, Atqasuk, Utqiaġvik, Wainwright, Point Lay, and Point Hope. The Iñupiat are an Alaska Native people whose territory ranges throughout Northwest and Northern Alaska. Archaeological research indicates that humans have been present in Alaska for at least 14,000 years (Kunz and Reanier 1996). Over thousands of years different cultures came to occupy Arctic Alaska and various parts of the program area, subsisting on wildlife available to them and developing various tools for survival. Thule culture, which emerged about 1,000 years ago, represents the direct ancestors of the Iñupiat living on the North Slope today and was the forebearer of modern whaling technologies and culture.

At the time of Euro-American contact, the North Slope was inhabited by kinship-based groups of Iñupiat who lived in either coastal or inland areas and traveled as needed, depending on food supplies and other factors (Spencer 1984). The coastal settlement pattern was characterized by permanent villages along the coast with outlying minor permanent and temporary settlements (Spencer 1959). One reason for the coastal villages' permanence was due to the marine mammal base—particularly bowhead whales—on which community members subsisted. On the North Slope, there is evidence for coastal Iñupiaq settlements from Point Hope (Tikigaq) in the west to as far as Demarcation Point near Canada in the east. The Nuiqsut and Kaktovik areas were known as places where Iñupiat and Athabascan people gathered to trade and fish, maintaining connections between the inland areas and the coast (Maguire 1988; Brown 1979; Impact Assessment Inc. 1990b).

Initial contact between the Iñupiat of the North Slope and Euro-Americans occurred in the early nineteenth century with the arrival of explorers. Exploration of the North Slope began in 1825 with the first Franklin expedition, which included stays by Sir John Franklin and his crew at Herschel and Barter islands. Commercial whaling along the North Slope during the second half of the nineteenth century brought the first major outside influence on Iñupiaq settlement patterns, affecting both coastal and inland settlements. Employment in the whaling industry and access to trade goods served to concentrate people along the coast, reducing interior populations.

Commercial whaling also introduced diseases for which the Iñupiat had no immunity, thereby further affecting demographics on the North Slope. It has been estimated that between 1854 and 1897, over 50 percent of the Native population in North Alaska died due to disease and famine (Burch 1979). Euro-American contact also introduced Native residents to alcohol, resulting in adverse social effects.

Following a decline in populations of caribou and marine mammals, caused in part by demand for these resources to support whalers during the commercial bowhead whaling period (SRB&A and ISER 1993), many Iñupiat had moved to Utqiaġvik (formerly Barrow) or Herschel Island (in Canada) where food and medical care were available. By the early to mid-1900s, many residents who had lived along the Arctic Coast had relocated to Utqiaġvik. The collapse of the commercial whaling industry in the early 1900s, because of a lack of demand for baleen and marine mammal oil from the increase in petroleum development, was followed by an increase in demand for furs. Also, reindeer herding was introduced as a means to

supplement the declining caribou populations. Both the fur trade and reindeer herding filled some of the economic gap left by the decline in commercial whaling in the early 1900s.

Sheldon Jackson, a Presbyterian missionary, introduced reindeer herding to Alaska Natives, and the Iñupiat maintained herds in the vicinity of Wainwright, Barrow, and Nuiqsut and elsewhere on the North Slope (Jackson 1906). The area between Brownlow Point and Demarcation Bay was divided into separate reindeer herding areas. Several families maintained herds at Camden Bay, Barter Island, and Demarcation Bay. Reindeer herding ended in the region in 1938 (Chance 1990).

Local mission schools and trading posts, established during the late 1800s and early 1900s, also had a profound effect on Iñupiaq settlement patterns through centralization of Iñupiat into permanent communities. Compulsory education in local coastal settlements forced many (though not all) of the interior people to abandon their more semi-nomadic lifestyle and relocate to coastal communities. Trading posts were often established near missions and schools, and these areas became focal points for the Native population, thus affecting settlement patterns during the early 1900s.

Because of the centralization of goods and services, the smaller coastal settlements that had once typified the Iñupiat of the North Slope are also no longer as prevalent. Seasonal coastal settlements enabled the semi-nomadic Indigenous population to maximize the use of the environment and to harvest wildlife that were migratory or may have been available only in particular locations.

The Iñupiat today continue to rely on these subsistence species, despite not all species being available near their communities; thus, even though the modern North Slope settlement pattern revolves around permanent communities, in order to continue to access subsistence species, the modern Iñupiat have established a network of camps and cabins across the North Slope to maintain their access to subsistence species. These mirror the camps and temporary settlements used in the past. SRB&A and ISER (1993) observed that the location of cabins in productive habitat was "a strong tradition stemming from the predominant lifestyle prior to the establishment of the town of Barrow, and continued to provide an important opportunity for children to learn and begin using subsistence skills."

Oral histories say the Kaktovikmiut (suffix "miut" means "people of") lived within and used the Kaktovik area many generations and over thousands of years (ASCF 2012). Archaeologists have identified sites on Barter Island with artifacts representative of the Thule period (Grover 2004). Both before and after Euro-American contact, Kaktovik has always been "a seasonal home for the nomadic ancestors of present-day Kaktovik residents, who traveled the area in pursuit of caribou, sheep, sea mammals, fish, and fowl" (Jacobson and Wentworth 1982). Archaeological evidence indicates that Kaktovik was a place where people used and possibly hunted whales; in addition, the name Kaktovik means "the seining place." Barter Island, where the village of Kaktovik is located, had been the site of a large Iñupiaq village and was an important trading center between various Iñupiat, Athabascan, and Canadian Inuit groups for centuries. Many Kaktovik residents maintain family and social ties with the Canadian communities of Inuvik and Aklavik (SRB&A 2010; USFWS 2015a).

Later, the village was a key seasonal subsistence harvesting location and a stopover point for commercial whalers. In 1923, Tom Gordon established a trading post on Barter Island (Wentworth 1979). During this time, Iñupiat who lived along the coast would congregate on Barter Island for subsistence activities and to sell their furs, and some settled there more permanently; however, until the 1950s, most people in Kaktovik lived a more nomadic lifestyle, living seasonally in such places as Camden Bay, Hulahula River, Griffin

Point, Demarcation Bay, Herschel Island, and other places 75 miles east and west of the island (Jacobson and Wentworth 1982); thus, the people of Kaktovik have a longstanding history and relationship with the program area that is based on the seasonal harvests of subsistence resources.

The trading post was closed in 1942 and caused the disbursement of many local families to barrow and Herschel Island (Jacobson and Wentworth 1982); however, the population of Kaktovik, which had grown throughout the 1930s, grew again in the mid-1940s, when Iñupiat were drawn back for construction of the DEW Line site at Barter Island (Wentworth 1979). Development of the island by the Air Force resulted in the destruction of and relocation of two village sites in the 1950s (Wentworth 1979; Impact Assessment Inc. 1990a; Mikow 2010; Kofinas et al. 2016). The current village site was not established until the 1960s (Wentworth 1979).

In 1968, the largest oil discovery in North America was made by Arco at Prudhoe Bay, resulting in a rush to develop the physical and legal infrastructure of Alaska so that production could begin (Coates 1991). Oil development and production at Prudhoe Bay became the nucleus for expanding networks of oil and gas production wells at neighboring fields (Impact Assessment Inc. 1990a, b).

The discovery of oil prompted passage of ANCSA in 1971 and the formation of the NSB in 1972. Formation of the NSB allowed residents to benefit economically through taxation of the oil and gas industry and provided for infrastructure development and jobs (USACE 2012). In 1973, after the 1971 passage of the ANCSA, 27 families from Utqiaġvik permanently resettled in Nuiqsut to live in a more traditional manner (Brown 1979). Many of those who moved there had family connections to the area (Impact Assessment Inc. 1990b). The families selected the present location of Nuiqsut for its centrality to subsistence species and ease of access to inland, riverine, delta, and marine harvest locations (Brown 1979).

Inuvialuit

The Inuvialuit, meaning “real people,” are Indigenous People whose homelands are the Mackenzie River delta and the coastal areas of the Yukon North Slope, next to the Western Arctic Beaufort Sea (Wildlife Management Advisory Council (North Slope) 1996). Like the Iñupiaq in Alaska discussed above, the Thule culture, which emerged about 1,000 years ago, represents the direct ancestors of the Inuvialuit and other Inuit groups (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). Archaeological research indicates that these people relied heavily on sea mammals, using skin boats and harpoons with bladder floats to hunt seals and whales. Inuvialuit ancestors adapted to cooling temperatures and an increase in sea ice (which began approximately 800 years ago) during the Thule period, eventually expanding their use of land-based resources and spreading into the Mackenzie River delta by around AD 1300 (Wildlife Management Advisory Council (North Slope) 1996; Inuvialuit Regional Corporation 2011).

At the time of contact with Europeans, the Inuvialuit were divided into approximately eight territorial groups, living along the Arctic coastal plain, from Barter Island in Alaska to Franklin Bay in the Inuvialuit Settlement Region of the Northwest Territories (Lyons 2009). The estimated Inuvialuit population at the time was between 2,000 and 2,500 (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). Each of the eight territorial groups resided in a primary winter village for a portion of the year, then dispersed into smaller harvesting camps during the rest of the year (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). The territorial groups established active trade networks with other Inuit, including the Iñupiat and

Gwich'in. Regular trade routes covered north Alaska and the central Arctic and stretched across the ACP to Point Barrow and Barter Island (Wildlife Management Advisory Council (North Slope) 1996).

Although contact with the West began as early as the late 1700s with European expeditions to search for a Northwest Passage, the Inuvialuit generally maintained a traditional way of life throughout much of the 1800s (Inuvialuit Regional Corporation 2011). A trading post was established south of the Inuvialuit settlement region, at the current location of Fort McPherson in the mid-1800s. This increased trade across the regions (Lyons 2009).

Direct, sustained contact with Western culture for the Inuvialuit began at the end of the nineteenth century, when crews from American whaling ships began overwintering at Herschel Island. This was a time of profound and rapid change for Inuvialuit people. Within a few decades, Western residential schools and hospitals and Anglican and Roman Catholic missions were established in Inuvialuit homelands. With the advent of the Western education system, it also became common for Inuvialuit children to be sent away to more distant residential schools for a large portion of the year. This directly affected a family's ability to teach Inuvialuktun languages and Inuvialuit traditional cultural values and practices to the younger generations (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018).

Today, there are approximately 5,000 Inuvialuit people residing in six main communities: Aklavik, Inuvik, Tuktoyaktuk, Paulatuk, Ulukhaktok, and Sachs Harbour (Joint Secretariat 2015). Aklavik, which is the Inuvialuit community closest to the program area, became a center of commerce and administration during the 1930s (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). While Inuvik has since replaced Aklavik as the center of commerce and administration in the region, Aklavik still has a population of approximately 600 (GNT n.d.). Residents of both Inuvik and Aklavik have family and social ties with residents of the Iñupiaq community of Kaktovik in Alaska. Many Inuvialuit still feel culturally connected to the North Slope of Alaska, including the Coastal Plain, due to their ancestral ties there.

Gwich'in (Alaska)

History (both pre- and post-contact) associated with the program area is described in USFWS (2015a). The Gwich'in are an Athabascan cultural group who traditionally occupied a massive territory that incorporated long sections of the Yukon, Porcupine, Peel, Chandalar, Itkillik, and Sagavanirktok Rivers and into present-day Canada to the Mackenzie Flats and River Delta (Burch 1998; Raboff 2001, 1999; Slobodin 1981). Archaeological data suggest that people occupied the Yukon River region (which includes the contemporary Gwich'in communities of Arctic Village and Venetie) at least 12,000 years ago (Griffin and Chesmore 1988). Associated with ancestral Gwich'in, Kavik artifacts from between 600-150 years ago extend into areas of the North Slope and Brooks Range.

In the north, interactions between the Gwich'in or Koyukon and the Kukpigmiut Iñupiat of the Colville River were marked by territorial tensions and hostility, culminating in a series of violent incidents that forced the Athabascans south of the mountains (Raboff 2001). Continuing battles with the Iñupiat and other Athabascans in the 1840s pushed the Gwich'in from the Koyukuk River east to Chandalar Lake and beyond. The Gwich'in were among the most nomadic of the Athabascan groups in their settlement patterns and continued to travel north to trade with the Iñupiat at Barter Island into the 1920s (Jacobson and Wentworth

1982). Similar to the Nunamiut farther north, the Gwich'in relied heavily on the harvest of large land mammals—particularly caribou, but also moose and Dall sheep—for their livelihood.

Some of the first contact with the Gwich'in by Europeans likely took place with the Hudson's Bay Company trading post at Fort Yukon in 1847, some of the latest in terms of first contact in Alaska. It continued with little contact through the end of the nineteenth century (Hadleigh-West 1963). Still, the indirect contact that occurred with other groups trading with the Gwich'in in the 1850s resulted in an epidemic that devastated their population, especially in the western extent of their territory near the Kanuti River. By 1870, most Gwich'in groups had moved into the Yukon Flats or east of Chandalar River. This constitutes the known modern territorial range of the Gwich'in today (Burch and Mishler 1995).

Continuous Euro-American presence in Gwich'in territory came later than for some other Indigenous groups in Alaska. As such, the traditional subsistence lifestyle, including a continued reliance on hunting and fishing as a primary source of food and as a primary basis for Gwich'in belief systems, was substantially maintained until World War II (Caulfield 1983).

A severe decline in caribou populations in the Yukon Flats area in the late 1930s and 1940s may have precipitated the need for the Gwich'in to adapt to a more cash-based economy (Caulfield 1983). The US established several Native reservations in Alaska following the inclusion of Alaska in the Indian Reorganization Act of 1936. The Venetie Indian Reservation included the Gwich'in of Arctic Village, Venetie, Christian Village, and Robert's Fish Camp. It was during this period that the Gwich'in made a final transition to permanent settlements (Inoue 2004). The early 1960s saw the creation of the Arctic Refuge, which included lands traditionally used by the Gwich'in.

Today, Alaska Gwich'in live in nine communities: Arctic Village, Beaver, Birch Creek, Canyon Village, Chalkyitsik, Circle, Eagle Village, Fort Yukon, and Venetie. While Arctic Village and Venetie have the strongest direct and historic ties to the Coastal Plain, the Gwich'in people as a whole have cultural and spiritual connections to the area because of its importance to the Porcupine Caribou Herd.

Gwich'in (Canada)

Despite being separated by the border between the US and Canada, the Canadian Gwich'in and the Alaskan Gwich'in share the same Athabascan heritage and history. Archaeological evidence suggests that the area of Northwest Canada has been inhabited for tens of thousands of years (Wolfe, Humphries, Pisaric, Balasubramaniam, Burn, Chan, Cooley, Froese, Graupe, Hall, Lantz, Porter, Roy-Leveillee, Turner, Wesche, and Williams 2011). Before European contact, the Gwich'in were organized into nine regional groups (bands) and occupied a large area extending from the Alaskan interior to the Mackenzie River Valley.

The Canadian Gwich'in reside in the northern Yukon and Mackenzie River Valley in the Northwest Territories (Fafard and Kritsch 2003; Committee 2002). They continue to have kinship ties to Gwich'in in Alaska and maintain sharing and social networks. Similar to other Gwich'in groups, the Gwich'in of Northwest Canada, known as the Tsii'deii, lived a semi-nomadic lifestyle based on the seasonal availability of plants and wildlife (Committee 2002).

Today, the primary Canadian Gwich'in groups are the Vuntut Gwich'in (Old Crow), Teetlit Gwich'in (Fort McPherson), Ehdiitat Gwich'in (Aklavik), Nihtat Gwich'in (Inuvik), and Gwichya Gwich'in (Tsiigehtchic) (Committee 2002). The Vuntut Gwich'in of Old Crow have a territory and dialect that is distinct from the

Gwich'in of the Northwest Territories (Fort McPherson, Aklavik, Inuvik, and Tsiigehtchic) (Fafard and Kritsch 2003).

The first Euro-Canadian contact occurred in the late 1700s, when the Gwich'in briefly encountered Alexander Mackenzie on what is now the Mackenzie River (Committee 2002). Contact with Europeans picked up in the early 1800s when John Franklin travelled down the Mackenzie River in search of the Northwest Passage (Kritsch et al. 2000). The Hudson's Bay Company subsequently established a trading post on the Peel River, which was relocated 4 miles downriver in 1850 and is known today as Fort McPherson (Kritsch et al. 2000). Trade was slow at first but grew over time, and soon the Teetlik Gwich'in made yearly trips there for meat and fur trading and food celebrations (Kritsch et al. 2000).

The establishment of Roman Catholic and Anglican missions in the mid-1800s and schools in the early 1900s further encouraged the centralization of the Gwich'in into permanent communities. Many children were sent away to schools during this time, often returning home with little knowledge of Gwich'in language or culture (Committee 2002).

The Klondike Gold Rush of the late 1800s and early 1900s brought further change to the Gwich'in with the influx in outsiders, establishment of police posts, and increase in economic opportunity. Gwich'in participated in the fur trade and also acted as hunters and guides for the mounted police (Kritsch et al. 2000; Committee 2002).

The Gwich'in continued to live a primarily subsistence-based lifestyle throughout the early 1900s, which was supplemented by the fur trade; however, in the 1950s the fur trade had collapsed, and the government began to establish more infrastructure and services within the region. In the 1970s the Dempster Highway was constructed and connected most Gwich'in communities to the road system (Old Crow is still accessible only by aircraft). After many years of negotiations, in 1992 the Gwich'in and the Canadian government signed the Gwich'in Comprehensive Land Claim Agreement in Fort McPherson. It provided for a cash settlement, surface and subsurface rights to a large settlement area, establishment of co-management boards, and a self-government agreement.

Today, there are approximately 4,000 Gwich'in living in the Northwest Territories and Old Crow (VGFN 2019; GTC n.d.). Despite modernization and centralization into such communities as Fort McPherson and Old Crow, the Gwich'in continue to keep their traditional ties to the land and culture through subsistence hunting, trapping, and fishing on their lands (Kritsch et al. 2000).

Social and Political Organization

Iñupiaq

Iñupiaq social organization traditionally revolved around the family and extended kin, in addition to trading partnerships and friendships (Hall 1984). The social and political organization of Iñupiaq societies revolved around the family; however, one person in particular—the *umialik*—exerted the most political influence. In coastal communities, an *umialik* would be responsible for organizing cooperative hunting activities, such as the bowhead whale hunt. The *umialik* and his wife managed a crew that assisted year-round in preparing for the hunt, hunting, and processing and distributing a whale once it had been harvested (Chance 1990; Burch 1980).

Following Euro-American contact in the second half of the nineteenth century, the social and political organization of the Iñupiat changed. These changes were a result of various factors, including compulsory education. This led to the following (Chance 1990):

- Centralization of people into permanent villages
- Introduction of modern technologies, which altered residents' methods for harvesting and processing subsistence foods
- Introduction of a cash economy
- Introduction of Christianity
- Incorporation of the Iñupiat into new systems of laws and governing systems

Alaska Natives began forming village councils, which were reorganized under the IRA. The ANCSA was passed in 1971 and resulted in the formation of regional and village corporations; the NSB formed in 1972.

Despite the changes in social and political organization over time, the core of Iñupiaq social organization is similar on the North Slope today, in that it encompasses not only households and families, but also wider networks of kinship and friends and individual family groups that depend on the extended family for support. The sharing and exchange of subsistence foods strengthen these kinship ties. The Iñupiat continue to uphold certain traditional social roles, such as those of the whaling captains, whaling crew members, and whaling captains' wives. Similar to the traditional role of the *umialiks*, today's whaling captains play a key role in Iñupiaq society and political life. Six North Slope communities, including Kaktovik and Nuiqsut, are members of the Alaska Eskimo Whaling Commission and have local whaling captains' associations.

Political organizations, while exhibiting the structure of Western organizations, have traditional leadership patterns (Case 1984). Village council decisions, based on precedent from previous group decisions, reflect continuity with the past, and all decisions emphasize the desire to maintain peace and order in the community (Case 1984). The many Native political organizations that have come about as a result of the political change over the past century have successfully adapted Western structure to achieve Native goals. Specific examples of these organizations on the North Slope are the NSB, Native Village of Barrow, Arctic Slope Telephone Cooperative Association, ASRC, Arctic Slope Native Association, and Alaska Eskimo Whaling Commission.

On the village level, traditional leadership by the *umialik* on the North Slope was replaced by a system that included elected officials serving in a village council presided over by a president or chief. Despite changes over the past two centuries, political positions with Native roots are still present and are being adapted into Western political leadership roles. Across the North Slope coastal whaling communities, the position of the *umialik* or whaling captain is still recognized, and many of the traditional roles are practiced, including generosity, providing a boat and supplies for the crew, and maintaining egalitarian principles. Galginaitis (1984) observed that the people in Nuiqsut regard the office of mayor as an *umialik*-position, and many of the mayors are recognized *umialiks*.

The program area is in the NSB, which has permit authority relevant to the leasing program. Other federal and state agencies, including the USFWS, which is the land manager for all nonnative land in the program area, also have permit authority related to the program (see **Appendix E**). Many residents of the eight permanent North Slope communities are members of the regional federally recognized ICAS and are shareholders in the ASRC.

The NSB and ASRC not only provide employment but also revenue and economic opportunities throughout the region. The NSB has taxing authority on all lands throughout the North Slope, while the ASRC and other village corporations generate revenue through leasing their lands and providing oil field services. As oil and gas development has moved closer to Nuiqsut, the community's Kuukpik Corporation has generated revenue, provided employment opportunities, and become a key player in advocating for environmentally and socially responsible development on the North Slope; thus, North Slope communities have shared in the financial gains associated with petroleum development since the 1970s.

Community institutions in Kaktovik include the City of Kaktovik, the Native Village of Kaktovik (a federally recognized tribe), and the KIC. Community institutions in Nuiqsut are the City of Nuiqsut, the Native Village of Nuiqsut (a federally recognized tribe), and the Kuukpik Corporation. In addition, the Kuukpik Subsistence Oversight Panel, Inc., was established in Nuiqsut in 1996 in response to development of the Alpine oil field.

Inuvialuit

Similar to the Iñupiat of Alaska, Inuvialuit social structure revolved mainly around families. Families lived together in groups that had an *umialiq*. *Umialiqs* were rich and powerful men who took on positions of political and social authority (Morrison n.d.).

Sustained Euro-American contact began at the end of the nineteenth century, as Herschel Island became a whaling center and winter headquarters for whaling captains and crews. Euro-American and Iñupiaq whalers became mainstays in the area, as did such groups as the Gwich'in, who came to Herschel Island to trade terrestrial game meat, which was preferred by the western whaling crews. Intermarriage between the Inuvialuit and their southern Gwich'in neighbors became more common during this period, which over time contributed to the diminishment of traditional disputes between these groups (Lyons 2009). The influx of other cultures, particularly the colonial Western culture, brought with it many changes to the Inuvialuit way of life, including the following (Lyons 2009):

- Centralization of people into larger, permanent village sites
- Introduction of a cash economy
- Semi-compulsory Western education
- Incorporation of Inuvialuit into Western government structures and laws
- Some loss of language due to enforced English policies at residential and day schools
- Impacts on the traditional annual cycle of hunting
- Introduction of disease and high mortality rates

Changes continued to occur with the discovery of oil and gas deposits in Alaska, triggering a series of exploration projects and proposed development projects in Canada (Wildlife Management Advisory Council (North Slope) 1996). Reacting to the adverse impacts of some of these changes, two Indigenous women—Nellie Cournoyea (Inuvialuit) and Agnes Semmler (Gwich'in Métis)—founded the Committee for Original Peoples' Entitlement (COPE) in the late 1960s. COPE worked toward greater aboriginal sovereignty and autonomy. Shortly after the founding of COPE, the Inuvialuit began work on the first comprehensive land agreement between Inuvialuit and the Government of Canada (Lyons 2009). In 1984, after nine years of work and negotiation, the agreement, called the Inuvialuit Final Agreement (IFA), was signed.

The IFA bound the Inuvialuit, the government of Canada, and the governments of Yukon and Northwest Territories to protect the land and to preserve Inuvialuit identity and cultural values (Wildlife Management Advisory Council (North Slope) 1996). It prevented a single group from making unilateral decisions about land use on the Yukon North slope and mandated that public comment and Inuvialuit recommendations be considered during decision-making.

To facilitate cohesive management between Inuvialuit communities and other governments, the IFA established the Wildlife Management Advisory Council (North Slope) and the Fisheries Joint Management Committee. The IFA also mandated that developers must have permission to occupy or remove resources from the land. As a result of the IFA, the Canadian government withdrew a large amount of land for conservation, which would later become Ivvavik National Park, Herschel Island Qikiqtaruk Territorial Park, and other conservation areas. Ivvavik National Park was established with the primary purpose of protecting the Canadian calving grounds of the Porcupine Caribou Herd, illustrating the importance of this herd to the Inuvialuit (Wildlife Management Advisory Council (North Slope) 1996). The Inuvialuit also participate in several transboundary agreements between the U.S. and Canada to co-manage species of particular concern. These include the Inuvialuit-Iñupiat Polar Bear Management Agreement and the Porcupine Management Agreement.

Gwich'in (Alaska)

The Gwich'in are one of several Athabascan cultural groups in Alaska and Canada. Traditional social and political organization of the Gwich'in involved people who lived in small autonomous bands composed of closely related kinsmen. Kinship affiliations were extensive, reaching beyond the immediate group or band and providing people with a network of relationships from which to seek assistance in time of need.

The Gwich'in had a kinship system based on matrilineal[44] clans organized into moieties[45] (McKennan 1959; Guédon 1974; Haynes and Simeone 2007). Political organization was decentralized and informal, with most decisions affecting the group reached by consensus. In some cases, a leader attained a particular status that enabled him to attract a following (De Laguna and McClellan 1981; Clark 1981). Today, Gwich'in continue to recognize certain highly respected individuals with the title of chief.

Beginning in the mid- to late 1800s, the fur trade, mineral development, church, and government all worked to undermine traditional kinship patterns by emphasizing the individual over the group. Europeans and Americans also brought new social values, laws, and economic models that undermined and even banned the traditional practices that supported the existing social structure and hierarchy. The Episcopal Church, for example, attempted to stop the ceremonial potlatch,[46] because missionaries believed it was wasteful (Dinero 2016, 2005; Simeone 1992). In doing so, the church failed to understand the importance of Gwich'in reciprocity by sharing wealth and maintaining physical and social well-being. The church's attempted ban threatened Gwich'in social and political organization and their survival. Despite the impacts of the Episcopal Church on social and political organization, the Gwich'in in many ways embraced the religion and viewed it as a positive force in their lives, while maintaining a connection to traditional belief systems that emphasized a spiritual connection between the human and animal worlds (Dinero 2016).

[44]Ancestral lineage traced through female relatives
[45]Social organization divided into two parts
[46]A ceremonial feast, where participants part with or destroy possessions in a display of wealth or prestige

Despite the various changes to social and political organization over time, much of the traditional Gwich'in social and political structure remains intact. Subsistence remains central to their identity. The people of Arctic Village and Venetie are primarily descendants of the Neets'aii band of the Gwich'in and, along with other Gwich'in, identify as the "caribou people" in reference to their main source of food and cultural and spiritual identity (Kofinas 1998). They view their primary cultural tradition as living with the caribou, with an emphasis on the reciprocal nature of their relationship with this important species.

Many traditional roles and practices related to hunting, fishing, and gathering remain in place today, and residents still observe traditional rituals and feasts, including the potlatch. Similar to the Iñupiat, sharing is central to maintaining social and kinship ties among the Gwich'in. Modern Gwich'in leadership also mirrors traditional leadership models, with village councils providing both moral and legal guidance to tribal members (Dinero 2005). The Gwich'in highly value traditional knowledge of the land and its resources; also, the passing on of traditional knowledge to younger generations is of utmost importance.

In the early 1940s, as a result of the combined efforts of the residents of the area, the US DOI established the Venetie Indian Reservation, which was meant to protect the lands for subsistence uses. After passage of ANCSA, residents of Arctic Village and Venetie, opted for title to the 1.8 million acres of reserve land, which they now own jointly through the Native Village of Venetie Tribal Government (Venetie Village Council 2013; Inoue 2004).

Unlike many Alaska Native communities, Arctic Village and Venetie are not shareholders in a regional ANCSA corporation and do not have ANSCA village corporations. As such, those communities do not receive any increased economic activity associated with resource development or shares therein by ANCSA corporations. Most other Alaska Gwich'in communities such as Beaver, Birch Creek, Chalkyitsik, Circle, Eagle, and Fort Yukon, are members of the ANCSA regional corporation Doyon, Limited, and have their own village corporations.

Since interest in developing the Arctic Refuge began in the 1980s, the Gwich'in—particularly the Gwich'in of Arctic Village and Venetie—have taken various legal and political actions to prevent such development. Based primarily on concerns about impacts on caribou who calve in the Coastal Plain and subsequent impacts on Gwich'in cultural survival, their opposition has led to many residents advocating for caribou and the Gwich'in way of life. Many of their people wish to protect their traditional lifestyle centered on the Porcupine Caribou Herd. However, in 1984, the Native Village of Venetie Tribal Government, proposed to offer their approximately 1.8 million acres of land for competitive oil and gas leasing (Senator Murkowski 2000). Many Gwich'in share a distrust of government rooted in generations of historical trauma and colonial encroachment on traditional lands. This distrust has resulted in some communities and residents being hesitant to participate in studies and share information, due to concerns that the information could be mishandled or used against them. One Gwich'in Cultural Expert recalled the concerns of the elders:

> *So, one of these days, it's going to all come towards us, the history of it, the bad way of life. Łyâa zhyàa, don't, lot of time, remember Roberts, they told Robert "Don't believe in the white people, because they're going to take what you want, and what you say they're going to use against you." So, we got we already got in defense over that, you know.*

In 1988, the first of many Gwich'in gatherings was held in Arctic Village to discuss the potential for development in the Arctic Refuge. Out of this meeting the Gwich'in Steering Committee was established,

whose stated goal was to "establish Gwich'in cultural survival as a major issue in the debate over oil development in the Arctic Refuge" (Inoue 2004). Meeting attendees included over 500 Gwich'in from both Alaska and Canada. Thus, while Arctic Village and Venetie have the closest ties to the program area and are most dependent on harvests of the Porcupine Caribou Herd, advocacy for protection of the Coastal Plain and the Porcupine Caribou Herd extends throughout the Alaskan Gwich'in communities.

Community institutions in Arctic Village include the Arctic Village Traditional Council; community institutions in Venetie include the Venetie Village Council. Both Arctic Village and Venetie are members of the Native Village of Venetie Tribal Government. Seven of nine Alaska Gwich'in communities are members of the Council of Athabascan Tribal Governments, and all are members of the Tanana Chiefs Conference (ADCCED 2018).

Gwich'in (Canada)

Traditional Canadian Gwich'in social structure is similar to that described for the Alaska Gwich'in (above); however, as residents of separate nations, their more recent social and political organizations involve the Canadian Government, the Gwich'in Tribal Council (GTC) and associated communities, and the Vuntut Gwich'in First Nation. All of these entities work together to co-manage Gwich'in land and wildlife (GTC 2018).

There have been numerous studies conducted or funded by various Gwich'in organizations, such as *At the Heart of the Teetlit Gwich'in Cultural Landscape*, funded by the Teetlit Gwich'in First Nation. Such studies demonstrate a lasting commitment to preserving their land and resources.

The Porcupine Caribou Herd is of high importance to the Canadian Gwich'in and has been a driver in the formation of agreements and legislation, such as the International Porcupine Caribou Agreement. It was established in 1987 and was signed by both the Canadian and US governments and was intended to help protect the Porcupine Caribou Herd, which migrates between northeastern Alaska and northwestern Canada (VGG 2017). Caribou Leadership: A Study of Traditional Knowledge, Animal, Behavior, and Policy is another example of co-management of the land and wildlife that was conducted in coordination with Tr'ondëk Hwëch'in First Nation, the Teetli't Gwich'in Renewable Resource Council of Gwich'in First Nation, and the Vuntut Gwitch'in First Nation (Padilla 2010).

The Gwich'in Tribal Council represents the Gwich'in of the Northwest Territories, while the Vuntut Gwich'in First Nation represents the Gwich'in of the Yukon (Old Crow). The Gwich'in Tribal Council formed in 1992 (GTC n.d.) and consists of a system of coordination with their federal partners to help support their vision (GTC 2018). The Gwich'in Tribal Council vision strives to be a "culturally vibrant and independent nation that is environmentally responsible and socially, economically, and politically self-reliant" (GTC 2018). Other Gwich'in organizations are the Gwich'in Development Corporation, the Vuntut Gwich'in Limited Partnership, and the Gwich'in Steering Committee, which includes membership by Alaskan and Canadian Gwich'in.

Mixed Cash/Subsistence Economy

Iñupiaq

The Iñupiat traditionally participated in an economy that relied on subsistence species and used trade to acquire goods not readily available in their immediate area. The concept of wealth was based on the number or amount of accumulated foods and goods; those with the most material possessions were the wealthiest.

Among the Iñupiat, the *umialik* was often held by the wealthiest person, who needed to have a surplus of food and property to outfit a whaling crew.

Iñupiat participated in extended trade networks that included both formalized and less formal modes of trading (Spencer 1959). Their trade was not limited to other Iñupiat, and they also traded with Athabascan peoples farther south, in addition to Inuit people to the east and Siberian people to the west. Trading often occurred through established trade fairs, such as those at Nigliq, on Barter Island and as far as Sheshalik in Kotzebue Sound (Burch 1981; Gubser 1965).

The economy of the North Slope underwent major changes beginning in the mid-nineteenth century. This is when commercial whaling introduced a new type of economy to the Iñupiat, followed by other economic developments, such as reindeer herding and fur trapping. The development of petroleum reserves began in the 1940s and is still the driving force of the economy on the North Slope.

Today, the Iñupiat of the North Slope continue to rely on subsistence species, while participating in the cash economy. Like other communities on the North Slope, Kaktovik and Nuiqsut have a mixed, subsistence-market economy (Walker and Wolfe 1987), where families invest money into small-scale, efficient technologies to harvest wild foods. Subsistence harvests are important in providing food to local households, and these foods are preferred by Natives, especially elders, over store-bought foods.

Cash from wage labor is also important in today's economy, as it enables residents to purchase gas, rifles, ammunition, transportation, and other tools and technologies they need in order to harvest subsistence foods. ANCSA corporation dividends rely heavily on oil and gas development, and many residents use their dividends as investments into their subsistence way of life. These investments can include gill nets, motorized skiffs, and snowmachines used to conduct subsistence activities. They are not oriented toward sales or profits but are focused on meeting the self-limiting needs of families and small communities.

For many Iñupiat, traditional hunting and harvesting patterns, which revolved around procuring subsistence foods when they were most available, now must be balanced with a need for income; thus, for individuals with full time jobs, wildlife harvesting is more likely to occur on weekends. In other cases, the wage provider of the household may not always be able to accompany other household members during certain subsistence activities but provides the cash for purchasing supplies and fuel. These arrangements, in which one person provides the money for other people to engage in subsistence activities, have become common in today's mixed subsistence-market economy.

Sharing is central to the Iñupiaq world view and one of the core values of their culture and society (NSB 2018). Sharing serves to maintain and strengthen social ties within and across communities. Customary practices like *Kivgiq* (the Messenger Feast) and *Nalukataq* or *Qagruq* (the spring Whale Festival) exemplify the interconnectedness of subsistence hunting and sharing in and beyond the community.

The trade networks that characterized the traditional subsistence economy between coastal and inland Iñupiat continue today, exchanging subsistence marine mammal products for terrestrial wildlife products. In fact, sharing subsistence foods with other communities and regions is a major component of the mixed economy, and it has been facilitated by advancements in rural transportation and technology. During a single year of sharing by Kaktovik households for key species, Kofinas et al. (2016) documented sharing ties between Kaktovik and 131 households spread across 22 other Alaskan communities, two Canadian villages, and 11 locations outside of Alaska. In addition, the NSB (2020) documented that in 2019, 88

percent of North Slope households shared subsistence foods within their community, 54 percent shared subsistence foods with other North Slope communities, 30 percent with NANA communities, 26 percent with Fairbanks, and 22 percent with other Alaskan communities. Thus, subsistence harvests on the North Slope are shared widely throughout the entire state of Alaska. Further discussion of subsistence uses of the program area by residents of Kaktovik and Nuiqsut are provided in **Sections 3.4.3** and **B.4.3**.

Inuvialuit

Just as their ancestors did, Inuvialuit people maintain a strong connection to the land and its resources. Many Inuvialuit continue to live a subsistence lifestyle, hunting caribou, seal, fish, and whales, and using other wild species of the North Slope and Beaufort Sea (Wildlife Management Advisory Council (North Slope) 1996).

Since ancient times, Inuvialuit have traded with neighboring groups, including the Iñupiat to the west and the Gwich'in to the south and southwest. As Euro-American whalers began settling in the area, trade expanded to include western trade goods, such as firearms. The Euro-American whalers also introduced a cash economy. In addition to trading with the Western whalers, Inuvialuit also became involved in the commercial whaling and commercial trapping industries, which reached their peak after World War I (Wildlife Management Advisory Council (North Slope) 1996).

As described in Usher (2002), the cash-based economy and reliance on wage employment became more widespread as development projects in the area increased. The bowhead whale industry collapsed around 1910 and, in its wake, decimated populations of caribou and marine mammal populations. The fur trade took over as the main economy of the region, and several fur trade posts were established. By the late 1960s, most Inuvialuit were adjusting to a way of life that included a mixture of wage employment and reliance on hunting, trapping, and fishing. As oil and gas exploration boomed in the 1970s and 1980s, Inuvialuit income and employment patterns changed even more.

Another factor that contributed to the development of a mixed cash and subsistence economy was the opening of day schools in Inuvialuit communities, which made a settlement-based way of life nearly unavoidable. The first federal day school was opened in Aklavik in 1951. Because attendance was mandatory in order for families to receive allowance benefits, families needed to stay in the vicinity of Aklavik during the school year. This schedule, in addition to the introduction of wage labor and economic pursuits, conflicted with the timing of many traditional subsistence activities (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018; Lyons 2009).

Despite the introduction of a cash economy, new technologies, imported goods, and a shift to a settlement-based way of life, Inuvialuit have worked to preserve their identity and their ties to the land. Part of protecting the Inuvialuit identity has been maintaining a subsistence-based economy, which persists today (Usher 2002). One method of maintaining Inuvialuit identity was through the Inuvialuit land claims and resulting IFA. The creation of the IFA was centered around maintaining Inuvialuit identity, including those cultural values that are intimately tied to a subsistence way of life. Today, the Inuvialuit people rely on both marine and terrestrial fish and wildlife, including the Porcupine Caribou Herd, which is a primary species of cultural importance (Wildlife Management Advisory Council (North Slope) 1996).

Gwich'in (Alaska)

Before Euro-American contact, the Gwich'in were seminomadic hunters and gatherers who moved seasonally throughout the year in reasonably well-defined territories to harvest fish, wildlife, and a variety of plants. The pre-contact Gwich'in economy revolved around subsistence species, and they traded to acquire goods not readily available in their immediate area. The subsistence economy was focused primarily on harvesting not only caribou but also fish, such as whitefish, and other species.

First contact between Europeans and the Neets'aii Gwich'in occurred somewhere between 1847, upon establishment of Hudson's Bay Company at Fort Yukon, and the 1860s, with missionary efforts in the region (Dinero 2016). Up until the discovery of gold in the Gwich'in territories in the 1890s (1893 at Birch Creek), the subsistence economy was largely intact, and Native people remained independent and essential to the Euro-American fur trading economy (Mishler and Simeone 2004). The Gwich'in increasingly participated in the cash economy, while maintaining a strong subsistence lifestyle. This increasing reliance on a mixed cash/subsistence economy, in combination with the establishment of schools and requirement that all children attend them, prompted a shift to a more stable village life, which opened the door for further changes to the traditional economy (Dinero 2016; Stern 2018).

Beginning with the gold rush and especially by the start of World War II, the Gwich'in were presented with alternative ways of living, which were not oriented toward a life wholly dependent on the land. A living based on hunting, fishing, and trapping became only one of several choices; subsistence became a component of a "mixed, subsistence-market economy" (Wolfe and Walker 1987), rather than supplying the entire economy as it once did.

The Gwich'in of Arctic Village and Venetie have a deep relationship with the land they occupy and the species they use. This identification of the Porcupine Caribou Herd Calving Grounds as a sacred site the Gwich'in per EO 13007 exemplifies this connection (see Section B.4.2 for additional information). In contrast to the Iñupiaq villages farther north, there is little economic development in the Gwich'in area and few opportunities for local employment (Kofinas et al. 2016). In most cases, seasonal employment rather than full-time or permanent employment directly supports the subsistence activities of individuals. They, in turn, share the harvest with residents, as well as those who live in villages and regional centers, including Fairbanks and Anchorage (Caulfield 1983). Sharing is a key component of Gwich'in culture and values. Studies on sharing and trade networks in Venetie and Fort Yukon have shown that subsistence foods, including caribou, fish, birds, and berries, are distributed widely throughout Gwich'in communities and beyond (Kofinas et al. 2016; Brown et al. 2017a), either through sharing, trading, or bartering. The relative lack of cash to support subsistence activities would make these communities more vulnerable to changes in the availability of wildlife, such as caribou. This is because residents have less capacity to travel great distances in search of subsistence foods or to purchase alternative foods that are less desirable.

Gwich'in (Canada)

Like the Alaskan Gwich'in, before European contact the Canadian Gwich'in led semi-nomadic lives, subsisting off the land on a seasonal basis. They hunted wild game, such as caribou, moose, mountain sheep, black bear, beaver, porcupine, and birds, and fished along the rivers (Kritsch et al. 2000). They also gathered plants for food and had yearly celebrations at the end of every long winter, where they traded goods with one another (Fafard and Kritsch 2003). These celebrations would occur during harvest season when the caribou herds were migrating through the region. As with the Gwich'in of Alaska, the Porcupine Caribou Herd remains central to the livelihood of the Canadian Gwich'in. In particular, this is the case among the

Vuntut Gwich'in of Old Crow due to their location and the availability of caribou relative to other species (Benson 2012).

The fur trade began with the arrival of the Europeans in the early 1800s and the establishment of trading posts, followed by a gradual growth of the wage economy (Wray 2011). The increase in settlers to the region created a need for hunters and trappers to provide fur and food. Gwich'in men began working for the new settlers, often providing manual labor, such as chopping wood and repairing boats (Wray 2011).

As schools opened and furthered the centralization of the Gwich'in, many Gwich'in women settled into homes and began making clothing and doing laundry for the newcomers (Wray 2011). With the influence of Western culture came significant changes to the traditional Gwich'in economy. Introductions to new hunting technology, such as snow machines and guns, made subsistence hunting easier, but the cost of gas and equipment encouraged participation in the cash economy to pay for these supplies.

As discussed above under *History* and *Social and Political Organization*, a number of other factors played into the transition from a subsistence-based to a mixed subsistence-cash economy: the Klondike Gold Rush, construction of the Dempster Highway, and reduced wildlife populations (Fafard and Kritsch 2003). Land claims by the Gwich'in were in many ways prompted by increased competition for wild resources and efforts to develop traditional Gwich'in lands. Such claims were meant to provide for Gwich'in management of their lands, wildlife, and natural resources, in addition to allowing for the responsible development of their own lands (Western Arctic Handbook Committee 2002; Wei' and Freeman 1995). Although there has been a significant amount of change to the Gwich'in land and culture, the Canadian Gwich'in have continued to keep their culture alive through subsistence hunting and continued care for the land and its animals, while participating in the wage economy.

Belief Systems

Iñupiaq

Traditional Iñupiaq belief systems consisted of two religious elements: hunting ritual and shamanism. These elements were similar to belief systems held by other Eskimo populations (Spencer 1984). Iñupiaq beliefs originally revolved around a system oriented to the environment and its animals.

Following proper hunting rituals was necessary to ensure a successful harvest. These rituals included actions taken before the hunt to avoid offending the animals and rituals taken after an animal was taken. Examples of this are offering freshwater to sea mammals, giving gifts to trapped land animals, and cutting the throat or opening the brain pan to free the soul (Spencer 1984). The more important the species was to the community, the more elaborate and extensive the rituals and ceremonies associated with it. One of the most important ceremonies on the coast, which remains important today, was the whale feast (Nalukataq); its inland counterpart was the caribou festival (Spencer 1959). The messenger feast (Kivgiq), which has seen a revival on the North Slope in recent years, was an opportunity for Iñupiat from across the region to come together for trading and sharing.

Shamanism was a second key component to Iñupiaq belief systems. Shamans played specific roles relating to illness, predicting weather, finding lost items, foretelling the future, and speaking to the dead (Spencer 1984; Hall 1984). Despite the existence of shamans in traditional Iñupiaq society, the traditional belief system was largely fatalistic (Chance 1990); in other words, Iñupiat believed that powers beyond their

control governed their environment. Their rituals and shamans, while having some influence, might prove ineffective despite their efforts.

Belief systems among the Iñupiat of the North Slope were largely unchanged before 1890, even though the region had experienced several changes from the whaling industry and various exploratory expeditions. After 1890, a number of Christian missions were established in the region, and rapid changes to Iñupiaq belief systems began.

The introduction of Christianity also introduced a rippling effect of changes that altered some Iñupiaq cultural values and traditions, particularly those surrounding housing, morality, subsistence, and social organization; however, despite these changes, the Iñupiat of the North Slope today retain a strong cultural identity associated with traditional subsistence hunting and harvesting patterns, and many traditional belief systems are strongly held and celebrated.

Iñupiat adhere to a set of core beliefs and values that are rooted in their culture. These contemporary Iñupiaq values strongly mirror traditional ones and include knowledge of the family tree, humility, avoidance of conflict, hunting traditions, family and kinship, respect for nature, sharing, and spirituality (NSB 2018). Many Inupiaq values are directly reflected in subsistence activities and practices; others reflect the importance of cultural continuity and social and family ties within and among communities. Examples of this are language, family and kinship, humor, compassion, love and respect for elders, humility, avoidance of conflict, and spirituality (USACE 2012).

Language retention rates are relatively high among the Iñupiaq of the North Slope, with 71 percent of household heads indicating that use of the Inupiaq language was very important in 2016 (SRB&A 2017). This could be evidence of the North Slope residents to promote knowledge of traditional values, such as through the establishment of the NSB IHLC Division, reintroducing the Iñupiaq language into schools, publishing elder conference proceedings, working with archaeologists to continue building their cultural history, and replacing English place names with Iñupiaq ones (Chance 1990).

Both Christian and traditional values and beliefs continue among the Iñupiat. While many traditional beliefs are no longer ascribed to, Christianity and the traditional belief system have become fused and often exist simultaneously in a single system (John 1996). Although there is primarily a Christian belief system in place, Alaska Native reverence for their environment and the traditional concepts of respect for the animals and each other is still in place and practiced. This is clearly seen in the values listed above, which emphasize respect for nature and hunter success. The Alaska Natives' respect for their environment and the fish and animals is thus an integral part of their belief system.

Sharing is central to the Iñupiaq world view and one of the core values of their culture and society (NSB 2018). Sharing serves to maintain and strengthen social ties within and across communities. Customary practices like *Kivgiq* (the Messenger Feast) and *Nalukataq* or *Qagruq* (the spring Whale Festival) exemplify the interconnectedness of subsistence hunting and sharing in and beyond the community.

Coastal North Slope communities, such as Kaktovik and Nuiqsut, maintain a strong maritime culture that centers on the bowhead whale hunt and emphasizes cooperation, participation in hunting traditions, and sharing. Whaling captains continue to have central roles as leaders in their communities and across the region. To the Iñupiat, protecting the land and water is essential to maintaining a culture that relies on the

harvest of wild foods. This includes maintaining lands that are untouched by industry and where residents can conduct subsistence activities in relative solitude.

For the program area and greater territory of the Kaktovikmiut, this belief in the duty of the Iñupiat to protect their homeland and to serve as stewards of the land and sea is described in the City of Kaktovik's document "In This Place" and is succinctly expressed in the opening general statement as follows: "We the Kaktovikmiut, the people of Kaktovik, are principally Iñupiat Eskimo, Native people of the Arctic Slope, the country that drains northward from the Brooks Range to the Arctic Ocean. We use and occupy this country, its associated waters, and the sea; and have claimed it since time immemorial by virtue both of aboriginal rights and our continued and undisplaced use and occupance [sic]" (City of Kaktovik and Karl E. Francis & Associates 1991, page 1)

Inuvialuit

According to an ancient story, Inuvialuit people are descendants of a hunter, his wife, his son, and an orphan girl who all survived a great flood by building a raft (Wildlife Management Advisory Council (North Slope) and Aklavik Hunters and Trappers Committee 2018). Other passed-down stories and legends tell about *ingilraani*, or "a long time ago." These stories, which are still told, provide a link to times far beyond living memory and serve to perpetuate cultural values (Inuvialuit Regional Corporation 2011).

Traditional Inuvialuit spiritual beliefs revolved around the belief that all things in nature have spirits. They could be helpful or harmful to people, depending on whether they were properly respected. Within this belief system, shamans (*angatkut*) had the power to intervene and communicate with spirits. People could seek the help of a shaman if they were sick, unsuccessful in hunting, or otherwise afflicted. The shaman could help to ward off or appease harmful spirits and even had the power to control the weather. *Aanruarutit* (amulets or charms) could also be worn to ward off harmful spirits (Inuvialuit Regional Corporation 2011). Many rules and taboos dictated proper behavior. Following the rules was a way to show respect for the spirits, while breaking rules could show the opposite and result in misfortune (Inuvialuit Regional Corporation 2011).

As Euro-American whalers moved into Inuvialuit homelands they brought with them Christianity, new belief systems, and new religious values and rules. The Inuvialuit resisted initial Christian conversions, illustrated by the fact that Anglican minister Isaac Stringer was said not to have a single convert during his time among the Inuvialuit. It was only after missionaries began incorporating elements of traditional Inuvialuit culture that Inuvialuit people began converting to Christianity (Lyons 2009). Christianity and many western systems and rules were eventually incorporated into Inuvialuit culture; however, Inuvialuit people today continue to have a distinct value system, including a strong sense of stewardship of the land and resources and a traditional knowledge base that dictates how to protect those species (Wildlife Management Advisory Council (North Slope) 1996).

Gwich'in (Alaska)

The Gwich'in have a spiritual relationship with their environment that is integral to their cultural system. Before the gradual incorporation of Christian beliefs and Western values into their existing traditional belief system beginning in the mid-nineteenth century, the Gwich'in followed a loosely organized, animistic religion. It centered on a reciprocal relationship between humans and the rest of the natural world (Slobodin 1981; VanStone 1974).

Gwich'in belief systems have a holistic view of nature, in that no distinction existed between humans and animals, and everything in nature was considered sentient or to have a spiritual essence. Plants and animals are not objects governed by instinct but social beings with a spiritual potency controlled by powerful spirits or guardians. According to testimony by Johnny Frank of Arctic Village, traditional spiritual beliefs hold that humans and animals were once the same, and they all shared the same language. Caribou hold a particularly special relevance to Gwich'in spirituality and were believed to share a physical and spiritual connection with humans (Dinero 2016).

According to Gwich'in elders, before humans and animals separated, they reached an agreement in which they acknowledged each other's hardships and came to agreement regarding human-animal relations. As part of the agreement, humans were given some of the wisdom of the caribou, while the caribou were given the ability to run fast. Caribou were still allowed to retain some of the wisdom that was imparted to humans and, hence, humans and caribou share a special bond (Kofinas 1998). In fact, the Gwich'in believe that a piece of caribou heart is in every human, and vice versa (Gwich'in Steering Committee 2004). The key cosmological figures among the Gwich'in were Raven, the cultural hero Attachookaii, and the trickster Vasaagijik (Slobodin 1981).

Christian missionaries of various denominations had considerable effect on the traditional Gwich'in belief system and used an intense five-fold strategy of building, speaking, teaching, healing, and traveling to undercut traditional ways of life and to provide what were perceived as appropriate Christian alternatives (Fienup-Riordan 1992). Early in the twentieth century the Episcopal Church attempted to abolish the potlatch, but was rebuffed, and today the potlatch is stronger than ever and remains a significant part of Native identity. Others fused Christianity and traditional beliefs into a single belief system as some of the Dena'ina had done with the Russian Orthodoxy and the Iñupiat had done with the Anglicans and Presbyterians. Lastly, some individual Athabascans saw the presence of missionaries as a good thing, saving individuals from alcoholism, while others saw a bias against Native people and their traditional ways (Reckord 1979).

The proper relationship between humans and animals is a central tenet of the traditional belief system. Animals were not only a source of food but powerful spiritual beings that must be treated with respect. Animals and humans shared an essence of personhood; both were sentient and volitional. They acted on their own values and choices and shared a fundamental organization in that each had a soul, a language, a family, and similar emotional characteristics, including anger and a desire for vengeance.

Animals and humans existed in a reciprocal relationship in which humans needed to kill animals to survive and animals desired to give themselves as food, but only on the condition that humans treated them with respect. The importance of reciprocity extends to humans as well—failure to share foods with others is not only frowned on socially but is considered a violation of a kind of social contract with game animals, threatening the success of future harvests (Caulfield 1983).

The importance of reciprocity in human and animal relationships is evident in contemporary Gwich'in culture through their continued identification as the Caribou People, their continued observance of certain customary laws, the continued practice of traditional rituals, such as the potlatch, and the strong belief in the sacredness of places like the Coastal Plain, due to its integral connection to caribou calving and migratory bird nesting grounds.

In recent community plans, both Venetie and Arctic Village provided a list of community values, which included topics related to the subsistence lifestyle, sharing, protection of land, elders and youth, education, employment, remaining drug and alcohol free, family, leadership, and unity (Venetie Village Council 2013, Arctic Village Council 2019).

Gwich'in (Canada)

Traditional Canadian Gwich'in belief systems are similar to those described for the Alaskan Gwich'in above. The strong connection between the Gwich'in, their homeland, and the animals that inhabit their homeland is illustrated by a traditional story of a meeting between animals and humans in the spirit world to discuss how to hunt and treat animals in the future (Wray 2011). The Gwich'in today still uphold this respect for animals, which is reflected in their stories and hunting methods and rules.

Similar to the Gwich'in of Alaska, Canadian Gwich'in belief systems focused on the spiritual connection between them and caribou. Canadian Gwich'in also believe that humans carry a piece of caribou heart in them and vice versa. The Gwich'in believe that they once lived in peaceful intimacy with caribou. Once the animal and human worlds separated, humans began hunting caribou, but a mutual respect was maintained; humans were allowed to use animals for food but agreed to treat their prey with respect and to take only what they needed (Wray 2011). Traditional laws among the Trondëʼk Hwëchʼin guide their spiritual relationships with caribou and include reciprocity in respecting and caring for one another; importance of habitat areas and the ability of the caribou to select places to feed, rest, and rear their young; the importance of sustainable harvest to Trondëʼk Hwëchʼin identity, and the responsibility to ensure healthy and abundant caribou herds for future generations (Trondëʼk Hwëchʼin First Nation 2023)

The establishment of Roman Catholic and Anglican missions in the mid-1800s had a dramatic effect on Gwich'in belief systems. Conversion to Christianity resulted in changes to the seasonal round, as residents were encouraged to come to town during religious holidays, such as Christmas and Easter (Committee 2002). Despite the adoption of Christian beliefs, many Gwich'in consider their relationship with the land and its resources to be a core spiritual value. In particular, they rely heavily on the Porcupine Caribou Herd, more heavily than some in coastal communities, who have a wider species base; therefore, the herd is considered central to the spiritual and cultural survival of the Gwich'in (Inoue 2004).

Climate Change

Many of the impacts of climate change on sociocultural systems stem from impacts on subsistence uses and resources (see **Section B.4.3,** *Climate Change).* Indigenous people are uniquely attuned to their environment, using traditional knowledge passed on through generations to harvest subsistence foods safely and successfully. Successful harvests are in large part dependent on a predictable seasonal round, whereby subsistence activities occur during certain seasons when environmental conditions allow for travel to traditional harvesting areas, and subsistence species are available within those traditional harvesting areas. In recent decades, climate change has caused warmer temperatures; changes in precipitation and the frequency and intensity of storms; changes in ice and snow cover; erosion; and changes in species migration, abundance, and health. All of these changes can affect the timing, location, and success of subsistence harvesting activities, as well as the processing of subsistence foods.

Climate change has the potential to affect subsistence uses by reducing the availability of subsistence species within harvest areas through changes in abundance or migration routes and timing; reducing access to subsistence harvesting areas through changes in ice and snow conditions, as well as the navigability of

rivers and coastlines; affecting harvester safety by causing residents to travel farther in search of wildlife, often in unsafe conditions; and affecting food storage and processing methods through degradation of ice cellars and increased precipitation. Decreased subsistence opportunities can have far-reaching sociocultural impacts within a community. When residents have fewer opportunities to hunt and harvest subsistence foods, they also have fewer opportunities to transmit traditional knowledge about the land and resources, process and consume subsistence foods in their home and at community feasts, and share subsistence foods with other households and communities, which are all key aspects of Iñupiaq, Inuvialuit, and Gwich'in belief systems. Changing ice and travel conditions, in addition to changes in the timing and location of wildlife migrations, may also cause hunters to travel farther from their communities, spending more time and money and taking greater safety risks. Increased accidents and injuries could increase public safety needs in communities. Erosion and melting permafrost may also cause the degradation of traditional lands and loss of traditional campsites, cabins, and historic sites, which are important to community identity.

Climate change may also affect sociocultural systems by increasing food insecurity and economic inequality. This could affect social structures, increase social stresses associated with increased exposure, vulnerability, and health and safety risks, and increase burdens on public services. All of these can add stress to social and political structures (Gray 2008, IPCC 2018).

B.4.5 Environmental Justice

Affected Environment

Environmental justice is defined in EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. It requires that proposed projects be evaluated for disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations, low-income populations, and Indian/Alaska Native Tribes. This EO was supplemented by EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, April 26, 2023, which directs federal agencies, as appropriate and consistent with applicable law, to identify, analyze, and address disproportionate and adverse human health and environmental effects (including risks) and hazards of federal activities, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns. In addition, in 2016, the DOI released the updated Environmental Justice Strategic Plan that establishes goals, objectives, and detailed guidance for federal agencies to ensure that no racial, ethnic, cultural, or socioeconomic group disproportionately bears the negative environmental consequences of governmental programs, policies, or activities (DOI 2016).

Consistent with CEQ guidelines for evaluating potential environmental justice effects of a proposed agency action under NEPA (CEQ 1997), this analysis defines the term "minority population" to include people who are American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, some other race (other than White), a combination of two or more races, or Hispanic. In other words, all individuals other than non-Hispanic, Whites are considered to be part of one or more minority populations. Also consistent with CEQ guidelines, the term "low-income population" is defined to include people who are living in poverty according to the U.S. Census Bureau's annual statistical poverty thresholds. In this environmental justice analysis, any American Indian or Alaska Native is considered part of a tribal population, whether or not he or she is a member of a federally recognized tribe.

According to both CEQ (1997) and BLM (2022) guidelines, an environmental justice analysis should identify communities within the study area having a concentration of low-income and/or minority

populations. For the purposes of this analysis, communities were determined to meet this criterion when either their low-income and/or minority population exceeds 50 percent, or their low-income and/or minority population percentage is meaningfully greater[47] than the low-income and/or minority population percentage in the general population or other appropriate unit of geographic analysis.

For the purposes of this environmental justice analysis, there are four primary study 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 Porcupine Caribou Herd and Central Arctic Herd —this section also includes 18 other Alaska communities that have documented customary and traditional uses for caribou in GMU subunits that are in the ranges of the Central Arctic Herd and Porcupine Caribou Herd (see **Section B.4.3**).

As shown in **Table O-1** in **Appendix O,** according to U.S. Census Bureau data, American Indian/Alaska Native residents of Kaktovik, Nuiqsut, Arctic Village, and Venetie—specifically Iñupiat in Kaktovik and Nuiqsut and Gwich'in in Arctic Village and Venetie—account for between 92.6 and 95.1 percent of the total population of each community. The total minority populations of these communities range from 93.2 to 96.0 percent of the total community population. The statewide population is 15.2 percent American Indian/Alaska Native and 40.6 percent minority overall.

The minority composition of Kaktovik, Nuiqsut, Arctic Village, and Venetie, compared with Alaska, is also shown in **Table O-1** in **Appendix O**. Based on U.S. Census Bureau data, the minority population in all four communities is well above the 50 percent threshold and meaningfully greater than the general reference population, as specified in the CEQ guidelines (CEQ 1997). Based on minority population criteria, these communities should be considered for potential environmental justice issues when evaluating the effects of the action. Additionally, as shown in **Table O-1** in **Appendix O**, while the proportion of low-income residents in Nuiqsut is below that seen in the general population of Alaska, the low-income population components of Kaktovik, Arctic Village, and Venetie are meaningfully greater, with 17.4 percent, 45.8 percent, and 31.2 percent of the residents in these communities living below the poverty level, respectively. Finally, each of these four communities is associated with an Alaska Native tribal entity. As a result, each community meets more than one criterion for potential impacts of the action to be of environmental justice concern.

In addition to describing the four primary study communities, **Table O-1** in **Appendix O** presents minority and low-income population data for the other communities within the study area. Among these communities, the only ones in which both the minority proportions of the populations are not meaningfully greater than that of the state are Wiseman, Bettles, Eagle, and Coldfoot. With the exception of these four communities and Utqiaġvik and Wainwright, the low-income proportions of the populations of the other study area communities are meaningfully greater than that of the state. **Table O-1** in **Appendix O** also shows that nearly all of these other study area communities are associated with federally recognized Alaska

[47]In this environmental justice analysis, the meaningfully greater threshold is defined as follows: if the minority and/or low-income population percentage in a given community is equal to or greater than 110 percent of the minority and/or low-income population percentage in a geographic reference area. For the purposes of this analysis, Alaska is the reference area.

Native Tribes. The communities not associated with federally recognized tribes are Wiseman, Bettles, and Coldfoot.

Kaktovik and Nuiqsut are located in the NSB, while Arctic Village and Venetie are located in the Yukon–Koyukuk Census Area (YKCA). With respect to the other study area communities, five are in the NSB, twelve are in the YKCA, and one is in the Southeast Fairbanks Census Area. As shown in **Tables O-1** in **Appendix O**, while the low-income proportion of the NSB's overall population is roughly equivalent to that of Alaska, the minority proportion of the NSB's population is meaningfully greater than that of the state as a whole. In the YKCA, both the low-income and minority proportions of the population are meaningfully greater than that of the state. In the Southeast Fairbanks Census Area, the low-income proportion of the population is meaningfully greater than that of the state, but the minority proportion of the population is lower.

The CEQ guidelines directs federal agencies to apply CEQ guidance with flexibility. It says to consider them as a point of departure, rather than conclusive direction in applying the terms of EO 12898. Following this guidance, analyses of potential impacts should be highly sensitive to the history or circumstances of a given community or population.

The CEQ guidelines also suggest that where an agency action may affect fish, vegetation, or wildlife, it may also affect subsistence patterns of consumption and indicate the potential for disproportionately high and adverse human health or environmental effects on low-income populations, minority populations, and Indian/Alaska Native Tribes. It is relevant to identify differential patterns of consumption of natural resources among minority populations and low-income populations, where the term means differences in rates or patterns of fish, water, vegetation, or wildlife consumption among minority populations, low-income populations, or Indian/Alaska Native Tribes, compared with the general population (CEQ 1997). Subsistence patterns are covered in detail in **Section B.4.3**.

As noted in the affected environment descriptions for sociocultural systems and economy (**Section B.4.4** and **B.4.10**, respectively), the different histories and circumstances of the relevant Iñupiat and Gwich'in, such as outcomes under the ANCSA and the formation of the NSB, are likely to not only result in a differential distribution of potential impacts from the action but also to affect the vulnerability and resilience relative to potential adverse impacts.

According to **Section B.4.4**, social and cultural values related to subsistence resources and activities represent a key area for the exploration of environmental justice. For example, primary concerns of the Gwich'in expressed during public scoping were the sacredness of the caribou calving and bird nesting grounds in the program area. This is in addition to more direct potential impacts on the reliability of the Porcupine Caribou Herd and waterfowl annual migrations through Gwich'in territory. In other words, potential environmental justice impacts related to potential adverse impacts on subsistence resources extend well beyond the immediate program area, and they encompass the social and cultural value of subsistence resources (and their uses), as described in ANILCA, as well as the value of direct reliance on these resources for physical sustenance.

Climate Change

As noted in BLM (2018a) climate change can be understood as an environmental justice issue. People who live in poverty may be particularly vulnerable to the negative economic impacts of climate change because

they have fewer financial resources to cope with these effects (EPA 2017a). Alaska Natives living in rural areas also may be especially vulnerable to climate-related effects due to their economic, nutritional, and cultural dependence on subsistence food resources (EPA 2017b). Often, conditions of poverty amplify adverse impacts on subsistence resource use. For example, if subsistence harvests decrease or subsistence-related travel costs increase, lower-income households may be unable to spend more money on fuel and other subsistence-related expenses, and they may be less able to shift to more expensive commercial food sources, thereby potentially experiencing decreased food security (BLM 2018b).

The Alaska Natives of northern Alaska and Interior Alaska, including the Iñupiat and Gwich'in, are disproportionately affected by climate change, both by the fact that climate change effects are more pronounced in these regions and by the fact that subsistence activities in the two regions are particularly dependent on ice, wind, and permafrost conditions. Recent research utilizing SNAP climate projection data reports that climate change is altering the environment of northern Alaska and Interior Alaska and affecting subsistence users' ability to access subsistence resources at appropriate times (Brinkman et al. 2016). The reduction of sea ice has exacerbated coastal erosion, the weather has become less predictable, the shore ice in spring is less stable for whaling, fall travel for caribou is hampered by a late and unreliable freeze up, spring hunting for geese is hampered by an early breakup, and ice cellars provide less reliable food storage. All these issues create significant concerns for many Alaska Natives because they are threatening their way of life (Brinkman et al. 2016).

B.4.6 Recreation

Affected Environment

Recreation opportunities and settings in the program area are largely as described in the Arctic Refuge CCP (USFWS 2015a), which is incorporated here by reference; a summary is provided below.

The primary recreation opportunities in the program area are wildlife viewing, camping, backpacking, hiking, photographing, hunting, fishing, and boating (Christensen and Christensen 2009). These activities include hunting and fishing for non-federally qualified subsistence users, permitted commercial activities, such as guided float trips and hunting, and individual visitors engaged in dispersed recreation, such as backpacking and photographing. Polar bear viewing and ski touring are also popular (USFWS 2018b).

The recreation setting of the program area is remote; in many cases, visitors do not encounter other people during their visit. The remote setting of the program area is a primary driver of visitation, with recreationists coming specifically to experience landscapes and wildlife considered largely untouched by human activities. Therefore, recreational activities are often directly tied to special designations such as wilderness and WSRs, where recreationists can experience relatively untouched and pristine landscapes (see **Section B.4.7**, Special Designations). The views, including views of dark skies, as well as solitude and quiet are all important characteristics of recreation experiences within the program area.

Visual quality contributes to the physical setting and directly influences recreationists' desire and satisfaction with recreation in the program area; therefore, undisturbed landscapes contribute to higher-quality recreation opportunities (see **Section B.4.8**, Visual Resources). Many people visit the program area in the summer, when near-constant daylight provides unique multiday recreation opportunities. Conversely, night skies are also an important component of visual quality that contributes to the recreation setting in the program area. The program area provides an unparalleled view of the northern Alaska night sky in its natural state due to the remote setting and lack of light pollution. As a result, visitors are increasingly coming to

the program area later in the fall to experience rapid decreases in average daily daylight and the opportunity to view and photograph the night sky and, if present, the Northern Lights. During the winter season, weather, surface water, land surface conditions, and near-continual darkness limit access to many parts of the program area. Therefore, recreation activities are less common during this season. In the spring, ski- and dog team-based general (non-subsistence) hunting is an increasingly popular activity, even if much of the program area is otherwise inaccessible for similar reasons described in the winter months.

There is limited overland motorized access to or in the program area. ANILCA (Section 1110(a)) and DOI regulations at 43 CFR 36.11 allow snowmachines during periods of adequate snow cover. Motorized recreation opportunities and use of motor vehicles to access other forms of recreation consist mainly of snowmachines, which are authorized during periods of adequate snow cover. Most snowmachine use is currently associated with subsistence activities. The only roads in the program area are near the community of Kaktovik. Local residents typically access inland areas by aircraft, skiing, or by foot. Therefore, like visual quality, the acoustic quality is an important characteristic of the recreational experience (see **Section B.2.3**, Acoustic Environment. The acoustic quality of the program area is directly tied to the lack of motorized use and accessibility. The remoteness of the program area typically allows the natural soundscape to dominate the acoustic experience. The natural soundscape is a key component of the recreation experience, especially for activities such as wildlife viewing, camping, and fishing.

Visitors to the inland portions of the program area arrive by chartered aircraft or by hiking, skiing, or floating from the Arctic Village, Kaktovik, and other access points. Air operators providing transportation services to visitors are managed through a special use permit system that is designed to implement regulations for commercial uses of Refuges and identifies the specifications for their operations. There is a relative absence of water bodies sizable enough to support float landings, so the vast majority of landings are made on land and where surface conditions permit it. Visitors enter the program area directly via chartered aircraft, from the south of Brooks Range via Arctic Village, Kaktovik, Fort Yukon, or Coldfoot, or to a lesser extent, from the Dalton Highway and then fly from Happy Valley.

While specific information on visitation and popular locations is not available, the USFWS does track the locations where permitted air operators land small aircraft to drop off and pick up recreationists. These landing locations are used to define priority recreation areas, or those locations within the program area most commonly accessed for recreation activities. Based on these landing locations, there are nine priority recreation areas within the program area. Another priority recreation area in the program area is the Hulahula River that is not captured by landing locations used by permitted air operators, which is an eligible and suitable WSR where recreation is considered one of its outstandingly remarkable values (ORVs) (see **Section B.4.7**, Special Designations).

Table B-22 identifies client use days[48] (CUDs) within the program area from 2018 to 2021. Besides the dip in 2020, which can be attributed to the Covid-19 pandemic, the table shows an increasing trend in CUDs. Additionally, there were larger numbers of floating, hunting, and other recreational uses in 2021 compared to the other years. Floating is one of the most popular recreation activities within the program area, however,

[48]One client use day is equivalent to each 24-hour period a person spends on a refuge conducting a specific activity, and therefore one person's visit may comprise multiple use days. Authorized operators are charged fees for each client use day they spend supporting visitors on Refuges.

Table B-22
Total Number of Client Use Days for Recreation Activities

Recreation Activity	Year			
	2018	2019	2020	2021
Floating	2711	2536	413	3553
Backpacking	905	628	278	502
Basecamping	379	916	14	646
Hunting	1684	1845	2251	3430
Other use	2711	2536	413	3553
Total	**5937**	**6305**	**3112**	**8176**

Source: (USFWS 2023)

hunting is becoming increasingly popular, along with other uses, such as polar bear viewing. Most visitors access the project area by hiring air service operators for transportation into remote areas. Other methods of visitor access to recreation opportunities the program area include by boat or on foot.

In 2021, eight commercial air service operators provided air taxi service for 811 visitors. Air taxi service supported recreation for 323 river floaters, 51 backpackers, 85 base campers, and 341 hunters (USFWS 2023).

Polar bear viewing is also a popular activity in the project area. In 2017, which is the most recent year for data specific to polar bear viewing activities, guided polar bear viewing accounted for approximately 54 percent of all reported guided recreation activities in the program area. There are viewing opportunities near Kaktovik, including through guided viewing tours. Expanded infrastructure at Kaktovik supports international visitors seeking the unique opportunity of viewing polar bears outside of captivity

During the summer and fall, the Canning and Hulahula Rivers support most water-based access to the interior areas in the program area. The Canning, Huluhula, Okpilik, Lago, and Aichilik Rivers each provide recreation opportunities for paddlers choosing to paddle out of the mountains and across the Arctic Plain. The Hulahula River is the only candidate for WSR designation with recreation ORVs located within the program area (see **Section B.4.7**, Special Designations). Smaller rivers, such as the Tamayariak, Katakturuk, Marsh Creek, and Sadlerochit, also flow across the Coastal Plain and provide routes for backpackers. Most recreation occurs along these river corridors, and visitors typically travel by plane to their headwaters in the southern portion of the program area.

As described in the Arctic Refuge CCP (USFWS 2015a), caribou viewing and hunting are popular recreation activities among program area visitors in the spring and early summer, with hunting occurring in March, April, and August, and viewing occurring in June and July. Caribou are the primary game species hunted in the program area, which is entirely in GMU 26C. There is also subsistence hunting of caribou and marine mammals that takes place in the program area (see **Section B.4.3**, Subsistence Use and Resources). In 2021, approximately 42 percent of all reported guided recreation in the program area was hunting (USFWS 2023).

Climate Change

The unique character of landscapes in the program area would continue to change in response to climate change. Increasing temperatures would directly affect recreation by varying opportunities to participate in over-snow activities, such as ski touring, due to changing and unpredictable weather patterns. Warmer temperatures associated with climate change would increase the potential for direct and indirect impacts on

recreation from the earlier thawing of permafrost and variable stream flows, which are altering or diminishing the quality of recreation and the ability of visitors to access them. It is possible that the effects of changing climatic conditions could impact priority recreation areas, including popular landing sites and rivers and streams with high-quality recreation values.

B.4.7 Special Designations

Affected Environment

Marine Protected Area

The USFWS (2015a, Section 4.1.3.3, Marine Protected Area) described marine protected areas (MPAs). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on the program area.

The Arctic Refuge MPA was accepted for inclusion in the national system of MPAs in 2005. MPAs have legally established goals, conservation objectives, and intended purposes, such as to conserve biodiversity in support of research and education, to protect benthic habitat in order to recover over-fished stocks, and to protect and interpret shipwrecks for maritime education. These descriptors of an MPA are reflected in the site's conservation focus, which represents the characteristics of the area that the MPA was established to conserve (NOAA 2017).

MPAs come in a variety of forms and are established to protect ecosystems, preserve cultural resources, such as shipwrecks and archaeological sites, or sustain fisheries production. MPAs are defined as "…any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein" (EO 13158, May 26, 2000). The goals of the national system of MPAs are to conserve and manage natural heritage, cultural heritage, and sustainable production. Natural heritage refers to the nation's biological communities, habitats, ecosystems, and processes and the ecological services, values and uses they provide (see **Section B.3**, Biological Resources and **Section B.4.3**, Subsistence Uses and Resources).

The DOI nominated the Arctic Refuge in 2005 and it was accepted for inclusion in the national system of MPAs (see **Map 3-64**, Special Designations in **Appendix A**). There are no special conditions for managing the Arctic Refuge MPA, but designation provides its managers with an opportunity to prioritize using existing management authorities and to better understand the ecological quality and function of its coastal areas.

All marine waters in the Arctic Refuge boundaries and marine waters and lagoons off the northern coast of the program area (1,625,600 acres; NOAA GIS 2017) are listed as part of the National MPA System.[49] Shifting shorelines and marine-freshwater boundaries at river mouths create some variability in the acreage estimate for the refuge's contribution to the National MPA System, on the order of plus or minus several hundred acres (USFWS 2015a).

[49]See the viewer of the NOAA National MPAs here: https://marineprotectedareas.noaa.gov/dataanalysis/mpainventory/mpaviewer/.

Wild and Scenic Rivers

The USFWS conducted a WSR review as part of their Revised CCP (USFWS 2015b, Appendix I [Wild and Scenic River Review]). The discussion below tiers to and incorporates by reference relevant information, while placing emphasis on rivers in the program area.

WSRs are rivers or segments of rivers designated by Congress under the authority of the Wild and Scenic Rivers Act of 1968 (PL 90-542, as amended; 16 USC 1271–1287). The purposes of the law are preserving the river or river section in its free-flowing condition, preserving water quality, and protecting its outstandingly remarkable values (ORVs). ORVs are identified on a segment-specific basis and may include scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values.

The Wild and Scenic Rivers Act mandates protections for rivers that are designated rivers of the National Wild and Scenic River System. For rivers such as the Hulahula, which are not yet designated but candidate rivers under consideration by Congress for inclusion in the system, Federal managers are obligated to use existing management authorities to protect the characteristics of rivers for the conditions under which they were found eligible and suitable (USFWS 2015b). River values are free flowing condition, water quality, and ORVs. A river's preliminary classification is a description of the level of development (one of three categories: Wild, Scenic, or Recreational) which must be maintained per the WSR Act for designated rivers and managers must use existing authorities to maintain for candidate rivers. The WSR study for Arctic Refuge (USFWS 2015b) was an agency-directed study, not a congressionally authorized study; however, where practicable and where it does not conflict with the purposes of PL 115-97, stipulations would be applied to protect WSR characteristics including water quality and free flowing conditions on rivers determined to be suitable and recommended to Congress to be included in the system.

The Marsh Fork-Canning, Hulahula, and Kongakut Rivers are north-flowing waterways, segments of which were found to be eligible and suitable for inclusion in the National Wild and Scenic River System (USFWS 2015b). The recommendation for this was carried forward to Congress in 2015. In the program area, the entire segment of the Hulahula River was found to be eligible and suitable. There are no eligible or suitable segments of the Kongakut within the program area, however, segments of and the Canning, Jago, and Okpilak Rivers were found to be eligible in the Wild and Scenic River Review (USFWS 2015b; see **Map 3-64**, Special Designations in **Appendix A**).

The Marsh Fork-Canning River (recreational ORV) and Kongakut River (recreational, scenic, and geologic ORVs) are not in the program area but are close enough that their ORVs are influenced by the qualities of the program area and activities within the program area.

The extent in river miles and the ORVs and preliminary classification of each eligible and suitable river in the program area are presented in **Table B-23**, below.

Evidence of climate change is apparent in Alaska. Temperature increases and precipitation changes have changed regional hydrology. Continuation of these trends may lead to changes in the hydrologic cycle (SNAP and TWS 2009, page 1). These changes could affect soils and the vegetation along the eligible and suitable streams, most noticeably by taller shrub intrusion and thawing permafrost. This would affect the scenic quality of areas viewable from the stream by blocking vistas. It is possible that melting permafrost could increase sedimentation and turbidity in these streams, reducing water quality.

Table B-23
Eligible and Suitable Rivers within the Program Area

River Name	Preliminary Determination	River Miles of USFWS-Administered Land	Preliminary Classification	Outstandingly Remarkable Values
Canning	Eligible	41	Wild	Cultural, wildlife, fish, recreational
Hulahula	Eligible and Suitable	26	Wild	Recreational and cultural
Jago	Eligible	36	Wild	Wildlife
Okpilak	Eligible	33	Wild	Scenic and geologic

Sources: USFWS GIS 2015

Wilderness Characteristics, Qualities, and Values

The USFWS (2015a, Section 4.1.3.5) described the wilderness characteristics in the Arctic Refuge. This section tiers to and incorporates by reference relevant information, while placing emphasis on the program area location. There have been no new data on the wilderness values associated with the program area since the completion of the Arctic Refuge CCP (USFWS 2015a).

The 1964 Wilderness Act established a national system of lands to preserve the natural and wild condition for the benefit of future generations. Public Land Order 2214 (1960) established the original Arctic Range for the purpose of preserving unique wildlife, wilderness, and recreation values. ANILCA Section 101(b) outlines part of the general statement of intent for the Act "to preserve in their natural state extensive unaltered arctic tundra [...] ecosystems; and to preserve wilderness resource values and related recreational opportunities including but not limited to hiking, canoeing, fishing, and sport hunting, in large arctic and subarctic wildlands and on free-flowing rivers […]." The goals and guidelines specific to the Arctic Refuge are outlined in ANILCA Section 303(2), which provides the direction and intent for management and conservation efforts in the Arctic Refuge. ANILCA Section 707 directs agencies to manage Congressionally designated wilderness in accordance with the Wilderness Act, except as provided in ANILCA. Further, ANILCA 304(g)(2)(B) requires the Secretary of the Interior to identify and describe "the special values of the refuge, as well as [...] wilderness value of the refuge" when developing plans. In the Arctic Refuge CCP (USFWS 2015a) the USFWS recommended the lands in the program area for wilderness designation; however, Congress did not act on these wilderness recommendations, and subsequently, the minimal management standard for the Coastal Plain must now be adjusted to account for the oil and gas leasing program required by the PL 115-97.

ANCSA directs the BLM to convey 45.5 million acres of public land to village and regional Native corporations. Section 17(b) of ANSCA provided for the reservation of public access easements which are now commonly referred to as 17(b) easements. ADFG reviews proposed conveyances to Native corporations and recommends that the BLM reserve 17(b) easements to provide public access across Native land to public lands and waters.

B.4.8 Visual Resources

Affected Environment

Visual resources are the visible physical features on a landscape, such as land, water, vegetation, animals, structures, and other features. The BLM developed a visual resource inventory (VRI) for the Central Yukon Planning Area (BLM 2018h) to the west of the Coastal Plain, using the process in its Visual Resource Inventory Handbook (H-8410-1) and BLM policy contained in Visual Resource Management (M-8400).

The VRI was based on physiographic provinces. Although the program area is not in the BLM's Central Yukon Planning Area VRI, the VRI is used to characterize its visual resources (as described below) because physiographic provinces span both areas.

It is reasonable to characterize the program area using the Central Yukon Planning Area VRI because there are negligible differences and landscape level elemental similarities between the two areas. The three physiographic provinces that span both areas are the Arctic Coastal Plain, Arctic Foothills, and Ambler-Chandalar Ridge and Lowland (**Map 3-2** in **Appendix A**). Physiographic provinces can span large geographic areas, regardless of landownership; the transitions between physiographic provinces are generally subtle.

Scenic quality is a measure of the visual appeal of a tract of land. All public lands have scenic value, but areas with the most variety and harmonious composition have the greatest value (BLM 2018h). In the VRI, each physiographic province was evaluated to determine its scenic quality. The Arctic Foothills and the Ambler-Chandalar Ridge and Lowland divisions received the highest scenic quality rating and have a great deal of visual variety, contrast, and harmony. The Arctic Coastal Plain received the second highest scenic quality rating and has a moderate amount of visual variety, contrast, and harmony. These three physiographic provinces are described below.

The Arctic Coastal Plain physiographic province is in most of the program area and covers 1,341,200 acres, 90 percent of the program area (BLM and USWFS GIS 2022; Wahrhaftig GIS 1965). It is characterized by a smooth, poorly drained plain rising imperceptibly from the Arctic Ocean, with scattered groups of low hills to the east and a much flatter section to the west. An abrupt scarp between 50- and 200-feet high separates the Arctic Coastal Plain physiographic province from the Arctic Foothills to the south. Pingos are sufficiently abundant to give an undulatory skyline.

All the rivers in this unit feed into the Arctic Ocean, crossing the program area in braided channels and deltas, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. Water is a major element of this landscape. This physiographic province has a low variation in topographic relief and a low variety of plant species found in the vegetation types of wet and moist tundra; low shrubs create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow and alder.

This Arctic Foothills physiographic province is in the southern part of the program area and covers 127,600 acres, 8 percent of the program area (BLM and USFWS GIS 2022; Wahrhaftig GIS 1965). It is characterized by rolling plateaus and low linear mountains. It has broad east-west trending ridges, dominated locally by mesa-like mountains in the north, while the southern area displays irregular buttes, knobs, mesas, and east-west trending ridges rising 2,500 feet above the surrounding intervening, gently undulating, tundra plains. Major rivers are swift, braided courses across broad gravel flats. There are a few small thaw lakes in the river valleys and morainal lakes closer to the program area.

The Arctic Foothills are crossed by north-flowing braided rivers from sources in the Sadlerochit and Romanzof Mountains, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars. The entire area is underlain by permafrost, with ice wedges, stone stripes, polygonal ground, and other frost features creating contrast with different vegetation types and barren ground. This physiographic province has a moderate variation in topographic relief. It has a low variety of alpine and moist tundra species, such as low mat-like herbs, grasses, and heaths. High to medium shrub thickets create

some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

This Ambler-Chandalar Ridge and Lowland physiographic province is in the southeast corner of the program area and covers 28,000 acres, or 2 percent of the program area (BLM and USFWS GIS 2022; Wahrhaftig GIS 1965). It is characterized by east-west trending lowlands with elevations of 600 feet and low passes 3 to 10 miles wide, with elevations of 4,000 feet. Rolling to rugged ridges 25 to 75 miles long and 5 to 10 miles wide rise to 4,500 feet and are characteristic of the northern portion of this unit (Romanzof Mountains). Major rivers are tributaries of the Okerokovik and Angun Rivers. Large rock-basin lakes occur in the valleys, while floodplains of major streams have thaw and oxbow lakes. The entire area is underlain by permafrost.

All the rivers in this physiographic province feed into the Arctic Ocean, crossing the program area in braided channels and deltas, creating contrast between the adjacent landform and vegetation and the barren soils of gravel bars and delta areas. This physiographic province has a moderate variation in topographic relief and has a large variety of alpine tundra of low mat-like herbs, grasses, and heaths. It also features closed white spruce and birch forests, with high to medium shrubs, and open low-growing black spruce and willow shrubs. These create some diversities in color, texture, and form between the low-growing heaths and shrubs to the tall shrubs of willow.

Vegetation is an important component in determining the visual quality of an area, represented by species, variety, extent, and color. The more variety of species a landscape has, the higher the scenic quality. Vegetation visible in the program area is alpine tundra, closed spruce forests, moist tundra, open and low-growing spruce, shrub thicket, treeless bogs, and wet tundra (see **Section B.3.1,** Vegetation and Wetlands). Vegetation also supports wildlife visible in the program area (see **Section B.3.3,** Birds, and **Section B.3.4**, Terrestrial Mammals).

Cultural modifications are also considered in determining the visual quality of an area. Cultural modifications can blend in with or stand out from the surrounding landscape. The program area is still primarily a natural landscape, where humans have not substantially changed the scenic quality; however, some areas have been modified by the activities of humans. Human-built structures are the most likely to be seen and have most modified the natural landscape. These structures primarily exist near the community of Kaktovik.

Native allotments and isolated cabins can also be found in the program area. Most of the buildings outside a community are in relative harmony with the landscape, as they are small and made of local materials and have primarily natural colors.

Artificial light sources are mainly limited to the community of Kaktovik along the coast. Dispersed cabins, overland travel, recreation, and occasional single- and twin-engine aircraft overflights can also create limited, intermittent points of artificial light.

Except for within the village of Kaktovik, there are no designated roads in the program area. Year-round access to and in the program area is primarily via aircraft. There is a gravel landing strip at Kaktovik that supports air travel from outside the program area and serves as the departure point for aircraft traveling inland. Aircraft are permitted to land in the program area. Several unimproved landing areas are used by small fixed-wing aircraft for landing on wheels to transport recreationists and researchers. The profile of

an unimproved landing area is low, with color changes that are introduced by brown colors in predominantly green vegetation, and there are more regular lines than the surrounding irregular vegetation.

Summer travel is primarily by watercraft; however, snowmachine trails and winter travel routes can be seen from elevated locations. Summer all-terrain vehicle travel is low to nonexistent and therefore no trails from their use are visible at this time.

Seismic exploration, authorized by Congress, was conducted in the program area during the winters of 1984 and 1985. Exploration during winter causes less damage to tundra vegetation and soils than in summer, but damage does occur. Because of the 1984–1985 seismic exploration, known as 2-D (two-dimensional) seismic, 1,250 miles of trails made by drill, vibrator, and recording vehicles crisscrossed the Coastal Plain tundra. Additional trails were created by D-7 Caterpillar tractors that pulled ski-mounted trailer-trains between work camps. The trails were about 4 miles apart. While 90 percent of all trails recovered well during the first 10 years after exploration, 5 percent of trails had still not recovered by 2009, 25 years after the disturbance. This indicates that about 125 miles of disturbed trail remained in 2009, based on a total length of about 2,500 miles of original trails, both seismic lines and camp-move trails (USFWS 2014). These trails disrupt the visual continuity of the expansive, undeveloped landscape.

Areas identified as having public concern for the scenic quality are known travel routes (especially rivers), areas of human habitation, areas of traditional use, and areas near Native allotments. Numerous areas are noted to have potentially high visual sensitivity. This is because area residents and visitors view the natural landscape as very important and have a high level of interest and sensitivity to changes to the natural landscape. Visual resources in the program area are viewed by various users of the Arctic Refuge. Views can be affected by weather conditions and time of day or year.

Users of the program area include the following:

- Individuals participating in cultural activities (see **Section B.4.2**)
- Individuals conducting subsistence activities (see **Section B.4.3**)
- Individuals in the village of Kaktovik (see **Section B.4.4**)
- Recreationists (see **Section B.4.6** and **Section B.4.7**)
- Individuals in route to various destinations (see **Section B.4.9**)

In the mid-1990s, no cultural modifications in the form of oil and gas development could be seen from Nuiqsut. By 2009, oil and gas infrastructure, including the facilities at the Alpine development, pipelines, and ice roads were visible from Nuiqsut and other portions of that analysis area.

Climate Change

Changes to the presence and composition of vegetation and water sources resulting from changes to the climate would affect visual resources. Also, an increase in the active layer is expected from a warming climate, resulting in greater potential for areas of land subsidence. This would change landforms, as well as the vegetation and water sources that the land supports. In turn, the presence and behavior of animals viewed in the program area could also be affected. Changes to the physical characteristics of the environment and biological resources (i.e., resources that are visible) resulting from changes to the climate are described in more detail in the GMT2 Final SEIS (BLM 2018a).

B.4.9 Transportation

Affected Environment

The affected environment for transportation in the program area is as described in the Arctic Refuge CCP (USFWS 2015); a summary is provided below.

Except for in the village of Kaktovik, there are no designated roads in the program area. Non-subsistence cross-country motorized travel, other than over snow, is prohibited; however, aircraft, including prop planes, are allowed to land. Year-round access to and in the program area is primarily via aircraft. There is a gravel landing strip at Kaktovik that supports air travel from outside the program area and serves as the departure point for aircraft traveling inland. Arctic Village and Venetie have gravel runways, which are owned by the Native Village of Venetie Tribal Government. Aircraft are permitted to land in the program area. Several short unimproved landing areas are used by small fixed-wing aircraft for landing on wheels to transport recreationists and researchers. Landing opportunities depend on topography, water levels, snow conditions, and weather. Kaktovik, Arctic Village, and Venetie all have regularly scheduled air service, although the frequency of service varies.

During the summer and fall, motorized and nonmotorized boats provide access along the program area's northern boundary with the Beaufort Sea. Motorized and nonmotorized rafts are used along the Hulahula Rivers to access recreation and subsistence opportunities in the central portions of the program area. Improved boat technology, such as inflatable pack rafts that have shallow hulls, support river transportation in shallower areas that were previously unreachable by boat.

Existing marine vessel traffic occurs throughout the Bering Sea and less frequently in the Beaufort Sea. Under a Most Plausible Scenario by the International Council on Clean Transportation, the number of vessels operating in the Arctic would more than triple the number of vessels in 2008 (International Council on Clean Transportation 2019). The areas of the Beaufort Sea with the most vessel use is near Utqiaġvik, Oliktok Point, and Deadhorse (Audubon Alaska 2017).

In the winter and spring, as snow cover conditions permit, overland travel via snowmachines is possible, especially along frozen waterways and the edge of the Beaufort Sea. Most snowmachine travel in the program area originates and terminates at Kaktovik. Snowmachine use in the program area is primarily for subsistence use, local travel, and recreation.

Climate Change

Increasing climate temperatures and associated loss of snow cover would limit the locations and times of year when ice roads could be viable in the program area. Less snow cover and soft tundra surface conditions could result in transportation infrastructure being concentrated in smaller areas. This could intensify traffic on those roads and increase the potential for conflicts with other modes as more visitors frequent the area.

B.4.10 Economy

Affected Environment

This section describes the existing socioeconomic conditions in areas that could be affected by exploration, development, and production in the Coastal Plain from the leasing program. All NSB communities, the NSB, and the state of Alaska are included for comparison purposes. Arctic Village and Venetie, which are communities outside the NSB, are also included in the discussion due to their reliance on subsistence resources in the program area.

This section provides baseline information on the following socioeconomic indicators: employment, income, population, and fiscal conditions (government revenues and expenditures). In addition, information on ANCSA corporations and a description of local businesses, local facilities, and public infrastructure is presented.

Population

Table P-1 in **Appendix P** shows population estimates by the Alaska Department of Labor and Workforce Development (ADOLWD) by community/area from 2013 to 2022 (ADOLWD 2023a). At the regional level, the population of the NSB increased by 6 percent from 2013 to 2022; while the state as a whole experienced a decline in population by less than 1 percent over the same time period. At the community level, nearly all of the NSB communities, except for Kaktovik grew in population; the increase in population ranged from 24 people (5 percent) in Nuiqsut to as many as 120 people (3 percent) in Utqiagvik. The community of Kaktovik experienced a 6 percent decline in population. Arctic Village and Venetie, which are communities in the Yukon-Koyukuk census area also experienced a decline in population by 18 percent and 10 percent, respectively from 2013 to 2022.

Local Employment and Income

Table P-2 in **Appendix P** provides employment and wage data by community (ADOLWD 2018). The local government sector employs the highest number of workers in all communities. Private sector employment is highest in Utqiaġvik, accounting for 43 percent of total resident employment, followed by Point Hope and Nuiqsut, where the private sector employs 39 and 38 percent of the resident workers. These communities also have the highest total wages in the region. Venetie has the highest rate of unemployment, with only 57 percent of residents employed. Arctic Village and Venetie both show total community wages much lower than communities in the NSB. Employment and income at the borough and state levels are discussed in the regional economy and state economy sections, below.

Local Economy: Kaktovik

Kaktovik lies on the north shore of Barter Island on the Beaufort Sea coast, in the Arctic Refuge. It is the community closest to the program area. The following provides more details on the economy, infrastructure, and fiscal conditions of Kaktovik.

Kaktovik is the easternmost village in the NSB and is situated on approximately 1 square mile of land (630 acres) and water on the northeastern shore of the Kaktovik Lagoon. A detailed description of Kaktovik's history is provided in the Kaktovik Comprehensive Plan (NSB 2021a). Kaktovik Residents are predominantly Iñupiaq (88 percent of the population in 2019). According to population estimates published by ADOLWD (2023a), 265 people lived in Kaktovik in 2022. The NSB's most recent census report indicated there were 246 residents in Kaktovik in 2019 (NSB 2020), while ADOLWD estimated 279 residents in that same year (ADOLWD 2023a).

Economic and employment opportunities are limited in Kaktovik because of its remoteness. In 2019, the estimated unemployment rate in the community was 18.2 percent; 68 percent had full-time permanent employment and about 9 percent had part-time or temporary and seasonal employment (NSB 2021b). Both subsistence activities and cash contribute to the local economy. The Borough, NSB School District, KIC, and the City of Kaktovik are the primary employers in Kaktovik. Short-term construction or skilled labor jobs with the oil industry, private construction firms, and the ASRC and its subsidiaries and summer jobs

related to tourism can also be found. Subsistence hunting, fishing, and whaling play a major role in the local economy (NSB 2021b).

There are 10 active businesses operating in Kaktovik, including the KIC, a hotel, a bed and breakfast, a couple of stores, and several tour and adventure businesses (ADCCED 2023b). The KIC runs the local store, which provides groceries, clothing, first-aid, hardware, camera film, and sporting goods. Fishing and hunting licenses, guide services, and aircraft and repair services for autos and aircraft are locally available (NSB 2021b).

The KIC is the village corporation established pursuant to ANCSA. KIC owns approximately 92,000 acres of surface lands in and around the community. All of the corporation's land is in the Arctic Refuge boundary. Kaktovik Holdings, LLC is wholly owned by KIC and has three subsidiaries—Kaktovik Enterprises, LLC (which provides services on power generation, storage, and control), Kaktovik Environmental, LLC (which provides a variety of environmental engineering, consulting, and construction services), and Kaktovik Telecom, LLC (which provides full-service, turn-key solutions for all telecommunications and tower needs). The company's operations are in Alaska, the lower 48, and Guam (Kaktovik Holdings, LLC 2018).

The latest income data from the U.S. Census Bureau indicated that the average per capita income in Kaktovik from 2017 to 2021 was $27,179; lower than the $39,326 per capita income for the state (USCB 2023)[50]. The median household income was $78,250 compared to $80,287 for the state. These values from the U.S. Census are in 2021 inflation-adjusted dollars. Another estimate of local per capita income is from the NSB's 2019 census survey of Iñupiat residents in Kaktovik. Based on the NSB survey, the estimated per capita Iñupiat income in 2019 was $17,432; adjusted for inflation, this estimate in 2021 dollars is about $18,913 (NSB 2021b). The disparity between the statewide and local income is important to note, given the high cost of living in Kaktovik.

The community incorporated as a second-class city in 1971.[51] For fiscal year (FY) 2021, the City of Kaktovik's operating revenues amounted to $2.36 million (ADCCED 2023a) (**Table P-4** in **Appendix P**). Fifty-nine percent of the City's operating revenues are generated by local funds, such as taxes, services, enterprise revenues, rentals, leases, and sales. Outside sources, including the community revenue sharing from the State and other grants contributed 41 percent of the total operating revenues.

The NSB provides public electricity, piped water, sewer services, and trash pickup to the community. Kaktovik has a public safety building and a fire station equipped with fire engines and an ambulance. The Harold Kaveolook School offers education from pre-school through grade 12 and adult basic education.

[50]This data is from the 2017 to 2021 American Community Survey 5-Year Estimates. The values are in 2021 inflation-adjusted dollars. The margin of error for the per capita income estimate for Kaktovik was +/- $7,010 and +/1 $421 for the statewide estimate. The margin of error for the median household income estimate for Kaktovik was +/1 $13,825 and +/1 $1,113 for the estimate for the state.

[51]A type of general law municipality or city that has taxation powers but with certain limitations. Section 29.45.100 of the Alaska Statutes provides that limitations on the amount of property tax that may be collected apply only to taxes for operating expenses and not to taxes collected to pay for bonded indebtedness. A special limitation on taxation by second-class cities is that the city cannot levy property taxes exceeding 2 percent (20 mills) of the assessed value of property in the city in any one year (Office of the State Assessor 2023).

Communications include phones, internet, mail, public radio, and cable television. The community also has a health clinic staffed by community health aides.

Transportation to the village is provided by scheduled airlines and air taxi service from Barrow and Fairbanks. Freight arrives by cargo plane and barge (during the summer). Air travel provides the only year-round access to Kaktovik. Marine transportation provides seasonal access to Kaktovik.

Regional Economy

The program area is in the NSB jurisdiction. Its population is predominantly Iñupiaq. In 2022, the NSB was estimated to have a population of 7,926 living year-round in its eight communities. In addition to the permanent local population, 1,310 oil field workers were in the Prudhoe Bay area in 2022, contributing to the total regional population of 9,242 (ADOLWD 2023b).

Oil and gas exploration and development is the primary industry in the NSB and the largest employer of the region's industrial workforce, including nonresidents. In 2021, ADOLWD recorded 4,404 oil and gas extraction and oil field support services jobs in the NSB (ADOLWD 2023b). These jobs are based in the North Slope, in self-contained work sites that are far from the NSB communities; however, few of the jobs are held by residents of the NSB. In 2020, only nine oil and gas jobs were held by NSB residents, which amounts to less than 0.2 percent of the total oil and gas jobs based in the North Slope that year. Total earnings from the oil and gas sector, which amounted to about $685 million, accounted for 62 percent of the total wages earned for all industries in the North Slope in 2021 (ADOLWD 2023d); however, a large portion of the earnings are not spent in the local and regional economy, as most workers reside permanently outside the NSB.

The annual unemployment rate in the NSB in 2021 was 6.4 percent, which was the same as the statewide unemployment rate. In 2022, the NSB average unemployment rate went down by 1 percent (5.4 percent), while the statewide unemployment rate was only 4 percent (ADOWLD 2023b).

The NSB is the largest employer of North Slope residents. In 2019, the NSB accounted for 30 percent of the resident workers in the region. Other primary employers include the NSB School District (14 percent), the city governments (7 percent), ASRC (6 percent), and village corporations (7.6 percent) (NSB 2020).

The NSB government was formed in 1972. It provides a wide range of public services to all of its communities, including capital projects. Its total general fund revenue in FY 2021 was approximately $444 million; 91 percent of the total general fund is sourced from property taxes (NSB 2021b). Oil and gas property taxes are the primary source of revenue for the NSB government. In FY 2021, the state-assessed oil and gas property in the NSB was valued at approximately $20.87 billion and the NSB received $394.3 million in property taxes on these facilities (a tax levied on oil and gas infrastructure). In FY 2022, the state-assessed value of the oil and gas property increased to $20.95 billion and the tax revenues from these facilities increased to $395.5 million (Office of the State Assessor 2023).

The ANCSA regional and village corporations in the North Slope are also important economic players in the region, employing residents participating in the oil and gas service industry and creating additional wealth in the region. ASRC is the regional ANCSA corporation that is owned by and represents the business interests of the North Slope Iñupiat. ASRC provides an array of oil field engineering, operations, maintenance, construction, fabrication, regulatory and permitting, and other services for oil and gas companies.

Village ANCSA corporations in the NSB also are active in the oil and gas sector. For additional details on the North Slope ANCSA corporations, see the GMT2 Final SEIS, which is incorporated here by reference (BLM 2018a).

State Economy

The petroleum industry is a major sector in the Alaska economy. Economic events related to the petroleum industry have pervasive effects across the State's economy. The drop in oil prices in late 2014 resulted in a significant decline in State government revenues. In early 2015 and in 2016, the State government lost 1,200 jobs, while the oil and gas sector lost 2,900 jobs. Other sectors were also affected; for example, the professional and business services sector lost 1,600 jobs and the construction sector lost 1,400 jobs (Wiebold 2018). In 2017, prices began to rebound, the industry increased activity on the North Slope, and oil and gas employment also increased. By 2019, the price of oil reached about $65 per barrel and the oil and gas industry jobs increased to more than 10,000 jobs again after two years. The price of oil dropped again to a record low in 2020 due to the pandemic disruptions, decline in demand, and a price war between Russia and Saudi Arabia. The State's oil and gas employment hit its lowest level in November 2020 at 6,074 jobs. By December of 2021, employment increased to 6,805, a 12 percent increase (Teel 2022).

The oil and gas industry represented 3 percent of total statewide employment in 2019 (pre-Covid employment levels); there were 12,121 jobs in the oil industry (Teel 2022). Oil industry jobs are those producing oil and gas or serving the industry directly—the workers include producers, drillers, and oilfield support services. Of the oil industry jobs, 58 percent are in support services. Many of the supporting jobs are in professional and business services and include engineering and geological firms, facility support services and waste management and remediation. In the North Slope, there are also a significant number of jobs in the leisure and hospitality sector, as workers are needed to operate the camps and support the large oil and gas workforce (Fried 2018). The average annual wage earnings of oil industry workers are 2.5 times higher than the statewide average. The annual average wage of producing jobs in 2019 was $232,546, drilling jobs paid $112,690, and support jobs paid an average of $103,564 per year (Teel 2022). For each job in Alaska's oil industry, there are 15 additional jobs in the Alaska economy connected to the industry. Given this, the oil industry is estimated to account for one-quarter of Alaska jobs and about one-half of the overall economy when the spending of state revenues from oil production is considered (McDowell Group 2020). Alaska's economy is still recovering from the economic impacts of Covid-19; total statewide employment level in 2022 is still below the 2019 level. However, ADOLWD projects growth in some of the state's major industries—oil and gas companies have recently announced new projects in the North Slope that are anticipated to generate additional economic activity, jobs, and income; the mineral mining sector is also expected to grow as a result of ongoing exploration and expansion of existing operations; robust growth is projected for other sectors such as transportation, health care, and agriculture (Martz 2022).

In 2021, the oil and gas extraction sector accounted for about 10 percent ($5.6 billion) of the state's total gross domestic product ($57 billion); note that this does not include the oil and gas support industries. The pipeline transportation sector contributed $5.2 billion to the gross domestic product; combined these two sectors accounted for nearly 20 percent of the state's gross domestic product in 2021 (BEA 2023).

The State government is highly dependent on oil revenue; its budget is sensitive to oil price and oil production. Petroleum-related revenues include oil and gas property tax, petroleum corporate income tax, oil and gas production taxes, mineral bonuses and rents, and oil and gas royalties (State and federal). The State's oil industry continues to be a significant source of unrestricted revenue for the State. Unrestricted

petroleum revenue amounted to $2.0 billion in FY2019, $1.1 billion in FY2020, $1.2 billion in FY2021, and $3.5 billion for FY2022 (ADOR 2023).

National Economy

The importance of the economic contributions of a leasing program in the Coastal Plain to the national economy and the importance of preserving the region for its unique wildlife, wilderness, and recreation values has been noted during the SEIS process (see **Appendix U**).

The Coastal Plain, which is part of the Arctic Refuge, has nonmarket environmental values that are important to the American public (Bengston et al. 2010). The national public's interest in the Arctic Refuge is focused on protecting its wildlife and maintaining its natural, ecological processes; this is referred to as non-use or passive use values. For wilderness areas, non-use values are often characterized as existence value (knowing an area exists even if one never visits), bequest value (ensuring an area is available for future generations), and option value (maintaining the option to visit an area in the future) (Holmes et al. 2015).

Non-use values are a component of an area's total economic value. For remote areas such as the Coastal Plain, they can be a significant component. For more detailed discussion of non-use values and valuation methods, see Valuing Option, Existence, and Bequest Demands for Wilderness (Walsh et al. 1984) and National Research Council (2005). For the Arctic Refuge, the non-use value primarily comes from knowing the area exists and continues to be protected. The public's concern is that new oil and gas exploration activities may change the way people think about the area (Kotchen and Burger 2007).

A study to quantify the non-use values of the Coastal Plain is outside the scope, funding, and time constraint of this EIS; instead, described here and cited below are other relevant, publicly available studies on non-use values.

In 1998, an economic assessment of the Bristol Bay Area National Wildlife Refuges estimated that the net economic value of its uses in 1997 was $82 million (this value is $193 million in 2021 dollars), while the non-use value was between $2.3 to $4.6 billion ($5.4 to $10.8 billion in 2021 dollars) (Goldsmith et al. 1998). A valuation study was conducted to estimate damages from the Exxon Valdez oil spill by determining a household's willingness-to-pay (via a nationwide survey) for an oil spill prevention plan and using the number of US households to estimate the damages or lost existence value (Carson et al. 1992; Carson et al. 2003). The 2003 study estimated that the public's aggregate willingness to pay to prevent another Exxon Valdez type oil spill is $4.87 billion (about $7 billion in 2021 dollars); the median household willingness-to-pay value estimate from the study was $48 (or $69 in 2021 dollars).

This study has also been used in other valuation studies for areas in Alaska (Colt 2001; Hahn & Passell 2010) as an available estimate of existence value for Alaska ecosystems. The authors of one study that was focused on the Arctic Refuge noted that Carson et al.'s (2003) estimate may be a lower bound for the Arctic Refuge's existence value; this is because it has more pristine area and therefore likely a higher existence value than Prince William Sound (Hahn and Passell 2010). Given that the Arctic Refuge is a national wildlife refuge, the studies mentioned here used the US population scale and not the Global population or the Alaska population (e.g., Bengston et al. 2010).

There have been other studies outside Alaska that have estimated non-use values for wilderness areas elsewhere in the US. A review of the literature on economic valuation of recreation activities, including

wilderness, that was published in 2015 found a range in per-household willingness-to-pay estimates to preserve wilderness areas (Holmes et al. 2015). The article cited the following estimates of economic value of wilderness recreation from various studies: i) $21.47 per recreation day valued in 1987 dollars ($50.51 in 2021 dollars), based on the average value from 12 separate studies, ii) $39 a day in 1996 dollars ($66 in 2021 dollars), based on the average value from 29 studies, and iii) $61.47 a day in 2002 dollars ($90.79 in 2021 dollars), based on the average value from 31 studies (Holmes et al. 2015).

In the absence of primary valuation studies for the non-use values of the Arctic Refuge, some studies have used the estimated value of oil in the area to determine how much each person in the US would be compensated for lost non-use values from oil extraction (Kotchen and Burger 2007), or how much each household would have to pay for preservation to match the value of oil extraction (NRC 2003). The idea is that if people are willing to pay more for preservation than the value of oil development then the loss of non-use values (costs) would outweigh the benefits of oil development. The 2007 study by Kotchen and Burger estimated the breakeven willingness to accept compensation to allow drilling in the Arctic Refuge to range between $582 and $1,782 per person, with a mean estimate of $1,141 one-time payment per person in 2005 dollars ($1,565 in 2021 dollars)[52].

Climate Change

Climate change could adversely affect the economy of the North Slope because villages are primarily located at or near sea level; any increase in mean sea level or violent storms may require relocating part or all of villages and subsistence camps. This would have an adverse economic impact on the villages, the NSB, and the State if villages had to be relocated. Climate change effects could also go beyond the State of Alaska and adversely affect the rest of the world.

[52]The breakeven willingness-to-accept estimate was calculated by dividing the estimated net benefit of oil drilling in Arctic Refuge (amounting to $251 billion) by the 2005 US Census population estimate of US residents aged 18 or older (220,377,406 people). The net benefit of oil drilling was determined using the price of oil in 2005 ($53 per barrel) and the USGS' mean estimate of economically recoverable oil (7.06 billion barrels), which results in $374 billion ($2005) in total revenues less the total cost of producing and bringing the oil to market under the best-estimate scenario estimated at $123 billion.

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Appendix C

Updated 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

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

C.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 $85 in 2023 dollars; Attanasi 2005). Alaska North Slope crude was priced around $81 per barrel in December 2022, down from a high of $112 in July of 2022 but up from $68 per barrel one year earlier (EIA 2023a), and the US Energy Information Administration (EIA) projects that crude oil prices may increase or decrease depending on multiple factors (EIA 2023b). Another study estimated that ultimate recovery in unrestricted Coastal Plain development could range from 1.5 BBO to 10 BBO (Attanasi and Freedman 2009). 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). Any proposed gas pipelines connecting the North Slope to potential

[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.

markets would first connect to better understood and established fields before connecting to the Coastal Plain. The future connection of any gas fields in the Coastal Plain to the planned pipeline is highly uncertain so annual estimates of natural gas production are not available. There are estimated to be 225 million barrels of natural gas liquids in the program area (Attanasi 2005). Some amount of natural gas liquids would be produced as a byproduct of oil production in some formations, these liquids would be blended into and transported with produced oil.

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 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 (USGS) often conducts resource estimates under the Technically Recoverable Resources classification, while the Securities and Exchange Commission 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 (DOI 1987, 1998). 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, 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.

C.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 may 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
- Resource demand for hydrocarbons resulting from climate change policies, technological developments, etc.

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.

C.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 C-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).

C.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 C-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 C-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.

C.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 C-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 C-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.

C.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. 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.

C.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 C-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.

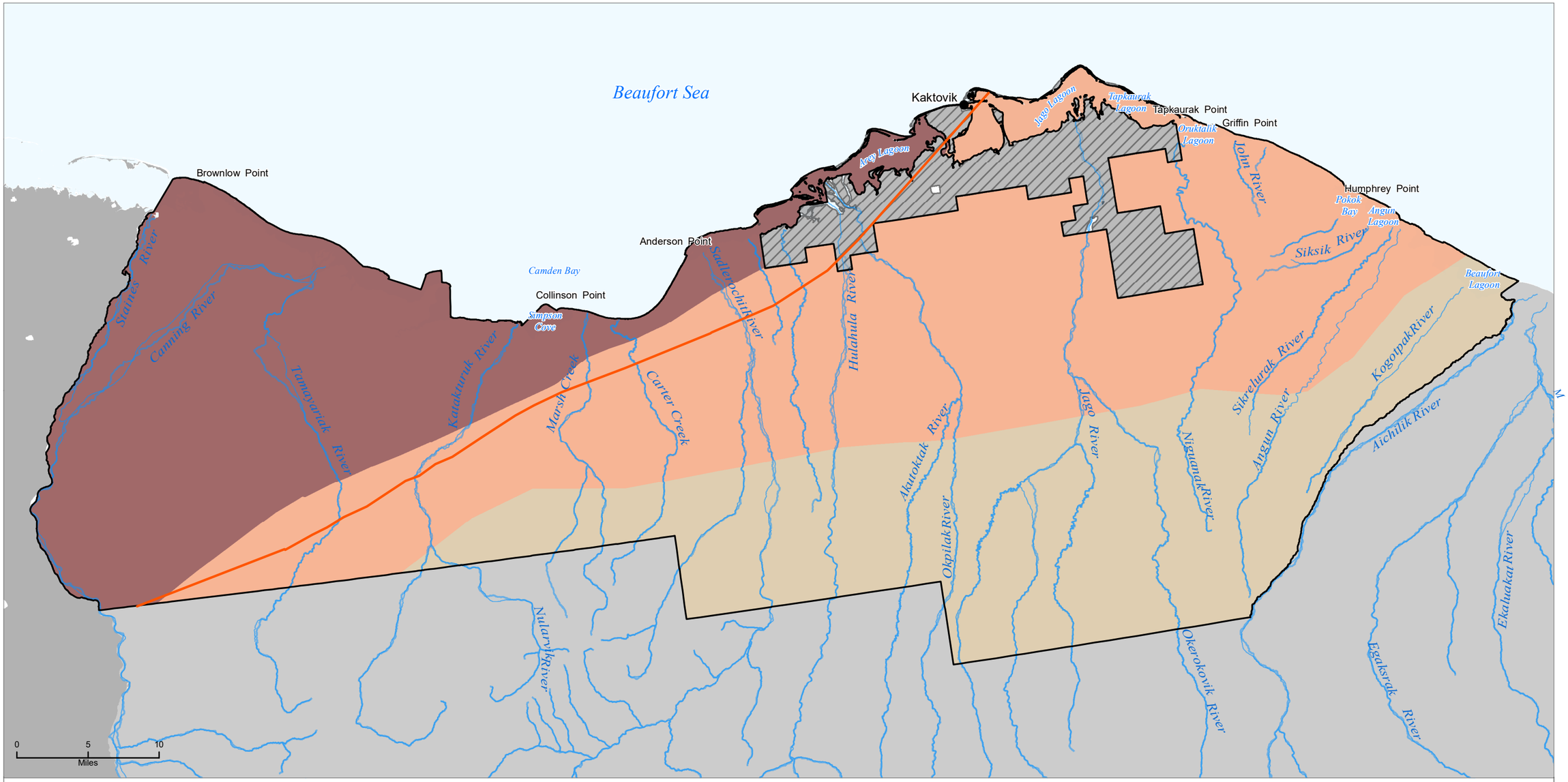
C.6 Method and Assumptions for Hypothetical Development Scenario Projections

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, 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 estimated at 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.

[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).



Marsh Creek anticline

Hydrocarbon potential
- High
- Medium
- Low

Coastal Plain Supplemental EIS Boundary

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

Data source: BLM GIS 2022, USFWS GIS 2022
Print date: 07/15/2023

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The time frame used for the hypothetical development scenarios assumes that a rapid rate of development would occur. Development at this rate is only likely to occur under certain conditions such as very high oil prices or if oil accumulations are found to be larger or easier to produce than expected based on current information. Because there is very little data on geologic conditions and petroleum accumulations, and because no infrastructure currently exists in the Coastal Plain, there would be a lag time between lease issuance 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 up to 50 years, recognizing the timeframe for production could be more than 50 years given the speculative nature of the long-range 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 development scenarios are abandoned and reclaimed. However, just as development is expected to occur in phases, reclamation would occur in phases.

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

- Industry would aggressively lease and explore the tracts offered.
- Economic conditions (particularly oil prices) would be high enough to support development in the Coastal Plain.
- 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.
- All production would be accomplished by horizontal well bores and each producing well would be paired with an associated 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]

[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.

- 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 and reservoir conditions.
- 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.
- At least one seawater treatment plant to supply water for water flood recovery would be constructed, each plant would occupy approximately 15 acres. The plant(s) would be designed to process sufficient amounts of water for water flood recovery, the amounts would be based on reservoir characteristics which are not known at this time.

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. Operators must use flaring over venting per 43 CFR 3179.6(b).

C.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:

> 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.

C.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 NPR-A 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, meaning a portion of the Coastal Plain would be offered for leasing under standard terms and conditions with no management restrictions, such as stipulations or required operating procedures, 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 petroleum development activity.

Table C-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 C-3
Estimated Hypothetical Development Time Frames

Project Phase	Estimated Time Frames of Activities	Projected Activities
Initial three-dimensional (3D) seismic exploration	Within 2 years after lease sale	3D seismic exploration
Leasing	Within 1 year of ROD	Lease sale
Exploration	Within 2 years after lease sale or end of lease suspension	• First application for permit to drill submitted for exploration well • First exploration well drilled • Assumes discovery with first exploration well
Additional lease-level 3D seismic exploration and/or initial exploration wells	Within 3 years after lease sale (would occur during 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 • Map construction resources including gravel and vegetation/soil characteristics • Map coastal areas for likely barge landing and marine infrastructure locations
Additional exploration wells	4 years after 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 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 lease sale	• Begin laying gravel for anchor pad, begin CPF construction • Construct oil transportation pipeline connection from anchor pad to existing infrastructure at Point Thompson • Continue drilling 2 to 3 exploration wells to identify satellite pad locations • Begin drilling production wells on anchor pad

Project Phase	Estimated Time Frames of Activities	Projected Activities
Production begins	8 years after lease sale	• First production from anchor pad • Winter gravel and construction on satellite pads
Production increases	9 to 40 years after lease sale	• All wells completed on anchor pad • All wells completed on satellite pads
Development of additional fields	11 to 85 years after 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 lease sale	• Plug wells that are no longer economically productive • Remove retired equipment, remove vacant gravel pads and roads, and reclaim the area

Table C-3 activities may occur throughout the life of the leasing, exploration, and development program, and the timeframes provided in the table are estimates of how quickly such activities may occur.

C.7.1 Exploration

The completion of 3D seismic surveys would be the first step in the exploration process. After the lease sale, operators would likely conduct 3D seismic surveys on their lease blocks. This would require winter travel by vibroseis (seismic vibration) vehicles and smaller support vehicles. Vibroseis vehicles are mounted on rubber tracks to minimize ground pressure. No air-guns or dynamite are expected to be used as part of the seismic surveys. 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 and 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 potential future prospects.

Following the completion of 3D seismic surveys, exploration wells would be drilled to confirm seismic findings and further explore the characteristics of the leased area. Exploration wells would be drilled in the winter, using an ice drill pad and an ice road to transport a drilling rig to minimize impacts. Exploration drilling rigs could also be flown in by helicopter in some cases which would remove the need to an ice road to the pad. 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, well depth, 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 if ice chips are used (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).

C.7.2 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 C-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 C-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.

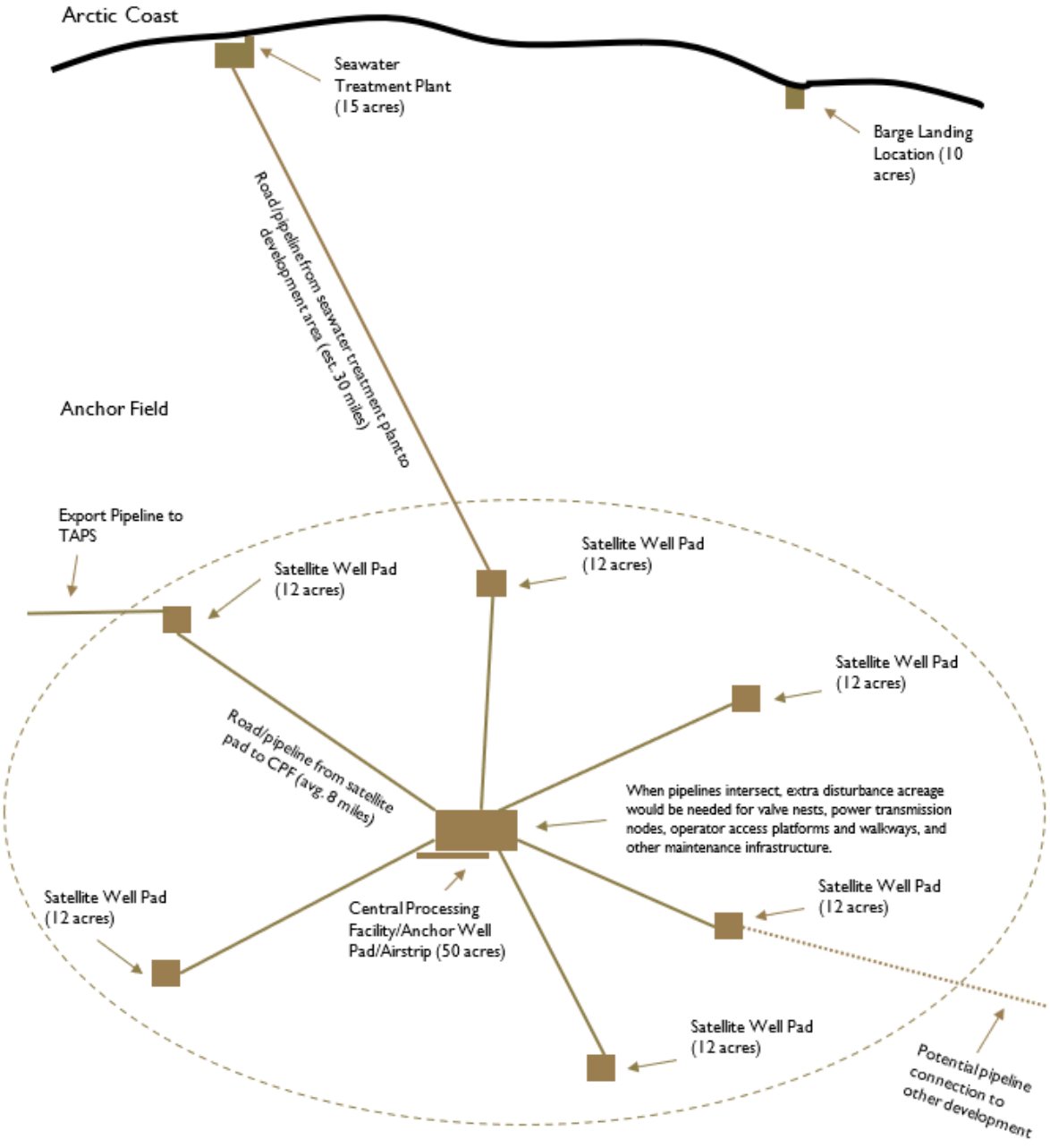
In this hypothetical scenario, development would start following the discovery of an anchor field. The first anchor field discovered is expected be in the western half of the Coastal Plain, most likely in the Topset play. Development would likely begin with the construction of a gravel pad for wells, 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 for barge landings. Barge trips are expected to begin in Dutch Harbor, Alaska, which is the first location within Alaskan water that materials could be shipped from to access the Coastal Plain. See **Map C-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 at the project level.

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. A barge landing in the Coastal Plain would likely use a floating dock for support; a permanent dock facility would not be developed. Overland transport from the existing dock and storage facility at Point Thompson is likely to be used in some cases instead of a barge landing in the Coastal Plain.

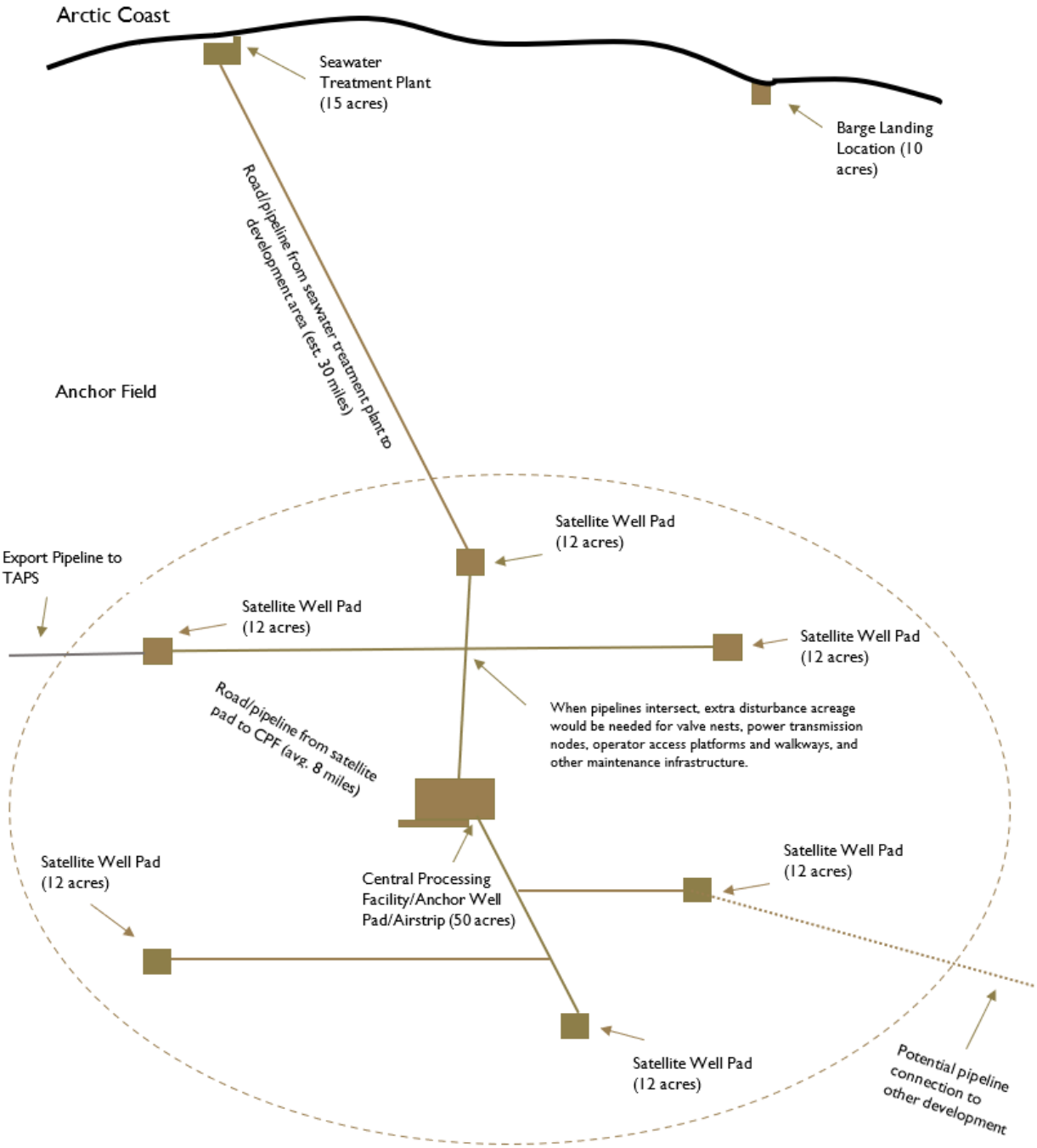
A seawater treatment plant could also be constructed along the coast, if needed, to source saline water for waterflooding, reservoir pressure support, or other subsurface uses. Local lakes are typically the preferred water sources, due to the cost and maintenance requirements of a seawater desalination 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.

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



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

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



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

Map C-2 Potential Marine Vessel Transportation Route

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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. Most buildings would be supported above ground on pilings to accommodate ground settling from permafrost thawing. Pile driving would be needed for the construction of these buildings. Some buildings like warehouses, shops, and material storage buildings may not be feasible to build on pilings, these could be built on a gravel pad with active and passive refrigeration conditions to help maintain ground temperature and stability.

To minimize surface disturbance and increase recovery of oil directional extended reach horizontal wells would be used for production. 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 gallons of water for a typical exploration or other vertical well to approximately 8 million gallons for a horizontal production well[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 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 would need to be approved by the ADEC before use. Solid, unburnable waste would

[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.

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 occur to maintain reservoir pressure and to increase oil recovery by pushing oil toward producer wells. 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. Satellite pads would consist of wells and the minimum amount of required production 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 planned 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 or it could be stranded from the Coastal Plain.

Two pipeline systems, the Alaska Stand Alone Pipeline and the Alaska Liquid Natural Gas (LNG) Project, have been proposed to transport natural gas from the North Slope with southern Alaska where it would be exported using LNG tanker ships. At this time, the Alaska Stand Alone Pipeline has been put on hold and development focus has converged on the Alaska LNG Project (Alaska Gasline Development Corporation 2023). The timeline for the pipeline to come online is currently unknown. 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, such as hydraulic fracturing of shale, 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 theorized 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.

C.7.3 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 this number may be exceeded for any particular development. From that point onward, production from the field 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 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, with the 2000-acre disturbance limit implemented, this RFD estimates that total recovery could be up to approximately 1.9 BBO depending on the alternative selected. . Given the limited data on the formations,

[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.

reservoirs, and resources in the Coastal Plain exact locations, timing, layout, and total production of any development that might occur cannot be predicted.

C.7.4 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 and reclaimed.

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

C.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 Supplemental EIS. Alternative A would not fulfill 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, management actions and resource trends as described in the Arctic National Wildlife Refuge Revised Comprehensive Conservation Plan (USFWS 2015), would continue. 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.

C.8.2 Alternative B

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 172 miles of gravel road would be needed to connect facilities. It is projected that at least 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 any of the development scenarios 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 from a barge landing or supply area outside the Coastal Plain to the CPF each winter under a roadless hypothetical scenario in order 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 development using roads. 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 disturbance limit would be reached and total recovery estimates could be up to approximately 1.9 BBO. 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.

C.8.3 Alternative C

Due to additional restrictions and stipulations under this alternative, including a 1,464-acre total limit on surface disturbance, development could be reduced, the potential locations for drill pads and CPFs 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 9 satellite pads would be developed under this hypothetical scenario, in addition to the two production pads associated with the two CPFs. An estimated 134 miles of gravel road would be needed to connect facilities, and at least 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 1,464-acre surface development limit is expected to be reached, and total recovery estimates could be up to approximately 1.4 BBO. 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. Under this alternative most areas with no surface occupancy (NSO) stipulations would be accessible by horizontal drilling from areas where surface occupancy is permitted or from adjacent state or Native lands. The area closed to leasing is predominantly low potential and is not likely to contain significant petroleum accumulations. The lower total disturbed acreage would result in a lower ultimate production total than under Alternative B but would likely not impact the level of production during the planning period.

C.8.4 Alternative D

Due to additional restrictions and stipulations under this alternative, limiting the leasable area to 765,800 acres and applying NSO stipulations to 726,300 acres of available area, the potential locations for drill pads and CPFs could be limited compared to the unconstrained scenario and Alternative B. Under the hypothetical development scenario for this alternative, 1,040 acres of surface disturbance is estimated to occur, and total recovery estimates could be up to approximately 0.5 BBO. See Surface Disturbance Due to Oil and Gas, below, for more details on the surface disturbance project to be created under the hypothetical development scenario for this alternative.

This new alternative incorporates more protective lease stipulations and ROPs than any alternative previously analyzed, has the most acres with NSO stipulations, and stresses protection of the four conservation-orientated statutory purposes of the Arctic Refuge. Infrastructure would be developed where surface occupancy could occur and would utilize directional horizontal extended reach drilling to increase recovery of the oil and gas resources.

In the long term, one CPS is expected to be built under a hypothetical scenario. Possible locations are the areas open for leasing under standard terms and conditions in the high and medium hydrocarbon potential

areas. The assumption is that approximately 6 satellite pads could be developed, in addition to the production pad associated with the CPF. An estimated 98 miles of gravel road could be needed to connect facilities, and one seawater treatment plant and one barge landing and storage pad would be need under this hypothetical scenario. Under this scenario, it is possible that a CPF and satellite well pads could be placed on Native or state lands adjacent to the Coastal Plain with wells extending horizontally into leased NSO areas in order to access oil and gas resources while reducing the disturbance footprint within the Coastal Plain.

C.8.5 Alternative D2

Due to additional restrictions and stipulations under this alternative, including limiting the leasable area to 400,000 acres within the highest hydrocarbon potential area and applying NSO stipulations to 231,700 acres of the available area, hypothetical development is largely constrained to the parcels identified as standard terms and conditions, making up 80,900 acres. Under this alternative, 995 acres of surface disturbance is estimated to occur, and a total recovery estimate could be up to approximately 0.4 BBO. See *Surface Disturbance Due to Oil and Gas*, below, for more details regarding the specifics for surface disturbance. This alternative stresses protection of the four conservation-orientated statutory purposes of the Arctic Refuge.

In the long term, one CPF is expected to be built under this hypothetical scenario. Its location would be constrained to the acreage not encumbered by the D2 Lease Stipulations 4 or 6. An estimated 3 satellite pads and related infrastructure would be constructed in support of the CPF. Approximate 98 miles of gravel road may be needed to connect hypothetical facilities, including a seawater treatment plant and barge landing with storage pad. Under this scenario, it is possible that a CPF and satellite pads could be placed on Native or state lands adjacent to the Coastal Plain with wells extending horizontally into adjacent leased NSO areas in order to access oil and gas resources while reducing the surface footprint.

This scenario anticipates a utility corridor traversing the Coastal Plain to market using existing North Slope infrastructure including the Trans-Alaska Pipeline system. The utility corridor would likely contain a single phase (processed petroleum product) flow pipeline as well as a service road, constructed parallel to the pipeline. This corridor would be routed through standard terms and conditions parcels to the greatest extent practicable to ensure the infrastructure is shared by future hypothetical development.

C.9 Surface Disturbance Due to Potential Future Oil Development

C.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

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

maintain a stable thermal regime. This hypothetical scenario assumes an approximately 5-foot thickness based on data from Point Thomson (USACE 2012).

C.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 and storage area with a floating dock or a module transfer island would likely be constructed in order to transport in CPF modules. Barge landings and storage areas at other North Slope developments generally occupy approximately 10 acres.

C.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 750 to 1,500 acres of road could be built. Road disturbance requirements are somewhat elastic in that operators could route roads through Native or State lands in some areas or build some roadless developments, especially if there were a possibility of the total disturbance limits being exceeded.

Pipelines are hung on VSMs and would be used to transport oil to the CPFs and eventually to TAPS. Other pipelines are attached to the VSMs 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, fuel gas and lift gas. The electricity would be primarily used for pumping and operations on CPF and satellite pads.

Pipeline VSMs are counted toward the total disturbance 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 120 to 220 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 5 to 9 acres of ground.

C.9.4 Gravel Mines

Gravel pits would be constructed to supply gravel needs for pads and roads related to future development. An estimated 6 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 areas

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 gravel 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 160 to 310 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.

C.9.5 Surface Disturbance Estimates

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

Table C-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
Pipeline VSMs	0.04 per mile
Seawater treatment plant	15
Barge landing and equipment storage	10

Sources: BLM 2004, 2012; USACE 2017

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

Facility Type	Alternative B		Alternative C		Alternative D		Alternative 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	Number of Potential Facilities	Estimated Acres of Disturbance
CPF, airstrip, anchor well pad, and other associated service facilities	4	200	2	100	1	50	1	50
Satellite pads	14	168	9	108	6	72	3	36
Roads	172 miles	1,290	134 miles	1005	98 miles	735	98 miles	735
VSMs (pipeline miles)	212 miles	8	175 miles	7	120 miles	5	110 miles	5

[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.

Facility Type	Alternative B		Alternative C		Alternative D		Alternative 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	Number of Potential Facilities	Estimated Acres of Disturbance
Seawater treatment plant	1	15	1	15	1	15	1	15
Barge landing and storage	1	10	1	10	1	10	1	10
Gravel pits and stockpiles[2]	—	309	—	220	—	154	—	144
Total (approximate)	—	**2,000**	—	**1,464**	—	**1,040**	—	**995**

[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

C.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.

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 C-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 C-7**, below.

Government revenues projected to be created by leasing and potential future Coastal Plain development are shown in **Table C-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 C.5**. Additionally, local governments could experience increased economic activity and revenues from an increase in hotel/bed tax collections.

Table C-6
Projected Employment Effects of the Hypothetical Unconstrained Post-Leasing Exploration, Development, and Production Activities

Effects	Jobs (average number of part-time and full-time jobs)	Annual Average	Peak
Direct	Exploration	250	650
	Development	2,260	3,300
	Production	770	1,200
Indirect	Exploration	130	390
	Development	1,720	2,500
	Production	1,020	1,600

Source: Northern Economics, Inc. 2023 estimates based on IMPLAN 2021 data year and assumptions listed in **Section 3.4.10 Economy** of the Supplemental EIS for the Coastal Plain Oil and Gas Leasing Program.
Notes:
Jobs during the exploration and development phases are seasonal and temporary.
"Direct effects" refer to the immediate economic consequences of the direct spending associated with the post-leasing activities (exploration, development, and production), and "indirect effects" refer to the secondary consequences that occur through the supply chain (i.e. jobs and income created by the businesses that supply goods and services to the oil and gas companies) as well as the induced effects that are generated when workers spend their income in the economy. In this SEIS, both the direct and indirect effects of post-leasing activities are considered indirect effects of leasing in the Coastal Plain.

Table C-7
Projected Labor Income Effects of the Hypothetical Unconstrained Post-Leasing Exploration, Development, and Production Activities

Effects	Labor Income (in Millions of 2017 Dollars)	Annual Average	Peak
Direct	Exploration	$26	$67
	Development	$233	$339
	Production	$133	$210
Indirect	Exploration	$8	$24
	Development	$106	$154
	Production	$64	$101

Sources: Northern Economics, Inc. 2023 estimates based on IMPLAN 2021 data year and assumptions listed in **Section 3.4.10 Economy** of the Supplemental EIS for the Coastal Plain Oil and Gas Leasing Program.
Note: "Direct effects" refer to the immediate economic consequences of the direct spending associated with the post-leasing activities (exploration, development, and production), and "indirect effects" refer to the secondary consequences that occur through the supply chain (i.e. jobs and income created by the businesses that supply goods and services to the oil and gas companies) as well as the induced effects that are generated when workers spend their income in the economy. In this SEIS, both the direct and indirect effects of post-leasing activities are considered indirect effects of leasing in the Coastal Plain.

Table C-8
Projected Government Revenues based on the Hypothetical Unconstrained Post-Leasing Activities

Government Revenues (in Millions of 2017 Dollars)	Annual Average	Total
North Slope Borough property taxes	$49	$1,119
State of Alaska royalties	$782	$15,648
State of Alaska taxes	$1,220	$24,425
Federal royalties	$782	$15,648
Federal taxes	$673	$13,459

Source: Northern Economics, Inc. 2023 estimate.

The management decisions and stipulations applied under Alternatives B, C, and D 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.

C.11 REFERENCES

Alaska Gasline Development Corporation. 2023. Alaska Stand Alone Pipeline (ASAP) Project. Internet website: https://agdc.us/about-us/alaska-stand-alone-pipeline-asap-project/.

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/public_projects/nepa/5251/41004/43154/Vol2_NPR-A_Final_IAP_FEIS.pdf

_____. 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.

_____. 1998. The Oil and Gas Resource Potential of the Arctic National Wildlife Refuge 1002 Area, Alaska. Arctic National Wildlife Refuge Assessment Team, U.S. Geological Survey. Internet website: https://pubs.usgs.gov/of/1998/ofr-98-0034/ANWR1002.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). 2019. Oil and natural gas resource categories reflect varying degrees of certainty. Internet website: https://www.eia.gov/todayinenergy/detail.php?id=17151.

_____. 2023a. Alaska North Slope First Purchase Price, Petroleum and Other Liquids. Internet website: https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=F005071__3&f=M.

_____. 2023b. Annual Energy Outlook 2023. Internet website: https://www.eia.gov/outlooks/aeo/.

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 (US 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.

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Appendix D
Traditional Knowledge

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Appendix D. Traditional Knowledge

D.1 INCLUSION OF TRADITIONAL KNOWLEDGE

Traditional knowledge, also known as Indigenous Knowledge, Traditional Ecological Knowledge, Indigenous Traditional Knowledge, and Native Science, refers to the evolving knowledge acquired by Indigenous and local peoples over hundreds or thousands of years through direct contact with the environment. This knowledge is specific to a location and includes the relationships between plants, animals, natural phenomena, landscapes, and timing of events that are used for lifeways, including but not limited to hunting, fishing, trapping, agriculture, and forestry. It is an accumulating body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (human and non-human) with one another and with the environment. It encompasses the world view of Indigenous and local peoples, which includes ecology, spirituality, human and animal relationships, and more. Traditional knowledge is critical in the assessment of impacts in rural communities, particularly with regard to their subsistence practices and cultural concerns. Throughout the previous 2019 EIS 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 SEIS. Excerpts from public comment meetings, consultation meetings, public comment submissions, and ethnographic and other studies containing traditional knowledge relevant to these topic areas have been organized under for use in the SEIS. Each excerpt has its origin identified as well. The information included in this appendix combines information from the 2019 EIS as well as additional information received during the SEIS with published sources that provide Inupiat traditional knowledge. In addition to providing general traditional knowledge, the following compilation addresses specific resources or issues where commenters and Tribal representatives emphasized the need to consider traditional knowledge during the SEIS process.

D.1.1 Cultural Resources

Iñupiaq Traditional Knowledge of Cultural Resources in the Program Area

- "My grandparents walked all the way from Barrow to here. And they had a reindeer herd. They were able to get some but it was hard. I think the only ones that didn't go with them was my Mom and my Aunt … I guess they made a trip over there to record the birth of my sister. But there were too many holes in the ice already so they had to wait and come back with a boat. Along the coast. We used to try and wait, we would stay out there. I have pictures of us traveling on water with the dog team, but once the ice is down there you can travel, but once the water is on the ice you can no longer travel. There were people all along the coast." (SRB&A 2012a)
- "There are a lot of unmarked trails up there [inland]. A lot of history actually. A long time ago before development when they were living in sod houses and dancing there was a lot of trade in caribou and muktuk. That is how they would do it. They would do a lot of trading in the winter and do a lot of hunting in the summer time." (SRB&A 2012b)
- "Yea, most [cabins] are in the Hulahula River area. You can see it on top of the mountains over there. If you go up, like 6,000 feet you can see lights in the fall time. We have a camp where two rivers meet on the main river. You can cut across and go to these lakes… it took us awhile to get our limit of arctic char and whitefish one year. When we used to have a cabin at Griffin Point we

would have like 30 a day and night, and my aunt would smoke the whitefish and we would freeze arctic char. I don't have it over there anymore now I fish whitefish down here by the airport. (SRB&A 2012a)

- "They are right on the lake, sod houses. On the Canning River. In the Canning River on the lakes. On the east side of Point Thomson. I don't know about the ones near Nuiqsut. They are around a lake." (SRB&A 2012a)
- "I don't know who has the allotments out there [in the Point Thomson area], my brother has one that is 20 miles from Prudhoe and 20 miles from the shore. The last time I went there was, we used to go there in the late 70's. My father passed away there, never been back there since then." (SRB&A 2012a)
- "A long time ago people from here would dog team to Barrow and back [so there would be a coastal route]." (SRB&A 2012a)
- "[There are] three units, 26c and 26b and 26a and we used to be 5 musk ox a year from the border to the Canning River. Like I said we go 100 miles in every direction. We would get them on Marsh Creek, East Fork, also on all of these creeks that drain into Camden Bay. Also Red Hill, they used to go over and collect red powder from the mountain and use it to tan the hides." (SRB&A 2012a)
- "The North Slope Borough has most of these sites marked, they have the Iñupiaq name for them. When Patterson got stuck, and they were at the Arey camp in 18… William Perry exploration. He got stuck, and ice bound, and they got stuck. One Hawaiian who was the cook and dishwasher, we always called the Hulahula the Itkillik River until the Hawaiian man named the Hulahula River. He was so fascinated, he would do a Hulahula dance every morning. He called it the Hulahula River." (SRB&A 2012a)
- "There is sod houses all over the coast but as long as there is no native allotments [where they plan to build]. Point Brower, just west of Beachy Point is on the Colville. That is over 100 miles away." (SRB&A 2012a)
- "We went seal hunting during May and in June, before breakup, we had to land again. The islands [off of the coastal plain] are used heavily for nesting and molting ducks, geese and pintails. The islands are important and have historical and cultural significance. There are whale bones and old ruins at Pingkok Island. The lands and its wildlife, fish, have changed today. Bessie Ericklok (MMS 1979b)
- "Our family stayed at Prudhoe Bay until the late 1930's. Our old sod house is still standing today. When I visited last summer, I saw the pingos we used for duck blinds was a burning pit. Our place is a barge landing place instead of a fishing camp site. I guess people that are aware of Prudhoe Bay know that old shack on the east dock. That's where her house is still in position. That's the one she's talking about. There are a lot of old sites, camping sites, fishing sites along the coast line. They are there and are being threatened by development." Sarah Kunaknana (MMS 1979b)
- "Yeah, I say that now because of Alpine we have had some displacement of camping sites, fishing sites. Some families have abandoned because of the development. The impact of noise and traffic and the infrastructure itself the roads and facilities. They tell us we can use our camping grounds to hunt and fish but it's just not… And besides that with the fire arms these days the industry is wary of that." (SRB&A 2012b)

Gwich'in Traditional Knowledge of Cultural Resources in the Program Area

- Commenters requested the inclusion of traditional knowledge to address potential impacts on the Gwich'in people from industrial activities in what the Gwich'in call the "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 Gwats'an Gwandaii Goodlit, 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
- "My grandpa, […] Grandpa Johnny, Johnny Frank. They used to go over to - over the Brooks Range and there's a - there's a big - on the other side is flat, they said, and there's one big hill, they said. Do you remember where that - some archaeologists went there, too, They found a whole bunch of arrowheads and - and like broken arrow and everything on, on that one hill, one hump on the other side […]. They think that's, that's a main place to gather in. [...] We never been there, but what we hear about this thing, you know, just like Grandpa Johnny was saying that that one place, he said that - or that big hill, he said. Big lump just out in the flat, just like that. I read about that - that thing about the archaeology that time. They were talking about they found a whole bunch of arrowheads and camping site and everything like that. [...] That's where they - they trade. [...] They went - they went over the Brooks Range, they said..." –Robert Frank, 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "You know, this whole area, people travel all over that land, up the coast and that way, and, oh, we just -- and, you know, there's graves everywhere. Some of them we don't even know. Yeah. Because they travel and when elder gets sick, they pass, and then they just bury them right there." –Florence Newman, 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "Vyàhk'it Gwinjik, aaha', Vyàhk'it Gwinjik ["Camping Areas Trail", aka Canning River] [...]. Yeah, there's animal trails they, they cover that too because it connect into that, it connect to this river right here. Hulahula, Chųų Choh Vęę' Tąįį ["Shore of Big Water Trail"]? Yeah, it connect it, so a group of Indians they went up this way, and the other half went this way. So, this is - they're gonna be- that's where they're gonna come back and celebrate a little bit and then they continue at large right here. [...] Vah k'ìt means- Vah k'ìt Gwinjik, "camping areas", that's what it means." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- “Every time we go sheep hunting- every time we go sheep hunting, when we see them butcher it, my mom say a prayer because that's the highest point in our area. Now hers – high - the next highest point in our area is that mountain in Arctic Village, Nitsii Ddhàa, and then Gwalat [“smokey area”, mountain SW of Arctic Village, aka Smoke Mountain] is the highest, and, and when we go to sheep hunting she pray. And that is - there is a trail along the Brooks Range, like he said. But then when we pass it - Brooks Range - that means we're going get into their country, we always leave a gift. So, there is artif - probably a lot of artifacts there because they leave a gift for, because of, do you see this big water? They respect that big water, when they see that, then they say another prayer.” –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “I brought up the thing with oh, Red Sheep Creek, okay. They're trying to take that away from us. That's traditional lands to us. That's been there. And they said we want to see a piece of artifact. On 8-22-22 of last fall, while we're at moose hunting, I found a piece of artifact that showed that human existence was there. Okay. And I don't know if it was Dinjii Zhuu or Neanderthal whatnot. But I found a arrowhead. Right, same place I hunt, everybody else hunted. So, 20,000 years ago, 6,000 years ago, I don't know, they were on the same hill, where I hunt- where WE hunt.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.2 Subsistence Use and Resources

General Traditional Knowledge on Subsistence Use

Iñupiat of the North Slope have a diverse resource base due to their proximity to marine, terrestrial, and riverine environments. Kaktovik residents often emphasize the outsized importance of the ocean and its resources to their cultural survival, although key coastal and inland resources include caribou and waterfowl:

- "Our animals reach along the coast. Just like you guys on having a garden or a farm where you grow vegetables. Like that. We don't grow any of that up here. And uh, let me say this. Our, just like from Brooks Range all the way to the ocean is like our garden. We feed on that. On sheep, caribou, seals, fish, whales. We feed on that just like our garden just like you folks have garden around you in your places where you grow vegetables. The whole place from the mountains to the ocean is just like our garden. We feed on it." Archie Brower (MMS 1979b)
- "Let me just further touch up on that the sea life here, that is our -- that is how we live. We are called tagiugmuit, t-a-g-i-u-g-m-u-i-t, which literally means we live out from the seas, and that is our life. And we have nunamuit, and those are the guys from inland. So anything that we take from the sea is what is meant, why we are here today. If it wasn’t for our sea life or depending on the sea, we would have a heck of a time." Fenton Rexford. (USACE 1996)
- “When we went to my father’s native allotment we would go about this time of year by Warm Creek. It is probably thawed out and you could go fishing with a reel. Catch some uh, 13-14 inch grayling. Tasty white meat. My mother used to have a pan and already be frying those up. Those camp robbers (birds) would be around to munch on the leftovers. For some reason I don’t know why we were feeding about two or three of those birds, they tend to eat the meat from the skin side of the fish.” (SRB&A 2012a)
- "My father used to go whaling to Cross Island in late summer. We also hunted seals, *ugruks*, after whaling. The whales travel very close to these Barrier Islands in the summer. We fish for *ikalukpik* from the ocean and the Sagavanirtuug River. We hook for graylings and net for *anaaklik* in the summer. We get all kinds of white fish by seining in the channels. The Savviugvik River is also

abundant for grayling. In the winter we trapped for white fox and hunted polar bear near, on the Barrier Islands. The Barrier Islands carry the same birds, mammals, and fish. It is one…I can't make out what that word is. What you do to one area will affect the others. The ducks and the geese use the Barrier Islands as their home. They nest in June on the sand spits. The pintails on the islands in July. On the islands in July. There are thousands of them that would be endangered because of this sale." Sarah Kunaknana (MMS 1979b)

- "I feel the Inupiat people are very much a part of the environment themselves. They are part of the foodchain. And as time has gone, and they've gone from hunting on foot to hunting by dog to hunting by snow machine, they have seen the animals move further away from them. And as helicopters and hercs and ships and more boats come into the area to develop something like the proposed off shore sale, if this does go through, we all know that there's going to be a lot of action out there. It's inevitable that the animals that use this area to migrate are going to change their patterns of migration. We all know that oil spills are bad but it's not the only thing. The noise and the amount of people can also change the animal's migration patterns." Mike Edwards (MMS 1979a)

Subsistence activities are central to Iñupiaq cultural identity and worldviews, and the activities associated with subsistence, including processing subsistence foods, sharing, and teaching the younger generations, help strengthen social and familial ties. A recent study in Nuiqsut captured the importance of subsistence to the Iñupiat:

- "We cannot go without it [subsistence]. Subsistence has been our way of life. For centuries." (SRB&A 2024)
- "The importance to me is it is in our tradition…. My family has done it as far as I can remember and as far as they can remember. It is just the traditional thing in our family culture. It means food to me." (SRB&A 2024)
- "[Subsistence] is very important, especially for our kids to learn. It's our way of diet. That's what I was raised to do and it's important to keep it going. My daughter has been following. I thought about taking my son out whaling because that's when I started, at six [years old]." (SRB&A 2024)
- "I do it [subsistence hunting and harvesting] for my people. And that's everything I hunt, beside furbearing animals. And I give half [of my catch] away. But my hunting is for all the people. Most of us will cook moose and save most of it for the feasts. I only keep 25 percent and give the rest out. I give away all my fish. I hunt for the people because I'm a whaling captain. That's what I do. That's how I was raised. I'll have four caribou for Thanksgiving, and four [caribou] for Christmas." (SRB&A 2024)
- "Well, it's important to the community. We can't always go out to the store and buy meat all the time. Our hunting ground is our garden, and our ocean is our garden too, you know. Today, when I see subsistence harvest, how it's about the community, especially the elders and people that are in need. Because we're not hunting for ourselves, but we're hunting for the whole community, giving for the people that don't live in this area. We send qaaktaq or fish, we send them out. We don't just harvest for ourself, we harvest for the whole community. That's one thing about subsistence…. One time I heard that from an elder. You don't go out hunting for yourself, you go out hunting for the community, people that are in need." (SRB&A 2024)
- The Gwich'in term Dinjii Zhou K'yaa Zhit Gwaradaii (Gwich'in practice of the way of life) refers to cultural norms and expectations are a moral framework binding the Gwich'in together, not

completely dissimilar to the laws American federal agencies operate under. Gwich'in Cultural Experts refer to Dinjii Zhou K'yaa Zhit Gwaradaii when commenting on the cultural conventions that continue to guide their long term, successful relationship to their animals, fish, birds, and plants while emphasizing elements of conservation and respect. Cultural Experts also maintain that the ideals encompassed in Dinjii Zhou K'yaa Zhit Gwaradaii should be applied to any consideration of development in the Coastal Plain. 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
- "I was born in Arctic Village way down below village in the mountains somewhere in 40 below in tent I was born. Ever since that, I'm up there, with the people in the village, all my kids was raised up up there. And I remember, ever since I was small, I watch, and I listen. I've learned a lot from that. In those days, when I was born, the land looks so good. The fresh air! Arctic Village got a good fresh air they always say. All the waters are nice and clean. All the caribou, all the animals are so healthy. And we eat those. And our people, they take care of them: food, animals. They take care of that creek, river, lake, mountain. That way, that way, north, east, south, west. They know their country. They got their own map. They know where to go for animal. If they want to get moose they know where to go. They want to get trout, they know that where to go. They know all their country. They've got names for all of them. They take good care of caribou. That's the way they take care of it as they keep the land clean. We can't even throw bone on the ground when I was growing up. We can't throw nothing in there. We can leave nothing out in the open." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "That's what our elders talk about too, like, your grandpa always says, like, live a good life, and that's what he means, you know, is being able to provide for yourself and your family. Having enough wood for the winter, having caribou and other subsistence foods in your freezer to get you through the winter. Having your family safe. Those are all things that represent a good life. And I just don't think, like, our elders aren't all that impressed if all you have to offer is money, that doesn't represent that good life they're talking about that they wish and they pray for us." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "[…] the caribou, and the land, and the water, and the air, those are need to be protected. Since I was a little kid, I remember they always talk about animal, animal, animal. Because that's what we live on. Be safe, how to kill it, when to not to bother it. Not to disturb them all the time, not to play with it. Not to play with what you kill. Not to waste what you kill. All the things from them, you know? Because they always think about future, future, future, the Tribe, Gwich'in. That's the reason we're sitting here, that's how we survived by our great, great, grandparents." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- “And then stuff - they start bringing stuff, and you know, but summertime they know all the places. Like I said the other day, they got their own map, our people up there. They know their country so well, if they want to - if they get tired of whitefish because they eat it too long, “Hey let's go look up, move up to Old John Lake, eat trout.” Right on that side, they go there and they eat a lot of trout. They get tired of it and they say “Hey, let's go back down, let's go back over there to the Red Fish Lake.” We go there, they eat a lot of red fish. And then they, fall time, you know, they know when, when is, animal is good. Like we're talking that, you know, we go muskrat hunting from springtime until June 7. That's, that's the day that they quit hunting for muskrat because they've got little ones in their stomach, we wouldn't touch no muskrat at all. If we do that, they'll been mad about it. We know, and they said “don't go fishing.” Because they're, they're really skinny right now. Wait till July. Because everything underwater, it's, they eat that but they don't, I don't know, they don't get fat from it. By the end of July, every animals are just nice and fat. Even the sheep. They just don't go up hunt sheep, they wait till the end of July, and they - You know, there's a berries on ground, we call it ts'eendaii. We don't eat that. I mean just when we're hungry.” – Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “And a certain date, we hunt through certain year, like fall time, vadzaih choh [“big caribou”], October vadzaih tsal [“small caribou”] and my grandpa Jamas, he taught me - I was just gonna shoot anything - no, he's taught me, you shoot these one. vadzaih tsal and they know it's fat. Well, see? That's how I learned. I asked. I can't just shoot anything, you know, because they go by the year.” –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “James Gilbert, back in the 80s when I was growing up always was peeking through his spotting scope. I'd say basically all through July, and we didn't have phones, no internet, no nothing back then days. But when the word was around that there's vadzaih, Vyuh Zhrąįį vakat vadzaih gwanlįį [“caribou, there are caribou on Vyuh Zhrąįį”] and everybody get happy. All the ladies “Jyaa kan [“exclamation”]! Even all the dogs. You know, it's just quiet in the back in a day, łąįį gazhral gakwaa hee [“dogs don't even bark”]. Sunday, Sunday zhrįh [“only”] that bell, and then all of them, they all sing “Awoooooo!” just from that bell? Yeah, I remember grandpa and them's dogs? Oh my god, they just like they just waited for that church bell. And then once they hear it, man, they just went crazy. But yeah, it was like, yeah, somebody brought up the dogs were even excited earlier because they know they're gonna go out and pack caribou. So, everything and everybody was excited. Everybody benefited from it.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “So we don't even eat caribou from May, June, July, August, last - first part of August, then we start hunting, August, July 31. We know that moose is in prime now. We know that June 4th, black duck is going to be here. Okay. And with that May we know that widgeon and all the other smaller ducks, then we don't bother them after that. They're going to lay eggs. So, the seasonal is very respectful. The four season, is we respect that four season all the time. Only time we get animal during the winter is when we need it. But the prime animals is when that, October, September, August, part of July, because the baby could defend himself and protect himself too. So, he already taught they all - that they already been taught by the other caribou, not to bother this one, or not gonna fool around with this one. You don't bother that trail. Don't go 50 feet over there because the wolf is gonna get you. They talk among each other. Yeah. My grandma always said that the animal talk to Indian people, you know. Me and Lawrence, Robert, were duck hunting in springtime, it gets dark. And first thing you know, I was standing right behind him. He was facing that way. God darn little owl grab his little - he had a marten hat on, you know, it landed right here! And then he

was trying to bother with me too, like this, you know, flying around! And then he took off. They're trying to tell us something. So, we kind of went around that lake and stand over there. See if we can get few more ducks. Little ducks - you know, I love to hunt when it's a little bit dark. There's just right there, you know, pop pop. But then the owl landed up here. "[SIMULATING OWL NOISE]". And then, it's your mom, nahan, naihnyaa ["I say to you, your mother"], had little baby. And Lawrence's mom had a baby. That's what that owl was telling us. Lawrence remember that too, you know. Yeah. Vigii goodlit jyaa diinahnyaa ["her child was born, thus we were told"]?" – Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "...can I ask you a question about traditional kinds of rules. And this is regarding like harvesting, harvesting, like duck eggs and seagull eggs. What are, you know, what are you supposed to do in terms of like, you, you come across it, you're gonna go and you're looking for it. You come across maybe seagull eggs or some other eggs. Like, how many are you allowed to take, and kind of what are the rules of taking those things?" –Sam Alexander, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "For instance, like caribou? I was telling, I was saying that before, in here, but you were not here. I was a young guy that time when they having, caribou is right up above Venetie. All the council and all the people went together at Daniel Robert's house, there's no community hall at that time. So, they took all his house, clean his house, and they put only chairs in there and they were talking about how many each family will get. They can't get more. After all that, after they discuss how much everybody will get, then they bring the hunter and then, the rest, they left, and all the hunters got there. "We're going to kill -" they, they pick one leader. It was Moses, Sam they pick. "We're going to kill that many. That's it." Well, they went up there, they kill 79. And no more hunting after that." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "But during when the caribou is calving, they don't even hunt there when they - even when they're hungry, they don't hunt - they don't hunt from April - I mean, May, after the first week of May when the embryo and eggs form eye, two eye, then everything stop, we don't, we don't, we could fish, but we can't shoot ducks, we can't muskrat, everything. Because that's when all the animals start, uh, the pregnant and they start, you know, that's the time, the pregnant time and then birthing time and, and then I always look forward to July 15, because my mom said we could go ground squirrel trapping, that big, that first part of, ground squirrel - really yummy. All that time we just eat stale, sometimes rotten fish from the springtime. When we got the spring fish, we dry it and smoke it and preserve it that way. That's the only thing we ate. I can't wait till July 15 to eat ground squirrel. Then we wait." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know, I remember a way back how it look: it still looked like that up that way, everywhere. Because people have respect for the land, for the animals, for each other. That's why it still look same and we don't want to we don't want to damage something we don't want to hurt those animals because they've got their own life's living. They know where to go springtime. They know where to go fall time. Summertime. They - in four season, they know all that and they watch it. They know what's coming. Springtime was a time that nobody bother animals because they got alittle ones in them. They save all of that for the next generation to 'till today. Everything is same up that way. We don't want no, no damage or, you know. We don't like that. Our elders, the one, don't like that. We always talk about our generation, generation, generation. You know what they say? If we kill too many ducks they will say, "Hey, you got enough there! We got a lot of food. Don't bother those animals. Save those for your kids and their kids and their kids and their kids." I remember I

was picking berries with my mom and my grandma. Way out in the country somewhere. We were picking berries and I step right on the blueberry bush, my mom: "Hey, hey, hey, don't step on that! Berries, there's not going to grow on that anymore. You damage the roots! Go around that!" You save that for your, for your children and their children and their children. That's how they are to everything. So, I'm glad we're here to talk about animal and caribou and there's lots of, lots of things. And I'm glad that I'm here to share with everything that I remember what it was like, what happened, where, when. I remember all that. Today, I'm still happy with the way they are up that way. The Chief, the Council, they look after each other. They share with everything. They love each other. They always, always tried to do something good for the village. And I'm proud of that." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "That's [summer] about the time all animals have their young. During this time, they don't hunt cause all animals are raising and feeding their young…training them. When I was growing up, a lot of times I was hungry. During this time is when I was really hungry cause we couldn't hunt. We just ate dry fish from spring. A lot of times, its overly dry…kind of grey, stale, and smelly. By this time, we're really tired of eating that. After the young squirrels come out of their burrow being trained. It was a long wait for me. Around July 15th, my mom said its time to go to the mountain and hunt ground squirrels. It's so good to eat fresh meat. During the summer months, all animals have their young. They nurse and train them. We don't hunt animals during this time." –Johnny Erick, Sr., 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "As a young guy, I've been approached by the older elders. And they said that they're not going to be part of the ANCSA because they don't want to give up their rights as being Gwich'in people. They want to, at the time we have a rope around our reservation at the time, there was Johnny Frank. And a lot of family. They went all the way around the reservation. And they call that Tł'an Yatąįį ["Halfway Trail"], yeah, reservation. So, so they didn't they didn't like the state, how they're approaching the government. They wanted us to be corporations [...] So, they didn't like it. They say they don't want to be part of the ANCSA. They don't want to give up their land. They don't want to get the free money. Because these guys they learned, they're self-sufficient Chiefs that work hard and made a living with their, for their children's generation. Like James Robert, he catch 800 marten every year, he catch 500 lynx every year. Every Chief they put that fur in front of the table in the community center. We're going to start a school. We're going to start a new church at the time in Venetie because Albert came down to build a new church too. So, those history, how the Tribal government advocate works is by teaching the younger children what the Constitution mean, what what's the law stand under the state, and what the law of sovereignty and means from government." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...And I still don't know the meaning [of "subsistence"]. But I know ANILCA is something good law for Native American, and especially for Alaska. Because there's a lot of places that's not developed. And the major thing in Alaska still is, is subsistence. And how I understand is that we, uh, ANILCA based on how much interest from all the Native of Alaska. And it could make, we could make changes. And that's how I look at the law. And that's how I understand it from the beginning. And it's a good law, just like Indian Child Welfare Act is a good law. And I like, you know, if we, if we go about it in, in a good way, and how, uh, what the law is for, I think we can use it. That's how I look at it." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- When we were growing up, we go up the ro - up the bend. There's ice then. We go ice and we fish in the hole up there in the creek. We walk up little ways then the creek that comes down from the

glacier. We go up and there's a big, deep water, that's where we fish. And then we build fire up there and we just throw it by the fire like that and we cook it. When, when it's done we just all sit there eating fish, eating fish. It tastes really good! Really good, it's fat. But same thing with the ground squirrel. Fall time they're really fat. That when they get them. Other time, you know they don't bother it unless they need it. And me and my sister Naomi and my brother Trimble, we talk about this course last five, six years, those people bring us grayling when they catch lots they share with everybody, give it to elders. You know we cook it, we don't even taste it. No taste to it. My sister was complaining, my brother was complaining, just like eating just plain paper. Before that they taste really good. Same thing with the ground squirrel. They don't taste anymore. All the, all the food are like that, maybe from that food that they eat from the lake or from the river. Or the water is too hot. Or the - maybe the water is too low. The stuff they eat bottom of the lake don't grow like it used to be. Something's wrong here. Even ducks, that one is still the same but the pe - the animal that lives in the water up that way, it's like that. If you ask Trimble he'll tell you. It used to taste really good. When we first killed caribou up on the mountain, when they start coming in my dad used to cook a big fat ribs to fire, oh tastes really good but now we don't even taste it. No taste. It don't taste like long time ago. Maybe it's from the water - I mean it's from the weather, or the water, or the plants grows, that's what we were seeing." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

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 Porcupine Caribou Herd, 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
- "We stayed in the village, there's only two cabins down there when we were young, when we were little. There's me, my mom, my brother, and my dad's sister Alice and her husband. We stayed in two little cabins down there. Our house was down by the river. Neatly kept and no floor, we just

throw our caribou skin on the ground and we sleep on that. Me and my brother, all of us. You know, in that time, I was, I don't know, about 10, 11, 12. I don't remember... We got big pile of meat by our house. Because my dad have to walk, walk, walk, uphill, downhill, that way, that way. He walked all over but nothing. There must be no caribou. Or they go other place, or we don't know because right now, if you can't find caribou, you could zoom up there, down that way, down that way. He'll find some right there. But by a walking, it's hard. My dad come home just tired, a lot of times he'd come home nothing. When he'd come in, like I said the other day that, when he come in, we look at his boots. If there's blood on it, we get excited. But if there's no blood, we're all gonna, "Ugh! he didn't get nothing again." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "This past fall, July to August, September-ish, the caribou was really late. And I was kind of getting worried because I didn't have no meat in my freezer. There was no meat in my grandpa's freezer. And so we got a late hunt. And it was good. It was a lot of work. And we made sure our grandpa's freezer was filled before we filled mine. And as of right now, I think I only have two bags of boiled meat in my freezer. And that was, you know, lasted all winter. But like I said, sometimes it's hard to order food or when we do our food shopping from Fairbanks, a lot of times we don't have - they don't have enough steaks or chicken. So, we rely on maybe 90% of the caribou." –Tiffany Yatlin, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So in the past 10 to 12 years, I recently started cutting caribou. Skinning it, preparing for the family. And it's not only my family, it's my grandfather, it's cousins, friends, you know, people in the community. And I've noticed a few times where we didn't get any caribou. It really affected us in a lot of ways. There's not a lot of resources, there's not a lot of employment. There is some employment, but it's not, it's not a whole lot where a family could live off of a paycheck. So, they, they really look forward to caribou. And I noticed a few times when we - it came in late or we didn't get enough. We had a lot of people in our community struggling with no meat to feed their families. And especially the elders, we would make sure they have enough because they can't live without the Native food. I have my grandfather, he's 85 years old and he, when he travels to Fairbanks or Anchorage he always has to have at least boiled meat with him to travel in a separate cooler because he can't handle the different foods as he travels." –Tiffany Yatlin, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "If, to me, uh, if the calving area where the, the animal I mean caribou go, if it never, ever been touched, you know, that would be really amazing because, you know, I just see how our elders, our people went through all that stuff, through all that, you know. They talked a lot, they express their feelings, their hardship, all that they did. You know, just so that place would not be disturbed. But still, you know, they're saying that, you know, we don't hardly use that area, but because we respect that area. We respected that area, we were told, you know, that's, that's a respected place. Because they're saying that Iizhik Gwats'an Gwandaii Goodlit, that's where the calving area is at. They were told - I mean, you know, it went down generation to generation that we cannot disturb that area. Because Florence is talking about respect the animal, respect the animal, we have to have respect for animals. We also take care of animals too. Because yesterday we're talking about the wolf and stuff, you know, wolf get hungry, you know, they go out, they have young ones, you know, and when wolf get hungry, like grandma was saying..." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Reliance on Migratory Birds, Fish, Furbearers, Marine Mammals, and Other Resources

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

- “There is a lot of trapping. There used to be a lot more trapping. I don’t know now. I don’t know if they are trapping over there anymore [along the coast by Point Thomson].” (SRB&A 2012a)
- “[You can make] polar bear pants, mittens, mask maker, make jewelry, gift the claws. First one I caught the tradition is to give the first catch.” (Voorhees 2019)
- “People don’t make things with polar bear hides as much now because they used to be wild animals but now they are like captive animals, there’s a sadness to making things with them. People who used to use the animals for arts and crafts, [the bears were] under the radar, on their own’ [today] it had a different meaning.” (Voorhees 2019)
- "Long time ago the people who lived before our time found where to catch fish, and this is passed on so that we fish where they fished before us. Down at the Bernard Spit, and to the west of us is Nuvugaq (Pt. Collinson) is where they used to fish. Aanalaaq (the area west of Anderson Point) right on the Beaufort Sea is another place to fish. Also when the fish is running right along the coast around July the people watch these fish moving along the shoreline and kaktok them. (seining) One of these people was Ayaki (Alice Putogool) and we used to watch her kaktok fish. The place to the west of Kaktovik where she used Kaktok is no more, its blocked sand spit now. "(Pedersen and Linn 2005)
- "Early spring around June, while the ice on the ocean still have not gone out and you can still hunt seals that come up on top of the ice, Hulahula River’s ice goes out. The area around the west end of Arey Island is a place where small *iqalukpik* start coming out of Hulahula River. These are what we start catching on the net. The bigger ones I think comes from the other rivers. While we are hunting seals, when we set a net out right at the end of the island we start catching fish. I would guess that these fish comes out of Hulahula. Also further west when I used to work on the Dewline station called Pow-3 (Bullen Point) the fish start coming out. There was a lot of fish coming out of rivers near there. In the summer I used to fish with a rod and reel, I would catch iqalukpik that wasn’t very big but they was abundant cause when I cast my hook I would catch a fish right away."(Pedersen and Linn 2005)
- "There are a lot of places where you catch fish, like east of here at Pattaktuq (Demarcation Point) the fish there is plentiful. To the west there are a lot places where you catch fish. "(Pedersen and Linn 2005)
- "This is the time of year when people's caches and ice cellars are getting a little skinny. The law says that you can't hunt caribou right now because the calves are awful large in the cows. The muktuk that was got last fall is getting used up by now. So, one thing that everyone is waiting for, anxiously, is the ducks and the geese." Mark Edwards (MMS 1979a)
- "When Tommy (her brother) and his wife went to Pattaktuq (Demarcation Point) they caught a lot of fish. They said that there was sure a lot of fish. They went there this summer with a net and caught a lot of fish. We used to camp there in the summer and catch a lot of fish. These are the places where you can catch fish, the places where people used to fish before us. Those are some of the places to fish. This summer I did not go there. Usually a lot of qaaktak. " (Pedersen and Linn 2005)

- [We fish in] Clarence Lagoon, Angun Point, Jago, Demarcation, everywhere, all around. On the inside and the outside in the summertime. Along the coast on the outside…. We get the same kind in the [Sagavanirktok] River, by the bluffs. You can see the fish. Qaaktaq, Iqalukpik. Lots of them. Snowmachine in the winter. We went there in February and March, me and my dad. That was the last time I went that way…. At Griffin Point on the inside. We get there by boat, Qaaktaq, flounder, dog salmon, silver salmon, Iqalukpik, Kanayuq. [I fish at Bernard Spit] but the waves are eating [the spit] all up. I just go there in the summer time when the lagoon has no more ice. We go there and catch fish. You can to farther to Jago…. All across this, inside and out [on Arey Island] all the way down to the point. Inside and outside…. Anderson [Point], by POW-D [Collinson Point]. (SRB&A 2010a)
- "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
- "The reason the [Coastal Plain is important] – you know, they have a lot of fish up there. They have a lot of different kind of specie fish up there. The caribou eats from the ground there. The fish eats from the ground. It's a food chain for the animals, […] we go back there and take care of it and speak on behalf of the animals around every stream up there." –Ernest Erick, 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "Sometimes like divii, divii ["sheep"] skin. Sometimes they're fat inside. It's dried up, tastes good. That's how we clean, clean inside of the skin when it's hard time. Lots of time it happened in my village. During my growing up I see it with my eyes. Everybody pray. Grandma Myra always pray. They always say that in the church too, they pray for them to come. We see some cow moose, but they don't want to shoot that cow moose because, because it's not right to eat it. Vagwaandaii kwaa ["it doesn't taste good"], they said, "it doesn't taste good." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Everybody's happy, make you feel good. When you eat your own food, it makes you strong and make you feel good. Remarkable, you know. Now, when I was raising up, you know, I used to hunt with dogs with my dad. You know, it was hard, but you know we got to eat. But he taught me how to respect it, you know? A lot of time Robert, like this winter, he really made me happy when he got to moose. There is no meat around. "Take what you want, I've got enough," you know? And that's what we - that's who we are, we share. You know, it doesn't matter who it is but we're in the community, small community, we all work together, we share. We teach ourselves we teach our kids, you know, I teach my boys how to respect. If you wound one go after it, I said, don't let it go.

That's respect, you know?" –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Just like us, that ANWR, we try to protect it for animal that we use, gonna have a little one there. We always think about you got to do it from the heart. Before you do something, he always pray. He always pray when you go out hunting. When you kill, take your hat off and pray, tell the God and Mother Nature to thank. You'll get another one next time. But don't just shoot it and walk away and forget about it. That's not right. That that's our rule the Gwich'in people always got: Don't shoot something that you don't eat, they said. If you're going to shoot something make sure you eat it all, don't shoot it for nothing, don't shoot that bird for nothing and leave it there to rot, no use. You got a respect for it. These are the stuff that they give us when we were growing up, going hunting. Me and that Robert's father, we always, first thing we kill we always pass it around to the elders first. I'm talking too much, I'll leave it to Florence." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "All these things we're talking about is, the main thing to protect every animal. Because I always think about ecosystem. The ecosystem is the most important thing. If they destroy that, what will happen? Just like few years ago, we were talking about just before fall it was, it was raining, then the snow fell, cover it. Look at how many sheep died. Look at the winter, how many caribou drowned when they tried to go across? That's where their trail is. Just like us, when we travel we ran into a problem, overflow, same thing, animal and us, human being. We all got a way, you know? We've got no choice. But we've got to prevent not to get in the water. But caribou, wherever they're heading, they just got to get there for calving, you know? That's reason we're talking about that National Wildlife Refuge. We try to protect it. That's where they got the little one. But the other predator, they want to survive too so they got a hunt for them too. That's where the disturbance is going on, that's reason every animal protect themselves from smelling, hearing, you can't bother their - just like what we're trying to do is protect the ANWR, the bear protect their habitat where they always hunt. They protect it. Every animal, just like the mink, they live on mouse, fish, they live on the river. They gotta protect that." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Oh yeah, when we went to Coastal Plain long time ago before we got colonized into the village, we use all that area too, that's one of our hunting grounds. You know, we migrate wherever there's food, but we don't go there to hunt caribou during their calving time. We don't hunt for anything there in the birthing time. Stops at June 7, and then to, to me it's July 15 because we go - I looking forward to going up Dachanlee for ground squirrel, because I'm just tired of that stale dry meat or dry fish. That's the time I got most hungry, those - in those time. Because we can't storage, you know, only dry meat and dry fish. And by the time we run out of that good fish, we're into bad fish. And in wintertime at least we freeze the meat and everything and, you know, we also have something to eat. But not that time. And yeah, so that's how we, when caribou is not around, when we can't you know, hunt caribou, that's what we depend on." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Anadromous. It's not the same. Because fish come from the ocean. It comes into these boundaries, Hulahula, and these five, six river with a cri - Sheenjik River and the Porcupine. So, this is where animals eat from, just about every animal within the state. That's why the Gwich'in people gathered back in 1929. They wrote a book, Johnny Frank, Jimmy Robert, and was written by a lady in 1929, explaining the stories of the Gwich'in people explaining the migration of the Gwich'in people what they used with the skin, what they use with a bone, what they use, secret of the caribou. Why we

eat it because of the good nutrition. Food that it has, rich. I got a good caribou two caribou that Jordan Peele shot. This fall time. It was that thick of caribou fat behind it. Some of the caribou like Mr. Sam explained, some of the caribou live on this side, some up here in this country." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Many people were hunting in a group long ago. There was a little river canyon, steep on all sides, with perpendicular rock walls rising high on both sides. There our people killed many caribou. Near evening they set large fires here and there, and at these they began to roast the heads of the young caribou over the fire. They were traveling in [Inupiat] country, but they were so happy that they forgot about it. […]" –Fredson and Sapir, 1925, as recorded in Draft SEIS Comments, November 7, 2023
- "...[Dajalti] set out north with lots of Gwich'in people, even Old Crow people were with him. They walked to the other side of what is now the Brooks Range. The Gwich'in traditionally hunted this area for sheep. When they got to the other side, Dajalti' told them to stay there. He told them to hunt lots of sheep and ground squirrel in the mountains. He told them to dry all the meat." –Maggie Gilbert, 2010, as recorded in Draft SEIS Comments, November 7, 2023

D.1.3 Traditional Knowledge of the Caribou

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

Iñupiaq residents from Nuiqsut have observed fewer caribou migrating from the east toward the Colville River Delta since development of Prudhoe Bay; while the Central Arctic Herd is the primary herd that occurs near the Colville Delta, many residents believe that the Porcupine Caribou Herd once migrated toward their community as well.

- "The caribou herds used to migrate through our village and now they migrate away from us. Last summer only three houses hung caribou. There are over 100 houses and most houses went hunting last summer. The offshore developments have caused problems with our fish. They are not coming. It's been eight years now. I know one family that hunted all summer, 80 days, and not one caribou. Where is the help for us when we go without?" (BLM 2003b)
- "I haven't noticed anything else except for the caribou splitting up because of the [TAPS] pipeline. They used to be all together and now they split up." (SRB&A 2012b)
- "We're getting to go further and further to catch caribou. Because their route has changed. They're not in our backyard. Now I have to go to other communities' backyards, like Anaktuvuk, Atqasuk and Barrow." (Nuiqsut active harvester. SRB&A Interview 2007) (SRB&A 2009)
- "There are just changes with the animals since development. Mostly just the caribou moving and coming in different directions. All the elders say the best time was when there was a tent city here [in Nuiqsut]" (SRB&A 2012b)
- "Yea, they will divert the migrations when they are in the middle of their construction because they will not stop for caribou pass by. The caribou were already affected by the TAPs. When those drill sites expanded that is when the caribou were diverted. They were diverted eastwards instead of going through the village. The development is going to be a concern to the wildlife. It will actually be more difficult to go further to harvest caribou. If they open that Umiat road what will happen to Anaktuvuk Pass and Nuiqsut? They will cut off our access to the Central and Porcupine caribou herd. That is going to be an issue when they build this. How are the wildlife, and the caribou, be address under that APP project?" (SRB&A 2012b)

- No, not enough. One caribou will feed your family but you got to worry about other families too. If you catch one you can't just keep it, so you have to share it between households. I would say about 10 [caribou is ideal]. Yeah – 10 or 12 [caribou], that would be enough to last all winter. When you haven't had it in a while and someone brings it over it is so exciting, when someone brings it over it is like a delicacy now, it is like a treat now. Caribou are so hard to find now, it is such a treat. When you catch one it is gone in a week because you are sharing it between so many families. We all watch out for each other when it comes to caribou. The other day a buddy of mine dropped off a caribou. There were 13 of us living in my house, so that one caribou went a long way for us. My kids, they love it. When you cut it up they can't get enough." (SRB&A 2015a)
- Pretty much the caribou herd, what they always talk about. The migration route is a big concern to all of that. As long as I have been here we used to get the caribou herd run through town. When I was little. It's been about 10-15 years or something. Since they actually came through town. They actually come into town, the caribou trails. You can see them come into town. And then there is a couple more, and on top of that hill around here, that hill has a caribou trail that has always been there and everything." (SRB&A 2012b)
- "Yeah, all of the caribou migrated through there. When I was a young man, I would wait for them there [near Fish Creek] with my uncle. Uncle used to say "you go right at that point" meaning at Nigliq. Used to be they migrated… even to Teshekpuk Lake. You know the caribou calving grounds, north of Teshekpuk… caribou kind of roam, up to the Brooks Range, up to Wainwright, this is the western herd…This is something else too. My own personal view is it because of the lights from the structures, the oil field infrastructure, and the smell. The smell from Prudhoe Bay, you notice with the haze that comes in. Those caribou have a good sense of smell." (SRB&A 2015a)
- "Mostly the caribou used to come from the west, back in the old days before that Alpine there was nothing around, we had caribou coming this way and that way. They mostly came right [through], the whole section of this from the eastern [direction]. Back in the old days, before that activity. Alpine, it started happening since they build that pipeline. Some [caribou] go further north coming in. Especially when they build that pipeline, they really divert that caribou that used to come straight across before Alpine was here. The pipeline's just right over here. All that pipeline goes there and the Western Herd, before the pipeline, they used to go straight there. They really divert that caribou. All those caribou used to come from the eastern herd and go right through." (SRB&A Nuiqsut Interview March 2009). (SRB&A 2009)
- "That's where most of the Porcupine Herd usually comes, around here, due to that pad; that pipeline that goes from Alpine to Prudhoe has pretty much changed the route of the caribou migration. The only big herd that usually came around is the Teshekpuk Herd; they came around. None of the Porcupine Herd that usually comes around, they never really came around, [because of] that big pipeline and the pads that connect to Alpine. And that other pipeline that goes all the way to Kuparuk. And from the north pad, CD3, down to Alpine. And then it goes to Kuparuk. It's shiny and makes the caribou not want to go through. Those caribou are scared of the pipeline. Some stick around. Some go towards it and go back." (SRB&A Nuiqsut Interview March 2009). (SRB&A 2010a)
- "I think what caused the caribou from diverting from the Prudhoe Bay, Kuparuk area is the height of the pipeline due to the fact, the requirement, a minimum of 5 feet, and especially when there's winter months, where snow starts building up, I mean there's absolutely no way that caribou can go underneath the pipeline, I think that's what's causing some of the caribou to come towards the west, especially the part of the central herd. That's something to be

considered strongly, and if there is to be development, within the NPR-A, there's a lot of ...(inaudible) ... that needs to be looked into and identified." (BLM 1997)

- "The Prudhoe Bay spine road is like a gate: the caribou get corralled in the area by roads, traffic, pipeline reflections, and staging. They get confused. They are scared to cross the pipelines, they are as scary as a grizzly bear would be to the animals. Some caribou are driven south, others are driven to the coast. If more roads are built, then there will be more blockage of the caribou. They will get stuck in the oil fields like a corral. The ones stuck south stay south and get little insect relief, while those going north get to the beach and the coast and get relief" (MMS 2007)
- "Yeah, they were basically passing through. We've got this Puviksuk over here, where they just discovered oil, and they want to put a test well over there, and that's where we hunt them. And now they want to drill over there, the caribou are going to get confused again. The caribou use these trails on a yearly basis and never forget. They seem to use the same route for their migration. They make it this far and they get criss-crossed about these roads. " (SRB&A 2019)

Kaktovik residents also observed changes in the historic migration patterns of caribou on the Coastal Plain following the establishment of Prudhoe Bay:

- As we were growing up, there was a lot of game plentiful, namely the caribou. But when development started in the years that he mentioned, they have been declining. Since this development of the oil companies started, there has been a very noticeable decline on the caribou. You have to travel way up, go up all the way to the mountains to catch any caribou nowadays. Isaac Akootchook 1990 Sale 124 Kaktovik. (SRB&A 2003b)
- Before the pipeline when I go to the mountains, a lot of caribou all over the place. And once in awhile-- but now nothing. I traveling around every day and last October when I go up there looking for caribou, nothing. Every time when I go there before, lot of caribou same place; but now, last October, nothing. Jonas Ningeok 1982 Sale 71 Kaktovik. (SRB&A 2003b)

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 Porcupine Caribou Herd, 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

Iñupiaq residents have provided observations on caribou habitat and movement in the program area, regional and historical differences in caribou, and environmental factors which can affect caribou health, migration, and abundance. Additional observations regarding caribou reactions to development are provided in Section D.1.13, Terrestrial Mammals.

- "Point Thomson to the east side, there was that caribou herd. Not the Porcupine, like in the middle of the state where they tend to go to the mountain. They don't cross the mountain range. They tend to stay in the foothills. When I was a child my father used to tell me that there were caribou's in winter that used to winter in Flaxman Island. They would eat the lichen. Those little plants and they would dig through." (SRB&A 2012a)
- "Yeah, Undoubtedly for good, the animals need a sanctuary. I have always joked and said that since I have worked the oil field for several years. Before that the closest I could get to a caribou was maybe 500 yards, but in the oil field you can get a whole heck of a lot closer. They know it is safe." (SRB&A 2012b)
- [The caribou] tasted different. It didn't taste like caribou. Kind of a soft meat, but - like, blank [tasting]. Didn't taste like caribou meat. You know how some caribou if you boil it a long time it gets soft, boil it less it gets hard? I tried boiling it less [to harden it up], but it didn't help." (SRB&A 2015b)
- "No not really [noticed health problems with the animals], for some reason a herd of reindeer mixed up with a herd of caribou and you get these half breeds and they look like caribou but they are real small. They are smaller than caribou. Like big bull caribou will be 800 lbs., those are mini's they are only 500 lbs., the bulls. They are a mixed breed of caribou and reindeer." (SRB&A 2012a)
- "They have reindeer in that area too [over by Point Thomson]. There used to be some out here but it rained that one time and then got cold and they couldn't get to the grass. We had to pick up reindeers out of our lakes and along the coast. Just that once. I remember taking 90 of them out. They had no nutrition because they couldn't get through to the ground." (SRB&A 2012a)

- "There were a lot of carcasses that one year when they starved. They said the first snow was mostly ice and it made the ice too hard for them to dig through and the caribou starved." (SRB&A 2012a)
- "For some reason this year and last year I just noticed that there are different times that animals are coming out. This time of year…in extreme winter you never saw caribou in the mountains; now there are hundreds. There are 600 or 700 animals, even in deep snow." (Voorhees 2019)

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

D.1.4 Sociocultural Resources

Social Impacts

Iñupiaq residents have expressed concern about the potential social impacts of non-local workers coming into their communities:

- "We have run into a couple of problems, like people from the south who didn't know about our way of life. People who didn't read our books or like they [people working in Prudhoe] were feeding some of the foxes and polar bears at Oliktok Point a polar bear mauled a guy, they had to shoot that bear. And the grizzly bear that went into the hotel, they had to shoot that bear too. Also rough necks from down south, they are roustabouts and they don't like natives and are prejudice. We tell the supervisors about that and they tell them they need to read the orientation book. We talk to the supervisors and that helps usually. We were here first. The US didn't realize people lived up here. They didn't know these people lived up here. They just thought about the major cities. They didn't realize there were these little villages up here." (SRB&A 2012a)
- "I think they are already impacting us. People want to bring up boats and stuff and run their own businesses. It is gonna, I mean, if they find ways to get land and stuff rich people are going to come in and take over." (SRB&A 2012a)
- "Sometimes I get scared that they are going to hire someone who is going to bring in some kind of disease." (SRB&A 2012a)
- "I wish there was better policing on some of the characters they bring into the town to work. We have had some bad experiences." (SRB&A 2012a)

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 Porcupine Caribou Herd 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 Porcupine Caribou Herd; the relation of the health and harvesting of the Porcupine Caribou Herd 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. Gwich'in Cultural Experts emphasized traditions such as persistence in the face of adversity (such as starvation or the continuing threat of oil development on the Coastal Plain) and the ideal of doing things "in a good way", meaning with honesty, humility, and without harboring malice or blame even for their enemies. Gwich'in Cultural Experts also describe sociocultural systems that incorporate neighboring cultures on the Coastal Plain, sometimes harmoniously, sometimes with hostility, but always in a way that reinforces identity and cultural continuation. 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

- "And then, and then another one is: teach the world in a good way. And [the Elders at the original Gwich'in Gathering in 1988] said, "We have to do this in a good way, because nobody knows us. Because nobody knows us, because they only talk about [Inupiat], igloo, and polar bears. And they don't know there was Gwich'in. They don't know there was Porcupine Caribou. They don't know what Gwich'in or Arctic Village." As they said, "We don't have friends. How can we win?" At that time, those Elders are crying, all the way through the elders are crying. And they pray, they sing, and they dance. Like, they have meeting all day and they dance all night. That's how it was in that feast in front of my mom's house, was feeding people here 24 hours a day. So, nobody is hungry. Anybody get hungry, they go and eat. And that's how they ran it." –Sarah James, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "I just think about that a lot, like, our very social structure is based on the land and how we, how we, you know, engage with the caribou, and how they provide for us. And so when I think about what is at stake, it's, it's our culture, it's our social structure, it's our diet, it's our economy. It's, it's everything about our lives, is at stake. And even if, you know, legislators or whatever, say, "Oh, we're just kind of exploring for oil and gas," or "we're just leasing this one little area," for us that signifies an opening up the door, that is unacceptable, because who's to say what's to come after that? You know? That's what I think about." –Charlene Stern, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "And that's why it's very important we do it, even if they're our enemy that we talk to: don't talk bad about them, don't treat them bad, treat them good. Like, they kill all our animals by that poison they use. They don't want us to talk about it. The war, they don't want us to talk about it. They want us to do in a good way. And once we do it in a good way we're going to win. That's why we're here today, that's what they say, that's 'cause they not like to tell us all these bad parts and make us angry, or hate. That's not what we're about, we're humble people, we're Dinjii Zhuu, Dinjii Zhuu mean

humble, yeah. And that's why I think, that's why they said that at Gwich'in Gather, to do it in a good way." – Sarah James, 2023, as recorded in Draft SEIS comments, November 7, 2023

- "Our elders, they talk about us, and we were there. We watched them do it, we listen to them, like he said this a big computer I got on my head, him too, her too. They put so much, so much in our head. A lot of things, a lot of things we left behind. We tried to do it in Western way, but it just don't work, it don't last very long. But whatever they put in our head, that'll last forever - IF we take care of it. We train our kids, we feed them good every day because we got so much to do today. They get us up early in the morning, four o'clock in the morning, "Come on! Get up, get up! We've got a long ways to go!" We get up, we jump up, we eat a little piece of meat then we help. We have to move from here to the other place because if we stay one place, we'll starve. We have to travel a lot. I am 84 years old right now. I walk many, many, many miles following our parents, our people, so we could eat. Everything that grows on that land up there, caribou get everything that he needs. Us too, we live up there and we get it, we got everything that we need, to move on." –Florence Newman, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "I remember when I first heard about, you know, people, like my grandma, my mom, all of them, when they first start talking about the calving area, you know, they're going to start drilling and stuff like that, it was a big thing. I was young that time. And I remember probably Robert, all of them had meetings and stuff. And they were talking about it. I wasn't involved then. But I remember people were concerned that, you know, they're going to destroy the land and, you know, and we're not going to get any more caribou, and stuff like that. And it was a big thing. I think that's when they, first everybody got together. And that's when they decided to have a gathering in Arctic." – Myra Thumma, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "Just like you're doing something over and over, you get tired of it, but you can't stop. That's what all the old people used to say. When we try to do something, we can't stop. We gotta keep on doing it. If we get stuck, we got to find a way to - That's what are we trying to do right now. We're trying to, we got stuck. So, we got to find a way to win it."—Frank Robert, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "I was telling them since that gathering 1988, since first it started, through that time to now, we lost a lot of people who fought the fight, like Johnson Solomon, there's a lot of people from Old Crow that was there, Fort McPherson. I mean, a lot of our elders that we lost, that was there during that 1988. So, by that, you know, we learned from our elders that are still there, that have been there. I wasn't there, but you know, I heard a lot of stuff about it. And I seen a video. And I mean, these, our people are, and we're not, you know, like college, we didn't have degrees, nothing. But we know, in our heart that, you know, this is, this is our land, this is what we're fighting for. And we all believe that, you know, and that's what our ancestors away before, you know. And we all carry that in our heart. And that's what the world does not understand, you know, who we are. And we believe that you know, and the stories that they tell, it lives on. So, it just kind, of you know, and it does get frustrating, you know, sometimes I remember back in 2017 or 18 when they we were down in Washington and they pass the law. I mean, they snuck it in, the 1002, you know. Me and Tonya over there, we're at the hotel and they brought it up, and we lost. But still we keep going, still we keep going, we're not giving up."--Myra Thumma, 2023, as recorded in Draft SEIS comments, November 7, 2023
- "We, we asked why they don't want to talk about it. Another reason is that they don't want to blame nobody on their life. We survive. And they're thankful we survive because maybe the Bible, maybe because we did something right. We did something right, that's why we survived, and they don't

want to blame nobody, and they don't want to do any revenges. That's the kind of people we are, we're humble people. "Dinjii Zhuu" means "humble", it's not "little" or not - that's how Lincoln finally explained it to me: Dinjii zhuu means humble. And everyone, all the Indian people, we call them Dinjii Zhuu people. So, we survived and we were thankful for that, and we don't want to start fighting again or, or blame somebody. That's why they don't want to tell us a lot of things. Lot of bad things happen. A lot of people starve, a lot of people suffer. Like, that's who we are. That's why another thing at Gwich'in Gather: they said we had to do it in a good way. That's the only way we can win. Yeah, and that's why they keep all these things. We gotta do it in a good way." – Sarah James, 2023, as recorded in Draft SEIS comments, November 7, 2023

- "So, with the help, with our friends and everything, we got the show going. They're wondering, we're started rocking the world with our drums. The echo from there, it's saying that we're going to protect our land from that drum. People hear it. Our black and white piece of paper start going out into the world. People was wondering what's going on? The world was wondering what's the Gwich'in people? They never heard about that before. And they found out that we're not the only one. Canadian Gwich'in are there too, the same blood that we have. So, we got friends with the media. We got friends with the recording system. We had friends with a camera guy. We made a lot of documents. We sent it out into the world. I'm very happy for Gideon James, he wrote a lot of documentary. He wrote a lot of those things into the world: how the Gwich'in stand, while that me and her, we walk the white man country to present ourself with the law people, with the Congress, with the senator, the House, Juneau Area Director. We present ourselves out there into the world, because we're being threatened. They were threatening the wrong kind of people. And we stand up in a good way, promise that we're going to do it in a good way." –Ernest Erick, 2023, as recorded in Draft SEIS comments, November 7, 2023
- “In our area there is a limited amount of fish and game, and only in their season. So it did not take the aborigines long to figure out that the caribou would be the most feasible game to ensure survival. There are some moose, but they are fairly new to the area, and scattered. The fish and other game in the area are very limited and cannot be relied on for extended periods of time. So the choice had to be caribou. But the caribou is a migrating animal and the Porcupine herd migration route is quite extensive.

  Until they can develop a way to harvest more than their primitive weapons allowed they had to follow the herd. From this existence a social, political and economic structure was formed. If any group of people is to survive there must be some form of moral beliefs and a way to teach it. So the culture and the very livelihood of my people is based on the caribou.

  The care of caribou is very much emphasized in our aboriginal educational system. The children learn to respect the caribou at an early age. The caribou has always retained its status as a food symbol, even in the stories that were told to our children. A lot of our stories were told with a concept that long ago all humans were animals and all animals were humans, except for the game animals. So the caribou is very much a part of our lives. There are still people in Arctic Village who grew up this way, and to them the caribou has a lot more meaning than food supply. There are still people in the village who can't even eat anything else other than caribou or domesticated animals.” –Lincoln Tritt, 1987, as recorded in Draft SEIS Comments, November 7, 2023
- “Please understand, we are a modern hunting culture-one of only a few left in the modern world. Our people are caribou people. Caribou provides not only food and materials for our people, but

also our spiritual life. For many, the traditional life is the only alternative to alcohol and the streets. Without caribou, who are we? What do we have to offer our children?

I have been coming to this town and traveling for my people for more than 20 years now, and I still get sick if I do not bring dry meat or dry fish with me. We just cannot get by on the food here. It is a small thing, but it's an example of what I'm talking about. It's the same for our people when they go into the hospital. We always bring them native foods. If we do not, often they just get worse and die.

The issue is not just the caribou either. All the land and animals here are important and respected by our people. It is our back yard and we feel about it just like you do about yours. More so, because we cannot move to another place to live our lives. They are all connected with this land right here; where our parents and grandparents and their grandparents have all lived and are buried.

I want to say one more thing about wilderness. For this area you should make clear that subsistence activities are to be protected. You define wilderness as a place where people are visitors. I'm sure this area seems this way to you, but to us this whole region is occupied already. Where you see empty land I see a hundred camps still used by our people. Where you see a faraway reserve, we see our back yard. This should not really be a problem, but we recommend that you restate the subsistence priority and list cultural preservation as a purpose of the refuge.

Finally, I would like to read the resolution of our people. This is a resolution that was passed by our people in June 10 in Arctic Village.

For thousands of years our ancestors, the Gwich'in Athabascan Indians of northeast Alaska and northwest Canada, have relied on caribou for subsistence, and continue today to subsist on the Porcupine caribou herd which is essential to meet the nutritional, cultural and spiritual needs of our people; and the Gwich'in have the inherent right to continue our own way of life; and that this right is recognized and affirmed by civilized nations in the International Covenants on Human Rights. Article I of both the International Covenant on Civil and Political Rights, and the International Covenant on Economic, Social and Cultural Rights read in part;

"In no case may a people be deprived of its own means of subsistence; " and

The health and productivity of the Porcupine Caribou herd, and their availability to Gwich'in communities, and the very future of our people are endangered by proposed oil and gas exploration and development in the calving and post-calving grounds in the Arctic National Wildlife Refuge, Coastal Plain; and the entire Gwich'in Nation was called together by our chiefs in Arctic Village June 5- 10 to carefully address this issue and to seek the advice of our elders; and the Gwich'in people of every community from Arctic Village, Venetie, Fort Yukon, Beaver, Chalkyitsik, Birch Creek, Stevens Village, Circle, and Eagle Village in Alaska; from Old Crow, Fort McPherson, Arctic Red River, Aklavik and Inuvik in Canada have reached consensus in our traditional way, and now speak with a single voice.

Now therefore be it resolved that the U.S. Congress and President recognize the rights of our Gwich'in people to continue to live our way of life by prohibiting development in the calving and postcalving grounds of the Porcupine caribou herd; and be further resolved that the 1002 area of the Arctic National Wildlife Refuge be made wilderness to achieve this end. Please understand, we are a modern hunting culture – one of only a few left" –Jonathon Solomon, 1988, as recorded in Draft SEIS Comments, November 7, 2023

- "And I think one of the things that also makes us unique is, you know, colonization, in a lot of places one of the first things it does is it emasculates men, because men, you know, traditionally in

our communities were providers, and it kind of does something where it separates them from their traditional role, whether it's hunting, fishing, gathering and then you start to see a breakdown of the community and the family. But our - we haven't had as much of that because our men are able to hunt caribou. Like, our young men are in a healthier position than a lot of other Native communities because they are able to fulfill those responsibilities. And you see that in the joy that they have when caribou season comes around, the confidence that they have in their role to be able to provide meat for the community. They have a purpose, you know, and the women also have their purpose." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Caribou is our food year round, you know, even if it's not - non hunting season for caribou, …that's when we store caribou away for during those times. And yeah, just before we came over, I have three daughters in my second daughter, she asked for, she said "dad I want boiled caribou meet with mayonnaise". So, that's like our main, we boil meat, we eat it with mayonnaise, and jalapenos. It's really good. But um, she asked for that, I looked in the freezers and I found fry meat, but you know, I just didn't have boiled - it, that kind of made me feel like, I'm like, darn. Next year, I got a, I got a goal for next year that I'm going to store more than I did before. But what I'm getting at is, you know, that I'm really happy that our children in Arctic Village, all of our children, even like, think about caribou. You know, that's pretty interesting to me. And I'm, I'm really, really what's the word? Shocked? In awe if, that we're doing it right, you know, that we're showing our children, feeding them, you know, their main, their main diet? And, yeah, that's pretty much what I think about caribou, you know, and I also think about life when I think about caribou, because that is our main, you know, main animal or main diet. I don't. We could we can't live without caribou. We can't. That's just, that's just like our life. So, yeah, that's what I think when I think about caribou, thank you." –Galen Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Those elders or talk on a video, my dad was one of them. His dad. Myra. All the elders were on that tape. We need to listen to that, we need to watch it. We see it, we live in it but we have to - it have to remind us over and over and over. We remind each other since we came, he remember what I don't some places. We remind each other to go on. That's why I said we still carry our elder's voice. When I'm having a hard time, there so much to do. That time, I hear my mom's voice: "Keep going, don't give up. If this don't work, go other way. Go this way. Try don't give up. Caribou all the animals are like that." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know after, after animal have their babies, and we don't bother, we just stay away. And you know, once they start running around, their mom and dad are out there hunting so they could feed the little ones. And while they're out there somebody got them, killed them. And those two little - there's five little ones in there waiting for their mom and dad to come back. They don't come back so they just starve in there. Oh, I just, I don't even want to think about that." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "In 1989 they, you know in 1983, you know, we went after A&A grant to I - we're gonna make tribal ordinance handbook. That's what we created. And that's a God darn good book. So, you put in fishnet down there, and if you're not taking care of it, we're gonna get it back, you know. Or the next guy, we're going to put there and stay till you come back. So, that's the kind of laws that we have, you know. So, that's where that toboggan, the size of your toboggan is how much caribou you're going to carry. […] These are the law, the law that our elders made. So, that's the law of the land. That Tribal handbook is the law for non-members or members of the Tribe." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "I have grandchildren myself. One is in Iowa, oh she loves caribou. So, we share that far: to Iowa. And I have another one, grandson, Lakota in Minnesota. Oh, he likes caribou, moose. So, I have an auntie that lives in Virginia, 80, […] 80, Yeah. Our Auntie Mildred Nichols. My grandmother's last baby daughter, baby girl. And she's 80 year old now. I have to share with her just about, "Mmmmm!" she says on the phone, you know, she know that she had an operation, and the only thing that helped her is the caribou, and the moose meat to get her re- nutrition back. I was really impressed, you know, and that's part of the sharing that University of Alaska did a few, uh, last maybe 20 years ago. You know, we document that you know, the sharing part. And we found out that caribou come from Arctic Village long ways into the country. The dry meat, somehow dry meat I have to send down there. And it costs me money but these are my grandchildren. And they're Red, they're Black, they're Brown, they're White. And those are the bloodline, you know, and specially my auntie, so impressed of what she eat from the land." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "See it - there's lots of ways we share with each other we, all surviving on each other, everybody we just got to work every day that's what my grandpa says, every day. If you miss one day your, your kid's gonna be starving because those days no job. We can't even buy the box of shells, $2.75. We can't even come up with it. Today $20 something, one box, you know. Because there's a lot of job everybody works, but way back then it's kind of hardships. But that's the reason we are right here" –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "…Rev. Albert Tritt, he baptized their [Iñupiaq] kids and some marriage[s]. I think, a couple of times, they meet up to the Arctic Ocean. My dada went up there once. My grandfather family (his parent, brother and his brother wife). They lived up there for a few months. They [Gwich'in] had other interaction [with the Iñupiat]. In fact, they had a meeting, back in early 1900 and 1914 or 17. Somewhere, in there. They had a meeting between the [Inupiat] and Indian because they interacted so much that a lot of them started to think about getting married to each other. But the elders got together and talked about it and didn't think it was a very good idea. They still interacted, in fact, my dad went up there in 1922. That was the thing about traditional system they were very conscious of loyalty. Because a lot of times people start fighting and the tribe become weak. So the loyalty was very important so if one parent of a child came from Arctic Village and one came from Barter Island or Kaktovik, the child could get everybody mad in Arctic Village and just go to Kaktovik. Then the child could mess around in Kaktovik and come back to Arctic Village. This was why they did this because how you raised a kid was very important for the future. Today they don't pay attention to that, there are too many greedy people." – Arctic Village resident, Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023
- "[When Gwich'in people migrated through the Brooks Range to the North Slope, they went to] Spring Creek, Kiihaiilaii Jik [...] Our people used to go over the Brooks Range. In our language, it's called Gwashrał. Our people go over the Brooks Range to the [Inupiat]people. They bring gifts for the [Inupiat]and bring prayer. They pray when they go up and when they come back. They don't hide their campfire – that way they [Inupiaq] know people are coming. If they hide their campfire, they [Inupiaq] would think the Gwich'in were sneaking up on them intending war. It's the same way with both sides. Once place there is a hill – that's where they trade stuff…its either at Spring Creek or East Fork." –Sarah James, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- "The Gwich'in use to have war with the [Inupiat]in the north. The Gwich'in got tired of the war. Gwich'in people were always on the guard. They needed 24 hour guards in all camps. No one could sleep good. So one day, Dajalti' decided to lead his people north to end the war. The [Inupiat]were

afraid of Dajalti', because he was a strong medicine man and a warrior. The [Inupiat]heard of him. He was so quick they could never catch him. When they shot arrows at him they could never hit him. Dajalti' said he thought of himself as a caribou hair that is why their arrows never hit him. […] his plan was to go down to the Arctic coast by himself. He wanted to look for the [Inupiat]so he started north.

He began walking along the (Arctic) coast. He got to a point where he saw lots of them there. They saw him coming and begin moving towards him. There were so many of them: they were like trees. Some were even lying on the ground. They kept approaching him, but he didn't stop walking towards them too. Eventually they all stopped and the [Inupiat]leader walked up to Dajalti' by himself. Dajalti' didn't stop walking towards him. The [Inupiat]leader got scared and turned around and tried to walk back when Dajalti' snatched the arrow case from his back. So at this point, the [Inupiat]knew they couldn't beat Dajalti' […] So Dajalti' spoke in [Inupiat] (their language) and they all listened. He said in a loud voice, "Be quiet and listen!!! My people never started this war with you! But you guys are the ones who come across the mountains and have war with us! I came over here to make peace with you. I don't want you to bother our people no more! If you do, I will come back here and clean you out! I will not leave one of you alive. Not one!!! You are going to do it like it or not!"

They were silent. They then came to an agreement to end the war between Gwich' in and [Inupiat]. All the [Inupiat]at that point started clapping hard for Dajalti'. Everyone was happy with the Agreement. Before he left he did two things: he told them to tell everyone they knew in all the villages in the north of what happened and what has been agreed upon. Second, he decided to sing them this song: 'The [Inupiat] (people of the coast) should cry the way I cry, because they killed my people. The [Inupiat] should cry like I cry.' To this day, the [Inupiat]never bothered the Gwich'in." –Maggie Gilbert, 2010, as recorded in Draft SEIS Comments, November 7, 2023

- "[…] long time ago they said a ship used to sail over from Russia. I don't know if they're talking about white people or Russian [Inupiat]. My mom said they called them Chiizyaa. They use to come over and go to Kaktovik. Whenever the Russian ship would come over a lot Gwich'in go up with caribou skins and warm clothes. They would buy a lot of stuff from them. My mom said they had a lot fun with each other. The white people chiizyaa, Russian [Inupiat]and Gwich'in would get together and drum. They had a good time with each other. There was a lot of people and they buy stuff and then they come back. I wonder what kind of stuff? Guns, chisel, fishing pole, stuff like that. They use to get all kinds of stuff. It's a really good story. They say the caribou skin from our people was really good. The caribou skin from here is black. They have caribou over in Russia too but theirs is grey. Lots of grey ones and they say it's hard to kill. They say the caribou are really smart. Caribou over there is hard to kill so they come over here. They gave them lots of caribou skins. All this happened before the war. When the Chiizyaa came over they had lots of fun." – Trimble Gilbert, 2018, as recorded in Draft SEIS Comments, November 7, 2023

D.1.5 Climate and Climate Change

Climate Change

Iñupiaq residents have observed the impacts of climate change, including changes in ice and snow conditions, and effects on resource migrations.

- "The ice has changed; the old anchored ice is missing; the early warm up leads to ice break-up; the whales are coming earlier (mid-April); both human activity and natural causes (global warming) are responsible." (EDAW Inc., Adams/Russel Consulting, Applied Sociocultural Research, Donald G. Callaway, Circumpolar Research Associates, and Northern Economics 2008)
- "As a result of climate change, [the bowhead whale] migration has started earlier." (EDAW Inc. et al. 2008)
- "Global warming causes the ice to go out earlier. As a result, whales pass by before crews go out on the ice." (EDAW Inc. et al. 2008)
- "Each year it seems like the whales go a little farther offshore; some of them, anyway. Some are still close to shore, where they have always been. There has hardly been any ice the last few years, and the lack of ice may be why some whales are going farther offshore; there has been no ice nearby." (EDAW Inc. et al. 2008)
- "I've watched seasons change all my life, they were close together and same length, now we don't have them anymore." (Voorhees 2019)
- "The blizzards have gotten stronger, [up to] 100 miles per hour this year. We used to have winds of 45 to 50 for three days [only], then that would be over." (Voorhees 2019)
- "How the seasons mingle, you can't tell now…the seasonal patterns and anticipations for animals aren't there." (Voorhees 2019)
- "The winds are changing too. It's not like it used to blow when we used to have storms in the winter. There are more winds that are different kinds, colder. [It] used to blow east and west and now we're getting north winds." (Voorhees 2019)
- "There has been less snowfall starting three winters ago. Or it blew away in the blizzards. When we travel up to the mountains in the springtime [there is less snow]. Some rivers are not freezing in early fall, that's another change, in October it used to be frozen so you could travel all over the hills." (Voorhees 2019)
- "It seems like it has been getting windier in the late fall. The wind tends to blow. We would get maybe about… we never used to have 60 mph winds. One time we had winds that were hurricane force 70-75 mph. It tends to get a bit wilder now. I don't know why, they have it recorded on those things that document the weather. It has been changing there; I guess it is due to all of the warmth. The cold air tends to rush in, and the cold air tends to stand still." (SRB&A 2012a)
- "Global warming has led to warmer temperatures and changing ice conditions; ocean currents are faster." (EDAW Inc. et al. 2008)
- "We have been having warmer winters. You should have been here in December! We had about 18 above. That would be winter, the darkest part of the year and it was warmer than the sunny time of the year. It was about 40 degrees warmer than it is right now." (SRB&A 2012a)
- "We [usually] had less ice during the summer, it is warmer in the summer. I don't know it is windy most of the time. I don't know where the ice is going." (SRB&A 2012a)
- "30 years ago I think during the late 70's or early 80's is when the weather really started to change suddenly. After a while you tend to notice, "oh, it's getting warmer." We would play out in 30 below weather in this time of year. That's December usually, now it's 18 above in December. Then we had one whole month of 30 below earlier this year it was like before. When we were growing up is used to be 40 below for a week at a time. Summer is just like any other summer." (SRB&A 2012a)

- "The water has changed where we went camping at Griffin Point, the water stays warm now." (SRB&A 2012a)
- "I noticed when we went Tomcod fishing in October we noticed the ocean was warm. We couldn't believe it! It wasn't cold like it used to be. We thought we were going to get cold right away but we didn't." (SRB&A 2012a)
- "It is cool in the summer too, not so hot, it kept the mosquitos away. Last summer it was cooler than it was in years past." (SRB&A 2012a)
- "Don't ask me about global warming. 47 below in December or January that is pretty cold and someone mentions global warming. We can get… we are getting wind and snow from the west. If you walk over to the snow fencing we have a lot more snow piled up and it is overfilling the snow on the east side… when the east wind blows you only 3-4 feet piled up." (SRB&A 2012a)
- "When I was growing up the weather was a lot warmer in both summer and winter. During the years past it has changed to where… in March when I was growing up the weather would start warming up. In like November, December, January, February, that would be the coldest part of the year. Today they still are but March is to. It is unusual to see something like this, where it is over 50 below to where it is cracking the tundra in March. When it cracks it makes a lot of noise, it never used to do that when I was young today it is changing. Our weather is so different compared to what I observed in the 40s and 50s. Today we don't have any [prevailing] wind directions." (SRB&A 2012b)
- "Along the coast and rivers and drainages, yeah. [The temperature is] rapidly increasing. To me I think it is just bottom line the climate change, global warming. And I head several years ago when they were dong tests out in the ocean they noticed the sea warming up through the years. A degree or two a year." (SRB&A 2012b)
- "I think it is temperature. Ground being warmer. Methane and carbon monoxide seeping up." (SRB&A 2012b)

Commenters requested that the EIS include traditional knowledge on past and present climate change effects on the Porcupine Caribou Herd 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
- "My mom said they told her about it [the climate change], but she didn't remember it. Maggie's grandma is Elen and Elen's dad is Dajalti'. […] [Dajalti'] talked about the hard times: the times of starvation. He said there were a lot of Gwich'in people during those times: the population was very high. They lost a lot of Gwich'in people in those times due to climate changes. […] Due to the weather, there was starvation […] all the animals were gone. The only animal[s] that survived was ptarmigan, porcupine, and rabbit. The ptarmigan lived off of willows. […] Another animal that survived was porcupine, because porcupine was eating the spruce tree: the porcupine lived by the timber. […] when the springtime finally came and everything melted, it became winter again all of a sudden. […] We lost lots of Gwich'in people that time, because before that there were lots of Gwich'in people. There was lots of snow and the rivers and lakes were frozen to the bottom during those times […] In a different time, the climate turned cold again. There was no snow this time, but lots of ice, everything was frozen. The caribou couldn't find water. There was only ice on the lakes and the caribou would lick the ice with their tongue. You see they can't break the ice, they just used their tongue to lick the ice, however, the caribou still didn't make it and they all died. Again, only ptarmigan and porcupine survived. […] My dad Dajalti' and his daughter Elen told me this happened; it happen a couple of times." –Maggie Gilbert, 2010, as recorded in Draft SEIS Comments, November 7, 2023
- "Yes, lots of changes. Even the lookout hills are caving in. It's all getting ruined all over. The lakes are sinking. I seen a lot of it drained out. Out past the airport there used to be a lake but now it's all dried up. There used to be lots of fish in it. […] That's what's happening. When permafrost is thawing out, everything tends to cave in." –Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023
- "Everything is changing a lot. Long time ago our elder they always say: in the future the weather will change. Hot weather will be here and the cold weather will be down there. Guess what? I see that today. How do they know? They know everything. It'll be like that, it'll be like this. Be prepared. Be ready for it. Now, I see lots of it happening now." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Snow

- "We used to have a lot of snow, it might have something to do with the snow fences. I am not sure how it affects the island but we used to have a lot more snow banks and I am not sure if that is something to do with the snow fences because it is not protected." (SRB&A 2012a)
- "You have to watch out for whiteouts. My dad when camping one time and he was on a snowmachine with two sleds. And his friend was by him and it was beautiful out and the next thing you know my dad fell down in a white out and he fell down and the sled fell on him. Watch out for the white outs. It could be a beautiful day." (SRB&A 2012a)

- "[We have gotten] more snow from the west in the last few years. I think it is a cycle. It gets warm for 2-3 years, and we got a cold snap and the northern lights and solar flair." (SRB&A 2012a)
- "One year we get more snow the next year we get less… the highest wind we had was around 50 miles an hour and about 5 -6 years ago we had 70 or 80 mph winds for about a week with gusts up to 100 and we were happy. We had 69 people at the school until the generator quit and then we took them to public works. We carried kids, walked hand and hand and then we checked on the elders. The wind was turning the power on and off and then black hawk helicopters came in… and we had to go through 20 foot snow berms just to walk. We had to close school, public work, fire station wasn't even there, but the clinic was running out the fuel and we had to hand pump fuel into all of the buildings because there was not power. We hung out and made sure everyone was safe. Later on we were on the national news because we didn't know, and some of the teachers had cameras and some people had internet and everyone got cut off. Once you go out you see wind. After the wind quit and there is a sheet of ice… grab a shovel. A lot of elders we didn't know where the fuel takes were and we had to dig them out and get them oil. There were a few building at Point Thompson when that storm was going on. They had better luck there, the shop here was frozen, we had snow all over, someone left the door open. After the fact we figure out that the auto-door was opening whenever it wouldn't go down. Heavy equipment froze. After we got most of the power up and had to manually close the door and shovel and… 4 or 5 days. Nobody got hurt." (SRB&A 2012a)

Ice

- "Pressure ridges are getting further and on the east side some of the pressure ridges are piling over the spit. The ice ridges are getting higher and higher. Last year they were pretty close but…." (SRB&A 2012a)
- "Make permanent roads [rather than ice roads]. They are melting millions of dollars every year and making brown lines. Just like ice breakers they break these lines and they break through polar bear tracks. The polar bear doesn't know what happened to their road. His path was disrupted by a machine. People don't believe me that when you break up more ice that the ice will melt more and that thinner ice doesn't stick around. When you break it up it just disappears it is less. The ice used to be thicker. It used to be 8 feet thick in Barrow and now it is like 2 or 4 feet think. The pressure ridges are small." (SRB&A 2012a)
- "It has always been windy and finally we got an east wind, which is warmer. When the east wind blows it opens up the leads." (SRB&A 2012a)
- "I have seen the ocean when it [ice] piles up. When it moves. With very little helps of wind. I have seen, here in Barter Island, when it piles up. When it hit the beach, we have a cliff out here. It is about maybe, thirty to forty feet high and during the month of June, if I remember right, the ice moved and that ice, maybe five to six feet thick, climbs up over the cliff. That's how strong it is. There's ice six feet or five feet right on top of a forty foot cliff." Phillip Tikluk (MMS 1979a)
- "As a young girl at Cross Island, I have seen how a sod house was covered by a pressure ridge in the wintertime. The wind was so strong that it covered one end of this island. The ice is very dangerous. The shore edge is very dangerous and unpredictable in October and November. During one December on one of the islands, another sod house was completely covered by pressure ridge. The ice had cracked and the ice was turbulent and it took two of Tookak's kids. Another movement and his wife was taken away. You cannot talk of the ice so easily. You cannot control nature, the wind. The wind is the greatest factor." Bessie Ericklok (MMS 1979b)

- "In talking about ice conditions, the ice current is very swift and he's using this example down here. The islands down here, they have piled up ice right on top. Once the ice starts piling, it can go anytime. And it will scare people once it starts piling up. And he does not know this…if it starts piling, the ice starts piling up, he doesn't know what's going to happen." Herman Rexford through Interpreter Emily Wilson Ipolock. (MMS 1979a)
- "He knows that when ice starts piling up, not only on surface does it pile up, but inside the water, also, it piles up. It's stirred up inside also. And when the ice is piling up, it is strong inside the waters and also on surface. And it's dangerous, not only to the animals but what they feed on also, is very dangerous. It will kill all the animals foods that they feed on in the ocean." Herman Rexford through Emily Wilson Ipolock. (MMS 1979a)
- "The ice conditions back in the day…you'd see the rough, piled up ice; nowadays I cruise all around the coast and it's mostly flat ice. We're losing our winter. Back in the day the ice ridges used to be very close [to shore] and now they are far away. It's easy for the ice to take off." (Voorhees 2019)
- "We can't go out on the ice, it's too busted up from strong winds." (Voorhees 2019)
- "Sea ice used to go out at the end of June and come back at the end of October…it's not like it used to be." (Voorhees 2019)
- "What I know from when I was a child…when school was out we used to go all the way to Arey Island at the end of May and there would still be ice out here, and we would be able to go camping for a week or two or three and the ice bergs would still be around here in June. The lagoon would still have ice by the fourth of July sometimes." (Voorhees 2019)
- "The ocean is changing too you know. In the late 60's to early 70's we used to have an ice pack from the Canadian Border to the Barrier Island about five miles or ten miles from shore. It wasn't a really dense ice pack; you could travel wherever you wanted about the ice pack. Nowadays you can look for 200 miles and not find the ice. It started in the late 70's early 80's and the 90's too. We started noticing that the ice was going. We would go out whaling and there was nowhere to sit. We would camp. And Look around." (SRB&A 2012a)
- "I think all the ice melted, that is the only thing I can think of I guess. It doesn't get as thick as it used to in the old days so it just completely melts." (SRB&A 2012a)
- "When it gets below freezing, the water tends to freeze all over the place. The freshwater lake and rivers freeze first and then the saltwater ice. We have to be able to cross it before we get inland. All the rivers tend to be frozen." (SRB&A 2012a)
- "I don't know… in the summer time the sea ice used to pile up with ridges now it doesn't do that anymore except maybe way down in the ocean. More than 20 years, but maybe 20 years ago." (SRB&A 2012a)
- "When we are hunting in the winter we have to be really careful; the ice isn't that thick anymore. The top may look frozen but the current may be eating at the bottom of the ice." (SRB&A 2012a)
- "You have to be careful, especially right after freeze up you have to stay off of the ponds and the lakes. We have to go around them. That is in October, right after freeze up. All of our hunters know to stay off of the ice. You really gotta wait for it to really freeze up." (SRB&A 2012a)
- "You see those ice ridges out there, they are huge like mountains, they are pretty far away. They used to be much closer to the Barrier Island, so that means it is getting shallower out there. When it moved north it means the offshore area is getting shallower. Not so much at Arey Island; it is right on the beach. Sometimes it piles up and over the sandbar but this is getting pretty noticeable

now, you can see like a mile and a half of ridges. It is following the pattern, one year it is close and the next year it is further. It depends on the current." (SRB&A 2012a)

- "No, it, when you get the Pingos… when you get [the dust from] those two pingos blowing in the spring all that dust builds up in the ice and when the sun hits the ice and the dust and gravel the ice seems to melt faster. And when the silt and ice settles, it gets pretty dangerous for snowmachiners. They have to go through clean ice instead of dirty ice or you will sink. When you get melting on the coast you have to go quite a way outs towards shore fast ice. It is the same on both sides, there are pingos on both sides blowing gravel. Onion Point where people go fish during duck and goose season and they have to snogo out in the ocean and travel off of the way around because the ice is dirty and dangerous. By mid-June it is already melted and turned into slush and stuff so you have to go further out. The further you go out the more safe it is… no only that but we get ice fog and people get lost and you need a GPS. Ice fog will play tricks on you, your eyes play tricks on you in the ice fog. It has something to do with all of the ice." (SRB&A 2012a)

Storms

- "We never used to have thunderstorms this far north, but lately they have been coming with a rain cloud and lightning." (SRB&A 2012a)
- "Maybe in the past 10 or 15 years, we have started getting the thunderclouds and lightening." (SRB&A 2012a)
- "Oh my gosh, we thought this village blew up when we heard them [thunder]. I thought for sure… we called over the CB and asked if everyone was all right. The land shook." (SRB&A 2012a)

D.1.6 Physiography

Iñupiaq residents of Kaktovik have identified key landmarks which help them when navigating the land, coast, and ocean:

- "Generally you look up to the mountain range and you will know where about you are. Like these close mountains you could notice where they are and how they look from one area to the next. They would show the promontories and you would know where you are. Like kind of high hills on the shore, you would notice those, landmarks to use. And that creek that came out by Camden Bay. We would head towards my father's allotment; there was a creek Tigivariak (sp) Island and the Tigivariak Creek. You could notice where you were at." (SRB&A 2012a)]
- "I remember when we had that pole, we used to camp by the pole. It was a landmark to us. Everyone was going out camping and we were left behind. They were like "follow the tracks" and by the time we left there were tracks all over the place. And we were like "we always camp by the pole" And that was where they went. I am not sure if it is there or not." (SRB&A 2012a)
- "There is a big hill and when we boat from Kaktovik and we follow that coast to Pt. Thompson and camp and from POW-1 you can see it on a clear day. It is flat and a hill. You can see the point because the mirage, the horizon brings it up. You start seeing it at POW-1 and when you get to Tiviluk Islands you can still see it. And when you get to Endicott you can still see it. You keep it to the right and you keep going. Even though it is foggy you can follow the waves and the ripples." (SRB&A 2012a)
- "Between first and second fish hole where is a mountain called Tiqok Mountain, like a nose, and a couple of lakes like Schrader Lake and Lake Peter. And there is an area at second fish hole and there is old man and old woman creek… Those are on the Hulahua River. There is blueberry hill

right next to it. There are several areas on the Siviochik River… also there is flat top mountain." (SRB&A 2012a)

- "Yes, I don't take a GPS. These places are important to help navigate. Also there is that Red Mountain. There is another spring, a sulfur spring on that river too. You can really smell the sulfur off of it. There are the warm springs and the hot springs. It is all noticeable. Marie Mountain there is this big flat area and a big drop off but that is also getting gradual." (SRB&A 2012a)
- "When we used to go to Canada we would take a snowmachine up the Jago River and we would cut straight across that way and go into Malcolm Mountain and Malcolm Creek and go into Klavik. But now since most of the snow buried most of these rivers…. When there is no snow it is pretty noticeable… it is smoother and quicker that way… when you leave here you follow the coast to Camden Bay and we will follow the hill and hit Marsh Creek and hit the creek and follow it into the Canning [River]." (SRB&A 2012a)

D.1.7 Soil Resources

Changes in permafrost are a key concern among the Iñupiaq of the North Slope:

- "It [permafrost] tends to melt wherever you tear it up and then there's a pond or whatever. If you take away the vegetation from the top of the ground and leave it like that it will tend to melt." (SRB&A 2012a)
- "When they dug the graves up there at the graveyard, there was a spot where we would get sod in though, the grave. It was slowly getting bigger; it was from one pass to another pass. It was a pretty big sized pond, you notice that when you take that sod off it tends to melt into a pond." (SRB&A 2012a)
- "There's reports, recent reports, even at Prudhoe Bay, where the permafrost is even affecting the infrastructure with oil and gas where they had to close down wells because of that." (BLM 2018)
- "[The permafrost], it is dropping, even the little road to the other end there was some areas that are dropping by the camp. That one is just along the road is dropping." (SRB&A 2012a)
- "All of our land is getting like this and getting lots of ruts [as the permafrost melts]." (SRB&A 2012a)
- "If the water hits it, it will erode the permafrost really fast. If it is just exposed to the light it takes a lot longer than if it is exposed to the water. I have seen dry permafrost stay around for 10 years and not do anything." (SRB&A 2012b)
- "No, but those pipelines that go over the rivers, now that will affect the river. There are those pipes that they sink that are filled with Freon and they keep the ground frozen. That is the only place I would see permafrost aggravation. Seems like they didn't go far enough away from the river. I bet those permafrost things will begin falling over." (SRB&A 2012b)
- "In some of the areas with permafrost there are sink holes. They have to be sure the pipeline is insulated so that it won't produce heat and melt the permafrost. It is pretty noticeable over here, there is a clear spot where there is a shallow pipe and it is clear." (SRB&A 2012a)
- "Well, there are several factors [affecting the land]. When the air force first came they used to change… they had to add more gravel from the beach because the beach was quite a ways out and they would bring in the beach gravel to make the pads for the DEW line. They would dig everything up. The gravel is coming from the inland now. They would bring all of the gravel from the beach to make all of these pads and now it is eroding, that was 40 or 50 years ago and if they didn't touch

it it might be fine now. You can notice permafrost on the north side of the bank and they had scientists study the ice. The island shifts, every year it moves a little. I don't know if it is magnetic or what not, some of the islands you know. The pingos near Nuiqsut used to be like 30 or 40 feet up and now they are like flat and now it is like they popped the pimple or they got sucked in and now they are all melting and now flat. In 20 or 30 years maybe they will be a lake. The permafrost where it was melting now forms a lake." (SRB&A 2012a)

Residents have expressed particular concerns about the potential interactions between melting permafrost on oil field infrastructure and activities:

- "It used to be bad we had geysers [after pipes broke], and when that gravel and that water started melting over the permafrost and that pipe would bend and finally break and eventually it would shoot up like a geyser. There were pipes in town that did that. I hear the pipe from Pt. Thompson to Prudhoe Bay is going to be above ground, like the TAPs. I hear that there is only like 8 percent of the TAPs that is buried. In some areas they have to bury it because I think the cold or whatnot affected the pipes. I think it is mostly buried in high altitudes." (SRB&A 2012a)
- "I think the gravel they have added on the tundra causes early thawing. But it is insulated by the gravel. At some point the gravel can sink and during the summer when it is hotter." (SRB&A 2012b)
- "Oh yea, like the Hickel Highway… they thought if you took a dozer you could just pile up the tundra. It was noticeable for the first five or ten years. I don't know how they did it but when spring came around and everything just flattened out [due to melting permafrost]. It was like 3 or 4 feet deeper." (SRB&A 2012a)

D.1.8 Public Health and Safety

Iñupiaq residents have described how past changes in subsistence opportunity, pollution, contamination of subsistence foods, and development in general have had social and health impacts on local residents:

- "We have shown that we start abusing other things, each other, drugs, whatever, when we can't meet our families' [subsistence] needs." Rosemary Ahtuangaruak. (MMS 1979b)
- "I have been a health aid for over a year now in Nuiqsut. And it is a tough job and I know. And I have found out in one year, that on our little children and the older people, their hemoglobin has dropped way down. Some of the little children have to have two doses of iron. And it's really hard. And it's because we are so short on our caribou and all the animals are scarce." Rosa Kaigelak. (MMS 1979b)
- "The changes are the burbot, that eat the fish. The burbot are more slimy in their skin, and the liver has changed; the taste of the liver has changed, the burbot liver. I don't know, maybe after that one big mud [discharge], when they drill and also when they are near Umiat, and there's a lot of debris in the Umiat area. We found out now that burbot, after they found out that they had PCP in the livers. The elders that have been eating those have died from cancer." (SRB&A 2013)
- "It just got worse [as development increased]. When they first started [building the pipeline] it [the drug and alcohol problem] was ok but after the pipeline started working it just got worse and worse. These people are ok when they are sober but later on like sometimes like a year or so everything turns around and they go to alcohol instead of trying to get away from it. That is what they done so… it has been up ever since. There is no way of stopping it." (SRB&A 2012b)

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
- "You know that caribou, if they, if they smell of gas or oil, it will affect their body. […] we get sickness from it. […] Because there's lots of stuff: if the air quality is good or not. All these information should be checked over that thing up there. Because their policy is really very important: water, ecosystem is mostly more because animals need it so they can eat it. Eating area, all the smoke go up and go down, all the smoke go up and go down. What develop on these ecosystems, you know? Then caribou come around and eating it, contaminated stuff, then goes into a food chain, will affect us, into human being." –Robert Frank, 2023, , as recorded in Draft SEIS Comments, November 7, 2023

- “But it's not just the access of [subsistence resources that promotes health], it's the activity of actually going to do it. The people that are going out on the land continuously, my dad always would say the people that were walking when he was young, and they continue to walk, they live the longest, because they're always walking on the land. Kept them strong. So, that's a component of health.” –Sam Alexander, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “And that 100 year old, they live to 129, it was it was a lot of them that age. 1962 when I was sitting there, they're all 80, 90, 100 year old. They don't even got white hair, because of their food. Very good. Yeah, gook'iighai' gaa gąįį kwaa [“their hair isn't even white”]. When Grandma was 80 year old, she was like the young woman like their grandpa. Yeah. My grandpa. Yeah. 100 and something, they don't even got white hair. They try to keep up with him with snowshoe. They couldn't do it, the young guy. Old man was almost 100.” –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “A lot of people, our elder when they're sick, when they're - when they can't eat they always ask for caribou meat. Caribou head soup, ground squirrel. My sister and my brother when they were in the hospital, same time that time, when middle of winter they want to eat ground squirrel, but lucky I had five in my freezer. Every day I cook one that - every day for them. They eat the ground squirrel and they drink the juice, they said that's a good medicine.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “I'm gonna just say activity - active traditionally, is a healthy man. Anybody that's active in our tradition is healthy.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “That's where all the health is. When you walk the land. And each bird is out there. My grandpa says and Myra says, since we met the white people, we getting sick!” –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “…when we are successful, everybody's happy. Everybody gets to have that taste. It's also, you know, medicine. Like a couple of months ago, Robert wasn't feeling good. Danny Sam went down, he said “Hey, Robert Frank's not feeling well, he wants some, you know, little brisket or whatever, you have from caribou and I dug in the freezer, found some brisket and ribs and little nilįį ch'yaa [“fried meat”] and send it down, makes him feel good, and like I say, you know, we have a lot of elders that were brought up in the old ways that are over here, basically living out their lives close to medical treatment. When you know, nowadays, medicine doesn't work, what normally does work is our traditional food. You know, that's bone broth, meat juice, you know, straight meat. I like that. You know, I mean, that's what always makes my stomach feel good.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “They had a lot of rules for us when we're going up. How to take care of the land, how to take care of animals, how to take care of plants, how to take care of the air. They don't like it when we burn something in the fire. They said “Hey, don't throw that in there! Take it out. It'll go up in the air and if it rain, it'll come back down. It'll get on your food”. That's why we don't want no oil in our country. When we feed our kids, our friends, our family, the whole people. We have to keep it clean. We're not gonna feed - I'm not gonna feed my little grandkids and my kids if that meat is not good. I know what got into it out there, I'm not gonna feed it to my kids, my grandkids, my people. That's why we don't want no oil in our country. We don't want them to destroy our land, good land, everything on that land we use it, long time ago and we're still using it.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "And at the same time [as strychnine for trapping], disease came, it didn't take them very long. A lot of our people die from starvation and disease and TB and changes. Yeah, they had to live in two world. All that made it very hard on our people. And, and then later on drug, I mean, later on alcohol and drug, so. And - we used to be lots of us before they got here. I think I counted about 100,000 people. At one point the way the story was told me, and hu - they said there was a skin hut from Arctic Village all the way to treeline, up, up to the mountain range, up to the north. And that's a lot of people. That's over, over, ten, ten, ten miles. And that means every skin hut is household, and whoever saw it, you know, that's a story. So, I, I figure it's about 100,000. And they were well organized. They were strong and clean. And they're organized very well. They don't die from anything except old age, most of the time. They practically carried them, these elders. So, that's how it was then. That's what I was told." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I know we went through hard times from the time trappers got here. French trappers. We - Russian didn't get to us. They stopped at Rampart. Well, anyway, they were gonna fight them back but they stopped at Rampart. So, French are the first visitor. They came here for trapping and that's all they came for. Fur, fur was really high price in England. So, that was why they were here. And they want to make money again, just like other places mining or whatever. And well anyway, but they bring poison with them. Liquid strychnine. They laced their bait, and then trap, and when that animal eats of that poison they die right there. Any other animal eats on it, they die. And you can't handle it with your bare hand, because if it hits your skin, it'll give you the tremble, it affect the nerve system. Well anyway, so a lot of our animals die. That's first thing they did. And they outlawed it, but they died. So, our people have to struggle to stay alive." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I was hoping they just, they should just leave it alone! We need those, our culture our traditional, we want to carry it on, teach our kids how to take care of the land, animal, plants, water. This is what we want for them. That way they lo- lo- live better out there. The food that we give out to our people, our kids, our, our friends, it gotta be good and healthy. I wouldn't give my, the food that it's not good. I can't give it to Myra. I don't want her to get sick. I want her to eat that and enjoy it." – Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.9 Air Quality

Many Kaktovik residents have reported that while they are aware of air quality issues farther to the west toward Prudhoe Bay, aside from a noticeable haze toward Prudhoe Bay and seasonal impacts from wildfires, the air quality in the Kaktovik vicinity has thus far been relatively unaffected.

- "We are so far away from anywhere [in Kaktovik] that the air quality is always alright. Sometimes when it gets real cold on a calm cold day the smoke tends to stay down. That just happens once in a while, not very often. It will get so cold that the fumes from the generator stay down towards the ground." (SRB&A 2012a)
- "It's so far off it dissipates before it reaches us over here [in Kaktovik], I know how it is when you work over at Prudhoe Bay you can smell all of those trucks and generators. They are packed close one to another. It is only two miles to this camp or two miles to that camp. They have their own air there I guess. If you go out here you can get a breath of fresh air up here! It never really changed. We have such a wide expanse that it doesn't really get us." (SRB&A 2012a)

- "Remember when that AKP tundra fire maybe 5 years ago the smoke blew right in. We were all wearing masks in the summer time. That's the only time that the air quality bothered us was that one summer." (SRB&A 2012a)
- "I think that when there's forest fires it affects us here from inland and from the Canada side because we don't have any trees here. But Canada has trees and over in the Prudhoe Bay area they have a bit more. It affects our land." (SRB&A 2012a)
- "It is that orange haze [from Prudhoe Bay] out there, right now on the ocean. Sometimes it comes out through the ocean. An orange spot." (SRB&A 2012a)
- "Just that dirty orange cloud out there [in the Prudhoe Bar area]. Must be all of the cars that are parked outside keeping them warm." (SRB&A 2012a)
- "I noticed a lot of the brownish-orange haze, we have been seeing that to the west. I don't know what it is but maybe it is industrial. I cannot smell it at all. It is a brownish-yellow haze. Maybe from the flairs they do out there." (SRB&A 2012a)
- "I am seeing more and more of that [haze]. Mostly during the winter. It might be there in the summer but we don't see it then." (SRB&A 2012a)
- "It seems to be more and more [of the haze]. When it first started it was maybe 20 years ago." (SRB&A 2012a)
- "Not so much health, but we see plumes. In west winds we see an orange or brown haze which is like 4 or 5 miles, maybe 2 to 3 thousand feet high. It is always out in the ocean. If they burn landfills it is very noticeable. When something blows up it takes a while to dissipate. It is usually when it is colder, it takes a while to dissipate… it is very noticeable when it is 30 below or above. Sometimes in the spring, when they are out there whaling you see a cloud over the village. It could be smoke, or could be dust from the road. When you are out 5-6 miles off of the coast [in Barrow] you can see all of the smoke in Barrow. You can see the dust being kicked up by the cars. It all mixes in the air. You gotta have the wind and the sun and it is like clouds of dust. You can do a 360 and you look at the ocean and it is all blue and you look south, towards barrow and it is dark, like clouds over Barrow. Especially when it is white out, you, you know when the sun is going to come up, you will notice all of the white where the moon in behind you. You know where it is going to rise and set. Precipitation and dust, and smoke from the smoke stacks. Vehicles really affect it. I don't know if we have cases of asthma or emphysema or chronic health issues." (SRB&A 2012a)
- "Depends on the weather and the cold. Those are the acts the federal government mandated, they were enforced. The smoke that comes out of my heating oil stove is no different than the trillions of cars in LA. Those cars in LA could produce more smoke which is more toxic. Here, if we had natural gas heating our buildings it wouldn't be as much pollution. If they had mandated that everyone put a filter over their smokestack, I would go back to wood. We used to burn whale blubber. At night all of that whale oil would burn. That produces more black smoke. It wasn't healthy, you wouldn't burn it all of the time only at night when it was cold." (SRB&A 2012a)
- "Air quality compared to how it was a long time ago has gotten a lot worse. I never notice the yellow haze around Nuiqsut when I was a kid. I started noticing it when Alpine came. I know when we are getting close to Prudhoe and that's how I know when I am getting close. When we drive there. We would go to get gas and see the yellow haze, now it is all around here now too. One of my aunts, Rosemary, she was a community healthy aid. She has noticed a lot of asthma in the last few years and that it's on the rise. You can see it on YouTube, she talks about all of that." (SRB&A 2012b)

Some Iñupiaq Kaktovik residents believe the haze in the sky has worsened in recent years and have concerns about the impacts of air pollution on the health of local residents. Iñupiaq residents from Nuiqsut have long had concerns about the impacts of air pollution on their community, in addition to the subsistence resources upon which residents rely:

- A lot of people have been getting sick from the air lately [in Kaktovik]. There are a lot of people that have been getting bronchitis and pneumonia for how many years. My buddy worked with the air quality people over here and he put out air canisters. He is still waiting to see the results of the air quality out here. (SRB&A 2012b)
- "If you talk to the elders every one of them takes oxygen. I don't know why, some of these elders can't breathe sometimes. It makes me worried. What happens if that blowout air comes over here? There are going to be a lot of sickness that comes from that." (SRB&A 2012b)
- "She has noticed a change in the air as the industry was working westward. None of our people got sick and no one experienced any strange odors. We noticed our air started to change. Today the air has changed a lot. The air is blowing towards the village and today we are experiencing the problems with Alpine too. The blowout has really affected the village [Nuiqsut] big time." (SRB&A 2012a)
- "...there are other persistent organic pollutants that are concentrating in our animals. There are studies of the polar bears that are showing these concerns. These pollutions from industry developed elsewhere are coming to our lands with the way the air currents are and the precipitation, they are coming to our lands and we did not have to identify the issues, but we have to deal with it. This adds to what is coming from the fields of Prudhoe Bay, Alpine, and Kuparuk. There are changes to the animals which are our resources for survival, the fish, the caribou, the whale, and others." (BLM 2003b)
- "I've been here -- a resident since then. I've seen some changes since I've been here, and mostly in the air quality portion. There's a lot of air pollution coming from a lot of this exploration and developments that are going on, especially with oil and gas industries. There's a lot of risk that come with the oil and gas industries in -- in our area. There's a lot of risk of blowout, fires, and a lot of hazardous air pollutants that are being produced from all of these developments with the flaring going on, with a lot of things going on here, especially with utilizing a lot of diesel equipment. There's a lot of diesel exhaust being produced. And a lot of the times, these diesel vehicles will be parked or running and idling and they'll be producing a lot of emissions, and it's at a ground level. This is where we breathe. A lot of our people are being impacted health wise. There's so many health problems that come with breathing in oil and gas development emissions, especially even from the diesel exhaust. Brings on cardiovascular health issues. It brings respiratory health issues to our people here." (BLM 2018)
- "I would think it's from, a lot of us talk it's from the air pollution. They were all the same [problems], these five I couldn't use. I got a little bit of fat from them. A lot of people have been getting caribou around here, they say "I've been getting a lot of sick caribou; I just took the head off." (SRB&A 2013)
- "Maybe pollution? One time I was way up here, 50, 60 miles out, and I could smell ash, I could smell that flare-up, and when I looked up there was fine particles of ash. I think that's why the caribous are getting sick. They're eating it; they're feeding on the tundra. [There's] lots of vegetation during the summer that they feed on." (SRB&A 2014b)

- “The air pollution too. You can see it on a real nice day. There is a yellow haze if you look out you can see it. You probably could see it now. It’s that way. Even in summer time you can see it too when it is a nice sunny day and you can see that yellow stuff.” (SRB&A 2012b)
- "Like maybe there is something we have to do to protect ourselves if there is some type of adverse event, if there is gas in the air or drilling mud. And you know, the drilling mud has chemicals in it. and It sits there, but it dries up pretty easily and it can easily get into our air. It can get turned to dust. And that, because, you know, it is so windy it can dry pretty fast and you know, particulates from that dust can get in the air and that can really affect a lot of people’s respiratory especially around here, people have– they are more susceptible to respiratory issues because of that. And there’s a lot of people that have sensitivities, they have asthma, the have… you know. Some people are more sensitive to those kinds of things. And the younger they are, and the older – the risk is even more." (BLM 2016)
- "...there are other persistent organic pollutants that are concentrating in our animals. There are studies of the polar bears that are showing these concerns. These pollutions from industry developed elsewhere are coming to our lands with the way the air currents are and the precipitation, they are coming to our lands and we did not have to identify the issues, but we have to deal with it. This adds to what is coming from the fields of Prudhoe Bay, Alpine, and Kuparuk. There are changes to the animals which are our resources for survival, the fish, the caribou, the whale, and others." (BLM 2003a)
- "The impacts that I observed was the yellow cloud of pollution above Nuiqsut. Years ago, when you looked to the east there was only one place where you could see that [pollution]. But now it’s becoming more and more evident. I work in Prudhoe Bay, but now in the spring when we start looking west from Prudhoe to where Nuiqsut is, then we start getting the haze over here. The pollution. That’s what I call it. I do [think the pollution affects the caribou]. Yeah. In terms of the health, it impacts our health. And the molecules from that pollution fall down onto the tundra, and then in turn we eat the caribou, and it is on the food that they are eating. And that’s unfortunate." (SRB&A 2019)

Gwich’in comments describe the connection between air quality and quality of life, and refer to personal experience about negative effects of current air pollution on the North Slope:

- “...we're just like an animal: we're out there, fresh air. We grew up in that. Later on, about 1952, before that they go Arctic Village to Fort Yukon, that's where they go with dog team. They get flour, sugar, and all that dry food, they haul it back. Takes about months, weeks, days, to go down and back. You know we live the, air fresh air all the time. When my dad come back from Fort Yukon, bringing cracker, sugar, soon as he walked in the door we smell him, we smell all the food, whatever they bring back from Fort Yukon. Caribou is like that. All the animals, they're out there in the country, they could smell far away, even if you're way far away they could smell you if wind is blowing this way.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “The caribou, you know, what really frustrate them? I know they use their smell. But one of the wolves, you know, yeah, they get nervous when they smell that sign of the wolf. And the grizzly. And the forest fire. And the - today aircraft coming in. They know airplane now. They know, they know that it's be - there's something coming on to them, onto the land, by the smell of the fumes coming off the aircraft. So, if seven bulldozer D-9's sitting up there in Arctic National Wildlife

Refuge, that smell is going to affect them. That's the, they'll be alert because they know that enemy is coming, by the sign of the wolf. Because those, the smell of the wolf, the smell of the bear, the smell of the other animals, it makes my - makes them move. Sometimes they should be staying at 1002 land more, but they get disturbed. And so they think about their route, where their ancestor has brought them, taught them how to survive. So, basically, they go by the trails, that their ancestors that put it there, you know. So, that footstep is still there." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "The ocean is right here, there's about six big boats up there, that breaks the ice on the ocean. And they sit there 24/7 running, weeks and weeks at a time, those boats. All that, you could just see the layer, it all comes to the calving grounds, the ocean, it goes hit water, water. All that, uh, I figured there's about six or seven miles between the ocean and also the mountain where permafrost harden up. You could just drive anywhere up there with a snow machine or vehicle. But to answer your question: yes. You know, that's why 1002 land should not be disturbed. That's the bottom line of it. It should not be disturbed because of the vehicle, some of them trucks, a hundred of them there sitting there and operating, running for 24/7. As soon as certain time as an oiler, you got to put fuel in there for the next 24 hour. So, if you add that up, that's a lot of fuel one vehicle burns, okay?" –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So the caribou eat nice beautiful tundra all mixed with all kinds of flavor on the ground. K'aii t'an, trahkyaa, natł'at, trih, nya' shril ["willow leaves, highbush cranberries, low bush cranberries, roots, moss"] He eat all that recipe: blueberry, he eat the whole thing. That's why it makes them fat. But if you burn it, it'll be difficult for them to eat. So, when they smell fire, they smell smoke it kind of disturb them a little." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.10 Acoustic Environment

Many Iñupiat have experienced impacts on the acoustic environment, particularly related to increased seismic exploration and air, ground, and vessel traffic on the North Slope and the resulting impacts on subsistence resource availability. Most commonly, residents report impacts on whales, caribou, waterfowl, and fish. However, residents also report negative impacts to their time on the land.

- "The fact that we are not used to it (noise) affects us. I know more of the traditional hunters would much rather have it how it was, the quietness. You could hear the animals coming in, maybe the sounds geese and ducks make. And not just the sound but the smell. Walrus' for one you can smell. You can also smell the algae that comes up from the sea bottom and gets green. When that happens you know there is some kind of marine life out there. Waterfowl or maybe seagulls." (SRB&A 2012b)
- "There used to be lots of caribou. There used to be hundreds out there. They calf, they migrate by the hundreds. Today, you can hardly see any. I think strongly because of air traffic. Small planes and helicopters fly fifty feet above the coast land. Driving our caribou away from their calving areas and migrating patterns and also cause caribou to leave their young. And, we all know, that can only mean a prey for meat eating animals." Nolon Solomon (MMS 1979a)
- "And I want to tell something about the seismic crew that went out this summer. There was just a little bit of it but it really bothers us over there. We don't see no whales, the seismic boat travels day and night." Nolan Solomon (MMS 1983)
- "And if you guys are planning on using your choppers, there is going to be a lot of noise. One time I was on ship and I had the headsets on and then heard an airplane, mind you, from under the water,

listening in. I can hear an airplane flying over. From that end of the mic to that end of the mic, I could hear it all the way clear. And when I went out there and checked, it was way up there. And that noise, whether you use choppers or airplanes, it's going to be disruptive noise." Susie Akootchook (USACE 1996)

- "And it's getting harder and harder for us to live this way and not old way on subsistence animals. The animals are getting further and further away from us. This winters, for example, we hardly see any animals around here. And he says, the planes, the ships, are very very noisy for these animals and that can drive them away. He said he's been out hunting before and he can hear, and with their own ears, the animals can hear better than the human being. The noise will interrupt seals, polar bears, whales, fish or whatever." Herman Rexford through Interpreter Emily Wilson Ipolock. (MMS 1979a)
- "When they was doing seismic I had to go quite a ways out, just see the top of the mountains here, then try to see some whales out there. I never, we never strike any whales that, that far out" (Richardson and Thomson 2002)
- "Too much noise out there or something. They were doing some seismic in that area, and that could be why ... [continues to talk but becomes very faint]. Have to go quite a way out to see any whales. And the drill rig was sitting out there a couple of, two years ago, [?] – we had to go quite a ways out. When there is no noise, [very unclear phrase] quick, and we go out there and get 'em pretty close." (Richardson and Thomson 2002)
- "Warthog[well] was all last year, and they, they spotted whales out there and they said to have eight of 'em just south of 'em, but they only know of one passing through. All the rest came back out in, around. We have a drill rig over here too, one time, somewhere back here…. out here, and hardly any whales, cause activity was going on. Also seismic activity. And it showed in their study, when we was in Prudhoe, that when, every time they, you know they were using that air hammer to detect the seismic activity below it there was no whales spotted – very little. Then after, after they shut down the numbers were like in the hundreds, that they had spotted. And it, and they told them that, yeah, no whales are going to go around a seismic boat or vessel." (Richardson and Thomson 2002)
- "The whales have been farther away from the shore ice; whalers in Wainwright started using outboard motors during the spring hunt." (EDAW Inc. et al. 2008)
- "The migration path has been the same ever since the drilling rig to the east stopped drilling. When this rig was active the whales went 15 miles out. Normally whales can be as close as one mile offshore." (EDAW Inc. et al. 2008)
- "Seismic activity changes the path that the whales take; it makes them go out much farther. After the Kaktovik whalers get a whale and during the period when they are onshore for a few days butchering and dividing it, the oil companies can work for a few days; when the whalers are ready to go out again the oil companies hold up their work until another whale is taken. This works for both the whalers and the oil companies. Since Kaktovik people have started to whale again the oil companies have started to listen to them. They usually just wait until the whalers fill the quota. This agreement between the whalers and the oil companies is negotiated through the AEWC. The whalers still need to obtain observers on all industry boats and rigs during industry activities." (EDAW Inc. et al. 2008)
- "My worst years as a health aide were the years whaling was impacted. The whales were driven further from the shore with the seismic activity at Camden Bay. The whale behaviors were different. It was harder to harvest as we were further from the land; that led to increased towing

times to land the whale to harvest. We had to cut one loose during the tow because the weather turned bad and the crews were at risk. That happens in the Arctic." (BLM 2003b)

- "I have a couple of concerns, or the hunter's concerns about the helicopters flying around while they are hunting and scaring off the caribou. And they were wondering if anybody could do something about it? Like if they see any hunters around over there, I was wondering if they could go to a different location and do their service?" (BLM 2004b)
- "Plenty [of traffic]. Especially those boats with loud noise. Go through my allotment every summer. Really loud, you can hear them from a distance. Airplane, helicopter fly everyday. Even small planes, sometimes, Summer, in summer, mostly always fly. They always go through towards Fish Creek, land by my allotment, helicopters down there. Every summer, in July, June. I never see much in August, I always go up river moose hunting. They got three of them [airboats]. They can go through the shallow water. Lots of noise. Some of them get spooky. That noise is no good for an animal. Yeah, when some of the caribou get spooked, they run off. When they get spooked the just start running away." (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)
- "The air boats, every time they go do their surveys, or checking their Conexes, they disrupt anything that is there and us too. And the caribous will take off, or the seals will pop down; anything that is near that [noise], they take off." (SRB&A Nuiqsut Interview April 2010) (SRB&A 2010b)
- "When there was seismic or drilling activity to the east of Cross Island, the whales were diverted farther away from Cross Island. As soon as this activity stopped (or rather, the year after it stopped) whales once again came close to Cross Island; some within a mile. This is the normal pattern; that pattern which was observed by whalers since at least the 1920s and before." (EDAW Inc. et al. 2008)
- "Prior to the development of Alpine I would catch hundreds of fish at the drill sites. As Gordon Brown said, it might be the noise and vibrations that are affecting the fish. The year the CD2 was built right on the bank, I caught a single fish. Where, in past years prior to the CD2, I would catch hundreds of fish. I used the same nets with the same mesh size. I noticed the vibration within the area; I could feel it. Fish abundance declined in the family net in that area. Using a 3-inch mesh, we were not catching many fish. One year we had a drill site outside of the Colville, at Kalupik. We didn't catch many fish when that drill rig was there." (MBC AES 2004)

Gwich'in comments describe vehicle noise and emissions on the North Slope (particularly along the Haul Road) disturbing caribou and altering their behavior:

- "So, if you ever go to the Dalton Highway, and you go maybe about a half a mile off of it, and just sit there and listen. And how many vehicles has gone by? You know it's a Ford truck, you know it's a car, you know it's about one, two, three semi-truck going about 85 mile an hour up to deliver either a pipe or, or equipment or parts that they need 24/7. You could just smell it off the highway. You could just smell - or you could just hear that vibration from the vehicle going up at 40 below. And not even two minutes later, you could just hear another one. Yes, it will disturb our habitat areas, you know, because what I'm just telling you guys that, that highway, caribou don't even go over there at all. They stay on this side of it. […] But it's not only the trucks and dozers, it's the helicopter going over them." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Once my father had an experience with a very strange sound. He was traveling with someone to Fort Yukon for tea and tobacco. That was when what I mentioned happened to him. The two of

them were going to the store that is at Fort Yukon, and they were camping for the night, it seems. Since they were going to the store, they were carrying along some meat and fat (to trade). On a pleasant evening they made camp under a spruce tree and hung their things up on it so they would be dry. Since they were hurrying to town, they ate quickly and they curled up to sleep. "When it was not yet dawn," my father says, "I woke up to a continuous rumbling noise." He grabbed his traveling companions. "I heard something bad! Pray!" he said to them. As they knelt, all at once the sound became even louder. It sounded like a great wind approaching. The earth seemed to shake, too. It was like a wind approaching, and someone whistling, and someone shouting, and someone crying, dogs barking, and all kinds of animals making all kinds of noises. All kinds of fearful noises were being made, says my father. They fled from their precious store of fat that they had put up before. Now it was getting right up to them; it was as if it were almost on top of them; and with their boots not even tied, they all grabbed their guns and all of them fled madly in the direction of Fort Yukon. They went from the place called Ch'aagaii [between 20 Mile and Christian Village] all the way to Fort Yukon, far as it is, without stopping for the night. At Fort Yukon they told with fear about the awful sounds they had heard, but who could know what it might have been? They stayed at Fort Yukon for a long time, because they did not want to go right back that way. They did not want to go back, but what would their children and wives do without them? After they took the tobacco, tea, and other things they had bought, they started straight back. They were so afraid that they kept one another in sight and went back only like that. They came to the place where they had heard the sounds, and what should there be but a column of smoke? They had recovered somewhat from their former fear but once again it came upon them. They started off to one side, running, and made a big circle around the place where they had camped before. They got back to their village, and found that there was a fire burning on the mountainside, and its smoke was what had deceived them. Now my father tells about it, but even now fear strikes deep into him, he says. Indeed, it is difficult to explain some of the things that happen on this earth." –Fredson and Sapir, Historic Interview, 1925, as recorded in Draft SEIS Comments, November 7, 2023

D.1.11 Petroleum Resources

One Kaktovik resident discussed oil seepages and how oil development can change the topography of the land:

- "I have heard that from Nuiqsut residents, that some of the pingos have deflated. They said that maybe it was a natural seepage and now that they are pumping that gas from other place those pingos are receding. We get them here, we also get natural seepage [of oil and gas]." (SRB&A 2012a)

An Arctic Village resident provided a Gwich'in account of how oil in the ground functions essentially as a sedimentary layer partly responsible for the structural integrity of the landscape of the Coastal Plain:

- "The oil fields I've seen are surrounded by water. Water will cover all the land. The oil in the ground is very thick, it holds the land together, keeps it intact. If they put water on it, I don't think the land will last. This past fall there was even earthquake in Kaktovik. Now there is climate change and we don't know what our future holds for us. We don't know if it will destroy all the animals. Even now it is warm outside (middle of December) it's like summer. It was never like that in the past. If everything thaws out, things will never be the same again. All the animals that the [Inupiat] rely on will be destroyed and they'll make things worse if they look for oil. After they are done

drilling and there's no more oil, the land will be destroyed." –Trimble Gilbert, 2018, as recorded in Draft SEIS Comments, November 7, 2023

D.1.12 Water Resources

Iñupiaq Traditional Knowledge

Oceans/Coastal Areas

- "I know there are a lot of big boulders along the coast in that [Point Thompson] area. Going along the Barrier Island and closer in sometimes. You gotta watch out for those big boulders. I remember going over to that area when I was little and they made us slow down, it was pretty shallow." (SRB&A 2012a)
- "Yea, like, there are a couple of spits along the coast, if there was a bigger map, there are a couple spits getting closer to Pt. Thompson. And when we get winds the waves get like 8 or 10 feet. There is a sand bar getting more noticeable by Pt. Thompson. The only way to find shelter is to take you boat across and find shelter but there is a lot of boulders before you get to Camden Bay. The safest places… it seems like every year all of the boulders are starting to stick out more. On the main Camden River the current… we have landmarks on the beach and we cannot follow them anymore. The west wind always kind of help move some of the silt and the east wind can come through and push it back." (SRB&A 2012a)
- "Because they put a causeway by Endicott and all of that gravel is affecting the island; the silt and water is going back and forth and whatnot. It is pretty noticeable there, and sandbars on Flaxman Island… Flaxman Island sandbar and Brownlow sandbar seems like it is getting narrower and narrower. Every fall there is open water." (SRB&A 2012a)
- "That [coastal erosion] is why we want the pipeline inland that was buried with a road over it. It is inevitable, but we want it 5 miles inland…. You got to figure out which way the prevailing wind is going." (SRB&A 2012a)
- "They are going to work on our runway soon, but our runway was almost ¾ full of water a few years ago. From the waves. They had to wait for the water to go down." (SRB&A 2012a)
- "There are booms, sandbags, garbage just floating out there in the ocean." (SRB&A Kaktovik Interview September 2010) (SRB&A 2011a)

Currents

- "We don't really notice that out there [the ocean currents], mainly it is pretty clear. Around here they are out in the ocean mainly there's a current maybe about three miles out, five miles out that generally goes from east to west for some reason. It's mainly out about three or five miles. My father used to put a line down to see how many fathoms, it averaged 16-20 fathoms. You could see that line trying to go west there with the current. Mainly east to west I guess." (SRB&A 2012a)
- "Heading east towards Canada there is a current that is so strong so that the people can't come back for a week or two. It is a big current out there. I think when they meet east to west it creates kind of a whirl out there." (SRB&A 2012a)

Changes in Depth

- "I guess it doesn't change that much, fifty years ago it never really changed that much but now the shoreline down there, it takes the gravel from one spot and moves to those little sand pit, it gets shallower and shallower and shallower. You have to go further east. There was one spot like Barrier

Island, it never used to be connected but it closed that up and made a new channel. I didn't think it would ever close that one spot for this island it used to be separate from the Barrier Island sandpit. There was a pretty wide area, about 100 feet from one spot to the other sand pit. It was pretty deep, about 30 feet deep. You could race through there back and forth. It was twenty or twenty five years before it filled up over there. That sandpit over there. Griffin Point, it used to be there ever since like the early 50's or 60's. And then a couple of years ago it washed all out." (SRB&A 2012a)

- "It is shallow on the inside of that island out there. Probably that. What is the name of that island? Flaxman Island. Right there. Inside that area there are always boulders and it's shallow[er than it used to be]. Inside there." (SRB&A 2012a)
- "It used to be deep there, but now we are seeing boulders on the beach; when the silt and stuff move around it exposes the boulders. When they come up, if you don't know the area you could put a hole in your boat. Especially over near the Stein, and from Brownlow to southeast of Flaxman, by Pt. Thompson some of the sandbars are closing up and some of the sandbar is going out and some of the gravel gets send out N or NW. Sometimes you hit those sandbars when you are out there fishing." (SRB&A 2012a)
- "You see those ice ridges out there, they are huge like mountains, they are pretty far away they used to be much closer to the Barrier Islands, so that means it is getting shallower out there. When it moved north it means the offshore area is getting shallower. Not so much at Arey Island it is right on the beach. Sometimes it piles up and over the sandbar but this is getting pretty noticeable now, you can see like a mile and a half of ridges. It is following the pattern, one year it is close and the next year it is further. It depends on the current." (SRB&A 2012a)
- "It is always different every year, like I said Brownlow, Dew line, Badami… some of those sandbars are missing and some new ones are being formed on the east side. Also the freshwater… lagoons and freshwater… everything is starting to close due to the silt and gravel, like at POW-1. We used to be able to pull our boat out but now it is further." (SRB&A 2012a)

Breakup

- "All that ice, it's been getting not as thick as when we were growing up. Then it would be seven or eight feet thick. Now if you go out there you probably only find it five to six feet thick. It doesn't get as thick as it used to in the old days. It tends to go out earlier especially inside of Barrier Island. Like from this island to the ocean. It would take another three or four weeks before it takes off. People have been out boating earlier and later in the year, like November. You can still go out boating in November." (SRB&A 2012a)
- "Usually the last week of September and into October you would have a hard time going out there [into the ocean because of the ice]. It comes about the middle of September, now you have to wait until about the last part of November somewhere in there." (SRB&A 2012a)
- "Maybe one time we didn't have ice until December, maybe it did that in the earlier part of the century but not lately." (SRB&A 2012a)
- "The ocean is changing too you know. In the late 60's to early 70's we used to have an ice pack from the Canadian Border to the Barrier Island about five miles or ten miles from shore. It wasn't a really dense ice pack; you could travel wherever you wanted about the ice pack. Now and days you can look for 200 miles and not find the ice. It started in the late 70's early 80's and the 90's too. We started noticing that the ice was going. We would go out whaling and there was nowhere to sit. We would camp. And look around." (SRB&A 2012a)

- "When I first flew over it was in September, but the ice has not stayed around at all. It just goes. It doesn't stay here that long. In September there was a lot of ice when they caught some whales and we went down to see if we could see them dragging them. Now there is not a lot of ice in September. It doesn't stay here that long after it breaks up." (SRB&A 2012a)
- "October the ice comes in around then, it used to be earlier than that. It used to freeze up earlier now it freezes up later. About 10 or 20 years ago it started freezing later." (SRB&A 2012a)
- "When the rivers go out, they used to go out in May now they go out earlier. When the ice used to go out it used to go out in July; now it goes out in June." (SRB&A 2012a)

Erosion

Iñupiat have observed increased erosion along the coast and river system. Increased erosion can affect boat travel along the coast and rivers, create unsafe conditions, and result in the loss of camps, cabins, and cultural resources:

- "We noticed changes in the landscape along the river from erosion. We first had a sod house then a cabin. But we had to move the cabin 150 feet from the river because of erosion. We used to have a cellar located 100 feet from the river that eroded away. There was lots of ice [permafrost] where our cellar was and it eroded away very fast. And the water level is coming up higher than in the past when it used to be east winds. The west wind causes the water to rise. The ice movement was so tremendous that it started affecting the landscape and eroding the bluffs." (MBC AES 2004)
- "Yea [we have noticed erosion]. All over the places both in Prudhoe Bay and on the west side. They think it [erosion] is happening all along the coast. (SRB&A 2012a)
- "One thing you have to know about building anything around here you have to build it inland to make it last any length of time. We notice all the erosion all the time. It's not a new thing. They have always known about erosion. You have to build further away from the river if you want it to last. (SRB&A 2012b)
- "The land is really different now. The whole land is changing because of erosion. Erosion is changing the landscape. You know, because of Global warming." (SRB&A 2012a)
- "Yeah along the coast it is falling off along the coast, from October until freeze up when the big waves and the wind comes." (SRB&A 2012a)
- "She cannot camp at Griffin Point anymore, it is too dangerous, the water got to close to her camp site so she had to move it." (SRB&A 2012a)
- "I have noticed along the coast that all of the sod houses are gone. Erosion has gotten to them and they have all washed off of the coast. A lot of them are gone." (SRB&A 2012a)
- "In my lifetime we have lost like 20 feet of tundra from the beach. There used to be ice cellars and now they are all washed out." (SRB&A 2012a)
- "The cliffs [around the Barter Island] are not the same anymore; there are hardly any cliffs on the island or down the coastline. They are eroding." (SRB&A 2012a)
- "Pretty constant, four feet have eroded in some area. We used to have a bunch of drums on Brownlow Point and now it is all gravel and the tundra is falling and it is really noticeable on Barter Island. They made a dock I don't know if it is holding up through the summer storms. If they do make the road and pipeline they should go inland like 5 miles. The beach provides insect relief for caribou and the caribou have got to be able to go under it. East Pt. Thompson and west Pt. Thompson they will make docks." (SRB&A 2012a)

- "When we were growing up, we would be 20-30 feet away from the shore, now you are lucky if you are ten feet away from the shore [because of beach erosion] up to the mainland. I never travel that much lately but I think it's the same thing. If it could happen to that little island I am sure it could happen there." (SRB&A 2012a)
- "Kind of, a little bit, but I think it has mostly been on the river and not on the coast as much. The river has a really strong current and the ice is so compact it builds up a lot. It will finally start grinding on the sides and that's what makes it erode a little more and pull under the tundra. Just from the ice. It builds up around the bends. And where it is shallow it does stuff like that." (SRB&A 2012b)
- "Atigaru Point has been eroding a lot. I used to dock at the point and it never got shallow….(SRB&A 2012b)
- "… Atigaru Point is now forming lakes and stuff inside the bay too. I see a lot of changes at Eskimo Island, there used to be a small island that was right on the other side of Atigaru Point. Eskimo Island has grown twice or triple as it was back then. It used to be a small island now it is expanding. Either the water has dropped but it is mainly gravel. The high part is tundra." (SRB&A 2012b)

Changes in Rivers

- "The rivers tend to be the same, I don't know where they get their water from but there is sure a lot of it. There is one spot in the river and it's like a mini glacier, it didn't used to melt all year long, about 70 or 80 miles in the Hulahula. It would go to one side of the mountain to the west side of the mountain and feed the river there. I don't know if it was still there or not, but it didn't melt all summer, like a mini glacier." (SRB&A 2012a)
- "On the main Camden River the current… we have landmarks on the beach and we cannot follow them anymore. The west wind always kind of help move some of the silt and the east wind can come through and push it back." (SRB&A 2012a)
- "The rivers are getting thinner. There is a picture over at the city from 50 years ago and now it is a lot thinner you know. The rocks wore down on the edge of a glacier and it is narrower." (SRB&A 2012a)
- "There are even some creeks forming on the island over there. There is one forming. The island is dropping. It's melting." (SRB&A 2012a)
- "Some of those rivers are shallow and all, they used to be deeper and now they are shallower. That is due to global warming." (SRB&A 2012a)
- "Some of those little creeks used to be longer, and now the creeks are smaller." (SRB&A 2012a)
- "When we are hunting in the winter we have to be really careful; the ice isn't that thick anymore. The top may look frozen but the current may be eating at the bottom of the ice." (SRB&A 2012a)
- "The Canning River is getting shallower. It is narrow but man it is deep. Put your net in and five minutes you got your limit. Another spot, a little mound not too far from Prudhoe bay, and down river from there, there is a curve, like an eddy, that makes it deeper and deeper and my Uncle used to go over there all of the time so…" (SRB&A 2012a)
- "[The coast line] is receding and it is getting shallower in a couple of those rivers over there. Like the Stein, on the Canning River, it is getting filthier; it is that one channel on the west side. People always raft down this river and get picked up on Stein, there is a gravel runway on Brownlow Point. That area is getting shallower and shallower. That is probably because there is a lot of silt coming

down the river and there are boulders in the [lagoons]… it seems like that area is getting shallower every year due to the silt and the erosion. All of that silt comes in and forms an eddy. All of those islands are getting closer to the mainland. The boulders are getting pretty noticeable." (SRB&A 2012a)

- "No, it is silt. It is noticeable on the [unintelligible]. We used to go quite a bit up the Canning River but now we can only get up to the lake because it is getting shallower. Maybe only get up a mile and a half two miles. All of those fish go up to the lake." (SRB&A 2012a)
- "Some rivers have shifted, like in Camden Bay, I am going east all of the time, it is all industry, you cannot shoot on the beach. We can go down the Canning River, towards Brownlow. The caribou come in this area and mix and you see long snouted short legged caribou and some of them just stick around. In some areas around the delta are getting pretty noticeable, you can always walk across from the west side to the main land. Mostly shallower in the bay areas, with all of that silt water and maybe more pingos along the rivers. It is pretty noticeable on Hulahula and Jago rivers." (SRB&A 2012a)
- "The people up there would like to see a three mile buffer zone from each side of the river. They don't want to see any roads going across this river. By that, I mean you have three proposed roads going across the Colville and going across Fish Creek on one of these road corridors. There is the initial drilling for the entire NPR-A program that we will be starting soon is based withing a few hundred feet from this river. We are adamant and persistent and presume that we should try and stop this because it's one of the most highly prized rivers that we have in the country where the people are concerned. By that, I mean without a buffer zone, where we will protect these rivers, it don't make any difference whether you drill three miles from the ocean shore or fifty miles up the river. It still drains into the entire river stream. Therefore, you have a prevailing chance of destroying the whole river all at one crack." Sam Talak (BLM 1982)

Lakes and Wetlands

- "We used to go camping on the tundra and the tundra seems like it is releasing oil, like the oil from the bottom is coming to the top. I don't know the place though. The thing is that we haven't seen cranberries from years and years. What I heard from people is that a helicopter flew over the land to kill a type of plants. Now we don't get cranberries." (SRB&A 2012a)
- "[Two community members] found salmonberries right here on the island. They went over there and I was on this side watching. They were there for a long time and there are berries growing on the island now. It is more wet [than it used to be] in that area past the dump in that lower part. Probably from the ice. It seems like the terrain of the island is melting. It is higher I think by the dump and then the marshy area. That's where the caribou came over here that one time. I don't remember that land being that much higher [than the surrounding area]." (SRB&A 2012a)
- "It is drying up, yea, the little lakes are drying up and the landscape is changing." (SRB&A 2012a)
- "I am not a hydrologist or anything but in some of the years, like with the Canning River, I have seen a couple of lakes that dry up but it always fills up with rain as the seasons progress. Not so much in the west area, could, when they make ice road they suck up all of the water and those little stickleback fish get sucked up on the road and it gets pretty noticeable on the road that these lakes are drying up. We used to have sticklebacks on the lakes on this island but the DEW line people pumped it into a tank but they are good fish. They are cleaning the lake they used to eat the algae and the mold, but now they don't." (SRB&A 2012a)

- "They say that during winter the water on the lakes and ponds are refreshed by ponds but they are really extracting a lot of water for their use in these camps. I think [community member] has a strong point, how much water these development projects are going to use water. They are important spawning areas out there too. How can they minimize that impact? They are using the river to ice chips to build ice roads and they pump a lot of water from the river to these ice roads every year those are being extracted. The only way to reduce that is to have a permanent road to connect these places. Not just to Nuiqsut but also to the different oil pads. Eventually there will be an ice road to Pt. Thompson." (SRB&A 2012b)

Gwich'in Traditional Knowledge

Gwich'in comments identify waterbodies on the Coastal Plain with Gwich'in placenames and describe the purity of the water there as being important not only to the caribou and other animals that rely on it but to the rest of the world as well. Gwich'in Cultural Experts also articulated their concerns that oil development on the Coastal Plain represents a threat to the purity of the water resources there, exacerbating decreases in water quality already occurring due to climate change:

- "The water that flows thru there [Iizhik Gwats'an Gwandaii Goodlit] is clean and pure. The water from Junjik and K'aiieenjik are all like that… clean, pure water. […] The warm mountains down that way have streams running out at the base. That's why they call it Veetsiihaiinlaii. This place called, Junjik Nahtryah Googit, is a good place to fish. Junjik has really good water – crystal clear water. K'aii'eenjik have good water too but Junjik water is much better. The water is from the stream from the mountain." –Trimble Gilbert, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- "Trimble Gilbert reports that Veetsįįkhąįįląįį [meaning "spring water running out of mountain"] was sometimes used as the route across the Brooks Range, traveling to the North Slope in order to trade with the Iñupiat and with the whaling ships. While the men were gone on this trip, women, children and old people would camp at Veetsįįkhąįįląįį waiting for the men to return. There is a spring (nan zhìt khąįįląįį) which flows year round on Veetsįįkhąįįląįį, and gives the stream its name. It is located at the forks upriver from the mouth of Nàhtryàh K'ǫǫ. Even in the coldest weather the spring continues to flow." –Caulfield et al, 1983, as recorded in Draft SEIS Comments, November 7, 2023
- "We're the last one that still have clean water in Alaska because there's no development. Like, that Brooks Range is very important for clean water, it's a water source. So, and then, just recently they found out that limestone cleans the water. So, we have a lot of limestone, all the way up to the calving ground." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah. They got only short, Coastal Plain. Not like Prudhoe Bay or that other area got big Coastal Plain. But this over here is just one little Coastal Plain mountain here, and the ocean there. Between here and there is not very far, where clean water. Once it gets into ocean, it gets all salty. So, we're talking about a very small, limited area that we want to keep it like that." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "And so water means a lot for the animals, the stream of it, when it's moving, it's alive. So, if it's sitting there like a pond, it's dead. You have to boil the water to drink because there's so much minerals in that water. But it's good to bathe in it because it helps your body, you know, arthritis." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Once the permafrost is gonna melt, that's gonna melt too. And there's a water bed that's coming out from... we've got a lot of limestone, so, it seems like it keeps a water even clearer and cleaner where the caribou go, that underground river. So, if they pollute that, then caribou, you know, we're gonna lose a caribou." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So after they said okay for the oil company to drill, in our North Slope, it took another nine years for the first barrel. Ever since then, water, it takes this last year, they took 10 percent oil, and 1,284,000 [gallons of] water, they put back into the Mother Earth. So, that, so those when I go up to Big Lake, 3.5 mile, we used to have lakes around there, it's dry now. Because before that it wasn't like that. Once that rain, it fills up the streams, a lot of fish in there all that dried out. But the reason why I bringing this up because the oil company, when they drill, they use a lot of water to refill those gaps that the oil hold back. So, and we're having erosion problem, a little bit of 3.4 earthquakes recently, up in northern Arctic Village between Fort Yukon and that area, we've been having them. If you look at the status of the earthquake, it's been there. I mean, there's a few. That ground collapse. And it shakes a little, because of that water spaces are not there anymore. And some time you take a lot of oil out. So, one year later last year, they got a big chunk of oil out of there. And they, and they put over 5 million gallons of water back into that hole. I have workers up there that's Gwich'in people, and I get the facts from them and I get, I get it out of them. Just like me and you we talk and when I talk about caribou, things like "Oh I like that" they said. And then I turned around and said, I asked them question: what the oil company does. So within that time, it's been how long now since oil development? How much water went into the Mother Earth that used to be solid. […] And well, they don't want to use salt water, they gotta have good water. So, they have to have the salt comes out of the water, then they get the pure water back, the ocean water. So, that's why ocean water is going down, because of oil company." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think all this is happening because of climate change. A lot a debris because you never know when we're going to get rain on snow or what. It's kind of messed up. So, every time it rains, you know, debris gets in the water, and then makes it more debris, sometimes that we don't expect. And I think further down, well the river change too, because there's less water some time, and there's more water sometimes. I guess that's why there's changes in there, in the river." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "That's how it is about water, long time ago too, they watch what they drink. They're not really careful about what they cook with and everything like that, they wash it, but the one they drink. If I remember right, in December the river water is no good anymore. December, like, that's when the snow, that crystal is good. And then all the way to springtime, then the ice from the river, the ice. We don't drink the water, just the ice. They could use it for other things. And then, when the spring come, ice move out, we still depend on ice or glacier. That's when we depend on, that ice or glacier. And then middle of summer, then we could drink from the river." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.13 Solid and Hazardous Waste

North Slope Iñupiat have observed impacts from development related to waste, including spills and other emissions, and waste left by developers, including decades-old development projects:

- "Any Dewline people ever go there? They leave a lot of drums on the ground in that area [near the coast by Point Thomson]. They did that how many years ago. In the 50's. When they weren't there there is nothing there. Now there might be drums out there. But then they cleaned the ones at Drum Island, at the Dewline there are still some underground here right by that road going out to the lagoon. Under the road. You could see drums and stuff under. But they have so many bases around Point Thomson." (SRB&A 2012a)
- "People that use the ice road leave trash, and animals eat that trash. Caribou and polar bears—have trash inside of them. Seals—plastic pop rings. Within the last 5 years, on the ice road, [I] see a lot of trash all over" (MMS and NOAA 2007)
- "Oil and gas. I think that that onshore development definitely has some issues with the resources. They use our lakes for water to build ice roads, and there are just a lot of little things that can add up to make the caribou have sicknesses. I've helped with little spills and I know they have that. It's the same thing with our humans. I can guarantee that at least 10 of my elders passed away from cancer, we had some from heart attacks, but at least 10 from cancer. I think it might be the air pollution, it might contain small particles, but it adds up. That one with the tumor, I cut off the head and took the horns, but I left the rest for the animals to eat, cut the gut open so it wouldn't explode." (SRB&A 2010b)
- "Because I will use Seal Island as an example. That is now Northstar. Before we all went to -- towards east of Cross -- east towards Cross Island, we used to be at Jones Island. That was our first whaling camp. We have been scouting for whales towards the east. None of them were sighted. Why? Because you can hear Seal Island bounding away when you can't see it in the clear calm water. Not even one marine mammal was sighted, not even one waterfowl was sighted, but we encountered one iceberg full of mud; not a natural mud, but it's a drilling mud type, and we have experienced that with my crew that were out there." Edward Nukapigak (MMS 2009)
- "And what about all the chemicals that they use for drilling? They got a lot of these chemicals that can bioaccumulate heavy metals in the vegetation. The caribou are eating it, the vegetation. A lot of the animals are eating it. They eat the vegetation around here. It's bioaccumulating; not only in the animals, it's coming up into our -- into our food chain over here, into our people that's being impacted." (BLM 2018)

Gwich'in comments identify concerns about solid and hazardous waste management:

- "And a lot of times the trash, there's a lot of trash. I got a report from a lot of people that works on the Arctic Slope, there is a lot of trash out on the tundra, because the wind is very, very, very strong there. And anytime, even if you have something, you, your scarf, wind is gone. So, there's no way they can keep it clean because the wind. That's how it is up in Coastal Plain, up in Prudhoe Bay, and everywhere. So, they promised we're gonna keep it clean, and there's no way they can do that. That's what I'm getting at." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.14 Biological Resources

Vegetation and Wetlands

Iñupiaq residents have observed changes in vegetation, including changes in the location and availability of berries and wild plants, in addition to impacts on tundra from development activities:

- "We used to go camping on the tundra and the tundra seems like it is releasing oil, like the oil from the bottom is coming to the top. I don't know the place though. The thing is that we haven't seen cranberries from years and years. What I heard from people is that a helicopter flew over the land to kill a type of plants. Now we don't get cranberries." (SRB&A 2012a)
- "I think more of the trails are showing more on the land. They are staying longer, they used to disappear. Now you can see those trails longer; snowmachine trails, walking trails, all trails." (SRB&A 2012a)
- "It takes a long time for the tundra to grow all the way back. It will leave a mark. That is why they invented the rollogons to try and avoid the tundra damage. The rollogons will leave a mark in the tundra after the snow melts." (SRB&A 2012b)
- "The wind, the causeway at Badami and maybe the current. They put a causeway… if they are going to put ice road I would caution them. The snow sometimes melt faster than the ice and it is green where the snow was and the road is brown. The ground will be brown from where they put that ice road too because it is salt water and it kills all of the plants under the ice roads. If they built permanent roads they wouldn't have to spend millions of dollars making those roads and pumping those lakes. I know there is a lot of maintenance with a real road, but I am sure they could make a normal road." (SRB&A 2012a)
- "It is noticeable that plants are dead from the salt on the ice road. High tide will bring ocean water as far up into the land…." (SRB&A 2012a)
- "This is a very rugged land. It's hard to survive up here. At the same time, the life that exists up here is extremely fragile. You can see the original tracks of some of the first cat trains that came across here, still up in the tundra today." Mark Simms (MMS 1979a)
- "If they keep making those ice roads the vegetation above ground, it is pretty noticeable in the summer." (SRB&A 2012a)
- "Some of the berries in the highland versus the ones in the wetland, in like Noligavik or Colinson point, you walk up there to pick salmon berries. It is more plentiful where it is wet versus where it is dry. They are bigger where there is more water under the berries." (SRB&A 2012a)
- "When the wind moves stuff around in the summer the seeds will also fall somewhere else. On the banks on the river banks, like these rivers when there is no wind or direct sunlight that is where they flourish. It is protected. We are noticing more bumble bees and more wasps because they warble in the skin. It is like milk, they used to be like candy." (SRB&A 2012a)
- "And the ice road does. When they melt and all the snow is gone you will see the grass and it is dead and flat. I have no idea why… Probably no oxygen getting to the ground because of the ice… I think it must be from the weight of the ice too. It is heavier than snow and the trucks add pressure to the ground." (SRB&A 2012b)

Gwich'in Cultural Experts describe traditional Gwich'in uses of plants for medicinal and material purposes, the cultural conventions for the respectful management of these resources, and the changes to these resources that they attribute to climate change and human encroachment:

- "Even today, the same deal, they make medicine it's the same thing, product, season, that we have up there. Those natural stuff that what the medicine is being made today, that's there on the land. But you got to know how to mix it like Tł'eek'iichii knows how to mix it. You know, a lot of people know how to mix that plant. So, they can eat and heal themselves. The Lower 48, they use sage,

we have the same thing up [here], but different plant: more stronger smell, beautiful smell, you burn it. I should have brought some here to holy holy each other you know? But uh, I just want to bring that up. So, tł'oo, trahkyaa, jidii gwanzhih daats'ak, voozhri gwanlii. They all have name. Every plant that there is, yahnyaa jidii, yaghan ["what he's been told, whatever he's making them"]. They know it, what it is. They work with it in the future, back in the old days when there was no medicine." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "People picked different kinds of plants and used them for sick people. [Maggie] counted 30 different plant medicines they used to use. When they traveled to different areas they picked them. Certain plants grow certain places like certain sloughs, certain banks, they don't grow anywhere. Shoh jak is red berries the kind we don't eat it. Taa shur t'an grows on a slough and banks below Taih choo [Big hill above Arctic Village] visible from Arctic Village. This plant grows on old sloughs and banks with sand and dirt. This is a medicine plant. Deetrya' jak is a medicine plant too. It is a small spruce brow with berries (but no one eats the berries). You dig it out and use the juice inside the stump. K'oh is a willow with different colors. Dzih tl'uu tree pitch used to heal cuts, toothaches, and other things, people still use it today." –Arctic Village Elders and Gilbert, 2010, as recorded in Draft SEIS Comments, November 7, 2023
- "And they watch the ground, too. You know when blueberries good. All the animals are like that, too. They know all the plants, all the berries, fruits. They know the weather. We get message from everything, plants. They always watch those berries, that [Gwich'in]. When it's ripe, they get excited. Now we got to go up to the coast. This berries tell us the sheep is really fat now. See, they just know everything. They know their country. They know their land. They know their animals. They know where's danger. They know which way is safe way." –Florence Newman, 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "[Gwich'in people do not travel to the Coastal Plain anymore] because it's pretty hard to travel nowadays than the early days. In the early days we barely had any trees up this way, you know. Now everything different climate. Trees grow. You can't be pushing your trail through. Those days they travel anywhere they want because hardly any trees. They wasn't growing. Easy to travel." –Johnny Erick, Sr., 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, with my experience, over last three, four years, I noticed that, you know, we usually don't get no birch or cottonwood. Now we all got it. I notice behind my sister's house two birch growing, and I was surprised, you know? Well that mean, meaning that global warming, you know, weather changing. Another thing she mentioned that berries, you know the berries are sometimes it's good shape, sometimes it's not. But recently a bear depends on it for hibernation, some animals too you know, even us." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I'm just sitting here thinking about berries. I'm one of the blueberry pickers. Last couple of years, I noticed the changes, like every time there's a forest fire, there's a lot of smoke. It's happened last couple years, every time we have a smoke - like last year, we had a forest fire somewhere around Venetie, Fort Yukon, and it went all the way up to Arctic. It was just everywhere, it just still. And because we didn't had no berries in Venetie, and I went up to Arctic to pick, I was going to pick couple of gallons. Then when we went out, we didn't find anything. So, those kinds of changes, I noticed that." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Fish and Aquatic Species

The following quotes provide Iñupiaq observations on fish habitat and migration on and offshore from the Coastal Plain, including within the program area:

- Question: Where are they [Dolly Varden and Arctic Cisco] going when they pass the Kaktovik area in the summer and fall?

  "They go up 2nd fish hole on the Hula Hula River, anyway this is what they tell me. Even the people who is doing some studies on the fish tells us that is how far they go inland, to 2nd fish hole. "(Pedersen and Linn 2005)
- "The *iqalukpik* and other fish that we catch and use come from all over, like Canning River, and some of them from rivers west of Canning, also from Hula Hula River, Aichilik River have a lot of fish, and some from Kongakut River. The *iqalukpik* are not just from the rivers near here, they migrate from far away not just from near Kaktovik. Then after they migrate from all over, then they go into the Mackenzie River, when they go into Mackenzie River they spawn. These are things that are passed onto us by our elders. The story is that the fish that hatched in the Mackenzie River are carried out of the river by its current, and they migrate into the rivers. This is the way that I heard these stories. These are not only iqalukpik, but qaaktaq and other types of fish that we catch. "(Pedersen and Linn 2005)
- "People try to get the current when they go fishing, they want to get the current when the fish come, it helps them travel out there." (SRB&A 2012a)
- "Not so much the currents, like NE and SE. All of the fish hit the shallows, and then they relax and know what to do… when they hit Brownlow Point they… find a spot where it is open and they can go up and down the Canning River and some follow the sandbar and follow it to Kaktovik. It takes months, like the Canning River fish, they go straight out and hit the Mackenzie River or thy go west and hit the Colville River." (SRB&A 2012a)
- "Yes, they spawn in the rivers, there is one thing that I understand is that they spawn in the MacKenzie River to the east of us, I don't know about this to the west of Kaktovik, I imagine that there are places where they spawn over that way. Like all the other animals such as whales, ducks, and others they know where to go to spawn. I have heard about them spawning at the MacKenzie River. "(Pedersen and Linn 2005)
- "The fish from Lakes Schrader and Peters usually migrate to the coast once in a while, but some of them are different in appearance. There are rivers flowing from these lakes so some of these fish probably migrate to the coast sometimes. "(Pedersen and Linn 2005)
- "These fish comes out of the rivers, moving back and forth. But these small fish that are in the lakes don't come out and they are different. The fish that are in the lakes never come out, and they die in these lakes. We who hunt are not looking into these lakes so we don't know about them because we live on the coast, but these stuff we learn from those people who have lived before us. These fish that are in the creeks which are small never come out of the creeks, at least I think they don't come out. They freeze and in the spring when the creeks thaw out some that are still living can be seen. "(Pedersen and Linn 2005)
- "This one elder named Ahlalook used to tell the story about iqalukpik centered around the Canning River area, and there are many rivers west of Canning River that have iqalukpik too. There are fish in the Shaviovik River that winters there and these fish we have seen and caught when that area hardly had any people living around there this was before Prudhoe Bay. There are other rivers with fish, the iqalukpik and other species of fish is all over. "(Pedersen and Linn 2005)

- "I think that beyond 3rd fish hole the ice goes down and the fish don't go past there. Anyway, I don't know of any places towards the pass that have any fish. All I know is that the fish go as far as Katuk, beyond that I have not seen any fish pass there."(Pedersen and Linn 2005)
- "There are a lot of places where you catch fish, like east of here at Pattaktuq (Demarcation Point) the fish there is plentiful. To the west there are a lot places where you catch fish. " (Pedersen and Linn 2005)
- "Iqalukpik when they start running comes out of the river, for instance the iqalukpik coming out of Hula Hula river usually run along Arey Island near the point of it. The iqalukpik start running around June. When they start running and you put a net out, you start catching them in June, and during the fall and winter when the iqalukpik start going back up the river you can always catch iqalukpik then. This is when they returning up the river in the fall." (Pedersen and Linn 2005)
- "The fish usually only go as far as 3rd fish hole because from 3rd fish on the river is shallow. After it freeze the ice usually fall down to the bottom of the river because it is shallow. The fish only go as far as 3rd fish hole for it is too shallow for them to go any further. The adult-looking iqalukpik are dark, almost black, and they are called old man fish. " (Pedersen and Linn 2005)
- "Early spring around June, while the ice on the ocean still have not gone out and you can still hunt seals that come up on top of the ice, Hulahula River's ice goes out. The area around the west end of Arey Island is a place where small iqalukpik start coming out of Hulahula River. These are what we start catching on the net. The bigger ones I think comes from the other rivers. While we are hunting seals, when we set a net out right at the end of the island we start catching fish. I would guess that these fish comes out of Hulahula. Also further west when I used to work on the Dewline station called Pow-3 (Bullen Point) the fish start coming out. There was a lot of fish coming out of rivers near there. In the summer I used to fish with a rod and reel, I would catch iqalukpik that wasn't very big but they was abundant cause when I cast my hook I would catch a fish right away." (Pedersen and Linn 2005)
- "The fish isn't moving in the winter. When Hulahula River freezes, some of the ice reaches down to the bottom in some places and it is shallow in some parts of it too. Except around the 1st, 2nd and 3rd fish hole where there are deep channels the fish are usually moving up river. At 1st fish there are usually a lot of fish." (Pedersen and Linn 2005)
- "Yes, they spawn in the rivers, there is one thing that I understand is that they spawn in the MacKenzie River to the east of us, I don't know about this to the west of Kaktovik, I imagine that there are places where they spawn over that way. Like all the other animals such as whales, ducks, and others they know where to go to spawn. I have heard about them spawning at the MacKenzie River. " (Pedersen and Linn 2005)
- "The Canning River is important. We go fishing over there, or I used to. People go over there for Grayling and char. It is a different whitefish than our whitefish." (SRB&A 2012a)
- "On the Canning River they have a lot of grayling. The aanaakliq, big whitefish too." (SRB&A 2012a)

Iñupiat have observed changes in fish populations over time due to environmental impacts such as climate changes, and impacts from development on the North Slope. Changes include the arrival of new fish species, and changes in fish distribution, migration, and abundance:

- "Since then, since they used dynamite in that river, they never find no fish in that river again 'cause they were using dynamite right in the river. They were using dynamite in the river, and they disturbed the garden of where they live off of, and they were very hurt about that. They didn't - there's a lot of people that disagree with that part. And there's even some people who were even living at Barrow at that time when they were using dynamite in that river, the main river where they go fishing 'cause it's closer to Barrow. And they used dynamite in it. And there's not - there isn't any fish in that river now. (MMS 2001)
- "I think the fish, we are getting less whitefish [since the TAPS pipeline]. We are not getting enough qaaktak. They may have changed their routes by putting in all of those docks. We hear about some of the seals that were dead and no one knows why they died. On the west side of the island we found one. It looks healthy it is just dead." (SRB&A 2012a)
- "If they are going to do causeways I would advise pilings and platforms. The causeways disrupt the fishes. They used to go through there for thousands of years and now they are getting lost." (SRB&A 2012a)
- "Yeah, the fish, arctic char, whitefish that goes through that area, you put 1200 feet of barge, where they going to go? We got the Colville and the Mackenzie fish that migrate through there." George Tagarook (USACE 2010)
- And also, that area is critical for Arctic ciscos that migrate through that area. And peoples around here in North Slope, also the peoples in Barrow, Wainwright, you know, wherever, they depended on that arctic cisco. They liked that fish. So if there's any kind of oil spill or activities in that area, they would divert their migrating route also. That's how come they got crossways in those - where? - at Endicott? They got crossways at Endicott and also at West Dock. To let the fish go through. They migrate, from what I understand, from MacKenzie River." (MMS 2001)
- "They said that they [new fish species] tend to be on the Atlantic side, they must be migrating up north or something. Different birds and different fish but the plants stay the same." (SRB&A 2012a)
- "I , Wilbur, have been fishing ever since I could remember. I believe the white fish here are not as many as used to be. Ever since the oil companies started drilling, I believe there's not much white fish since they have started drilling at Flaxman Island. I think since the oil companies, we start to have less animals such as ducks, seals, fish of all kinds. Also, in the fish, the Wildlife put tags on are not good to eat. For when they put the tags on the fish near the tail, these fish with tags, most of them always have pus on them. Also, traveling through dog sled and snow machine, I have seen copper wires which were put out by surveyors are damaging our animals. I have traveled from here down near Wainright by dog sled and snowmachines. Through this area, all the oil camps that I have went through have drums that drains oil and prestone to the ground. Never clean the area that they leave behind." Wilber Atuananuag (MMS 1979b)
- "I am pretty sure the fish is like a 2 or 3 year cycle. Two years ago we had less fish than last year, especially on the east side. Most of the fish go up on the Hulahula River; the big arctic chars would come up and spawn and we would catch them at the fish holes and now Land Otters are migrating south and there is hardly any fish at first or second fish hole. I think I need to set out some traps to there are more fish. If there are no fish because of the land otters than I am going to get them all. The elders are complaining that there is no fish in the fish holes and that is because the land otters are eating them all. Those otters have lots of pups, they multiply like rabbits. And if they are at 2nd fish hole they are coming from the south and working their way down river. We used to catch them up at third and two rivers come together and there is an eddy and we would drill a hole and pull out

fish. If they didn't make it up to third fish hole they would…. Second fish hole is getting shallower because of the current." (SRB&A 2012a)

- "Not only did we have a decline in the qaaktaq when they were doing the horizontal drilling, we used to go fish at the Putu for burbot. After the HDD, there was no more. I had never heard complaints before the development was here. Our fishing was great every year. After Alpine, after North Star… everyone wants to blame global warming." (MBC AES 2004)
- "Maybe they changed their route. We are hardly getting any of those whitefish." (SRB&A 2012a)
- "Every year people come up and put tags on the fish here. They are changing their routes." (SRB&A 2012a)
- "We noticed we are getting saffron cods in our nets. We didn't know what kind of fish they were. They come from southeast Alaska. We are getting more and more, I think our water is getting warmer. We are getting more salmon and different salmon are coming up in our nets and a couple of years ago we got a squid in our nets." (SRB&A 2012a)
- "I am concerned with industry building more and more ice bridges every year. They build these ice bridges over the rivers of the Nigliq Channel as well as the Colville River. These ice bridges are used to enable rigs to travel over the river in order to reach the drilling site. These ice bridges are built in December and January. My theory is that late in the season, with the building of ice bridges, migration routes are being blocked. With ice bridges being built across rivers, it naturally forms ice underneath. By the time the ice road was done in April we found about 70 feet of ice formed beneath the bridges and only about five feet of open water left at the bottom for the fish to pass. That practically covers the whole river and prevents any wildlife or fish to pass the river at these areas where ice bridges have been built. I would like a study to be done to determine if these bridges are being grounded to the ground. I feel that the bridges affect the fish greatly as well as the community. Industry says no, we need the oil here, but further studies need to be done to do it right… This is a concern because the fish travel within a specific temperature of water and a specific depth. When the ice forms and blocks those specific areas they will turn around and go back or elsewhere. They probably will not go underneath and figure it out. A similar situation is seen among the caribou and the pipeline height. When the caribou encounter the pipeline they will turn away and go somewhere else. They will not stop and think that perhaps nearby there is a crossing path that could be used. With the forming of ice bridges I believe that the fish that encounter it will turn around and go back. I don't think they will go under it." (MBC AES 2004)
- Hardly any whitefish this year because there was so much traffic from Canada, hauling fuel, seismic, and they are planning on doing more seismic. They are going to go 80 miles out and come back. They said they will start here and finish by Barrow in August. That is really going to disturb the bowhead migration, we are probably going to have to go out further and we really don't like people going out with us, like media." (SRB&A 2012a)

Gwich'in Cultural Experts describe the interconnection of fish and other animals on the Coastal Plain, the difference between fish from the Coastal Plain and other areas inhabited by the Gwich'in, and traditional methods for respectful management of these resources:

- "The Hulahula fish taste a little bit of salt because it's closer to the ocean." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "What they told me is that it's [putting bones in the water] good for a fish, the smell." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Those are ch'agwat ["bright, glittering"], the one they can't, water- where we fish, where we make holes to fish, we put a lot of ch'agwat in there, make it way down, ah tr'araanduu nahaa ["we twist it, you understand"]." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "And a caribou head, after you know, just the salt, throw that out there, make the fish come around." – Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Gee, I don't think we even put it [discarded bone fragments] in the river, because they said fish will choke on it. So, we usually buried it in a hole covered with dirt. They don't want us to throw something danger to the water because that fish in there, cheh łuk jidii tthak zhyaa a'àa ["underwater fish something whole right there eating it"], they eat anything. They said the fish will choke on it. So, we don't do that." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "One story, various people, elders, leaders [people who told him stories about Old John Lake and the fish in it]. Lake trout, Neerahnjik t'ee shih hil'ee nilii ["Lake trout is a special food"]. I learned it take Neerahnjik ["Lake Trout"] forty years to be an adult. Maybe that's why it's very special. Traditional food, respect it. Nomadic people living in skin hut, respect it so much, k'ii'ee nindineeriidal izhit doorway nihdineegiiyahchik kwaa, backdoor nihdeegiiyahchik ["They do not bring it in the front door. They bring it in the backdoor"]. Don't harvest it. Get it only for occasion. Same goes with sheep. […] It takes a long time to be a ram, forty years to be a Neerahnjik ["Lake Trout"]. It is only used for holidays and Gwich'in holiday. Not to be for commercial use." – Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023
- "Once, you know, it's wintertime. Winter is ice cold. If the animal's sick, he ain't gonna survive, no. He's going to die. Only the good ones. They're gonna die. So, when they hibernate, they get in about that far under the ground, they hibernate. Only their little heart moves, the fish. But pike and them, they're just like year round. The lush is there year around. They left, they follow the water. Grandma Cole, she says eltin ["pike"], the northern pike, he's a trail breaker, you know. He's the one that makes - underwater he makes trail for the rest of the fish to go to the habitat areas. Man, that's pretty neat, you know? So, if you lose that, if they contaminate those areas they ain't gonna survive. Down in Washington, DC, I see that spawning fish but that's in the creek. And that's the only thing they had. Right there. We want to eat him right there but we can't. But those about like 20 of them. We cannot disturb it, you know. So, if you went down to Wisconsin and those Indians down there, they get their animals back like the white owl. They put it in a park. They have white owl, they have habitat, fish habitat, and it grows those, uh. So, they make their own lakes and they make their own creeks down lower 48, to have the fish there. I see that a lot during my BLM days." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You see that cotton flying around? Yeah, that's when the fish is coming." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Marine Mammals

The quotes below provide Iñupiaq observations regarding the habitat, behaviors, distribution, and migration of marine mammals, including polar bears, seals, and whales, in and offshore from the Coastal Plain, and changes in those characteristics over time. Impacts of development, particularly on whaling activity, are also discussed.

Polar Bears

- "The [polar] bears usually come in August or the beginning of July. When all the ice melts they go to the sand bar and lay there and rest until we catch a whale." (Voorhees 2019)
- "It's depressing when you see this: polar bear bears are on land, rather than on the ice because there's no more ice." (Voorhees 2019)
- "The planes this summer were harassing the bears down on the island on the Arey Island and the bears took revenge. They went to where they parked the planes and they messed them up. You really can't harass the animals. I have heard it said that once the migration starts you can't really mess with the migration. They won't take the same route if they are harassed. The one thing they always taught us is to let the first ones go. They will follow the trail. But if you mess with the ones that are making the trail you won't get as much." (SRB&A 2012a)
- "They need ice to survive for the seals…but during the summers we're ice free. That's why the bears are coming from the barrier islands, from the west side and coming from east, coming to Kaktovik." (Voorhees 2019)
- "It's hard to say, from the village…there are still healthy ones around, healthy ones are more leery and wise to stay away from town, the skinny ones are more bold to come into town looking for food." (Voorhees 2019)
- "The ones that I see that are scrawny, [and their] skin color is blemished or dirty." (Voorhees 2019)
- "Maybe that one [present in the village at the time of interviews in June 2018] couldn't hunt out on the ocean, can't catch the spotted seals; it's gotta come into town to get what's easier to catch. The healthier ones, they're out there on the ocean; they are probably eating the ones that he couldn't catch." (Voorhees 2019)
- "There are more skinny bears around than there used to be. There's a big variety [of conditions] when there's the bone pile, but when the summer is here you'll see them trying to eat food, then they're skinny." (Voorhees 2019)
- "When the bears first come around they are pretty skinny. They just lay around and conserve their energy. When they start feeding on the bone pile they fatten up really quickly. They probably couldn't survive without the bone pile at this point." (Voorhees 2019)
- "Last year we were boating in June and we were seeing dead polar bears when we were walking on the beach. There were 3 dead bears. It looked like they were very skinny." (Voorhees 2019)
- "During the fall is when we have our really nasty weather. Most of the bears are caught out on the ocean, [and] they have to swim all these miles; some of them swim a couple hundred miles from the ice flow. When they get to the beach they are tired and dehydrated, [and] they will make a nest. [They sometimes] freeze to the beach, then can't get out. In the fall time. The first thing they always do is make a bed to rest. There have been quite a few dead on the beach." (Voorhees 2019)
- "The bone pile has been there for about 30 years. The number of bears coming to the bone pile has declined over the years; [I've] definitely noticed fewer. When I first came around there would be 100 plus bears around." (Voorhees 2019)
- "The polar bear population has declined; there are fewer than fifteen years ago. I started to notice that decline around 2008. There was no summer ice around that time; [I] noticed ice retreating." (Voorhees 2019)
- "There are fewer polar bears in general now, but when they congregate, there might be 60…they disappear overnight and come back the next day." (Voorhees 2019)

- "Bears that are coming around town are scrawny, lethargic, and not moving as fast as they used to." (Voorhees 2019)
- "I started to see that difference in their behavior two or three years ago. They are lethargic, and come out from nowhere, you never saw animals like that [before]. When the mothers—in the fall was when they used to kick their cubs out—they'd be running, around like an adolescent, that's what they used to be like, like a bothersome kid. You've got to run after the kid. The bears now are lethargic. The older ones have no purpose, when they see you… once in a while when you encountered them the bears would get spooked, now they are aimless, their direction in what they're doing is different. They are looking for a place to rest or something." (Voorhees 2019)
- "They've been always eating fish since I've been there. Nets are a major attractant. That's a number one rule in Barter Island." (Voorhees 2019)
- "Arctic Char they [polar bears] like best. They get them out of people's fish nets." (Voorhees 2019)
- "A [polar bear] got caught in fishing nets. Two years ago, we had to tranquilize one. They were dragging the nets out from the water. I think they learn, this one guy would put [the net] up on the beach, there would be bear tracks around and it was set in the water. They learn." (Voorhees 2019)
- "I have seen them eating young caribou. In spring or fall time there's always caribou in this area. Polar bears eat fawns right after they are born. First I've ever seen it." (Voorhees 2019)
- "When ice comes in they take off…In November, December, January and February they take off [for the sea ice]. As soon as the ice starts leaving they start coming to land." (Voorhees 2019)
- "We are out there every day seeing bears. The majority of the bears that come here and to all the other communities on the North Slope—these bears are very smart, they travel with the whales and come all the way from Point Hope, Utqiaġvik, and Nuiqsut in the spring. The same number of bears is coming in every year. Resident bears. Then they head up out on the ice. They hang out here until the middle or end of November. Freeze up is a month behind schedule, so bears stay longer." (Voorhees 2019)
- "[There is] still more summer with global warming, but [it's] still real cold. The bears come every year, never miss. In May, June, July, August, September. They've got four legs [so] you don't know where they are going to be." (Voorhees 2019)
- "Same bears come each year, from their parents, over their years, they bring their little ones. Local bears. Come out around springtime." (Voorhees 2019)
- "The last five or six years there was an abundance of them at one time all of a sudden in March April and May [but not in 2018]." (Voorhees 2019)
- "We usually see a few when they come out of their dens in March. Then they look pretty healthy; they've been denning all winter, just getting out of their holes and looking for food." (Voorhees 2019)
- "The one we're seeing now [June] is the first we're seeing. Did it come from a den or the ocean? It's so scrawny." (Voorhees 2019)
- "This bear that is here now is the first I've seen. I'm assuming it came out of a den, but maybe not. They should be coming out in March, April, and May, they should be coming out, but there's nothing. The last five or six years there was an abundance of them at one time all of a sudden in March April and May. The ones that are coming out in June--this is unusual." (Voorhees 2019)
- "When we see a big skinny bear…we get a few of that a year, we are thinking he's old and sick, [seals are] pupping out there [so he shouldn't be hungry]." (Voorhees 2019)

- "One or two bears seem to straggle in in June. They check out the bone pile, scouting it out, they're used to coming here during whale season, they know there's going to be a supply of blubber at the bone pile." (Voorhees 2019)
- "[Industry] does studies of dens—body heat—to make sure there's no dens [at development sites]. There are no known dens right around Barter Island; I've never noticed any; they're miles and miles away. They used to be out in the ocean, some way up in the hills. On the river system there's huge banks, big snow drifts on the side. The closest one is probably 12 to 15 miles away." (Voorhees 2019)
- "There is less snow but if they find snow banks they can still den [where they have before]." (Voorhees 2019)
- "We keep them away from the whale when it's first caught, but they are really smart animals. We make noise, scream, and wave our hands; sometimes we throw something, they're really scared of four-wheelers, when we rev them up they will turn around and walk off." (Voorhees 2019)
- "The animals don't forget; they never forget where they get their first good meal [of the season] and they'll come here every year. Males, females, and cubs." (Voorhees 2019)
- "They took our traditional fishing area during our fishing season, when we put nets out, they know what that is. We are losing our tradition of fishing for Arctic Char, Arctic Cisco, Smelt [and even Salmon]. We are having to use the area near the airport. Now we do it right near the airport." (Voorhees 2019)
- "When people go whaling, the bears aren't going to wait, it's going to escalate, usually it's just a verbal method of controlling or stopping. It's a year-long problem. It's permanent now with the bone pile." (Voorhees 2019)
- "[Bears] probably couldn't survive without the bone pile at this point." (Voorhees 2019)
- "Bears have not gotten more aggressive at the bone pile. They don't chase after people, some of them try to come in when the whale is being butchered, [and] people chase them off with a Honda [ATV]. Cops and the polar bear patrol [come]; everyone gets involved and watches their backs. But [the bears are] not violent." (Voorhees 2019)
- "The snow is melting. People forget to put the maktak away, and nanuq smells it. Everything's melting out. Smells...bring bears in." (Voorhees 2019)

Other Marine Mammals

- "Those bearded seals tend to stick around where the mouth of the rivers are. Flaxman Island, there's a couple of creeks that come out on the west side of Point Thomson that come out. And then that Canning River there tend to be a whole bunch of bearded seals. There are a lot of fish, so they tend to stick around the mouth of the rivers. They go out when the ice flows are around." (SRB&A 2012a)
- "He says uh, when they were out hunting whales down here in the shallow area, in the area down here, the whale was not very big. Nine to ten feet, maybe. And it traveled in the shallow water and he say, they were trying to kill it and it would roll around in the mud. And they lost the whale. But they do travel in the shallow water, especially when feeding. They can come close to the shore. And this was when they first started whaling." Herman Rexford through interpreter Emily Wilson Ipolock (MMS 1979a)

- "I think they were interested in Seal Island. The marine mammals are really sensitive to noise, both vessels and barges. Kaktovik has a concern about Bullen Point they use that during summer for caribou hunting, they go as far as Bullen Point because they use that as a main camp for subsistence and they want to divert those barges outward. Go out to the main ocean and come back between Flaxman and Stockton Island. We told Exxon Mobil that the noise doesn't affect the caribou but it does affect the ocean, the traffic you have to Point Thompson is not the problem… Kaktovik feels like they should divert that barge away from Bullen Point…" (SRB&A 2012a)
- "Yes, Cross Island, our fall whaling, it deflected the whales further north and we had to go further out north. It's not safe. We lost a boat and a whale, from seismic work. The whales get spooky and it's hard to catch a good whale that is spooky." (Nuiqsut active harvester; Experience timeline: 1992 and ongoing; Experience location: Cross Island. SRB&A Interview 2007) (SRB&A 2009)
- "You probably heard of the sick seals on the Bearing Sea and the Chuckchi Sea. I saw a baby seal that was dying and my dog was trying to eat it and the back flippers had no fur. I saw a baby seal and its head was gone, and the fur was off of its tail and there were maggots and there was not on the ground. My dog was trying to chew on it. Lucky I did because there was not hair on the seal's lower part, it had that disease. Uguruk, and seals not so many. The marine mammals on the eastern side are more healthy than the ones on the Chukchi Sea. I think it is probably because there are more people hunting. It is combat-uguruk hunting over in Barrow." (SRB&A 2012a)
- "We rarely see seals, hardly anyone hunts seals around here. Sometimes they're hard to find. There are spotted seals. We rarely see ugruk---we hunt them in July. I caught two or three in the last years. I love it out there and hate to see it go to waste." (Voorhees 2019)
- "Seals are around but [there are] not as many as there used to be when there was ice. Ice seals seem healthy. [They have] lots of fat, and look healthy." (Voorhees 2019)
- "Nowadays the seals go far away with the ice. The polar bears come around because they cannot find the seals—the bearded seals that they used to hunt to eat. [Now] they mostly eat the little ringed seals, or spotted seals, four- or five-foot seals." (Voorhees 2019)
- "This time of year the seals get black. They say "don't hunt them with the black on their head." Their meat doesn't taste good; there's something wrong with them this time of year." (Voorhees 2019)
- "I remember when I was about five or six back in the 60s there used to be some [belugas], they'd bypass here and go to Canada, but lately they've been coming by maybe because of the warmth [mentions this could affect the whales' food chain]." (Voorhees 2019)
- "And the bowhead whales particularly migrate inside the Barrier Islands, from Flaxman Island all the way to the Cross Island. They travel inside the islands once they start migrating in mid-August, early August. When the smaller whales start migrating, and they do sometimes rest in Camden Bay and that's where a lot of bowhead whales rest, feeding and they have another resting and feeding areas between Camden bay and all the way to Cross island, beyond Cross Island." Edward Nukapigak (USACE 2010)
- "From crustaceans, the shellfish, and then the ugruk is the one we really depend on . They eat the clams, the other foods to survive there. And that will greatly affect what we will live on, those smaller animals, shellfish, the smaller fish, which the fish depend on. The shrimp, those kind of things are all tied nto the whale and ugruk." Fenton Rexford (USACE 1996)
- "Research ships and ice breakers have changed the [whales'] paths." (EDAW Inc. et al. 2008)

- "Last fall we had interference with the choppers and some of the ships. We were located on Cross Island and we could go all the way down to Flaxman Island. And they told us that they were going to operate on Corona only and they didn't tell us that they were going to reopen Hammerhead. Instead of going their route, the last part of September they started going through the islands with choppers and some of those supply ships weren't supposed to be where we were hunting whales and some of them just went straight out after they said we wouldn't have any interference from oilers, choppers and supply ships." Billy Oyagak (MMS 1986)
- "If there's any kind of activities on the east side of this for whaling, any kind of activities on the east side of Cross Island, it would divert whale out from the coast line, from their migrating route. If there's no activities, we get - you know, like last year, we stayed only - stayed out only eight days to get our quota. See, if there's any activities in the area, we might spend two or three weeks 'cause we have to go way out. And then trying to tow those with a small boat is very hard, I mean, very hard, especially when it's stormy, kind of stormy, you know. But you could try to tow it, with a small boat, it's very hard. (MMS 2001)

Birds

North Slope Iñupiat have provided knowledge about waterfowl habitat and behavior on the Coastal Plain, including changes in the species of birds they are seeing on the Coastal Plain in recent years:

- Waterfowls ... there's a lot of eider ducks. That's where they nest, all those sand spits from Thetis Island to…(Inupiaq)... all those. One island, I think its, its Pole Island where there's a little bit of moss growing in the sand spit. Ducks, they pull their downs off when they fly they molt down fur ducks. When they are floating before they fly they are plenty ducklings, plenty ducklings." (SRB&A 2003b)
- "This one area [on the Okpilak River] here [is the most important area]. Early May and June, that is where all the geese come through. After work I would go over and come back about two or three in the morning. I take a snowmachine and cut across or follow this trail when there is adequate snow cover." (SRB&A 2010a)
- "It is kind of crowded around here so they [birds] nest over there in that area [towards Point Thomson]. I am not sure how they are doing with all of the polar bears over there. They never used to have that many in the summertime." (SRB&A 2012a)
- "[There has] not [been] much changes in the birds. We are seeing different species." (SRB&A 2012a)
- "The tundra plant life, it never changed. But the birds have been changing. I have never seen a robin up here but then I did. The plant life stays the same but the birds, man. One fish washed up about three years ago, a fish with sharp teeth." (SRB&A 2012a)
- "I don't know about birds over that way but mostly fishing, there's a creek that used to be at Power 3 and after work they would go out and go fishing right there. There are some fishing spots there alright. They go into the River and they migrate from one river to another." (SRB&A 2012a)
- "The tundra plant life, it never changed. But the birds have been changing I have never seen a robin up here but then I did. The plant life stays the same but the birds, man. One fish washed up about three years ago, a fish with sharp teeth." (SRB&A 2012a)

- "We saw that black bird with an orange beak and it was like a winter bird. We thought it was a mountain bird but it was bigger than a mountain bird. Also they saw a robin. Also those funny looking brown bird, maybe a night hawk. Really fast at nighttime." (SRB&A 2012a)
- "A lot of new birds, smaller birds, hawks, and eagles [started showing up]; I noticed about three years ago. This year I've seen a lot more of the smaller birds, they're really showing up now [June]." (Voorhees 2019)

Gwich'in Cultural Experts identified the Coastal Plain as a crucial habitat for waterfowl nesting and described concerns that development in the area would negatively affect nesting and migration behaviors that have already been substantially impacted by climate change and contamination of waterfowl habitat elsewhere in their migratory ranges:

- "So, water is going to be most important for the Gwich'in people and also the, the migration, and also the, the waterfowls. Because this is the nesting area, the whole universe. I mean, the whole Alaska people - Alaska land, is a nesting place. It's a birthplace, the birthplace of the salmon, the birthplace of the fish, it's there, it's here, just like me and you." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "That's one thing, the beautiful white owl is kind of, a lot of it is gone now. But there's a few around in the Arctic Wildlife Refuge area, and where the trees and the Arctic Slope, when they meet the trees, this line of that line is where the birds nest. The one that, inside of the, inside the tree line, but there's willows out there that, that little chickadee - I mean, that snowbird, they lay eggs on there, just like the ptarmigan, you know. So, most of all, they kind of hide their nests. So, when they take off they don't leave no scent. So, they taste good too, some of them. They do." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Same thing with the geese. They have their young ones up at ANWR, I've seen them lot up there." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, and the only thing I want to say about... we've been taking care of this habitat, you know, just the way to make sure nobody bother or, or, or disturb the animals. But when they were coming back from the south, they're so happy to come to Alaska to nest, but those habitat, in Washington DC, or Florida, those waterfowl habitat is not very clean anymore. So, the last few years, bird flu has been coming back. It's in the vein. So, I don't blame the Alaska. I don't blame the Yukon River over dip - no fish. It's the people to the south that's making these problems for the Gwich'in people. Yeah, those habitat are dirty because they don't know where to go. And they want to go back to Alaska, but it's winter. They know that too. And that's the big problem. United States Government needs to understand that. And because those habitat down there, it's not very clean for the animals that live in Alaska. It hurts the Native people." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "When we harvest our birds, normally they're coming from soybean fields, corn fields, all those Iowa garden fields wherever, but they're coming up - and that's generally the time we get them, we usually don't bother them, bother them after they come because usually they hit that high jet stream and are out of there. So, we don't get the chance to get them. But somebody made a comment about the river, and I need to get back to the question of the river and how it affects the fish and whatnot. But we're getting to another one. But um, yeah, they do - the birds - like Robert said, the goose, those are the only geese we get but those geese that we get in our homeland are the ones that nested on the south side of the Brooks Range. So, they, you know, in order to beat the freeze, jump into

Chandalar River, East Fork whatever River and run on down to the Yukon, and hopefully by the time they get there, they're old enough to fly and have got enough training." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "There's something changed. You know, there's – those are the thing I see lots of changing. Just like for instance for duck. When they come, they usually come – like black duck. They usually come around June 4. Now? May! Early! What's going on? They come in too early. Sometime we're gonna shoot black duck, it's already went by. We left out you know. We just get a few. And another thing too, we used to have no goose around here, last few years, they really land on the Big Lake, resting place. What seems to be the problem with the foods where they used to fly, before you know? They've been coming in. Lots coming in up there. Those are the waterfowl, changing. I don't know what's going on with the geese, we never see that many case around Venetie before, around Big Lake." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Every fall I watch geese when they're flying back. They always fly over my house coming from up north, they make a good "V". I was standing outside and I watch them, they were coming, and just when they were up here, I don't know what that leader did, he turned around and hit the second geese, and then that one were coming this way and did something or told them something. That leader flew back, put himself way back end of the line, and the one that he beat up took his place right in front of me that leader got fired! If you watch animal you see a lot of amazing thing they do. The female sit on the eggs, don't do nothing, but the dad is out there on the lake, dive and grab something. Dive again. Then fly back to his, that female and feed it to her. Then he'd go out and do it again all day long. I was watching that. Me and the old men watch it one day." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, with the seismic, whatever they're doing, where all the nests at? They're all on the ground. All these birds, snow owls, whatever, they all come back to the same spot. So, they're just going on a line like that, all grid, and they're running over all these nests. Everything's born on that ground there. So, how do they not think they're not disturbing the ground? I'd just like to say that. If it was a EPA thing, you know, they would stop projects for birdhouses. They were put aside. You know, take it down move it, preserve it, but, you know, what you're doing here, like I said, compressing all these nests into the ground. So, after that seismic, next year you have some issues with some birds not being able to use their nests again. I just thought I'd throw that out there." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, same thing with these, I don't know the swan - I never see swans' little ones around, around my area. But after the spring, everything quiet, quieting down, quiet down, I think they all go up that way because they know where to nest and everything like that." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Comments by Gwich'in Cultural Experts also describe general Traditional Knowledge about birds including their cultural deference for nesting and other conventions that help to prevent overharvesting and changes to bird behavior that could otherwise affect their access to these resources:

- "One time, we were waiting for him to come back, my dad, and he had snowbirds, all clean, little, they look like little ducks. They look like. A lot of them. My mom got happy because she said they're good. So, we ate the snowbirds. It was really delicious." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "The old elders' words, you know. The way […] when you speak Gwich'in, elder speaking, we have to listen to them. If we can't understand their way, there's a book that Gideon, a lot of them made, the Gwich'in language: one side English, one side Gwich'in. If you got it in mind, the pronunciation is there. For example. Ducks: dats'an ["ducks"]. Ducks, there's all kinds of different ducks. So, there's a name for every duck. From, from, from, from helldiver, from snipes, we all have language for that. Every one of those." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "They're all about, you know, like if you watch the seasons, ok, weathermen, weather, whatnot. I watch animals, I watch the sparrow: when the sparrow is gone, that means a high jet stream came through, and they don't fly. You know, they don't they just get on jet stream and go. My grandpa explained this to me a long time ago. He says look up in the sky, you know, it's fall time. He says you're gonna see the geese, they're gonna start going down. And he says, they don't flap their wings all the way down to the state side, he say they catch them jet streams. So, they're the best meteorologists out there, the birds. You watch the birds, it's like I say, right at the end of July, to me is when the big jet stream starts going back south and you have your cold coming back. Right? So, warm is going this way, and then the sparrows and all the birds start going that way." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know there's different birds, and we know which one too. If it's gonna rain, this one bird could tell us. If there's caribou coming, that one bird could tell us. When there's a bad news coming, the other bird tell us. I guess birds are like that. They learn, they watch, and they listen, that's how their parents raised them up, that's why, that's why they live out in the woods. We don't help them, they make their own living out there just like us. They watch, they know the season, they know spring, summer, winter. They know everything out there, those animals. What's danger for them, how to take care of those little ones in the nest. And the little one learn from their parents. They're just like people. Some birds are really, really wild because they got their own property out there. Years and years and years and years. If something coming to hurt them, they fight back. They fight back. Isn't that what we're doing?" –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, there's, uh, just like after spring, spring hunt, they hunt normally like, one way depend on how it come in, if nothing come in everybody stop shooting. That's the way that all our elders tell us to do because it's time for them to nest." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I go around looking for bird nests all the time, just to see how they're doing and all that. I can't go near it, I have to stay long distance. I can't touch it. If I touch it, he leaves that nest, it's contaminated." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, they get scared away. Another thing too, when they have nests the bird knows it, in that area. And they'll come back the summer, they'll come back direct to their nests, and I know this. Every time I cut wood I see bird nest, I just let it go, you don't cut it down. Because they know - I know they won't come back there. The noise will scare them away." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "There's not a certain time, it's all about the weather. There's not a time, it's about the weather, the jet stream there, that's the time. Like I said yesterday, the birds, the swallow, and I brought up swallow, he's, he's the meteorologist, those birds are the meteorologists. I don't know if it's a humidity, something they pick up in the change in the, I don't know, I can't answer that. But it's something that they identify that tells them "Hey, we got a high jet stream going south, let's go!" If

not, you're flapping 10,000 miles!" –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- " The birds that are around all winter, the effects right now, we don't see the camp robber. Maybe a few, don't see the ravens because trash is pretty much kept up well, and the ravens are where the caribou are at. And there is no caribou around, so. That's our sign of caribou being around: camp robbers are being around, there's caribou around. So, you want to know the effect? Yeah, right now, we don't have no caribou. So, we don't have, we have a few ravens, but not like it is when you see it in the fall time. When we're up there hunting. Lots of them. Lots of ravens. It's a good sign." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Humans. Go out there and disturb it, and they're not going come back, you know. Same thing with eggs. Better off just not to touch it, you know, leave it. Take what you want, you don't need it, just let it go you know. We don't even get grouse before, you know? And we're getting all that. Rabbits, all these, you know, we never get those before. Something is going on from the south, even moose, vegetation is different compared to Yukon Flats to our country. I could tell by the smell, vegetation's different. Same thing with the birds you know, they depend on lakes and all that, you know. There's a lot of changes." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah. But duck eggs, we pick them and we boil it and we eat it, some springtime. After they, before the little one grow in there, it's good. If that little baby start growing then we won't touch it." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Because now it's gonna grow into a bird, it going grow into duck. And then we don't bother them during the pregnant, or when they're forming eyes. Any animal, that's when everything stops. Hunting. They know when - we know when they're gonna have little, when they got pregnant time, then we stop hunting them. That's, like, she said she remembered June 7 everything start. I remember June 11th, or around that first week of June. That's when we stop hunting everything, because that's when the animal is gonna raise their young." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "We don't bother animal at all, unless we got no food." –Raeann Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Well, the elder in Fairbanks I told him "Hey, you want goose?" You know, I asked her "Do you want to goose?" At first she said no. "But where it's from" she said. And I said it's come from Yukon Flats. "Okay, then" she says, "but not around here in Fairbanks." Xena Sam. "Not here," she says, "I'm not going to eat anything from around here. But I will eat the animals from my home. Because it goes to northern atmosphere." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "First week of June - they hunt for ducks. Then they gather duck eggs. First of June, they boil or fry duck eggs. Once the eggs start moving, they don't bother it. … At the end of the first week of June, the eggs got two eyes, embryo form. When they boil or cook it, it moves. That mean it's alive." –Sarah James, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- "… [Iizhik Gwats'an Gwandaii Goodlit] is also where the migratory birds and ducks nest and lay their eggs – black ducks, mallards, geese, swan, loon all use this area. It is a safe place for them and they are multiplying. This sacred ground has been used by man and animals since long ago. Since long ago, it was used by animals for that reason…we don't disturb it and keep it sacred." –Trimble Gilbert, 2018, as recorded in Draft SEIS Comments, November 7, 2023

- "In my country there are many ducks. When early spring is about to arrive, the ducks always come back from the outside country. When the ice is about to go out, we always see the ducks. When we see the ducks, there is great happiness. The young men go out in all directions, hunting for ducks with guns. The ducks always come back to us from far away. After the ice goes out there are many on the lakes. After early spring comes and there is no more snow, the ducks lay eggs. Among the grasses, in concealment, is the only place they lay eggs. They lay their eggs, and there we search for the eggs. We always go looking for them among the lakes in birchbark canoes. In early spring there are many mosquitoes, and carrying our canoes around (portaging between the lakes) we always go hunting for ducks. Soon fall comes and they return whence they came. Even though it is cold, a few stay with us. In spring they are fat, and in fall when they are about to return they get fat again. Soon they leave us until next year." –Fredson and Sapir, 1925, as recorded in Draft SEIS Comments, November 7, 2023
- "In the old times, they always talk about animals. We don't shoot ducks while they lay eggs and nesting. We don't bother animals when they have young ones. […] They cut it [hunting/subsistence] off while animals have young ones. They had a really strong rule since back then you're not supposed to touch bird eggs. The mother care of it." –Calvin Tritt, 2018, as recorded in Draft SEIS Comments, November 7, 2023

Terrestrial Mammals

Iñupiaq Traditional Knowledge

Caribou

Iñupiat of the North Slope have observed the impacts of oil and gas development on caribou behavior, migration, distribution, and health. As the closest community to oil development on the North Slope, Nuiqsut in particular has experienced the impacts of development infrastructure and activities on their caribou harvesting activities. Kaktovik has also experienced impacts related to nearshore development and activity, as well as development to the west within their traditional harvesting area at Point Thomson. Below are Iñupiaq observations of the impacts of oil and gas development on caribou. Traditional knowledge about caribou habitat, migration, and distribution are provided in Section D.1.3, "Traditional Knowledge of the Caribou."

- "We oppose the road from Pt. Thompson to Prudhoe Bay… we asked them to move that pipeline further inland, not just a mile, because we were concerned with coastal erosion. How the pipeline will be built will affect the caribou migration. It will be difficult for Kaktovik, Anaktuvuk Pass and Nuiqsut to harvest in winter summer and springs. Marjorie said store bought goods are very expensive and we do the best we do to preserve our meat. People are sharing their meat or whatever, their animals. They are being shared and being used as a daily diet because the store is really expensive. Even a person living from paycheck to paycheck it is difficult. Subsistence is very important and we will continue to depend on these." (SRB&A 2012b)
- "I have to go a long ways to go caribou hunting. I don't know why. I don't know if the airplanes are changing the direction of the animals or what. They are a little dot when you are on the coast. You have to go a long ways to go and get them." (SRB&A 2012a)
- "You can hear them [choppers] in town. It will scare the caribou's. They will be easily spooked for days. They will just start running and keep on running and running. With that chopper it likes to go on the rivers and around here the way the rivers are there are two river split apart and then go

together and the caribou are in the middle. And the birds are trying to avoid the activity and noise." (SRB&A 2012b)

- "I think they [animals] kind of get used to it [noise from development]. But these helicopters on the surveys drive everything away. Even like the caribou about 2 miles away, oops there they go. They will not stay." (SRB&A 2012a)
- A lot [of traffic] continuously – all summer long. It's the surveyors. They're surveyors out there. I don't know who they are, but all summer long they're just there. I think they're the ones – I don't remember the color – but I think it's the same helicopter that takes off and lands at Alpine all the time, but they're dropping off these equipment for surveying and bridge planning – whatever they're planning – to make these bridges for these roads. Basically at Miluveach, they're really utilizing that area to drop [supplies] off. They just so happen to utilize the area where the caribou are. Wherever they're setting their camps and drill sites is the best route [for the caribou]. When these animals travel, they travel on the lowest slopes possible and the most level, and where these people want to drill just so happen to be on a [migration] route. Right at the creek, and this is a flat area. You can see clearly for at least four miles; it's so flat, you can see as far as you want – but they basically use these two mounds for grazing areas; they're the feeding grounds, and when the disturbance comes they force them to go to Pisiktagvik and then Alpine. The helicopters are flying from Northstar to there. And from Oliktok to Northstar Island, the offshore drill rig. Every time that helicopter came in they just scare them around and the caribou move to where they left. (SRB&A 2015a)
- "In the NPR-A Northwest draft, it says that there will be 150 flights a year. Well, Alpine, the model of a smaller footprint, had 1900 flights from Alpine in the summer of 2001. How was it expected we would not be impacted in a significant way with the subsistence harvest study that showed our village harvested there? They claim that the caribou herd is healthy with numbers, but the only caribou I got last year was bad. Twenty caribou were harvested in October when we could access areas not accessible by boat. Seventeen were sick. When I went camping last year, I waited three days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oilfield. It went right over us three times. The herd was right there and it put us at risk. I had my two young sons with me and it made me very angry. What am I to do when the activities that have been handed down for thousands of years to our people are being changed by the global need for energy?" (DOI, BLM, 2003e)
- "I've heard from other hunters complaining about caribou looking sick. I caught a couple maybe two or three years ago. It's possible. I think the caribou are getting sick because of the flares they are burning over at Alpine. You see this dirty air. And we have north winds a lot of the time when they burn that yellow smoke and it gets deposited on the tundra. That's why I think the caribou are getting sick. I'm concerned for our health too. You can see those flares for miles. What they're burning is, I think unwanted gas and it's harmful to us humans over here in the village and the animals too. I just see that smoke from miles away. Alpine's north and a lot of time we have north, northeast wind in the village here. It's not good for us when they burn." (Nuiqsut active harvester; Experience timeline: 2004; Experience location: Just up the river. SRB&A Interview 2007)(SRB&A 2009)

- "They claim that the caribou herd is healthy with numbers, but the only caribou I got last year was bad. Twenty caribou were harvested in October when we could access areas not accessible by boat. Seventeen were sick. When I went camping last year, I waited three days for the herd, to have a helicopter to divert them away from us. When they were diverted, we went without. We have had to deal with harassment. We had overflights three times while trying to cut the harvest. It is disturbing. The next year we had a helicopter do the same thing, but it was worse. They were carrying a sling going from Alpine to Meltwater, another oilfield. It went right over us three times. The herd was right there and it put us at risk." (SRB&A 2003a)
- "Also when they are coming from Deadhorse the oil companies, I have heard thousands of caribou cross the road, and migrate this way, trying to get across and the vehicles will keep on going and the caribou get spooked and turn around and go back [and not cross the road].Security should allow the caribou to pass, block the road. It could be this year; these caribou could also be affected by wolves or wolverines." (SRB&A 2015a)
- "They got to at least either stop for a while or give them a weekly flight instead of flying every day. I would say try not to fly too much during summer time. A daily or weekly schedule. I'm not against oil companies. But during winter time they can go out there, because there's less caribou. During winter time I wouldn't mind. They're from Alpine, that's for sure [helicopters]." (SRB&A 2010a)
- "They're too far out, too far from the rivers. Gotta be lucky [to get them] when they're migrating, but they never came through last year. Now they're over toward Atqasuk. There's none over there. People gone to Umiat and back around. Like I said they were at the dump for months. Traffic, when they start putting in all those ice roads, constantly going back and forth. The roads and stuff scare them off, the congestion and we have to go further to get caribou. Three years ago people were going 75 miles just to get caribou and that's ridiculous. Just the oil companies, the ice roads. I heard that's what's been keeping them away from town. Go back and forth on the ice roads, it's putting a hamper on it. Once the ice road gets built there's equipment and congestion, seems like they go further [the caribou]." (SRB&A Nuiqsut Interview March 2009) (SRB&A 2010b)
- "Well, actually, the only way I would describe it is less fat [on the caribou]. They were good eating, though hardly any fat in them. I don't know [why]. Maybe it could be from the pollution from the oil industry, or they could be lacking food in that area. It's not that normal." (SRB&A 2010b)
- "This summer with that agreement with KSOPI and ConocoPhillips that they were to report daily when they start flying, that has helped. No flights took off during the duration of the summer harvesting. I said there are caribou here, the caribou are coming. We have caribou in the freezer and hanging right now. Get it while you can, they will be here one day and gone the next day." (SRB&A 2013)
- "Stay away from the hunters. I mean, when they see us, they should go. If they had VHF to communicate with us, we could tell them they're getting too close and scaring the caribou. I know they got radios to communicate. And us, with the boats, always have VHF. This could help. Search and Rescue does it, communicates with VHF all the time. I don't see why the oil companies don't do that. 'Hey you're getting too close, scaring the caribou.' (SRB&A 2010b)
- "It's mostly the pipeline that is affecting the caribou pattern. In the 70s when we first came, there would be 10,000 in a herd but now, due to the pipeline, it affects the people here and they have to go 30 miles out in all directions to hunt for caribou. It's too shiny. The coating is too shiny. More likely…when we were riding on the ice roads one time, we could see quite a few caribou crossing but maybe in the summertime, due to the reflection of the sun, they don't want to cross. They'll

pass right under the pipeline [in the winter]." (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)

- "Also the pipeline is so reflective that sometimes the caribou thinks that is the edge of the ocean, the ice pack, so that is why they go and travel further south of us. Those pipelines are still shiny, it's not coated. All the way from Alpine, pretty much from CD north, all the way to Alpine, it's so shiny; all the way it looks white. And it's reflecting. We always address that with them, and they say they might change that but they didn't. That always [is] a problem with their representative that comes to our meetings." (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)
- "Pipeline height is always an issue. Five feet minimum is inadequate. I mean you hear so much. You hear that it's a concern to the community. And the coating of the pipe, the outside layer, you know, it's just like a reflection especially during the summer hot months. I mean you could see that, you know, the pipe having reflection. I think they should put better, you know, coating or something that wouldn't reflect. I think that's where the problem -- maybe -- I don't know. Maybe that's one of the issues that needs to be addressed, that it's deferring the caribou. I mean there's some studies, I think, that needs to be done." (BLM 2003b)
- "And under the ice, different seasons of the ice breakups, those kind of things [offshore development] will have a very bad effect on the wildlife population of the offshore. Not only offshore. We also get migrating caribou that come into the ocean for a salt lick. They have come from a long migration route and they are deficient in minerals. They go down to the ocean in little lagoons and lick the salt, the salty ice, so I know that happens." Fenton Rexford (USACE 1996)
- "Yeah, [the caribou are] smaller and thinner [less fat]. I don't know [why]. Seems like they're eating less, because all these oil companies are spreading all around us where they're [caribou] migrating." (SRB&A 2010b)
- "There are studies that I have seen from ABR. The ABR studies show that once development got started, science has proved that they moved their calving farther south. And oil and gas development is doing the same thing. I would like to see that all the people that are doing the studies around here would come together in one room and analyze the impact together and not just the caribou. It would be nice to see all the scientists come together to talk about that in the community center. And we could ask questions. The western world has always told us that they have to see that in black and white, and they should start with the traditional knowledge as their baseline. That Teshekpuk Lake is one of those things that really, really shouldn't be touched because of the importance to calving grounds." (SRB&A 2019)
- "It varies whether we have a lot of activities going on. When there are a lot of activities going on, we hardly see any or they [caribou] change their migration route. Oil and gas, airplanes, helicopters, bird survey people—airplane, floatplanes. Either there are less caribou or they are changing migration with activities. I don't know which." (BLM 2004a)
- "Well, [all] I would like to add is about what I'm going to say if I'm going out caribou hunting. I like to go out caribou hunting and I don't like to go, I don't like any helicopters to interrupt my hunting. Every time I go out, there is always a helicopter flying, flying, flying. Like always a helicopter flying. Sometimes they fly high, sometimes they fly medium, sometimes they fly low. I think…[the caribou] stay away from… [the helicopters]. [The helicopters keep] bugging the caribou. It seems like they were chasing the caribous out of town sometimes. I realized that, 'Oh no, they're gonna chase the caribou southwest, more [farther] out, and give us a hard time getting the caribou by Nuiqsut.' Some people say you don't have to complain about this on the VHF. I just

want them to hear [the complaints], so I just wait for the oil companies and I talk about this. So I stopped going out there because there was helicopter traffic in summer time. [Caribou] used to walk around in the village, [we] used to shoot them." (SRB&A 2014a)

- "The Porcupine Herd that comes from Canada through here, when the pipeline, when it went all the way to the Meltwater, when they build that pipeline to Alpine, they stopped seeing them. Oliktok to Meltwater." (SRB&A 2010b)
- "Prudhoe Bay has been here for 30 years and they are also used to us so I don't think the activity affects the caribou. The caribou are curious still." (SRB&A 2012a)

Other Terrestrial Mammals

Iñupiaq knowledge holders have also provided observations regarding other terrestrial mammals on the North Slope, including brown bears, wolf and wolverine, and moose:

- "Brown bears are coming up farther north than they have in the past. You start seeing them when it warms up." (Voorhees 2019)
- "[Brown bears] are fast and smart, and they will outsmart you…they disappear into the mountain. The people that do a lot of hiking, I'm starting to worry about them, come from somewhere else, they would have chance encounters. I fear for those people, they don't have that protection." (Voorhees 2019)
- "…the declining number of moose in this area, we always thought it was from drilling muds or other kind of chemicals that were abandoned in the sites. " (BLM 1997)

Gwich'in Traditional Knowledge

The Gwich'in possess considerable Traditional Knowledge about caribou behavior including calving and migration. Cultural Experts expressed concerns regarding the potential effects of oil development in Porcupine Caribou Herd calving grounds on the Coastal Plain:

- "If you look at the map of Alaska, just south of the so-called 1002 area is the Brooks Range. It is a pretty rugged range of mountains. There are just so many passes through which the caribou herd can pass to get to our area. If there is any kind of obstacle, we fear that the Porcupine herd would alter their migration route and bypass our area altogether. This would be disastrous since we are still very much dependent on the caribou." –Lincoln Tritt, 1987, as recorded in Draft SEIS Comments, November 7, 2023
- "There is a border right here, right above Old Crow. They have, nobody goes in that area too, hardly anybody besides the Gwich'in hunter. They migrate, they eat that special food in that area. And they go back to ANWR. After that two years went by they all migrate all the way up to 1002 land. That summer is coming, it was spring, ice, the snow is melting. Any which way towards ANWR caribou's going. It can be any kind of caribou herd that goes to 1002 land. So, you know, you know that 107 year old Myra Roberts, you know, she, she's got a traditional dictionary in her hands at all time. Why is it because either the weather's disturbing them, or there's too many wolves that's disturbing them, or some kind of oil activity is going on, on both sides of the border. So, that's when we don't get our food. So, a guy like me, a hunter, I could just about get anything for an elder. I could go around 200 miles down the Yukon, and fish for trout, or fish for whitefish, put fish in - or Old John, really high nutrition. All kinds of different nutrition there and Old John." –Ernest Erick,

2023, as recorded in Draft SEIS Comments, November 7, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- “Caribou hang around Arctic Village area up that way. When those female carry a - when they're pregnant, how do they know? They all gathered and then they start walking up that way. Um, just like um, in Arctic Village, they go up that way, same way every year. They got their own calendar. They know everything. Just like parents. Those pregnant caribou. All the caribou have respect for that female. They start walking up, but guess what? They walk really slow. It's far away. Just like they're going to the hospital, they take their time because it's - they worry about the pregnant caribou. They walk slow all the way up. I don't know how long it takes them. And when the caribou born up there, and they stay there, nice clean food they're eating. Pregnant caribou eat all the good things for the baby inside. After they born, they stay there. They hang around there until that little baby starts walking. After the little baby is strong enough to walk, they all come back really slow. It's fall time.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “You know we live the, air - fresh air all the time. When my dad come back from Fort Yukon, bringing cracker, sugar, soon as he walked in the door we smell him, we smell all the food, whatever they bring back from Fort Yukon. Caribou is like that. All the animals, they're out there in the country, they could smell far away, even if you're way far away they could smell you if wind is blowing this way.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “I found out that every creature lives on this earth gotta feeling. Even the water, even ground, all the plants. Caribou know about everything. They watch the weather. They know four seasons: they know what to do springtime, they know what to do some summer time, they know how to prepare for the winter. All, all the animals are like that.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “Caribou have two routes. So, I think that what they do is they follow the food chains, vegetation. Ernest said that vegetation is not that good, and then use a different route because I notice that they go over to Canada, then to Alaska, because these [are] parts of food chain, you know, for migration.” –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “The Hulahula. Usually they come up and over the Hulahula and then come into Spring Creek, and then, you know, Jago is next mountain river over I think. But uh, yeah, those are becoming scenic rafting views, and there's a lot of hiking going out that way, you know. So, that migration route has been affected for about 20 years now.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “James Gilbert, always looking at the caribou back in the day. And he was always looking northeast at uh, Vyuh Zhraįį. Like I say, we haven't seen that in 15 years. I mean, we haven't. And that's due to the human activity, hikers whatnot. Like I say, you said it came in late, and it has been coming in late. And they're all been coming out of the Wind River drainage. And that's because of activity on the Hulahula, I'd like to say.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “And, and then the first thing that comes up, up in the Arctic Coastal Plain, up there, up here, in the springtime is that fuzzy grass. You know the one is trying, you kind of, throw it away or something like that, well, anyway, those come - that's high nutritional, for the caribou for the calf - for pregnant caribou. So, that's why they go up there, they, they grow their furs not even down here, because up there in Coastal Plain is windy all time, all winter long. And there's no snow, there's

piles of snow here and there, where, there might be polar bear denning, but most of the places are pretty clear. So, that's where the first vegetation come out, even before down here, so and that's why they go up there to have their calf, to feed on that. And it's good for pregnant, and it's open where they can - at same time all the other animal are having their little young too, like the wolves, the eagle, the grizzly, all they along the foothills, and they got the ground down in the Coastal Plain where it's breezy, no mosquito and all that. So, that's why they go there. And they need to, the mother needs to take care of herself before birth, and then birthing time, and then nursing time, and then training, and that calf need that Coastal Plain to run. So, he can run away from predators. And he needs - she needs all that. By the time he - they learn that, then the calf, then, then it's time to move because mosquito come and even mosquito alone could drain out a calf because their hair is very short. Caribou, caribou her hair is very short because every year caribou loses their, their winter fur, and they, they, they grow new fur, fur so caribou, mosquito get to them. So, they had to move - they have to go through the predator's area in the foothills, but the calf already learned how to run so. And then they get up to the mountain, away from the predators, and breezy up there. By that time that's a plant up there, grow so, and they stay up on the mountain until their hair gets kind of long from - for mosquito and then they head - then they start migrating again to wherever they need to go." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "...caribou goes on ice and eat those little round little houses that belongs to the muskrat. That's the value of food. Every lake in that country. Every lake, the North Slope, every lake muskrat lives on there, caribou eat the house. It's so special, that food, that caribou eat his nutrition on that just one little 40, 50 caribou eats that one, that one place you know. So, you have a migration of 30,000, but the muskrat is one of the iron for the body." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I don't remember caribou have their babies around here. They have to walk way up there. Just like that places just a safe place. Open, open place. A lot of food, lot of moss, everything just like the hospital. When the woman's pregnant we take her over there, everything is ready right there. They're like that up there. And for themself, they take care of that land. Make sure that it's clean. Because they'll use it again next year, and the year, and year, and year. Nothing changes up there because they took care of it. They take care of that area. Once that little baby born, they stay there. When that baby is strong enough, they start back. A lot of caribou come back with little ones. And they're making a lot of noise, those little young ones. When big herd coming, you just hear a lot of those young baby one. They're so happy, they're, they're making noise on their walking. You could hear them a long ways. They're happy that they're here, every year, same, same, same. If we disturb them, if we damage the ground, if we ruin the water, if we ruin the air that they breathe, it's really, really gonna affect them. Just like at home, if I'm making a big pot of soup and he come in and put something else in there, "Hey! Don't put that in there. Put it away. I'm not going to feed that food to my kids, and my people," because it's not good anymore. Caribou seem to feel the same way. They want their little ones to grow up big and strong, because they have to travel from way over there back to Alaska." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Like I said when those caribou are ready to have a baby, they start walking, they gather big herd of caribou. They start from Arctic Village area and then they go. They're walking really slow up that way. They go slow, and they eat good, and they drink good water because they worry about those female that have young one in their stomach. They - all the caribou have respect for her. And they take care of her, they walk slow all the way up. And when they get up there, they know, caribou

know about the country more than we do. When there's a big herd coming, they always have a leader. He looked after all the big crowd of caribou. He was a leader, one leader. Early in the morning he take off, that leader. He check the ground, he checked a water, he check all the country up that way. Which way he's gonna lead these caribou? Make sure that we'll have good water, good food. He check all the food. And then when they get up, he leads them. That way, wherever. Safe way to travel. If we went up there and start using motor, gas, oil, tear-up the ground, ruin their trail, they wouldn't know what to do. They wouldn't know which way to go because they go - they do same thing every year. This young one that born up there, next year, he'll do that. Just like what he's, what the other caribou did. Generation to generation." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "The only thing I hear about was long time ago, is uh, forever, every year you know, they go different route, different route. But, the reason they follow each other, right after on the same trail: there's a little thing between their finger in there. That's their mark. That's what all the old people said long time ago. That's what they smell and that's where they go." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Porcupine caribou […] travel north from their wintering areas, which vary from the Yukon to Alaska. The caribou will wait for the snow to be soft and easy to move through, rather than walking through ice-topped snow. They start moving in March, when it is just starting to warm up. However, they must also start to migrate early enough that the ice on the rivers they need to cross will still be solid. If it's not, they'll stay in a safe place for a time." –Gwich'in Tribal Council and Benson, 2019, as recorded in Draft SEIS Comments, November 7, 2023
- "... During the summer months, all animals have their young. They nurse and train them. We don't hunt animals during this time. That's when the caribou go to calving grounds, that's why we want to protect this area. The birthplace is like a hospital for animals. We have respect for that area. The caribou want to give birth in a private, clean, quiet area. … The pregnant female caribou need to eat good. They all go to the calving grounds. At one point, there was 350,000 caribou there. Before it went down to 120,000 caribou and now it's going back up – maybe 238,000. They were all born at the calving grounds. They don't come over the Brooks Range cause it's too much brushes, and their predators like the wolves that's why they only go to the calving grounds. Also, they have a good food supply there. The plants grow even before the plants grow here in Arctic Village. During the winter, it's very windy at the calving grounds so there's hardly any snow. In the spring when the sun come back, it's the first place the plants start growing. Their food is very good and nutritious. That's another reason they always return there. The pregnant caribou really need to eat good and rest. The winds is always blowing there. At the same time, the bear, wolves, eagle, wolverine…they're all raising their young also. These animals stay around here where there's food for them. That's another reason they go to the calving grounds – no bear or wolves there. They need big open area to train their young to run so they can protect themselves. It's good before post calving, birth, nursing and training. That's why they go there. This side of the Brooks Range…too much mosquitos. Mosquitos can kill a newborn caribou. When the calf is born, there's not mosquitos but the time there's mosquitos, the young caribou can run. They are trained for speed. When they're not ready, they stay in the coastal area because there's ice. But now there's hardly any ice. When they stay around the coast, mosquitos don't bother them. When they're finally ready to come to the mountain, they can't have their young on the mountain cause there's no food for them. There's still snow, that's why they go to the Arctic Refuge. They roam all over while there's no mosquitos. Some of them roam and some of them stay in one place. In April, they move in the

direction that they are facing." –Sarah, James, 2018, as recorded in Draft SEIS Comments, November 7, 2023

- "…the caribou has to go up to the coast to have their calves. They can't have their calves anywhere else because around here they would die off. Because this land is not flat like at the Arctic coast. On the coast the wind keeps the snow down. Also, the caribou can see for a long ways and can spot predators. Wolves and other animals like that are at a disadvantage there because the ground is just right for the caribou to run on but not for others. Down here it is the opposite. That is why we do not like to have too many snow-go trails all over the place. This would screw up the mouse trail and if you kill off the mouse you also affect foxes, wolves, hawks, eagle, owls and others who uses mouse for food. Also, when the snow-go trail hardens, the wolves can use it to run down the caribou. In this way, the wolves can clean out the caribou. So all the care we take up here is connected. We don't do anything for nothing. Everything we do has a purpose." –Arctic Village resident, Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023
- "They got good ears and they could smell a long ways. […] they were trained, well trained. Caribou train their young one really good, generation to generation. That's why we still got all the animals up there because they take care of the land, they take care of water, they take care of everything. All their food, place where they stay, underground, on tree, there's animal everywhere." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Gwich'in Cultural Experts noted stark differences between the Porcupine Caribou Herd and other herds that have already been extensively affected by development on the North Slope, and expressed concern that these sorts of deleterious changes would soon affect the PCH if development on the Coastal Plain were permitted:

- "That's the same by that, Western Herd. I was hauling wood, I ran into tracks, small tracks. I was kind of wondering, that first thing in my head is Western Herd. You know, it's different, you know? Caribou are pretty smart. You know? When it's time to feed people they know. It has a lot to do with the weather, you know, so. Very, they are smart, they know that country." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "How do you tell the difference between reindeer and caribou? I speak Indian to the old lady, grandma. And she said that they got bigger fur here, just like musk ox right on the foot. Yeah. Yeah. And that one time a lot of caribou was coming back to this from the south, going up to ANWR during the springtime. It mix with, with, a deer, a reindeer because there was too much [disturbance on] the coast, they got scared, and they got mixed, you know. So, they all went to ANWR, yeah. And then that's where the Porcupine Herd, took them all the way up to ANWR and they found out where they're at, and they went back down to, they went to the west again yeah, they know where they belong." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Appearance. It's like, you're sitting on, say Tąįh Choo ["Big Hill", near Arctic Village], looking around. You look for stuff that's not normal, right? Dark spots, brown spots. I had an incident way back when I was about 12 years old, I got a couple of caribou. And they were just by themselves. And I noticed they look different. They were more bushy, smaller. First person I brought it up to was James Gilbert. And he said, "that's a nor - that's a Western Herd. That's reindeer." And he basically explained to me what was different about it, "I said, it looks funny. Don't look like our caribou." Yeah, and they were bushier, smaller heads. So, they're just like, tinier and bushy. [...] Yeah. So, and yeah, yeah, he's told me those were reindeer. This was April when I got them, these

bulls already had their diijì' ["its own antlers"] growing, you know? But uh, yeah, I noticed they were just bushy and small headed, and they just look different to me. Like I said, it was the appearance that made me see it because Porcupine, you know, you got the big, strong looking healthy bull caribou. And, you know, they're, they're more. I don't know how you say, more, larger looking. Right? And there's a short little, like a musk ox caribou." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "...then it goes with which group that caribou is, is he with a group? Is he the one that got chased off that's running and, like, panicking and looking for his yeah, there's stress, there's behaviors like I say, you know, there could be two, three of them, you know, they lost their herd, but they're in a panic to try to find them. So, they're just moving, moving. I mean, we see caribou- [...] up in sheep country, you know? I mean, hey, look at that, what is that? Jesus Christ, It's a bull caribou and he's on a grade like this [GESTURING STEEP GRADE]. But, you know, like I say they, they do, they stress out, like I say, for me as a hunter, when we go out and look for them, you want to kind of find the pack that's like - lucky if you, you know, when it's plentiful, you look for the bigger herds, because they have more eyes to watch when they eat. So, that's going to be a better group to go after. You go after a group of 10 that's, you know, always on the alert, lookout for wolves and they're always breaking trail. So, that's a group that's going to be a little more, uh, the quality of the meat is going to be less because they're always on the move. So, they are, they're stressed. So, you kind of want to look for those 200 group, you know, and then what you're doing is you're looking for the grandmas, the ones that can't birth no more." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "It depends on what it, how it occurs, you know, like, as gatherers and providers, you know, we don't want to chase that animal. Like I say, like I say earlier, you don't want that animal to know we're even there until you put them down. Right? There's incidents where, you know, like, we've chased the moose with the snow machines. It's tough, because these muscles are all tight from running, you know? And, like I say, there's incidences where, let's say, June, when you got your young bulls, cows are already up in the calving grounds, and you got your caribou that are crossing the valley there, but man they're moving fast, you know, getting away from k'iijol ["gnat, mosquito"]. So, like I say that active meat, you know, that's like eating Michael [Phelps], you know, you don't want to you don't want to eat that, you know, athlete, you don't want to have muscle meat, you know? You want that good stuff." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Lichen, they grow just about everywhere. But they're like a sponge, they kinda, they're dry when it's dry, and when it's wet, it's kind of spongey. Caribou needs to eat that because they're always on the move. And it doesn't give their nutritional value to the body but it retain nutritional longer. So, they'll be on the move all the time. They never settle down. They always on the move, there has come they - cause they call it migration. And they migrate all the time because that's their life. And nobody knows any scientists don't even know why they move the way they move, or migrate the way they do. Us, we think it got something to do with their feeding ground. So, so like people are saying that they depend on muskrat, muskrat come out every win - all winter long. They got a path under the snow where they bring up food from down on the bottom and eat there, and they need fresh air too anyway, so that's what they do. And, and springtime when they come on the move, either they go through Aklavik or through between Arctic Village and Venetie, there's a lot of lakes there, they lotta lakes in Arctic Village, they go through those places because of that. I know that." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "You know, we've been here thousands of years, even the caribou. And I was just thinking about how the oil development will disturb the migration of the caribou, their route. Once they do that, you know, the caribou will not know where to go. And that 1002 area, that's the only place that they go to get their nutrients and stuff. Right now … bringing in all the planes, all the equipment and all that. And those will cause the carbon that will be in the air, the soil, you know, that's where all this stuff, the caribou goes and eat, that's a nutrient, the special food that they have, and also our caribou too, they're really sensitive. I mean, all that, you know, the air, the air will be polluted. There'll be no food there, and our caribou will just be everywhere. I mean, that's a place they go every year to have their young, their calves. And that's what we depend on. I mean for 1000s of years, I mean, last year, I try go back home every year to Arctic. And last year I was there. I was up there with Julie and Jim. I mean, it was just so, man, I mean, it was just so amazing how they-the whole family comes together, they just know what to do. How they all kind of, I mean, it was just so neat." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "This is how I see things: white man, they make paper in a computer. They put something in the fish so that fish comes up the river. That's what they call a study". But those habitat, caribou, they put a collar on it. "Oh yeah, we seen it, that group all travel up in this area on the Chandalar, follow it and then they go migrate down to Venetie." Those are the things that they see. But they don't know what the Gwich'in people do and what the caribou does. So, bear that in mind with me. That's how I feel today thank you." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

The Gwich'in have long relied on the Porcupine Caribou Herd for sustenance and materials for their survival, including skins for clothing and shelter, and bones for tools. But Cultural Experts also described a deep cultural connection to the caribou that goes beyond mere reliance on the animals as a resource. To the Gwich'in, the caribou also sustain their spiritual and cultural existence, and are a philosophical keystone in their entire world view. Cultural Experts describe these more complex connections and deep respect for caribou in terms of DInjii Zhou K'yaa Zhit Gwaradaii (Gwich'in practice of the way of life), the cultural norms and expectations that serve as a kind of legal and moral framework for interacting with each other, the caribou, and their world in general:

- "All right. I'm gonna tell you what I think about caribou. I think it's everything for us. It's our medicine. It's our tools. It's our meal. Last two years, I haven't been able to harvest any fat bulls. My old lady gave me an earful about the third year coming up. But anyways, you know, caribou, it helps a lot of the people back home, especially the elder ones that are becoming of age where they get sick. You know, they don't want to eat what's at Safeway or Fred Meyer, they want to have caribou soup or marrow ch'izhèe ["marrow"], whatever. Just like Robert Frank here, I sent down a package with Danny Sam, he said you weren't feeling good and you wanted some Native food. And so, I sent that down to him and he enjoyed it, I heard. But that's what it's all about. And, you know, that's like our kids coming over here, when they get excited, they want to go to McDonald's. But it's same thing back home for all of the older people. That's our McDonald's. It basically is, it's pretty much 80% of our diet. Some people might say it's more but, yeah. So, like I say, it's very essential to our people, it's been a tradition that goes way back, it sustained our people for many of years. And it's something that's a recycled habit, every year like he says, August, that's best time we all go out and look for it […] But like I say, they hunt in a different time of the year when, you know, they're rutted out. I could say some of the words but yeah, I, we don't mess with that. Um, yeah. And it's been all over our country, not only up in our region, it goes as far as Yellowknife

[…] Everybody that lives in the Arctic Circle depends on the caribou. Doesn't matter if you're Russian, American, Greenland or whatever, we all eat the caribou. It's a must for all of us. That's all I'll say." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "When I hear the word caribou, I think about our ancestors. Also August, because that's, that's when they come back from the 1002. That's like the best time of the year to hunt caribou. Meat, meat for our families, providing for our families, fried meat, smoked meat, camping on the mountains. Everybody that's camping on the mountain, get the caribou harvested, take it back to the camp, dried, smoke it and get as much as we can that will probably last, I think that will last us for the winter, bring it back home, put it in our freezers, you know, and I thought, I think when I think about caribou, also, going back to our ancestors, I think about my great grandfather, James Gilbert. He was a, there's a story about 45 caribou shot on the mountain and the story, it's foretold that he's skinned all 45 caribou for the village and to me that's just, I mean, all 45 caribou by yourself, if you tried doing one, you know what I mean?" –Galen Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I know that come to caribou, maybe I missed some - uh, Florence said some of it earlier in the prayer, that we don't throw bones away unless we throw it in the river so it won't give out scent, and that was - those kinds of stories are very important. It's our medicine. It's our song. It's our dance. It's our food. The horns are very special because they're remains. And we respect animal's privates, privates. And there are prayers, and tools, and clothing. We got a lot of stuff on caribou. That's who we are." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know, back in the day, when I was growing up as a kid, when the caribou would come through, there would be no camps on the mountain, everybody would basically have camps at the toe of the mountain by Marty Creek, and all the hunters were allowed to go up and get them and bring them down. So, what I'm trying to get at is when we're taught to hunt, we're taught to be sneaky, quiet, no disturbance, you know. That falls back to back in the day, when they got them in the caribou fence, you know, they're very clean about it, blood and all, they would exchange the moss and leave it as is. But uh, so that goes back to human contact with the animals. So, it's always been minimal. You know, we don't have deers or nothing. So, basically, the only contact we had is with our dogs. So, if you had a camp, whatever, on a mountain, they come over and they see a tent structure, boom, they're gonna walk the other way because that's not normal for them." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I was thinking about when we were talking earlier, how do we engage younger people in this work? Like, what is their first memories? And actually, I think some of those first memories are them eating caribou for the first time. A lot of our young babies, you know, the parents and the grandparents make sure that they get a taste of their foods from very early on. And they eat with us, you know, we're not the type of culture that uses a lot of baby food and stuff like that, like we introduce our traditional foods early. And then as the kids get older, I was thinking, every one of us has participated in our dance groups over time. You know, that's another thing because our songs are in reference to caribou and some of the other animals. So, even just by dancing, and not even fully understanding the words or the songs, you're getting exposed. And over time, I think that involvement and your understanding just grows. And I was thinking about Gideon, you know, he's been a longtime dance leader, and over the years, he's given drums to a lot of the people that have contributed back to the community. And he always paints like a caribou on there. And I think he does that as a reminder that this is who you are, this is who we are. And it doesn't matter if you live outside the community or whatever job you hold, this is where your responsibility is. It's just a way

of reminding us about that." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Oh, we're not talking about just food, we're talking about our connection with the caribou also, spiritually. Yeah. You know, we're, it's like we're expecting them. You know, during that time of season, you're expecting them, you know, even just to see them, you know, spiritually. If we don't see them, spiritually, that really ruins us, makes us sick. You know, we're worried. So, yes, it's not just about food, it's about... I don't know how else to put that. It's not just about food, no. Spiritually, you know. Every time I see a caribou, that I don't shoot, you know, and say, "Hello Jyà'. Mahsi." Travel long ways, you know, and just to see him I always say that, my dad used to say that, "Hello Jyà'. Come back when you're bigger." –Galen Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...we always protect the caribou from the time we were born to the time we die, because that's who we are. That's our life. That's who we are. Nobody can change that, can't take that." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Vatr'agwadąąhgwaii, k'at nihkaa, it'll show up tomorrow, they say. For sure next day, they're on that Vatr'agwadąąhgwaii, and then they meet. They said don't bother it. Let the first bunch go past first. So, we just waited. They're taking all their dog pack out of cache, dried up one, that's when our dogs start yelling. They know. They're just happy! Happy and just jump around! We're doing that over there too, jumping around! The caribou's coming, vadzaih ah'al ["caribou are coming"]! They pass, and they wait for a while. And THEN, now you guys could go up and hunt. That's when they go up. At that time, they listen to their Chief. What Chief tell them, they have to do it. Or they don't ha - they don't do it. Then everybody go up that way, camps all the way down. They take good care of the meat, they don't throw nothing away, just the lung, because we don't eat lung. They leave it over there for crow, for raven. And they put some fat over there for camp robbers because they're the one that told us the caribou's coming. We trade with them. When we camp there, big meat place caribou, I mean dry meat place, from right here to there, layer, layer, layer. All the bone parts are around the fire, they're cooking it." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "At that time you know, they always come this way. One day they know that it'll come, because every year it's like the same. Because we were there. Today we're gonna see a caribou. They always come about this time. And my dad is outside with scope, and a lot of people are just waiting around, you know. Talking, tell stories, pretty soon he say "Hey, I see one caribou up there, up on Old John Mountain." Gosh, we were just happy! You know they come from Old John Mountain, right this way up to, uh, mountain up there, Dachanlee." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Some time they, like they said, you know, they go, Gee, they don't - they supposed to come today. My dad this up there with telescope. Supposed to, caribou was supposed to come up. On Old John, Old John Mountain, it's other side that big lake, a lot of people just stand around waiting for him. When he see caribou, one caribou, they all get excited like I said other day. But if that caribou didn't show up there, they'll say there's something wrong here. Supposed to come today. They didn't show up, they went the other way. Why? Why did they went that way? Because there's something wrong right here on the main road. Somebody camping around there, make all kinds of noise and, you know. They're not coming this way. They had to find another way to go that way." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- “It's... We wish, sometimes we wish we know what caribou was doing, that's what we're talking about. They can't talk, they can't say nothing. Guess what? They got good leader, just like, just like we do. They follow what the leader do, they do what the leader want them to do. They have respect for their leader. You know what leader do? Wake up early morning and walk ahead, about a mile from down that way. While he's eating, he's looking around, he watch the weather. Then he goes back and then they start. He already look ahead, he know that which way they'll go. Depends on the weather, and depends on the ground, depends on the food. While he's down that way, he looked around you know. See, there's a lot of food this way here. And then if there's nothing, he'll think, “Gee, there's no food. There's no - what will we eat if we go this way?” That's why he went ahead and check it all out. He checked the weather. He checked the ground. He checked the distance. He looked at all the country, which way is easy to walk.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “Ok. Well, yeah, like I say, and you can, like I say, if you watch the herd, you can see which one has a baby and which one is not carrying. And you pick the one that's not carrying this year didn't birth this year, doesn't have somebody to tend to, she's going to be the one that's in best shape. You don't bother the one that has that little calf that she just had in June, you know, she's trying to provide for both of them. So, there's rules and ways of harvesting.” –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “...what I do here is that a lot of Gwich'in here in the village, in this Fairbanks, and when they need caribou meat or for sickness, and for medicine, I share that, that's what I do. I share that, what I gather up there. And just recently, my cousin from Birch Creek was dying, and he request caribou meat. He said, “What kind of caribou meat?” I told him, I said, he said, “Tongue, the tongue, with the debris on it,” you know, whatever he was eating, it's always in the - sometimes it's in the mouth. “With that thing on it,” he said. Debris on it. And “That's what I want” he said. But uh, “And then if you don't have it, give me meat that have -” you know when we're out there, somehow or another, all these leaves or whatever gets on it. As clean as we try to keep it, it gets on it. “Get a - uh, boil me a caribou head or fried meat with some debris on it,” you know. And I find one, I gave him a soup of it, and he said “Boy, I'm gonna die good,” he said. He's - they already, they already- he knew he's gonna die. And he's only have few - two days, or less than few days. That's, that's how they use a caribou. That's how it's a medicine to them. They said they gotta have that caribou meat in order to get their journey, get on their journey. And that's why we cook for them, so they can have food for their journey, prepare them to go. Our food's very important for that. That's why they even pass a law where they can get a moose or caribou for funeral. And that's how much it is important to us, caribou, for our next journey to the Other Side.” –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “I'd like to share this with you guys, and how much, how much important caribou is, without the caribou I don't think we'll be here. All the animals. We survive on that.” –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “Caribou... when, you know, our Chief, when we're, when we're celebrating something and we're dancing away, he always tell us: “Let there be lotta caribou, let there be a lot of caribou!” in our language. Vadzaih goolįį! vadzaih goolįį! [“let there be caribou, let there be caribou!”] we're just swinging around because we're asking for caribou. I remember all that. We don't waste anything. We use the skin, bones, meat, even caribou jaw. We used to grind meat on that because we don't have those, to make it soft. There's all kinds of games that come from caribou. They make all that

for us and we're - we play with that, that we don't have no school. They make all kinds of games for us." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "A lot of time we tell these young people so they'll know: after the leader pass, and then the next one, now you could go up and hunt. We have respect for them and they have respect for us. We don't want to ruin their trail. If we're going someplace, if we go to some place every year, if somebody come with a tractor and destroy the trail, then we wouldn't know what to do. Caribou is the same way. All the animals, they are smart. A lot of them are smarter than us. They know how to make a living out there. They're busy from morning till night trying to feed their little ones, training them, just like our parents." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "In the village my father used to have a telescope old one, those long one. Like August 20th, they all gather around my house my dad is right there watching caribou, supposed to come today! We're all excited and we're just waiting. Pretty soon he said "Hey! there's a caribou up on Old John Mountain," other side that big lake. We all get excited. They even play with each other those old - our parents and grandparents that are so happy. They wrestle and happy, and us kids too, we're just jumping around! And you know what? All the village dogs, they start barking, barking, jump around, jump around. They know. They know that they're gonna eat good. Just like us. They go out to the cache and they bring back - they bring out all the dog pack, dried up one. Dogs when they see that, they're really excited, just jump around happy. We are too. They know why their master bringing those packs." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "There's a lot of times the wolf helped - helped them out because the wolf know how to hunt. That old lady was living and a wolf got that one caribou. That wolf got it and he was going up the mountain with it. "Hey Shitseii! Ąįį vadzaih shantł'ąhchii ["Hey, grandchild! Give me the caribou"]," yahnyaa. That wolf gave up that, gave up the caribou. Only caribou they see, but the wolf got it. Googàa, that old lady, she kind of made some words to her, you know: "Hey Shitseii! Ąįį zhoh shantł'ąhchii!, ["Hey my grandchild! That wolf they gave food to me"]!", yahnyaa. He left it behind for that old lady that time. Yeah, that's one story that grandma taught me about that." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...we all have language for that. Every one of those. The caribou when they migrate, the leader is khaiik'eelik ["leader, 3rd largest bull"]. Yeah. And then you have the young, young bucks in the back, they learning from them. The big Chief up there, you know, so, and then you have all the ch'ayah t'ok kwaii ["nursing cow"]. They're either the male or female, little calves that learning how to migrate, how to, uh, where we're going to eat this year or that year or next year. They know that, it's in the blood of the caribou. The Porcupine Caribou is a very - that animal is a very important for to be protected." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...us, we're kind of traditional way, speaking on behalf of the caribou and all the species that's living up north. So, what they smell is going to be affecting them, what they eat is going to be affecting them on the ground, the little one. One of these days, the young people is going to have a little baby themselves, and that kid, when he grows up, he's going to remember where he was born at. So, that's just the way the little caribou calf is born up there in 1002 land. And that's why the younger men, caribou, they teach those little ones where to go. On the bottom of their foot, that 100 year caribou footprint could still be smelled there. That's how they migrate. "Well, we've been here last year, so let's take the left, go to a Koyukon - uh, let's go to Canada" you know, because the Canada got more of nutrition, more sweet. When you talk about eating caribou, Porcupine Herd is

the sweet animal taste. The Koyukon love the caribou. But when they eat the Western caribou, because it's been contaminated a little bit more, so they have no choice of eating it. That's why the 1002 land is more cleaner than the western Canada - western side caribou. It tastes differently. That's the reason why." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Back in days, my grandparents, they always are worried me about caribou. Because that day we didn't have no four-wheeler. We didn't have no machine, we use dogs, dog pack. You know, that's the life we have. Is that what they want to take away from us? I lived with it, you know, I, I grew up with it. And I know, and I know caribou is having a hard time you know, because if we don't protect it, we're just going to wipe it out, you know. Like when we make village rules, hunting rules, you know you have to follow that. Here we're fighting for this and we can't just wipe them out, you know? You get what you want, limit, limited, and that's the hard part. You know, people gotta eat but, you know, because somehow protect it, you know?" –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know, one thing I was thinking about, too, when we were talking about like, caribou migrations. If they, their migration gets interrupted, or they get further and further away from our community, there's like an impact, even if our hunters are able to go further in to get them. When they bring them back, it's different, like our tradition of being able to go up to the mountain where we expect them, and to be able to have like our tents and our camp set up there? Like, it's, our culture kind of lives in that space, you know, and so when the men bring it back, like, people start drying right there, they start cutting right there on the land. And there's something different about that, than even bringing it back into the village. And to, you know, cutting it up and putting it right into your freezer, or something, I was thinking about that, like when my mom is over here in the city, and, you know, when we bring meat back for her, it's different, because she's like cutting it at a table and putting it in the freezer. It takes it away a little bit from the cultural context of the learning and the knowledge transmission, I think that happens on the land, you know? Like going out with you and stuff, like seeing how people quarter and harvest the caribou is very different than if you were to do it in any other context. Like knowing the process and the stages of how you take it apart, how you save things, how you use the water around you to clean certain aspects of it, how like the lichen and stuff, you know, on the ground, kind of like gets on a meat sometimes, like, there's just a whole, a whole, like, knowledge base around harvesting right there on the land, and then having the ability to like, process it more traditionally, than if you know, it's store bought meat or something like that. It's just so different." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "It is difficult to hunt moose. Even when it is sleeping far away, it hears noises. It has good eyes. It can smell things far away. As soon as it sees something, or smells something, or hears something, it flees. Because it is this way, it is not often killed. We only go hunting for it where we think there is a good place for it to feed. It stays around little streams where there are lots of willows. When we go after it, we search for its fresh tracks. We look at all these things if it has eaten recently and defecated. In fall one hunts it more than at other times, and it is very pleasant." –Fredson and Sapir, 1925, as recorded in Draft SEIS Comments, November 7, 2023

Gwich'in Cultural Experts also commented on changes already occurring in the behavior and quality in caribou and other terrestrial mammals, and attributed it variously to climate change or unknown causes:

- "You know, we all live by good water, good food, good animal. Animal live the same way […] they know where there is a good food when they're coming this way, you know, they always have a leader. You know what leader do? Early in morning while […] all the caribou are resting, he get up and he walk ahead, checking out everything, which we could we go today. He walk ahead and come back. He will look for woo- he look for the food, over this way nothing, over that way, so we got to go this way. After he go back and then he lead them out because he went that way already, check it out. He looked at all the hills that they have to climb, or down the hills. And they have trail that way before, that one they use every year. Everything is changing for them too. They don't go that way before. How come they weren't that way? Our people always say." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.15 Landownership and Use

Some Kaktovik residents have expressed frustration with the politicization of ANWR development and lack of self-determination when it comes to developing and hunting on their traditional lands. Many have expressed concerns about the lack of local involvement in creation of the Refuge, and the resulting regulations on subsistence harvesting activities for local residents.

- "Yea, mostly social, every time they hear something it goes in one ear and out the other. It is really frustrating when people cannot provide the things we want. Economics, they are depriving us of our land and it is insulting. We have rights as humans. We shouldn't be treated as second class citizens all of the issues are discussed 6,000 miles away without consultation with the people here. We want a round table like this, we want federal, state, local, borough there. We also want the elders and the youth there. We want everyone involved in the discussion. It is frustrating because Arctic Village sides with the environmentalists… we also want industry, we had ASRC and some of the lawyers just thought maybe they were giving us too much. The NSB we had funding from the borough and ASRC and the city of Kaktovik and we did the funding on that document and President Clinton stopped everything and I said we cannot stop; we have the right to develop our lands. They use Nuiqsut as a scape goat and now they are entering NPRA, they are opening up their second choice area now, ANWAR was their first choice." (SRB&A 2012a)
- "I don't think there is much that can be done. We might sit on a billion cubic feet of gas and turn generators on, but you have to ask congress. I don't know if they will finish partying or make an impact statement. But they dang near started everything with that Arctic National Wildlife Refuge." (SRB&A 2012a)
- "They came in and documented where people come down the major rivers, congress makes rules without our consent. Like the National Wildlife Reserve. They did it without us knowing it. President Carter came into town and had us sign a document without reading it, and that was an insult. That was 32 years ago. That was during I think, 12 years after TAPS. They made a wilderness in our backyard. I was only 30-something years old at that time." (SRB&A 2012a)
- "There were no official meetings or anything [regarding the creation of the National Wildlife Reserve]." (SRB&A 2012a)
- "It's locking everything up [the National Wildlife Reserve]. It's all emotional, people are sympathetic, they see the mountains and they don't want people to touch it, but we hunt and fish and we need some development. Fish and Wildlife make money off of the recreationalists and they want to charge us 100$ a year for a camp. We have been camping up on the hill forever. I am not going to pay them to go hunt up there." (SRB&A 2012a)

- "Democrats… we need economics and America needs the oil and 9/11 came around and everything went downhill and it frustrated even more than the environmentalists. On-land development we were trying to get the environmentalists in because we were opposed to offshore and now they [development projects] are all over the ocean here, Greenland, Ireland, we are all fighting offshore, we wanted help here but they [the environmentalists] wouldn't even acknowledge us because we eat whale. We told them that we eat caribou and fish but they didn't listen they just wanted to focus on the whale." (SRB&A 2012a)
- "In the 1970 …people leased to one of the oil companies a portion of their land. Their name is on the lease… they were looking in the wrong spot if they went further west within the boundaries of their reservation…. They are supposed to do the road and the pipeline and we have documents that [community member] leased a couple of thousand acres for oil and gas and they don't want us to develop our oil and gas." (SRB&A 2012a)
- "Socially it is really frustrating that when you bring in the projects and don't tell anyone and it is passed 6,000 miles away without the consent. How would you feel about that? Where do these things come from and how come I am not told. It has been going on for 10 or 15 years right after TAPs. Not just development but also ANWAR this area is made into a wildlife refuge and it was protected against our consent. We cannot hunt over the continental divide. I cannot hunt and travel how we want in this area. We have river rafters coming down these rivers and ADG&G is collecting fees and laughing all of the way to the bank. We don't collect fees, and F&G has this rhetoric about protecting the caribou and resources and now they want to charge us to camp. We have been camping for years on our native allotments and now they want to charge us! Not only that but we have to get fishing and hunting licenses. The prices have gone up a little bit but that is for a good cause, they have to make regulations and print and mail the regulars and that costs more than 48 dollars and I will do that. I want all of my regulations to be done correctly so I can continue to hunt, I am a hunter. I need to know the regulations because I am a hunter. If I am going to die I want to die full! Social, it has been pretty emotional the environmentalists have sensationalized our situation and they are laughing all of the way to the bank. Friends of the Earth are collecting money from little old ladies and men to save the wildlife refuge and these groups are laughing all of the way to the bank… where does that money go to? Lawyer fees, they are fighting us. Those environmentalist lawyers are using all of these natural resources derived from oils and tree. If they want us to quit using oil they should quit making all of these other things they use oil, like lip stick." (SRB&A 2012a)
- "I guess uh, we just had to do what the federal government said to do [regarding TAPS]. We used to live on the north end of the island towards the beach. And then here comes the government and says they have to move us all. We are right in the landing where all of the old DC3's and they though one of them would crash into us. But we never had a plane crash. All they did was move us from there to here." (SRB&A 2012a)
- "I think it was mainly towards the North Slope Borough and Arctic Slope Regional; those people had most of the say. They would come around and talk and say it would be good for this and that and people just follow right along I guess." (SRB&A 2012a)
- "It would help but you would have to knock down the government to get anything done on this side of the Arctic National Wildlife Refuge. Otherwise you can do what you want." (SRB&A 2012a)

The following Iñupiaq comments provide descriptions of traditional territories and establishment of present-day communities:

- "Jeez, probably this whole map [is Nuiqsut territory]. As far as the Sag River, next to the haul road. We are going for wolves, but if I see caribou I will shoot it. Pretty much a straight line across and hit the oil well [Kuparuk]. Franklin Bluffs is the farthest I have been on snowmachine. From Nuiqsut straight over. The bluffs are straight up and down; there is no way up unless you find a valley. To the 'Pam' marker. All the way to the Ikpikpuk River. The foothills, you get up on top of them. All the way to Barrow and on the Meade River. I go different routes every other year, try something different. I follow the whole coast. Some times I cross Admiralty Bay or I cross just south of it. We have always been taught to stay off of Teshekpuk Lake, to stay on the land. They say it does not freeze all the way, it is warm underneath. It is just like the Colville because it is always flowing, there is a swift current. Every now and then we go to Oliktok Point, in the wintertime. We don't go in the oil fields. We used to go to the east of the village before 25 years ago before Kuparuk started. I have been half way to Anaktuvuk; we used to haul maktak and meat to Anaktuvuk for the holidays. We look for caribou at the same time." (SRB&A Nuiqsut Interview November 2006) (SRB&A 2010a)
- "Areas used for caribou hunting were (and still are) a function of season, as the existence of snow cover determines whether or not easy overland travel is possible. In summer time, the Paningoonas hunted caribou all along the coast of the Canning River Delta, by boat and on foot. Josephine tells that during the summer, when they saw caribou along the shore of the mainland from Qikiktaq (Flaxman Island) they'd go hunting. Their hunting area extended as far east as the Canning River's main channel and as far west as Point Hopson. They would sometimes walk as far as three or four miles inland in pursuit of the caribou, and they did a lot of backpacking to bring the meat out. In late winter and early spring, the Paningoona girls traveled with their father up the Staines River to hunt caribou. The caribou wintered in a large area to the west of the Staines River, between ten and twenty-five miles inland from the coast." Josephine Paningoona Itta and Mary Paningoona Akootchook 1979 Sale BF Kaktovik (SRB&A 2003b)

Gwich'in comments describe traditional use of areas on the north side of the Brooks Range and into the Coastal Plain, evidenced by toponyms and oral history accounts of family members who traveled and resided in the area:

- "Yeah, on my note I have "ocean." They respect lot of water, they call it chųų chooh, that means big water. And they respect water, when they see it they pray, wherever they come to the ocean. Another thing they pray is that, like Nitsii Ddhaa, it's the highest point in our area. And that's why it's respected. Because we could see a lot of land, and they respect that, and when they come to Brooks Range, they pray there too, because that's the highest point. And also it's, you know, it's they pray and then they give a gift to the land. They leave something there. It doesn't have to be anything valuable, it's just giving gift to the lands when they climb that Brooks Range. And when they see the ocean too, they give gift because of the water. And that's what they do before colonize, before we start living in village, they use all that area, this. Yesterday we have all kinds of trails of Gwich'in names in the Coastal Plain. So that mean that we were using it at that time, but we don't hunt caribou during their calving time, and we hunt caribou there too. And we also have a place where they settle, I mean live before, up that way at one time. But after they put us into village life, we don't go up there anymore. So now, we know where border is at, where our border is at. That gift is not to get into north country, it's just a gift to the Earth because we climb the highest point and see the water." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "I will talk about long ago. There was a man named Too'iintin and he had a younger brother. He also had a wife but she passed away. His brother also passed away. He lived along the coast most of his life even though he was a Native from here. Since he lived there, the [Inupiat] probably all knew him but they didn't bother him. He mostly survived on sheep. When my mother [Maggie Gilbert, 1898-1983] was a child, they used to go up to the ocean. They would go there to get stuff they need." –Trimble Gilbert, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- "They [historic Gwich'in and Inupiat] had war because we had to protect our hunting grounds, too. They got the Coastal Plain back when they had war. This is what they want to eat, you know, so us, too. There was 85,000 of us at the time, and the disease got us, tuberculosis, the measles. It was not brought to -- it was brought to us by the preacher. […] We traded with the [Inupiat] up there because they had good tobacco […], and we trade with food. We give them sugar, lard. They give us tobacco. They gave us grease so we can have light. We taught each other." –Ernest Erick, 2019, as recorded in Draft SEIS Comments, November 7, 2023

Cultural Experts expressed concern regarding the true intentions of colonial powers in their territory and reiterated their historical resistance to encroachment:

- "So, the old man Robert, the old man James, the old man Tritt. They didn't like it [encroachment and exploitation by Euro-Americans]. So, so they made the boundary, you know, and so let's go take care of the animals here. Whatever they're going to do- whatever, people coming to us, you know, they watch out. […] So, one of these days, it's going to all come towards us, the history of it, the bad way of life. Łyâa zhyàa, don't, lot of time, remember Roberts, they told Robert "Don't believe in the white people, because they're going to take what you want, and what you say they're going to use against you." So, we got we already got in defense over that, you know." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Gwich'in comments also refer to landownership and use more generally in terms of selecting the location for Arctic Village:

- "Yeah, that's why they put Arctic Village where, the river - Arctic Village is famous for that little creek, a bridge over it? That's famous when we were nomadic people. People used to stop there to get their fish, fish trap there. We need to do that too. Well anyway, fish trap there. That's - that's why they stopped over for that. So, it's a special place for all those things. So, that's why they put Arctic Village there: fish trap. And they used to clean creeks, all the way to the lake where it comes from. They take all that debris out with their hand, and knife, and axe, and canoe. And they clean it, keep it open so fish would keep running. And we never done that for many years too. And they used to do that to that creek up at Ts'iivii T'it too, and that never got done for many years. And they used to do that for fish sometimes." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "When they chose to have an Arctic Village there, they had to settle certain place because or else they take our kids away. So, they chose Arctic Village because that was the tree line so they can build a cabin, and trapping even, and for wood reason, rest of them there isn't no, wood, I mean no, no trees. Now trees all the way up to Brooks Range. Another thing they chose Arctic Village because all those lakes got fish in it year round. If we don't have nothing else to eat, we'll have fish. And then another chosen is that's where caribou tend to migrate through. Used to be, like, her dad looking binocular, looking for caribou all the time. I remember that. He had his binocular this way,

all direction all the time. Because we don't know which way it's going to come in. And when we were leaving, I remember when we were leaving Arctic Village 1954, Arctic, for schooling Fort Yukon, caribou came in over Tth'aa'eetsii [“rocky ridge point”, ridge north of Arctic Village, aka Paddle Mountain]. Remember that fire too? Smokey, but he spotted it on the Tth'aa'eetsii and they shot whole bulls by the airport. That used to be more airport there. So, that's where they shot caribou. I remember that. It was really fun, fun time when we were leaving, Arctic Village, but it was fun for me to go to a different place too, but it was fun because they were just getting caribou, caribou show up from Tth'aa'eetsii. So, never know which way it's going to come in. But now we only looking at east because as it comes in. And they changed route, and they keep asking us: “How come the route changed?” We need to answer that as much as we can. And then, in those days, that's what I remember when we were leaving in 1950. There was caribou came in, we shot somewhere, where the airport is at? Yeah, and my mom was just happy because she, she can bring some meat into Fort Yukon for her friends when she gets to Fort Yukon. She was happy about that, I remember that. So, that's how it is then.” –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.16 Environmental Justice

Iñupiaq residents observe how oil and gas development on the North Slope has led to a loss of traditional lands and hunting restrictions without adequate mitigation. Residents also express frustration about the large number of meetings and public hearings, where residents often feel their concerns are not being heard:

- “Meetings, public hearings, more and more of those are coming around. I don’t know about much else, but do they even hear our concerns. It seems like they are asking the same kind of questions and we are telling them the same kinds of things. Do they even record what we say.” (SRB&A 2012a)
- "We need to identify alternative subsistence sites if we're going to lose areas to subsistence, where are we going to have a chance to go to? Are there other communities that are going to allow us to use their subsistence resources? If we go without in our area -- because now we've got pipeline that circumferences us and we can't get to caribou around us, what other areas are we going to move to? What are we going to do for fishing and other activities? " (BLM 2004b)
- “We will have meetings and it doesn’t change anything. Like at Umiat, they assumed 40 years ago that what we didn’t know wouldn’t hurt us but now it is all spilling out of the ground.” (SRB&A 2012a)
- "And now we're getting restrictions to our hunting rights, which is wrong. And we go there quite often, like Carla said, whether we fish, whether we hunt caribou on the sea and the land, we go there. We gravel on snowmachines through there, boats. I mean -- and they said that we wouldn't be restricted. Now we're getting restrictions from -- from Point Thomson. Our land, our sea." George Kaleak, Senior (USACE 2010)
- “Yeah, we can't go near the pipeline. You can't shoot near the pipeline. That's restrictive to the hunters. They always warn us not to shoot toward the pipeline or cross under the pipeline. So if the caribou are on the other side, they don't want us to go near it. You have to get permission from Conoco Phillips to go there.” (SRB&A Nuiqsut Interview May 2010) (SRB&A 2010b)
- "There's -- like I said, there is no laid law in these sales, of who is to follow-up on the little guy, the hunter. That's what it always comes down to, the hunter and fisherman. They put all their effort

and time into catching these caribou and fish and duck and geese, and when there is no success because of impacts of oil and gas, there is still no mitigation measure for them. " (BLM 2004b)

- "Using the vouchers isn't enough. If you're gonna divert our caribou, that 10 gallons of gas ain't gonna get us there. We're gonna go further out, got to spend more money on gas. Mitigation hasn't done nothing, since they're gonna divert our caribou further south. That's from the oil company mitigation, from the city [City of Nuiqsut]. Some of these mitigations are being misused. Given to non-hunters around here. They want to gas up their vehicle, not go out there [hunting]. Go to City and write where you're going and what game you're going for. Some of the non-hunters mistreat it. Last year they shut it down cause there was misuse." (SRB&A 2010b)

Many Kaktovik residents have expressed a sense of powerlessness over their future as a result of outside interests influencing major decisions about their traditional lands:

- "It is a difficult question to answer because we don't want this place developed so much that it affects our community. But everything on the land has already affected our community. But it came. We were invaded in our own land by the military and they took over our land in a way that we could not do anything about it. We didn't even know we were a part of the USA. We were a village to ourselves, a community to ourselves. It is still changing and we still don't have any control over it. If it is for the community, how is it going to help us? It is here. We have the schools, we have warm houses, we have the school. It has affected us, it's good but it is bad. We have no say over the process they have imposed on our land. Our postage. The way we pay for things, groceries. We have no control over gas, postage, it is affecting the whole state of Alaska but it affects us more in the village. How can we change it when we don't have any control? We can have control with our own corporation, but we have to pay for it. You live in a city, you have a road, you have less postage and cheaper food or you can grow it. You can grow your own vegetables. Most of the food we have is from the animals but we have to pay for the run of the place. The gas, you have to have gas to go hunting. The stuff from the grocery store. We have to pay to have a warm place with no way to pay for it. It is hard for people to get jobs up here. It really is difficult; we get things at a big cost. It costs a lot for us to get what we want. If there was some way, you know they always have, what do they call those things... I can't remember. You know when they should allow for us to live in the village; we should receive some type of compensation from them. There are babies being born, they stay here but a lot of people have to go to the city if they want to make it because they don't have to pay that much." (SRB&A 2012a)

Comments by Gwich'in Cultural Experts express a sense of marginalization by continued efforts to force development on the Coastal Plain which they understand stems from a confluence of the colonial culture's short-sightedness, greed, and institutional racism:

- "Let me tell you again, that caribou herd is part of our existence, part of everyday life. That herd is not just our main source of food. We also do caribou dance, sing caribou song, wear the hide, use bone for tools, tell stories about it in Gwich'in language, based on our caribou existence. English is our second language. We are one tribe that is keeping our language. Users of the Porcupine caribou herd cover a vast land. It includes the whole Gwich'in tribe, extending to our neighbor Canadian Gwich'in and the Yukon Flats villages of Alaska. We are as a people, originally from this country, still dependent on caribou for food and other uses. Besides hunting caribou for our own food needs, we also barter, trade back and forth, and share among each other. That is how we get

our supply of salmon fish, which we don't have in Arctic Village, but they do in Fort Yukon. Tribal sharing is a traditional value that we practice even today of what our ancestors did to survive. I don't see any other alternative values that we would exchange for the traditional values of sharing that we practice today and must in the future for our culture to survive. It will be a threat to our tribe if caribou get displaced off the migration route or decrease in numbers due to oil and gas exploration and development. Regardless of what anybody says or does, we haven't changed our position. There is enough said on environmental protection. The vital issue of preserving the land and habitat is very important to our tribe. As a nation we are already concerned about our natural land. Being Indian, our major concern is land protection. That's our priority. So we support environmental protection. My people have always respected and cared for the environment, and in return it has taken care of us. This is the natural way, our way." –Sarah James, 1987, as recorded in Draft SEIS Comments, November 7, 2023

- "Our people and our Gwich'in culture have lived in this region for thousands of years. Before that our first ancestors were living here for who knows how many more thousands of years. For all those hundreds and hundreds of generations we have been nomadic hunters, and we continue to be hunters to this day. Ours is a rich land and our people lived well most of the time. Our people rise and fall with the caribou. I was told of times when the smoke of the fires rose like the quills on a porcupine, there were so many camps in the hills. Later disease killed many of our people, around 1920 I think, and the caribou died off at about that time as well. This is the belief and the history of our people; that our future and the future of the porcupine caribou are the same. Now the caribou and our people are both coming back again. … Please understand, we are a modern hunting culture-one of only a few left in the modern world. Our people are caribou people. Caribou provides not only food and materials for our people, but also our spiritual life. For many, the traditional life is the only alternative to alcohol and the streets. Without caribou, who are we? What do we have to offer our children? … The issue is not just the caribou either. All the land and animals here are important and respected by our people. It is our back yard and be feel about it just like you do about yours. More so, because we cannot move to another place to live our lives. They are all connected with this land right here; where our parents and grandparents and their grandparents have all lived and are buried. … Where you see a faraway reserve, we see our back yard." –Kay Wallis, 1988, as recorded in Draft SEIS Comments, November 7, 2023
- "It is emotional, it is, because you know, that's the way we live, you know, that's what they trying to destroy: our culture, our way of life. You know, that's what we have. That's what we want to continue. You know, even with our kids, you know, I speak to my kids in Gwich'in, and they listen, you know. That's what it's all about..." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, … my son had an awareness pretty young about this issue, especially because he was, how old, seven? When the Tax Act was passed, and so my involvement really picked up at that time, traveling and stuff. And I remember, you know, I don't know if he was listening to me talk, or he was watching something on TV, but he asked me, "Why does President Trump want to open the Refuge and hurt the caribou?" And it's like, so hard to even, like, put into words to explain that to a seven year old or whatever age. Because for him, that represents our family, that represents our way of life. And it's like, he couldn't even understand why somebody would want to threaten that, and for what? And so I'm trying to explain to him, you know, there's money involved. And it just like, he's like, "So what?" it doesn't matter, what matters is, you know, the caribou and stuff." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- And I was on tribal council, and so one day over the radio or TV, whatever, how the news got to me that they're, they're going, they're gonna develop gas and oil up there, and I got really angry that first time I heard, and, and I did like that, I do get angry. And so I don't know what to do, who to talk to so of course I went to Gideon, and Gideon said there's nothing we can do about it because nobody knows us. There's not enough of us, not Arctic Village, not Venetie and Arctic Village, or the whole Gwich'in in Alaska, or a whole Gwich'in in Canada, and here. We don't have that power because it's oil. Oil is everywhere. Oil, everything in here is made by oil. And it's huge. Unless we're gonna make friends, then we might win. And that's only to - and then I was so angry I said 'Well, I will! I'm gonna do something about it,' I told him, and I just walk out, I was still angry. I just walked out. And then, then we had our next Porcupine Caribou Management Board meeting, I told them, 'Hey, it's something that we have to do here.' And they agreed to come to each village and ask elders what they gonna do." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So, every which way you look at it: humans. Actions are having an effect on all game, all life. Look at right now. We just had a big fisheries meeting that was down in Anchorage. They did not go with the Natives of Alaska. They requested for 24 hours at one time for all of them that fish so they can have their food, but nope. They said no, no, no, no. You know, commercial fishers pay us more money. So, we're gonna let them do it, whatever. Kind of frustrating. In a way, I think they keep going after our food resources, you know, for Natives on the Yukon, our food on the north. That's how you deprive people. But like I say, we're unique, more than any other people in the world for what we have and what we're standing up for. And I can only say it, I will be here till the end. We're never going to win, we'll only going to continue fighting, unless the people that make those decisions come up and live the life we live and they can see it and experience it. That's the only way they're gonna get their minds changed." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "This issue is huge. And it's very important. We're standing for the whole United States human rights. So, they never dealt with human rights before Unite - uh, Congress. They always tell you that: "Oh we take care of our Indians in America, we provide for them food stamp, everything! So, we don't have human rights in United States". But this time, we're, we're, they gonna have to deal with it, because only the Congress will make it permanent protection. So, this issue is huge." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I just protect the Refuge generally, because it is a public interest land. That's what they made it right now. I just want to reiterate on how important these meetings are. And, and that we were part of the Coastal Plain. And colonization is one that keep us from using that today. But it's still important because our caribou go up there, and our caribou come back to our country. And they left that out. And they left out Native culture preservation, and there's a law for, it's NEPA they call it, and that has to be part of it this time around." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, like I said they need to stop all these experiments, burning fossil fuel. You are not fixing nothing by research. You need to start doing things. We already got all the information. Everything we need to know, we already have. It's just that some people don't listen. In the western systems they do not teach you to listen. They deal more with words and not the subject." –Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023
- "When I was on break from college, I went home and interned for the Tribe, just about every summer. I travelled a lot on behalf of the issue, and have just sort of seen, I think the toll that it's

taken over time. […] one thing that's remained consistent is the Arctic Refuge. That's been a consistent priority for us. And it takes up a lot of time and energy, like away from our Tribal leaders and the job that they have to do locally. I've seen our Chiefs have to travel to all sorts of meetings over the years and to advocate on the issue. And it's also brought a lot of attention to our community in the form of like, you know, videographers and people really wanting to like, highlight the Gwich'in experience with the Refuge. And so I've seen over time our community have, like, people visiting, wanting to interview us. I think there's a lot of sort of fatigue that comes with that, because it seems like everybody wants a piece of our story. But they don't understand the context and the full way of life. And so they come they get their interviews, they leave they, you know, do a film or whatever, and they get kind of that attention and notoriety. And our people are sort of left with, okay, well, how did that really benefit us, it might have shared some of our message. But I don't know, just after how many decades of that, it wears you down." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "That's another big thing. They studied - they study us, they studied people everywhere else like, up in coastal area. They even got university up there, even got a lab up there. But, the Interior, they consider, like, in our area Venetie and Arctic Village is empty. It's empty because there's no population and there's no money, so they don't study us. But up that way they study, they're ahead of us on climate change. And they - Canada is ahead of us on climate change because they don't, they don't put money into our area." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...we Indigenous people, not only in Alaska, but throughout our world here, seems like all the Indigenous people are under attack. You have the Indigenous people, the rainforests that are getting pushed out of there because they want to knock down the big trees. And these people haven't even seen [other] human beings before. So, yeah, and it is, it's going on the Yukon River right now. Their main diet is the salmon and their fighting for that, and here we are, we're fighting for our caribou." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Gwich'in Cultural Experts singled-out potential oil development on the Coastal Plain as the major threat to cultural continuation, and often touch on the toll that constantly fighting this development has had on mental health and family life:

- "We're constantly, constantly having to worry, and fight, and stress, show up to meetings, we have to leave our kids behind at home, they have - you know, most of the people here have kids at home that they have to leave and come to these things like this, or things in Washington DC, we have to leave them behind. And we just pray that whoever's taking care of them is doing, you know, good. But we know we have that responsibility to show up. And it's, it's our kids have to deal with our absence. And then we're just hoping and praying that they're, they get the importance of it. Most of them do they do. They understand or they grow to understand, and then they grow to, like, get into these roles. But they still have to deal with our absence. And we just pray that we, we're doing right by them, you know? And we're doing it for them too." –Tonya Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Sometimes I think about what would our experience be like if we didn't have to fight this battle, you know? Like, think about all of the energy and the resources and the time that we could have gotten back from all those years, and how much further we might have been in our own self determination if we didn't have to react all the time to the Arctic Refuge, like if we had, you know,

that extra resource and time to invest in ourselves as a Tribal Nation. It would be interesting to see where we might have been." Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "I was like 10 years old when they had the first Gathering in 1988, and it really did have a profound effect on me. As a teenager, I was, I don't know, it was like I was drawn towards Tribal politics. When I - so through high school and stuff, I started getting interested in Tribal stuff and about my Tribe, and so I started writing papers towards, about the Refuge in our culture. And a lot of my college papers were on that subject and how the Gwich'ins are - like it fascinated me how our small Tribe fought against the oil industry, millions of dollars that they had, and no matter what, because our elders always do it with a good heart, do good things and teach the world about our culture and, our, why we want to keep it closed. And, and I think that it worked, that it is working because this is where we are we, the President, you know, stopped it the same day he got into office, which was amazing. And, so that's how I got it really did affect me and like how I was just really proud of our people that we did that, and how it's really related to our culture, and how strong are our people are. And how they still - they're still strong." –Margorie Gemmill, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Well, there - those that goes out had to leave their own families, you know, because we know we had to work and take care of our little ones and stuff. And a lot of time they have to sacrifice, you know, leave all that behind and go, and speak on behalf of our people. I remember when I was in Washington, my daughter got sick. I can't be there. You know, and a lot of times... So, there's sacrifice that they do." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think or, well I wish we don't have to keep fighting for our lands to be safe and, um, just like, I think Sarah said yesterday that we're the only ones that have still have clean water. And we have to keep fighting for that, no drilling in our land because caribou is our main source of food." –Raeann Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think we learned that from our elders too, like, think about Trimble and you know, Also, and Gideon, and Sarah, and, I mean, all of them. Like, how many different times we've asked them to come to the table to help us with Arctic Refuge, right? And, and they've seen so many setbacks, I'm sure they're so tired of the issue, but they show up every single time. And I think about that, that's what's expected. And that's what we do. And it's frustrating sometimes I think, during the scoping process and stuff you saw our people give testimony and they were frustrated, like, "Seriously, this again?!" Like, when is it going to be done? And we get frustrated. And I think that the federal government, you know, it changes, different people come in and out, but for us, it's always the same, our position remains the same. So, they may come and go and we feel like we're having to re-educate them all the time. And it doesn't matter sometimes whether it's a Democrat or Republican, the threat is always looming." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "And I can remember too, like Tonya and I, when we went to DC one time, there was some kind of a bill that was going forward. I don't even remember what it was, but it was threatening to Refuge, and I remember her and I spent a full week going to all the different congressional visits. And we were just terrified. [...] we just went to office after office talking about the importance of caribou. And several of those congressional people said, "We'll vote with you," like "we support you." And then I remember we were actually in the, um, I don't know, 'congressional hall' when they were voting, and you can see them vote, with how they vote, it was a little card that they used,

it was green, or red. And I remember, there's at least one person that had said that they were going to vote with us, and when they put the card in, we could tell it was like a red light, that they didn't. And I remember her and I were just devastated. And we lost that vote. And afterwards, we were just like so bummed out, like we had just spent so much of our energy that week trying to convince people to vote, you know, in protection of the Arctic Refuge and to see people just sort of listen to that and not take it to heart, that was hard. That was really hard. So, we've been in it long enough to where we've had wins and we've had setbacks. And we just know, until we get permanent protection, we just got to keep moving." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "I was eight years old, at the first Gathering. And similar to Raeann, I was raised mostly here in Fairbanks. But I spent all my summers back home and Arctic. And so I was there during the Gathering. And I was only eight. But I remember a lot of the elders, and just how they were so happy to see each other after so many years of being apart. And I remember being in the tribal hall and just all of these families from the Yukon coming there. And I remember like the old, old elders like, you know, the the generations that really were raised on the land and predominantly spoke Gwich'in, how they would just visit and talk with each other. And I remember just sitting there and kind of listening to all these speeches in Gwich'in and I didn't understand the language. But I knew it was an important issue back then. And it was like the very first time I think I fully saw, like tribal sovereignty and action. And specifically from a very Gwich'in sort of perspective of, you know, how everybody got a chance to speak to the issue equally, and everybody's voices were important. And I remember some of the elders that spoke, and how like, much respect everybody had for them, because they prayed a lot in our language. And I remember the meetings are very long. So, even back then I knew it was super important." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I first heard about it when I was in elementary. I remember like elders, my grandpa Trimble, Florence, a lot of elders from different villages like Beaver, Stevens, and I remember they would come every year for school, beginning of the school year. It was some type of workshop that they did. And they would tell us stories, tell us what's been going on. And yeah, they would always have some type of projects for us. Like, I remember, my grandpa's showing us a bow and arrow he made, and like the arrowhead and how he made it. Just listening to the elders at a very young age, that's - but then I didn't really understand it. I mostly listen to the stories, being I was like, when I first hadn't heard about ANWR, all of that. Yeah, and like what Raeann said, it wasn't really interesting. Interesting topic for you know, little kids. But it was good to know, and then. And then, yeah, when I really wanted to, like, get involved was when I saw like Lisa Murkowski and another representative go into Arctic. And I heard my uncle Dan, talking about his youngest daughter, Jenny, when she sees caribou, she thinks it's yum, yum. It's candy, yeah it's candy. And yeah, when he said that, to like, Lisa and other government officials, when he said that all them like, and I got thinking like, what if that got taken away from us? That's when I really wanted to somehow be involved." –Angel Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "The way we live off country, if somebody come in, try to disturb our animal, our food, our water, the air... I don't think we'll be happy, we'll be worried because we've got too many little ones behind us that we have to look after. We have to be prepared for them, everything for their future. That's why we're telling them everything so they could grow up. You know, caribou do the same, thing all the animals. We even can't cut trees down when we're little, because they said the animals live

on it. A lot of animals are eating off of that tree." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "You know that, that gathering that she talked about? I don't know what year it was, but uh, I have a video, in tape. I watch it, me and my kids and my grandkids, we watch it sometimes. And, you know, like she said, we lost a lot of elders. We did. We lost a lot of elders that talked about the calf grounds. They got a high voice, and they recorded them. Lot of elders from Fort McPherson, from Old Crow, and Fort Yukon, and here. And all the elders, they went up there how many times? They come over with charter and they have a big meeting. And they, they all had a strong voice that they learn from the people before them. It just goes on and on and on and on." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "That's the baddest place, because some - one time, you know. I remember what Jonathan Solomon said: if they're in our shoes, they're gonna starve, he said. If we're in their shoes, we'll be on the street. Because we don't know each other terminology. We don't - they don't know how we survive up here, we don't know how the[y] survive out there. No freedom out there. No freedom on their side, but there's freedom on our side. That's reason we survive. We try to keep it safe for future generations. Because these things are very important, whatever we're doing. We've been talking about it, this thing, since like, 78? Way before that, like 68, 69, I remember all we talk about all the things, what we're doing. That's reason I was just listening. Pretty soon my computer will be out, you know?" –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I don't think it [having to fight oil constantly] force us out, it just gives us more strength to know that, you know, we have to fight this we can't back out." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "We were talking about it, both village, over and over, over and over. So, we finally decided that we should have a gathering. That way, lots of input, you know? There's a lot of strength from others who use a caribou. Not only caribou, you know, I was talking about ground squirrel, and all that little, like ptarmigan. Pretty soon the ptarmigan might get sick, and us, how about if we eat a bad ptarmigan? It's scary for our life. We don't want to lose nobody. See, those kind of protection we were talking about way back." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I remember what Myra said too: "When you fight for the caribou, the fight will never end." "How come grandma?" "Because those people that work for it, they gonna get retired and another new people will get their place and they don't know what they're doing so they're gonna come up and say: 'we need this we need this' then us, we're going to gather and we're going to try and get the answer." That's where we are right now. Sometime, sometime I think that all these fight that we're doing for every, every step we've made. What's going on in this society is, it changed by us, who else? We're the one that making everything bad and everything good too. But our government wants us to be safe that reason they say that but what they doing is not right too, for Indigenous people. We need our resource. We live by our resources. If we got no resource, what will happen? Big question mark. That's the reason, we're sitting here to prevent it. I'm happy for this little meeting we're having, and gather information to try and get them the answer what they need, you know." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, I was angry, and I didn't know what to do, I was boiling hot. Well, anyway, first thing I went to my, my brother Gideon, and I told him, they're gonna do it. You know, what we're gonna do about it? And he said, there's nothing we can do about it because oil is huge. It rules our world, everything around you made out of oil. And nobody knows us. Nobody know where Arctic Village

is at, we can't do it. Venetie, Arctic Village, Venetie can't do it. The whole Gwich'in in U.S. can't do it. Even in Canada, and they can't do it because it's huge. I don't know how we can fight it. You know, unless we make friends, he said. They got to know us first. So, maybe we can't do it or anything right now. I said that, I said "We will!" And I just kind of boil out of it. And then I just calm myself down. And I said, I'll just leave it to them. And we were doing that fishing - I mean, Porcupine Caribou, manage board, we were working on that. I was on there. And when we had the meeting, I brought it up. We have a little bit money. I said, can we just do something about it? Let's ask the elders, they said, so I had to do something else so I didn't get on that trip with that, uh, Porcupine Caribou Management Board. They went to each village and they asked the elders. And then when they came back they said, we have to come together. Elders said that because, Myra Kaye., we have to do it. Because that's how they make decision during the bow and arrow days. That's the only way we going to make decision." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "I tried fish in Fairbanks area, but I cannot eat those fish because they're contaminated from Chena River. Those fish that the hatchery pour into the lake is not very good food for human being, the more science, the more protection on those area, you know, it's just like blown out of the air, when I present that inside of the Fish and Wildlife, they're having a meeting there, you know. So, the contamination is coming towards the north, and we're trying to hold it back. And now it's trying to get into the birthplace of the animal, all species animal, etc, etc. It's just like the Gwich'in people: animal grow, grow, grow, grow. But the southern - the south side is affecting us. By not - they don't care about decontaminating that water. Contamination is very bad for caribou and also the fish. They don't - I, uh, the white people are not writing the laws the way the Indigenous protection, the state of Alaska. So, that's why we need more elders to speak on the behalf of the Mother Earth and also all the species and waterfowl. Because I need the white man's telling me that we're going to need to protect those area. Thousands of thousands people, lawyers, judge, representatives, are facing that Arctic National Wildlife 1002 land. They need to have a heart, the white people. Because they're disturbing us, disturbing the migration because of just a little 10-oh, million acres of land up there. The last of the frontier. I don't know how to speak to guys that knows it all, but they don't know enough on the nutrition and the migration and where the routes are at, you know, so... So once we done this all this talk, and have a direction for the oil people and also the government, I don't want to fight any more!" –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Springtime, when we know the birds are coming we all are happy, big smile on us. It's very important for that life, what they call long time ago, the way we used to live. We didn't want to lose that, white people, we don't want to lose that at all. The oil development people: we don't want to lose these values that our ancestors brought us here, we don't want to lose that. For the words for the generation, let's continue what you're doing, read these documents what your forefathers presented today, carry it on. The dollar could be later but we need to protect those areas that we have." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I don't remember much about the Gathering in 1988 because that was the year I was born. I tell people that, as a joke, you know, but also being serious. I was born in 1988, April, and Gathering was in June, June or July, I remember I was a couple, a few months old. So, so to answer your question I, I don't really remember hearing about up north until like, George Bush, Jr. went into office. That's when I really started caring about drilling where our caribou, migr - calve. So, that being said, I was not terrified, but you know, it's like, who's this guy? You know, like, he's the

president of the United States and he wants to open ANWR, where our caribou calve. So, that's probably where I really started thinking about this. You know, I just liked the whole idea right away. And also too, another little thing, I remember hearing about meetings, you know, remember mom and dad, mom had to go to the meeting, we had to stay home and, I'd say, "What's a 'meeting'?" And my first thought was, I thought everybody went to the hall to cut meat. You know, 'meat'! I thought everybody went there to cut meat. That's what I thought! And then later on, I find out, you know, it's a 'meeting', everybody talks and all that. So, that's my first memory of hearing about a meeting. So, yeah, I think about George Bush when he first got elected, that's where I started hearing about he wanted to drill. And yeah, I didn't like that at all. I didn't like that about George Bush. So, that's, that's probably about it. I first started hearing about ANWR, drilling, and one person that's in office that really wanted to. And, you know, when you grow up, you have your little buddies, you know, there's rumors that go around, and I was terrified too, and my friends were telling me hey, you know, George Bush wants to open ANWR, the village is gonna be like a city. You know, there's gonna be roads, there's gonna be, you know, I got scared to tell you the truth. You know, as you get older, you realize, you know, that wasn't so true, but you know, it CAN happen." –Galen Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.17 Transportation

Iñupiaq residents from Kaktovik have expressed frustration with the lack of affordable transportation to and from their community, and the need for greater access both to subsistence use areas and to the road system.

- "I don't know why they can't help us out if they are using our lands over here. It is so hard to get a mattress, a stove, a fridge. It is very difficult for us to get anything out here. If they gave us a road that would be good." (SRB&A 2012a)
- "One of the things that really affect the community is airfare and the post office. It takes a week for me to get something from Barrow to here. It has to go to Anchorage and then come here. The route that they have for the postal service is ridiculous. I am not sure why that is but it is messing with our economics. It takes twice the amount. You have to pay twice the amount to have it shipped here. One loaf of bread is ten bucks in our store. Geez!" (SRB&A 2012a)
- "Yeah, it is a big problem here. A lot of people are making money on account of us, Frontier, Northern Air Cargo. They are getting a lot of money and there aren't many jobs here." (SRB&A 2012a)
- "It took an act of congress to develop ANWR and a couple of those rivers are scenic and we cannot build bridges over those rivers. We were not consulted." (SRB&A 2012a)

Most of the Gwich'in comments on transportation refer to travel routes and methods, including those used to get to and from the Coastal Plain. Rationale for travel to these areas includes subsistence, trade, exploration, and to seasonal residences there and on the coast itself:

- "One time they said there's a caribou went across but they got stuck. So, caribou avoid that place because they could - and the whole place erode too, right now. I mean the white sand is still there but we keep their summer trail from Arctic Village to Ts'iivii T'it ["up against spruce", stream/lake NE of Arctic Village] and we never did that for a long time, so all that climate change, water that whole summer trail between Arctic Village and Han Geeraataii, it's all washed away. So, we can't do - it's all muddy now. So, her place Han Geeraataii, that's where we meet the river, so that's how

- that's why they call it a trail by the river. That goes to Ts'iivii T'it. So, that's the only place we can catch up on our summer trail and walk the summer trail to Ts'iivii T'it now, not through." – Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Yes [the Hulahula was on the Gwich'in travel route to the ocean]. So, you look at these three rivers. That's part of the migration river there at least down to the, it's just like the caribou border where they walk. Okay, half of you guys go this way, half of you, the other half go that way. So, they communicate with one another, caribou. You know that horn and the sound of the animal, it means a lot for the herd." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So, when I traveled from fish camp, I had to have that dry fish. I have to have it. I had to have the ri - little rice with it too, something that will last a little bit longer in the nutrition -wise. And so yeah, that's why they have pouch. Baby crying? Put that little piece of meat in there and they'd be quiet after that. The only - breastfeeding was very important. So, the woman have to eat good, because they're taking care of the baby. Sometimes there's two, and the other one was just nine month older, some of them. So, shih tłoo ["soup"] that's the main thing, that grease bone, they boil bone, the even carrying bone, they know it's going to, just put it in water and just make everybody get a cup. The young guy he wait last because he's a scout guy, he travel you know, so. So, you have 150 people going up to ANWR. They all have a job, every one of them are identified. You are the woodman, you are the coffee maker, you cook dinner. But if we have flour, you know the ladies mix the flour up. So, one have somehow, experts make fire, he's the expert. Everybody had their different knowledge to be a Tribe. So, when Alexander came from over on other side of the world, a Canadian, he sketched these people. How they survive, you know. They were clean. The Gwich'in people. They had their own clothing. Chief had his own clothing. Yeah. Wintertime they take off these stuff. They put fur back on, the fur made by animals. Just the chief, he looks good those days. Yeah, he's the chief. You know, he's dressed up good with porcupine quills and zhoh vadhaa ["wolf skin"], wolf skin you know, and you know he's, he the hunter, the hunter, he's dressed good too, he dress like a hunter. He goes out every day, 200 mile even that! By the time the sun comes back he's already back home. He said he see a lot of caribou that way. So, they all go, they follow in all those areas! They go to Coastal Plain, they fish out of the ocean. They see a whale, but they don't bother because the [Inupiat], they communicate with the [Inupiat]people. Yeah and you know the history was always there. I hear the old story from my grandmother, she carry that 100 year, those stories." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I heard they carry, like a canoe too, men when they go out hunting they carry it, then when they come to that lake they paddle across. Then when they get on the land they carry it again. That's how they traveled." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "You know, those days before us, that was way before us. People travel all over the - all over that way. And they don't, they don't waste no food. They even save all the caribou foot. They tie it together and they put it up on the tree. They do that so if somebody didn't have food for his family, they gonna go look for especially around the old cache. They look on the tree and they get those foot. They bring it to the camp and they boil it, and we eat those foot. They give us one foot, for me and my brother. We eat little piece out of it, and we drink the juice, and we share that one with our dogs. I talk about it the other day. Because we need those dogs, they, they haul our stuff everywhere." –Florence Newman, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- “Just like that trail we talk way up there to the coast: all of them, they went up that way. Yeah, this way, that way, this way, they're all going to meet, that one place. Those days they don't go in the community, five mile out they stop. Then, if they're welcome, they're gonna ask them to come.” – Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “So, Aaha' K'eegwaadhat, Creators, haagiindaii [“Yeah, God, Creators, they know all about it”]. They know, a lot of times the only thing they had was fire to pray to, you know, those Gwich'in people, Indian people. You know, a lot of our story, or, story combined with Canadian Indians too, you know. And Lower 48. It's just like a line of education, a trail of the education, you know, that's how it was. The Gwich'in country is all trail, foot trail. Everywhere, it's grown over but if you walk from Fort Yukon to Venetie, you're gonna see: oh, there's a trail here but there's a tree growing on it. You know, they had trail from fish camp all the way to Tsuk K'ǫǫ all the way up to Christian Village. They got the summer trail, winter trail, Shoo [“Happy”, old village between Venetie and Fort Yukon], all over. This is all trail. They investigate: what's going on Yukon? That's why they send them out. The young guys, the young guys, they send them out, they're faster.” –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “So there's a trail, there's the flat country, and there's the mountain, they walk, there's a trail that they walk all the way on top of the mountain from the coast, all the way, there's an old traditional trail there too. A lot of people they don't know that, only Indian, just by word to word, you know. That love went long ways, the love of the people.” –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “[Travel for trade] Depends on season too, sometimes spring time was a lot easier to travel, or just before freeze time, it's easy to travel. But if it was summertime then they go through Spring Creek. The other time they go through when things are a little frozen.” –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “That [Kongakut] goes into Sheenjik, ties into, it ties into, just about Hulahula, you know? It all ties in. So, those times- those days you know our people was just like: “Let's go discover, let's go discover” you know yeah, “Let's go see what's this river and this river.” –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “Chųų Choh Vęę' Tąįį [“shore of big water trail”] all of this Chųų Choh Vęę' Tąįį they call that, where the water - big water - lead. that's what they call Chu- water, Chųų choh vęę, gogwahnyaa.” –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- “They respect lot of water, they call it Chųų Choh [Arctic Ocean], that means big water. And they respect water, when they see it they pray, wherever they come to the ocean. Another thing they pray is that, like Nitsii Ddhaa, it's the highest point in our area. And that's why it's respected. Because we could see a lot of land, and they respect that, and when they come to Brooks Range, they pray there too, because that's the highest point. And also it's, you know, it's they pray and then they give a gift to the land. They leave something there. It doesn't have to be anything valuable, it's just giving gift to the lands when they climb that Brooks Range. And when they see the ocean too, they give gift because of the water. And that's what they do before colonize, before we start living in village, they use all that area, this. Yesterday we have all kinds of trails of Gwich'in names in the Coastal Plain. So, that mean that we were using it at that time, but we don't hunt caribou during their calving time, and we hunt caribou there too. And we also have a place where they settle, I mean live before, up that way at one time. But after they put us into village life, we don't go up there anymore. So, now, we know where border is at, where our border is at. That gift is not to get

into [Inupiat]country, it's just a gift to the Earth because we climb the highest point and see the water." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Place Name: Gwatàaraatąįį Njik - "trail goes over the top stream".

  Source: Hadleigh-West, Frederick. 1963. The Netsi Kutchin: An essay in human ecology. PhD dissertation. Louisiana State University.

  Gilbert, Trimble. Visiting Elders Professors Program. 2018 fall semester, University of Alaska, Fairbanks. Interviewed by Joe Matesi."

  Gwataaraataii was an important route [trail] for Gwich'in people traveling to the North Slope and the Arctic Coast for war or trade with their Inuit neighbors, and later to trade with whaling ships." –ELOKA, Gilbert, et al., 2017, as recorded in Draft SEIS Comments, November 7, 2023
- "Spring Creek, Kiihaiilaii Jik - There's a passage [north through the Brooks Range]. It's a good place to go thru and it's a shorter route. Open area, not much trees. A lot of climbing but it's very good for walking. Along the East Chandalar, it's a long way but they go by boat or canoe. From there, they go over. It's a good route too but it's long. Up that way, there's lots of water – lots of lakes, lots of tussocks. After they go over the mountain, the ground is very good. But from Junjik, Kiihaiinlaii is shorter and open area. It's really good way to walk. It's better than the other way but it's good coming back down. They make boats and its faster coming back down. [...] Our people used to go over the Brooks Range. In our language, it's called Gwashrał. Our people go over the Brooks Range to the [Inupiat] people. They bring gifts for the [Inupiat] and bring prayer [...]" – Sarah James, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- "[Question: When you people go up towards the coast, which way did they go? Along the river or thru the mountains?] The Hoola River. My father [Isaac Tritt], and Grandfather Albert [Tritt] went up there. My dad talk about it when he was young. When they arrive up there, he said he admired the [Inupiat]. They live a tough life but still they are very happy. There's lots of animals up that way – caribou, sheep, fish, seal, whale…everything. The [Inupiat]use to come down this way too. My grandma talk about it. She said she was young. They would get together, have potlatch…dance. But they never married each other. One time, they got together at Old John Lake. They get along with each other. Our people even spoke [Inupiat]. […] They always took same route. […]"–Calvin Tritt, 2018, as recorded in Draft SEIS Comments, November 7, 2023
- Arctic Village resident: "…the caribou has to go up to the coast to have their calves ... That is why we do not like to have too many snow-go trails all over the place. This would screw up the mouse trail and if you kill off the mouse you also affect foxes, wolves, hawks, eagle, owls and others who uses mouse for food. Also, when the snow-go trail hardens, the wolves can use it to run down the caribou. In this way, the wolves can clean out the caribou. So all the care we take up here is connected. We don't do anything for nothing. Everything we do has a purpose." –Gustafson, 2004, as recorded in Draft SEIS Comments, November 7, 2023

D.1.18 Economy

- Related to the economy, Iñupiaq residents often discuss the negative economic impacts of a loss of subsistence opportunities, as reduced subsistence harvests require residents to purchase store-bought foods to supplement their diet, and reduced resource availability requires residents to spend more time and money on subsistence activities. At the same time, increased revenue and income can help supplement residents' subsistence lifestyles, as residents can put their income toward subsistence equipment and activities. Due to the high cost of living (e.g., high heating, fuel, and

grocery costs) on the North Slope, mitigation to address these impacts, such as the fuel vouchers offered in Nuiqsut, only go so far. In addition, jobs and revenue often bring uneven benefits to a community, with some residents have advantages over than others. The following quotes provide observations on the economic impacts of development on Iñupiaq residents: "The high cost of energy is one of those things that is important. Housing is one of those things. The transportation network, many other communities suffer from their high transportation costs, and in some cases are suffering from the lack of transportation, because the inability of some services to be made to our communities through airlines." (BLM 2019)

- "We recognize the importance of oil and gas development for the national need for energy, it's not that we oppose this, it's that we want development to be done in a way that's not costing to us. We have increased our distance of travel to try to attempt a harvest as well as the number of trips that we make to try to harvest. These are costs that come up on our families. Our families have to try to go without other things because we're trying to continue our traditional lifestyle." (BLM 2004c)
- "And on this other part, compensation. Compensation, that would be money, right? I can in no way, see how money can replace the wild animals. Because, we were compensated at one time, when they put in the Wells dam. We were all given three thousand dollars ($3,000) a piece. And a lot of that money was put away for the children. When they became of age, they got that money and what did they do with it? A lot of them bought cars and wrecked it that night or got drunk with the money or spent it on clothes or went and had a few steaks and that was it. The money was gone and there was no more salmon to rely on." Marilyn Agiak (MMS 1979a)
- "And things that will help to reduce these are looking at the pipeline routes, making sure that the pipeline is high enough that the caribou are able to migrate, that we're able to follow the migration and hunt without having to travel to an area that's designed to allow us to hunt through them. The cost of our travels come out of our pockets, it takes away from other things that our families need. And it's really important that the cost of trying to live our lifestyle is not taken from our families." (BLM 2004c)
- “You know, gas is so expensive around here and you have to wait for vouchers to come up. The gas is so expensive and the oil for heat is so expensive.” (SRB&A 2016)
- “Last year they were short, maybe only two days, we don’t catch no moose, we try to catch caribous…. Yeah, last year I didn’t go to work, so I didn’t have much money to buy gas, so I was following my cousins.” (SRB&A 2016)
- “I tend to stay away from that [overland hunting] now, ‘cause it seems like a lot of people have four-wheelers and they’re scaring them [caribou] away. And it makes me a little mad, because when summer hits, it’s four-wheeler, four-wheeler, four-wheeler. And I mean, they keep saying they’re just over the bluff, but if they just wait they’ll come, so they don’t come close [because of all the four-wheeler traffic]. There are people with steady income [and so they can afford to get out there], but they could just wait so those who don’t have that ability can get them.” (SRB&A 2016)
- “In addition, last year caribou and fish were scarce; therefore we didn’t have as much traditional sustenance as we were used to. As a result the community was unhealthy and we had fewer jobs. We had to buy products from the stores in order to eat. Last year was very hard for us all.” (MBC AES 2004)
- “Well, the impact funds started helping us with the fuel, we’re getting fuel vouchers. I’m not sure, Conoco I think. Only help we got out of them. More vouchers will certainly help these outrageous gas prices.” (SRB&A 2010b)

- "Impact mitigation funds from Pioneer and Conoco Phillips. That helps because if the helicopters scare our caribou further from here, like to Fish Creek, then that helps to go out there. We can get fuel vouchers from that impact fund, and once or twice a year they will give out a small check to the household, but you have to be an active subsistence household, not just any household; like the elders aren't active, but they have people hunt for them." (SRB&A 2010b)
- "[The fuel vouchers] was only supposed to be the people who weren't working who could get fuel, but some got them even though they were working and had jobs. That worked out pretty well. Twenty gallon limit. Three to four times a month. You could pick it up and then the next week or the next two weeks you could pick it up. We haven't got that this year [2009]." (SRB&A 2010b)
- "They need to beef up their mitigation, because we have a, when you have a village of almost 500 and there's 104 households and they compete to get the fuel vouchers, it's not enough to cover your subsistence activities for the whole year. That's part of the Conoco mitigation measures, and the city administers that program. Like the mitigation fund they initiated is nickels and dimes." (SRB&A 2010b)
- "Now a days they do [have programs that help the community]. But there was nothing like that at the beginning. Now a days BP or Shell or Exxon bring things into the community." (SRB&A 2012a)
- "Using the vouchers isn't enough. If you're gonna divert our caribou, that 10 gallons of gas ain't gonna get us there. We're gonna go further out, got to spend more money on gas. Mitigation hasn't done nothing, since they're gonna divert our caribou further south. That's from the oil company mitigation, from the city [City of Nuiqsut]. Some of these mitigations are being misused. Given to non-hunters around here. They want to gas up their vehicle, not go out there [hunting]. Go to City and write where you're going and what game you're going for. Some of the non-hunters mistreat it. Last year they shut it down cause there was misuse." (SRB&A 2010b)
- "It really help us, the local hunters [fuel vouchers], we want to keep it going for next year. It really helps the hunters to go further to hunt when the animals are diverted away from their usual migration path." (SRB&A 2011b)

Kaktovik residents have expressed concern about the lack of economic benefits for their community while outsiders use their traditional lands:

- "They want tourists here but they let Fairbanks bring people here to hunt and camp without anyone knowing. Either the city or the corporation or Native Village should be paid a percentage." (SRB&A 2012a)
- "Well Um, I don't rightly know, there might be jobs there, but just like I say we have been locked up over there. We have to go to Prudhoe Bay to get a job some other spot but this village. All the other jobs tend to be taken and then you find out that there are no jobs. I don't think it would have that much of an impact on this part of the world anyway. It sure wouldn't lower the price of gas or diesel. If they drill one little well here we pay pennies on it, we filled up a 298 gallon tank and it was $1,100. That will last 2 months until we get to the warm weather. So you figure you have to have $5,500 a year to heat your house with a diesel stove. Or more than that to add for real cold weather. You heat up when you have real cold weather or when the wind is blowing your furnace is on all day. Just using up the diesel. Unless they find a way to get gas here or open up ANWAR we will have to wait for the Federal government to make up their mind. Obama has been president

and they say "we have done this" and next thing you know it was automatic. They have put the government on automatic. They are still squabbling." (SRB&A 2012a)

- "That's one of our social economics that we are losing. The city doesn't have a tax for things like that. We pay borough property tax, airline tickets. It is $380 just to go one way to Barrow. It's supposed to be equal opportunity for everybody. Just because they put Kaktovik on the map doesn't mean that prices have to go up. Our economics are being spent somewhere else. They charter a plane to Prudhoe Bay to Kaktovik, they get a guide from outside, all of the money goes back to Anchorage and Fairbanks." (SRB&A 2012a)
- "They give it all to the State of Alaska, they all give dividends. When I ask they just deny us. I asked if we could get a barge from Point Thomson over here with heavy stuff. They won't let people sell local arts and crafts. They always turn us down." (SRB&A 2012a)
- "Yea, they will be shooting air guns up there, that is going to be on who is doing the seismic stuff. They said there is going to be no exploration but they are still picking up data. We used to say no, and we finally got smart because they still did it anyway so now we say, okay how about jobs. And we got locals who want to help. What is worse than saying no [to industry] is saying yes because we want people to have jobs, and we want donations for the non-profits. Every summer we used to have a softball game with Arco and BP… now it is too expensive to fly from Prudhoe to Kaktovik that they don't want to spend the money. We cannot hold the plane down there because we are playing softball. They would drop them all off and pick them up later. That is when the charters used to be cheap but now with Era and Frontier it is so much more expensive." (SRB&A 2012a)
- "We have been asking for something for the kids, like a playground or more for them. We asked for a basketball court. They said it was going to come in stages, but that never happened. We would like to have our gas prices go down very low, this is where the companies are getting their fuel from. Why is it so expensive? It is so much money." (SRB&A 2012a)
- "Social and economic programs, we had industry come in and one incentive they brought in was door prizes and I really hate that. And they brought food and that made people sleepy. I don't like the door prizes and the food. Like celery and broccoli… fruit and veggies are good not sugar and pop but food-food is bad. Also door prizes, I hate them. If the door prizes were not monetary that would be ok. Useful things should be handed out like camp stoves, gloves, four wheelers pickup trucks. Monetary stuff was bad, things like 10 gallons of gas and heating oil or food vouchers at the local store are better. Healthy food and fit bars. That stuff is all good." (SRB&A 2012a)

While development can bring jobs, Iñupiaq knowledge holders emphasize that jobs do not bring enough local jobs, or local residents are only offered low paying jobs. In addition, many view full-time jobs as incompatible with Iñupiaq values and the seasonal round.

- "I wish that the subsistence reps were hired locally, because industry controls everything, and I think that it could be done better, work with the local people." (SRB&A 2011b)
- "But our people must understand that they must be able to stop illegal drugs so they can get a good position assuming that this goes forward. Like myself I had a good job working my way up to be a baseline foreman at PS2 and I was a lead foreman at PS2 we were all respondents to Alyeska until I got injured. I worked my way up to leadership and hiring my people was my priority and I have seen a lot of non-natives that were hired. I pressured ASRC to stop hiring outsiders when there are qualified people to hire in this position. I fought…. I was trained and I know what industry does. I worked for different oil companies and I know that some are prejudice to Natives. They say it is a

white-man's place in these oil fields, that was the kind of input I would get from insiders. Is that prejudice still ongoing? Are they pressuring our people because they are shareholders? Is that how they are today? So anyway… these are my experiences so this is what I have done to support my people. Right now earlier I was translating about what Marjorie said about job opportunities with equal opportunities with natives and whites." (SRB&A 2012b)

- "Our younger generations are planning to move out because there are hardly any jobs. I have five kids of my own but one already moved out looking for a job. Oil companies promise jobs, but they hire people from the Outside and don't keep the promise to hire locals. My oldest son went to Barrow for a job for three or four years." (Nuiqsut active harvester; Experience timeline: since 201 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007) (SRB&A 2009)
- "I think some people left Kaktovik to work over in Prudhoe, not many but a few." (SRB&A 2012a)
- "I think it will have an impact because this is going to make more and more jobs for our youngsters. Hopefully local people who apply and don't have qualifications will be trained, and given those qualifications. We don't have the technological training that we need for those jobs." (SRB&A 2012a)
- "It is more like we left that happiness and we were much happier going about things our own way. The population of this village has increased. Jobs were scarce back then. Jobs for pipeline were only seasonal jobs. They were very rare that our people had permanent jobs and they didn't stay very long because it was better for them to stay at the village. I worked on the pipeline and was exposed to those drugs, and people from New York, Texas, Oklahoma… those jobs should have gone to our Inupiaq people. Instead we had to join the union to go to those places. There were only a few who worked for the oil companies… today the jobs that we are seeking are sometimes union projects and if you are native and not in the union you will be turned down. Our cooperation is fighting for, our cooperation is trying to get out of hiring union contractors. At the same time our people have to be drugs free to pass and go to work." (SRB&A 2012b)
- "I think there is more, but there are some of us old-school people who don't know about all of these new technologies. How are we supposed to get jobs when we don't have the knowledge? I think it has a big impact on us old school people. When I was graduating they were just putting in the gym and computers here, they got it right after me. I wanted to go out of Kaktovik for school but they started high school here [so I stayed]." (SRB&A 2012a)
- "Increase in the impact funds that would help the community's lack of funds from the industry… we are getting minimal funds from those people who are out there producing. As far as the TAPs and that natural gas pipeline… they need to look at native hiring policy. We like to see that they are non-union projects. We want our natives to be able to go to work instead of filling out forms to become a union member. I was told that I had to join the union to work for the TAPs… when I got to the union the line was a mile long and I saw a lot of outsiders; that was during the booming days. I bypassed all of those people and went inside and got a job. The majority of our people were left out because a lot of outsiders were brought in and all of that money that should have been in AK went to the lower 48 and that money benefitted the lower 48. How are we going to benefit if this pipeline was to go forward?" (SRB&A 2012b)
- "They should train these native people so that they can get these jobs so that when this is finally approved they can hire people from this area. The people need to be well trained so that they can fit in and be able to work in these jobs. That is one thing that needs to be brought back to your people…." (SRB&A 2012b)

Gwich'in Cultural Experts commented that their subsistence way of life offers a route to wealth that transcends money in which identity, health, and social cohesion were prioritized over materialism:

- "I want to break that down on how I feel about that, why I said, 'families' for the word of wealth. [...] I said family because, you know, you can have all the monetary possessions, money at the end of retirement, whatever. But as we get old, whatever happiness that money can buy you can't make you as happy as you are being with a family. So, that's why I said family, it's because, yeah, I did have the opportunity to go out, I still have that opportunity if I want to go out and basically, make money. But like I say, money, at the end of the day, can only buy your heat, your water, your food, pay for your rent, your vehicle. And that's it. That's all you live for. But traditional way of life that we live, we wake up with a choice to represent and be Dinjii Zhuu. You know, and we get to be our own, make our own decisions in life without being told to show up here at this time. So, with that lifestyle, we get to teach our kids to do what my grandparents taught me, and my father taught me. I can't train, teach my kids to be an asbestos abatement remover. You know. That's how I feel about that." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...when the guys go up there to like the Sheep Creek and get their sheep, it's almost like a rite of passage, it's like they're so proud and happy. So, we have that identity. And having that identity is wealth. Many people in this world are lost. A lot of people are out there, they, they feel like they're lost and they don't know, they don't know, like, their passion or why they're living. And as we know, we're Gwich'in, we know our life, we know, our people from the past. We know who we are and what we do, and why we do it. And so like why take that, and that's our wealth." –Tonya Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Wealth to us as having our community be happy, healthy and continue." –Tonya Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think a wealthy person in Arctic villages is a person who has a good setup. Wood, big pile of wood, water, clean yard, good house he built, well fed dogs, fat dogs, good living, you know, good healthy living, eat their traditional food. That's what I think about when I think about wealth. Yeah. You know, your, your set up, you know, you're prepared for the worst, you know, like. Yeah, we're really wealthy people..." –Galen Gilbert, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "My perspective of wealth probably would be, I think, I think we're very wealthy, not money-wise but culturally. Like, money is just like an extra thing. Because we do, we live off of caribou, geese, ducks, I've had geese and ducks all winter, we're actually on our last few until, what, May?" –Raeann Garnett, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I just think that our people haven't ever really been super money driven, you know, like, we had opportunities in the past, to have more development on our lands and stuff. And even if that was an idea for some people, like, our collective value is based on the land and we know that development is in conflict with that a lot of the time. It's just not worth it for our people. I mean, sure, you know, our families have to make money. But we would rather, think both, have a career or a job that can just supplement our lifestyle, and not necessarily take us away from our communities like working in a oilfield often does. Our men would rather work in the community, raise their families. And a lot of times those developments, like, the local people, the Indigenous people don't get the highest paying jobs anyway, it's like the more manual labor. And it's, it's only profitable as long as the resource is there to be developed, and when that, you know, depletes, what, what's there left, right? And I also just feel like, for a lot of our communities, our ways of life, like

a big infusion of money often is harmful because it can feed social ills. And we've seen that In some other communities in the Arctic when there's been development projects that people get quite a bit of money and you know, the issues get worse. And I just think our people in general, money is only as good as it allows us to continue our way of life and to pay for gas to hunt and pay for electricity to you know, keep our houses warm. But very few Gwich'in if any, I feel like would prioritize money over caribou." –Charlene Stern, 2023, as recorded in Draft SEIS Comments, November 7, 2023

Despite the relative persistence of the Gwich'in subsistence economy, Cultural Experts noted dramatic changes to this feature of their society within their lifetimes. These changes were often contextualized as the continuing effects of colonialism and corporate encroachment:

- "Because I was mad, I always mad about... back in uh, I got, I got elected on around 60... 68? Yeah, around 68 I think. We were talking about all these things, in the future, but my big mistake those days: Venetie don't even have a pencil. No paper. Counselor doing everything inside their head. Even that, they set aside that land. I remember my parents sent me to Fort Yukon to get groceries, you know what they use? Paper sack. They use a .22 shell with a black cap for pencil. Soon as this thing don't write they pick another one. And then they put it back and they pull another one. That's how my dad made the list. Those days I traveled from Venetie with twenty dollar. Twenty dollars! If you're going to charter a Super Cub: five dollar. But today? Three, four hundred dollar from Fort Yukon. Look at how many changes. Sometimes I think about all those food price, how much it cost way back compared to today. I always tell my grandkids about it. We used to buy tea about, like, pound, little pack, six of them together: two dollar. Ten pounds of sugar: $3.75. Today, 10 pounds: twenty bucks. Everything is just like, we just... nobody worked. Everybody sewing, sell, that's only way our parents raised us. Or else tan skin, sell it, my mom always do that. That's only way. That's where I came from. That's reason today, what I see, every place, every place we go, we kind of have this [GESTURES]. If we don't have it, we're nothing today. Back then? Even if you got nothing, like that, you were still somebody, very important person. All these changing since then, I saw lots of stuff. Some of them I was talking about it around here, like trapping, what's been changed on my trail. Just like last night I was thinking about what we're talking about out there. What will affect that ecosystem, you know? What will hurt ANWR calving ground? I saw that thing in Arctic, that's reason I was telling them. Everybody should know, everybody notices, that young boy over there, he notice it. I was driving to Arctic. You know on the airport, to the airport village to the airport? I see a little spruce tree turning yellow. What caused that? By that foam from those machines? That's what will happen in ANWR in the future. They should check the Dalton Highway, the one that going up Slope, to Prudhoe Bay, on the side. Guarantee EPA got a something. Maybe that thing well spread too, you never know. By rain wash, it move, you know? Just like permafrost." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "There's a, just like long time ago we talked about, we were talking about sharing stuff. I like that sharing stuff area, because my grandpa told me they gotta go over the Brooks Range to share their stuff. And other side they gotta share with us. We talk about that. But the route where they took, maybe this guy know about it, that's reason he mark that map, that trail where they go over there and meet each other, you know? All these things we're talking about is, the main thing to protect every animal." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.19 Cumulative Effects

Iñupiaq residents of the North Slope have already experienced cumulative impacts of development on their subsistence, economy, and social systems. The ever increasing network of industry related infrastructure on the North Slope and associated exploration and development activities has resulted in a shift in subsistence use areas over time, and changes in resource distribution and migration. Residents emphasize the interconnectedness of the land, sea, and wild resources, and how a single oil spill would have effects on the entire food chain. In addition, residents note that the piecemeal approach to environmental impact analyses often fails to consider the big picture.

- "All of our food comes from the Camden Bay area. The migration of ducks and fish come from that area and what would happen if there's an oil spill of some sort, from that area to our area would wipe out everything." Nolon Solomon (MMS 1983)
- "The other concern I have is how this activity is going to affect the migration of the Central Arctic herd, which we utilize. They have to come through this proposed development and probably continue development to the south of this area with other leases. So, yes, it's a concern that one small area is being considered at this time for environmental impact statement, but not the entire region that will eventually affect us." -Robert Thomson (USACE 2010)
- "And now we're getting restrictions to our hunting rights, which is wrong. And we go there quite often, like Carla said, whether we fish, whether we hunt caribou on the sea and the land, we go there. We gravel on snowmachines through there, boats. I mean -- and they said that we wouldn't be restricted. Now we're getting restrictions from -- from Point Thomson. Our land, our sea." George Kaleak, Senior (USACE 2010)
- "Anyways, welcome to Nuiqsut, the most impacted community on the North Slope. And I say this because we are surrounded. If you look at the map, we're surrounded by development. When we go hunting, we're surrounded by choppers and whatever and we have to go further out. And for how many years we've been speaking this same impact? I know you've tried to find ways maybe to minimize it, but not on this project; you maximizing the project. When you proposed Alpine, you said it was going to be a minimal impact. That's a lie, because I live here and I -- and I've lived it. You've given us money, called us subsistence mitigation impact for each project. That's turned into a social impact for this community when we are fighting over this little piece of pennies we get from this development. For every infrastructure that goes up, we lose land to subsistence. I have -- we have a cabin down there, which is two miles from CD2. It's land loss. So is that little -- by Nanuk, right -- right out, just a little south of -- north of the bridge. Nobody goes there anymore. The families that used to go there, they should go there, but that bridge is only 500 feet away from their camp. That's another land loss. What are you doing with the land loss to subsistence hunters? I'm asking all of you agencies; what are you doing with the land loss to our subsistence, our camp sites? We see that in Prudhoe Bay where the Native -Native allotment… And this community is too close to that development. We didn't envision all this when we first moved here in 1973; we didn't envision all this pipeline and all these roads. The most important and the most impact I see is the social impact to this community, to our kids, our future. They're always talking about our future. Our leaders are always talking about our future, but I don't see very much but a little much teen center right here, just a hangout with nothing. When Barrow got a hold of all these NPRA monies and they got Piuraagvik and another renovation going, a cultural center, everything from this development, they got it; so is Wainwright. Where is the one for our community?" (BLM 2018)

- "We've seen many decades of change. We've had changes to our whaling. We've had changes to our caribou hunting. We've had changes to our fishing lifestyle. These are all things that have been beared upon our community members. We've had other people from industries state about how we force the oil industry to pay for freight to get our whale home. Well, they forget that they don't want us to use traditional use areas, that we would have put them in ice cellars to store them until we could get them later in the season when the river is frozen and we can bring it back on our own means, but now we can't use those areas. We've got many sites like that that we don't use." (BLM 2004c)
- "Within the city of Nuiqsut you see all the activity of Alpine. The caribou migration has really changed over the last two decades. Our subsistence users have to go further for waterfowl and caribou. We've experienced this both on and offshore. Development really affects our wildlife. Our subsistence users have really had to change the last two decades. Much further to go for harvest." (Nuiqsut active harvester; Experience timeline: 1987 and ongoing; Experience location: Nuiqsut. SRB&A Interview 2007)(SRB&A 2009)
- "Much of the development nearby already has altered migratory paths of the wildlife; caribou for example, they don't migrate in the areas traditionally. That change is significant. " (BLM 2004c)
- "Trapping was abundant east of here. Now, we don't go over because of the oil field. Just recently, it is known that the foxes are very dirty, discolored and rabid in that area. Trapping is done elsewhere. We used to see grizzly bears around. Now, they are not around. Where's the caribou now? One summer when we used to walk miles looking for caribou, we came across two dead caribou for unknown reasons. The animals have faced a change. We have faced a change since activity began. If there is to be further activity, the fish and the sea mammals will suffer and we will suffer too. We depend on the fish, wildlife and the birds, still, today." Bessie Ericklok (MMS 1979b)

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 Porcupine Caribou Herd. 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

D.1.20 Unavoidable Adverse Effects

Gwich'in Cultural Experts, many of whom have firsthand, personal experience with oil development on the North Slope, are deeply skeptical of the industry's ability to conduct its business in an ecologically sound manner. Comments include concerns about the lack of accountability, pollution from the inevitable trash, spills, and toxic emissions, and compression or other disruptions to the tundra due to vehicle traffic and seismic exploration:

- "Yeah, they're going to be doing seismic, they got trailers, cables dragging all over, and I know they're doing this aerial sonar from the plane. You got basically, you have to get your fuel out there, you gotta accommodate - you got a lot of activity going on. And they say they're going to use the same trail to go in and then come back out right? To minimize impact, I think. No, there is going to be a footprint. You can take a picture after they're done from the satellite and you're going to be able to identify it and they'll say hey, here's your impact. And they're gonna, come up with some kind of wording on why and whatever. Yeah, I believe it is. Nature is supposed to be peaceful and quiet. Undisturbed. Especially where big nursery is happening not only for caribou but for all other life. And that's where they want to go. One of the last untouched place in this world. And we're just trying to speak on their behalf I guess." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "On with that oil seismic we've been talking about: if they do that up there, it's going to impact a lot of animals because of a noise vibration, they did it before. It affected a lot of animals. Especially around the Yukon Flats. I did that for two months, walking in snowshoes, and seen it, you know? And that's what's gonna impact us up there. All the noise vibration, it's just constantly going, you know? Like you said, 24/7." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So, so I got paid for being a demolition on North Slope. I set up TNT, all the way up, one mile stretch. And then I stopped at the end and I'm ready. Yeah. And I just go like this, and it just goes "Boom! Boom!" Sixteen, twenty feet down, all that gravel, is a big rock like this all blew up straight line, all the way up. That's a lot of vibration. I had to get - I got paid for it. And when I, when I was doing, then when I saw the caribou, gee, I didn't like that. He was running so fast over that way to the east, you know? I didn't like that. There's no ground squirrel anymore around that area up there. […] So, I'm sorry that we have to talk about these kinds of stuff, what's, what is contaminating from vehicles? Yes, it does. If you're just sitting there at, right out here, if you leave your car running on the snow, you're gonna see black on there. Okay? And that's only two hours it's been running and you see how much black is there. But if you're 24/7 for twenty vehicles running daily, and some of it is left behind, because of broken, uh, sometimes they don't have a place to put those things, they just leave it there and continue on what they're doing. So, so it really, it really affects

the human being, also the species of animal, mainly the caribou. You know, if you smell diesel right now, it's gonna bother you for the next, for the next hour or so, you know? Yeah, just like lynx bait, if you get one little drop on you and you start going - I was, I'm always doing that, smelling my "Where the hell is it?" you know? Yeah." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Plus I work in Prudhoe Bay, I hate to say this but, when they transferred oil to another facility, they have excess gas and they need to get rid of it, burn it. And that sounds like, worse than a jet. It's really loud. Prudhoe Bay is 24 hour a day, like it's, you could just smell that diesel. Every time they do refueling, they use duck pond, but still yet they don't follow that rule. But they get caught, you know, by OSHA. So, you know, I knew a couple of people reported that and Doyon got in trouble." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "All the seismic. We get all the seismic in Yukon Flats, with Doyon. And they used dynamite. And that thing is a bit like, like 20 miles of vibration, and I, come to think of it, I think that's what causes the moose to migrate up." –Ernie Peter, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "…water is really important, but that track of Nodwell they use up there on the North Slope, goes into the water, what they leave behind from the exhaust, into the water. How about the track oil? How about when they re-fill? Did they drip into the water? How about when they're oiling that thing? When they're greasing it, see?" –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think all the equipment will leave a footprint no matter how big or small. I do think it's gonna be something, they say the wider they got their tracks the better it's supposed to travel over the terrain, but it's square feet, that's more square feet that are pushing down, compressing I'll say, down with the snow and whatnot, so, yeah, it does leave a trail running D-9 from Venetie to Arctic. Right now, you're gonna see the effects that killed that willow, you know that willow's gonna die, the grasses are gonna die, so, it does." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- Myra Thumma: "Just imagine all the toxins, everything that they use up there will go into the lakes, the swamp areas, all the little streams that we have. I was thinking about that last night, wow."

  Sarah James: "Right. And where the caribou calving ground, it's very small Coastal Plain."

  Myra Thumma: "And it's almost like a sponge there. Once it soaked up something, [...] it goes deep into the ground." –Sarah James and Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So if that happens, you know, we're gonna see a lot of changes in our water resource, and our plants, our animals and all that. And we're gonna see a lot of changes. They don't see further back, I mean, ahead like 10, 20 years. I mean, right now all they want is money. That's what they want." –Myra Thumma, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, so main thing is, you know, like we are trying to fight for this place of the birthing, calving ground, everything that's on there is plants, bugs, birds, moose, caribou, sheep, polar bear, grizzly wolf, wolverine, fox, name it, and it's up there. But they all contribute. It's a cycle. They all contribute to that cause up there. The root system - if you look at a root, the plant the way it goes down into the ground, right? What we, as humans put on that and it goes into that ground, it flips upside down. You ever look at a map and look at all the river drainages? It looks like a, basically a

root system going into the ocean." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Well, I've been wanting to say this since yesterday, but my grandfather Trimble said to me, not too long ago about, uh, before the Earth got polluted, he said ducks and geese used to taste really good. Before the Earth got polluted, he said ducks, geese, even parts of the caribou tastes really good. Until, you know, since seismic drilling started happening, they taste, he said they taste different from back then. So, that's a true fact. He said, you know, yeah, he just said, you know, they used to taste different but, good better. But now these days they don't taste the same. Parts of the caribou used to taste really good but now just taste - it doesn't taste the same. And then I asked, yeah, of course I asked him why you think, he said because, you know, the pollution of the Earth. That's what he said. So, I wanted to say that since yesterday, but I was just waiting for the right time, and I hope that you know, my grandfather Trimble said that, so. I think the same thing, of course, but you know, course I don't know how it tastes back then, but, you know, I'm sure it was better than it is today." –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "I think they really mess up all the ecosystem, all the water, all the air, and all the snow […] Yeah, if it's in the Coastal Plain, it will contaminate the water and then goes - the water goes into the nest, and then when the summer comes, the water goes down and then spring, springtime when the birds come, look where they are: contaminated nests." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "That could impact the water and the animals and the birds by going into the streams. So, if you have a mountain that, like this, uh, Coastal Plain, everything drains to the ocean. Everything drains to the creeks and lakes. And we know in fact that we have fish, all kinds of different kinds of little fishes that lives there. But okay, let's start up our snow-go, go to Fort Yukon from Venetie on a 40 below weather. And if you go turn around, maybe a halfway point and follow your same trail back to Venetie, you could smell that fumes, from a snow machine, from, uh, if you have if you have five F-35 going through ANWR on the flat country, you know, that'll leave a big vibration there." –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So the fumes of the truck leaves a layer of contamination maybe a drop from the exhaust, sometimes we got fail rate when you're dealing with heavy equipment or truck driving, you have a fail rate, sometimes you blow a transmission. I mean we know it, because- [...] mechanical problem and it leaves, if you're not a respectful person as the operator or the mechanic, you will contaminate that land. Yeah. And by five miles stretch, you're delivering freight. Yeah, you're going over, maybe beaver dams, maybe you're going over fish habitats, maybe you're making vibration noise, too much of vibration noise. If you're dipping into water, you know, I mean there's a law says that you cannot go over in a vehicle unless you build a bridge to go over a creek. So, it's only, I mean it's gonna be a problem if the superintendent don't do his job. The EPA, when the migration comes up in the North Slope, and the white EPA engineer says that they really respect, they really respect the, uh, they respect the caribou migration, you know, they do in North Slope. So, but in 1970 you have this sewer where you put toxic stuff in there, you know, and those are the smell that's gonna smell. And it effects the animals. But to build a road from there, 50 miles, one truck in the wintertime goes 50 mile on snow. That contaminates the snow by the fumes. And oh, there's human waste too. So, you know?" –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Another thing too, just like, I remember we're trying to take some Cat up to Arctic, and we were heading to the mountain and, uh, from the Cat sometimes, you know, that hydraulic thing always busts and goes to the ground and nobody ever cleaned it. I guarantee these things happen." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "If there's oil spill, it will go all over cause the stream flows down and there's no trees, just tundra. There's some rocks but mostly tundra. Everything will get ruined. They always say they can clean it up but there's no way. They can't shampoo the tundra. All the plants will be ruined. They say they'll drill for oil in winter – they'll do it on ice and build ice roads so they won't ruin the tundra. Where they say they are gonna drill, it will only be a foot. They say they won't leave a footprint but it's all a lie. Wherever they drill, wherever vehicles drive…there's oil spill." –Sarah James, 2018, as recorded in Draft SEIS Comments, November 7, 2023

D.1.21 Relationship Between Short-Term Uses and Long-Term Productivity

Gwich'in Cultural Experts uniformly condemn the sacrifice of stable and productive ecosystems for personal material enrichment:

- "They're already developed about, like, 90, 95% of the coastal, Arctic coastal area, and they - what have they done for us? What have they done for the state? Not much. We won't benefit from it. And that's what I believe. And like, my uncle Jim, he said, in an article I read, he said, "Why do we need money to live like Gwich'ins? Because we already live like Gwich'ins." And that's who we are. It's just, I don't believe in, it won't affect - I mean, like, I don't see no benefits from it. Like, it's, like, what do you say? Like, kinda like they're trying to bribe us. But it's something that, that wouldn't fall through, even if they said no. Breaking treaties, like that. That's how I see it." – Margorie Gemmill, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "So, this is not just an environmental issue. It is just about the survival of an ancient culture that depends on the caribou. It is about the basic tribal and human rights to continue their way of life. The Gwich'in are the caribou people. For thousands of years, we have lived with the caribou right where we are today. … It's not just what we eat, it is who we are. Caribou are our lives. It's in our stories and songs and the whole way of the world. Villages like Arctic Village and Old Crow hunt the caribou the most. But, every Gwich'in community takes part by trade and giving, and some come up to hunt with their relatives. … It's not just the caribou, though, it's the whole ecosystem that we are concerned about. It's about all the animals, plants, ducks, geese, other birds, and fish. Also, we still have clean air and clean water. … The oil companies try to say that development would not hurt the caribou, but they are not telling the truth. Our old people knew that. They say that the birth place can never be disturbed. Even during hard times, it was always protected by our people's ways. … After almost 20 years, pregnant cows and cows with calves still avoid any areas where there is activity. … We think of it as biocultural reserve, not just a wildlife refuge." –Sarah James, 1991, as recorded in Draft SEIS Comments, November 7, 2023
- "Yeah, we could smoke ground squirrel out of their colony by putting smoke into their hole, then they're going to come out, and shoot them or snare them or trap them. But we don't do that either because that's not, that's not a humane way to get our food, unless we're hungry. So's beaver. Beaver den we don't even go near it, they respect their home." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "...we never harvest eggs. You know that? [...] We never, when we see some, if we need it we'll get it. But I think everybody got a carry in front old people. They was always say: "Don't shoot anything

that you can't eat, and don't take something that you're not gonna eat. Leave it alone." Because there's, there's a long future ahead of us, we'll need it. They always try to ration something, our Tribe. So, they always encourage each other about saving, you know, not to take too much, just what you live on. Because these are very important we got this... they look at the future. They always said that it gonna be bad in the future. War will start, all that ground gonna be changed. Oh, the water will be no - no place to get water to drink. Just like right now in California, they wanna - they want to build some kind of pipeline or something, I overheard that in the news. See, all these things connected. How could Gwich'in Native old people see in a vision, you know, that far? Whatever they told me I see it today." –Robert Frank, 2023, as recorded in Draft SEIS Comments, November 7, 2023

- "Like I talk about that. Trappers used poison. A lot of people don't want to talk about it. Yeah, a lot of people don't want to talk about it because it kill a lot of our animal, everything. And my mom said, before they came, there was a lot of birds and ducks in the springtime, even put shadow over the land. There was a lot of fish, a lot of trickles in the creeks and lakes and rivers because there was a lot of fish. Noise is very loud, and they can't even hear each other, how we talk right now? They practically have to yell, to listen, to hear each other. That's how noisy the environment was. And after the trapper did that, they stopped them. But when that happened, seemed like the country shut down, the noise, the next spring or something like that. It just went down and down and down to where we could hear needle drops. The reason they don't want to talk about something like, was the Bible was given to us and that we believe, in forgiveness and all that other stuff." –Sarah James, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.1.22 Irreversible and Irretrievable Commitments of Resources

Gwich'in Cultural Experts identify industrial exploitation as an unacceptable reason for the destruction of their subsistence way of life:

- "[…] This is a clean area here, all that 1002 land and the Gwich'in land, you know, it's a clean area. Right now it's clean. And we're going to bring this same situation, what they did from North Slope? … No way! We're gonna fight it to the last. " –Ernest Erick, 2023, as recorded in Draft SEIS Comments, November 7, 2023
- "It's funny, if I was to do a, submit for a permit to build a road, say, through the Yukon Flats. "Whoa, whoa, whoa, that's a wetland!" You know, there's a lot of nesting birds, fish. So, that's an EPA question. That's a pretty hard permit to pass. But, you got ConocoPhillips or Hilcorp who has the history of bad maintenance or care, or whatever... housekeeping, let's just use word housekeeping. They're willing to just throw them down permits and go ahead drill, you know, as long as you get money out of it. But they forgot about the fish that are having their eggs or babies, the birds, the caribou. How do they forget about that?" –Robert Sam, 2023, as recorded in Draft SEIS Comments, November 7, 2023

D.2 REFERENCES

BLM, (Bureau of Land Management). 1982. National Petroleum Reserve-Alaska (Npr-a). Subsistence Hearings. Barrow, Alaska. November 22, 1982. U.S. Department of the Interior.

BLM, (Bureau of Land Management). 1997. Npr-a Integrated Activity Plan Environmental Impact Statement. Scoping Meeting. Nuiqsut, Alaska. April 10, 1997. U.S Department of the Interior.

BLM, (Bureau of Land Management). 2003a. Alpine Satellite Development Plan Environmental Impact Statement. Transcript of Scoping Meeting Proceedings. Barrow, Alaska. March 17, 2003. U.S. Department of the Interior.

BLM, (Bureau of Land Management). 2003b. Alpine Satellite Development Plan Environmental Impact Statement. Transcript of Scoping Meeting Proceedings. Nuiqsut, Alaska. March 18, 2003. U.S. Department of the Interior.

BLM, (Bureau of Land Management). 2004a. Alpine Satellite Development Plan: Final Environmental Impact Statement. U.S. Department of the Interior. https://purl.fdlp.gov/GPO/gpo84294

BLM, (Bureau of Land Management). 2004b. Public Hearing. In Re: Amendment to the Iap/Eis of the Northeast Npr-A. Transcript of Proceedings. Nuiqsut, Alaska Kisik Community Center. U.S. Department of the Interior.

BLM, (Bureau of Land Management). 2004c. Public Hearing. In Re: Anilca 810 Analysis for the Amended Iap/Eis of the Northeast Npr-A. Transcript of Proceedings. Nuiqsut, Alaska Kisik Community Center.

BLM, (Bureau of Land Management). 2016. Meeting Proceedings (Public Comments) Greater Moose's Tooth 2 Seis Public Scoping Meeting #1 Nuiqsut, Alaska. https://eplanning.blm.gov/epl-front-office/projects/nepa/65817/89370/106877/2016_8_22_NUI_GMT2_scoping_meeting_transcript.pdf

BLM, (Bureau of Land Management). 2018. Willow Master Development Plan Scoping Meeting Nuiqsut, Alaska. https://eplanning.blm.gov/epl-front-office/projects/nepa/109410/158637/193869/Willow_Project_Nuiqsut.pdf

BLM, (Bureau of Land Management). 2019. National Petroleum Reserve in Alaska (Npr-a) Public Meeting: Scoping for the National Petroleum Reserve in Alaska Integrated Activity Plan Public Scoping Metting. Nuiqsut, AK.

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. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. MMS OCS STUDY # 2007-062. Anchorage, Alaska. https://www.boem.gov/BOEM-Newsroom/Library/Publications/2007/2007_062.aspx

MBC AES, (MBC Applied Environmental Sciences). 2004. Proceedings of the Workshop on the Variability of Arctic Cisco (Qaaktaq) in the Colville River : November 18, 19, and 20, 2003, Kisik Community Center, Nuiqsut, Alaska. U.S. Department of the Interior, Minerals Management Service. MMS 2004-033. Springfield, Va. http://www.boem.gov/BOEM-Newsroom/Library/Publications/2004/2004_033.aspx

MMS, (Minerals Management Service). 1979a. Federal / State Proposed Oil and Gas Lease Sale (Sale Bf). Public Hearings. Kaktovik, Alaska. May 15, 1979. U.S. Department of the Interior.

MMS, (Minerals Management Service). 1979b. Federal / State Proposed Oil and Gas Lease Sale (Sale Bf). Public Hearings. Nuiqsut Alaska. May 16, 1979. U.S. Department of the Interior.

MMS, (Minerals Management Service). 1983. Diapir Field Lease Offering (Sale 87). Barrow, Alaska. October 24, 1983. U.S. Department of the Interior.

MMS, (Minerals Management Service). 1986. Proposed Beaufort Sea Oil and Gas Lease (Sale 97). Public Hearings. Nuiqsut, Alaska. December 12, 1986. U.S. Department of the Interior.

MMS, (Minerals Management Service). 2001. Official Transcript-Public Hearing Nuiqsut. Draft Environmental Impact Statement for Liberty Development and Production Plan. March 20, 2001. U.S. Department of the Interior. OCS EIS/EA MMS 2001-001. Nuiqsut, Alaska.

MMS, (Minerals Management Service). 2007. Chukchi Sea Planning Area, Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea: Final Environmental Impact Statement. Anchorage, Alaska.

MMS, (Minerals Management Service). 2009. Public Hearing for Draft Environmental Impact Statement, Minerals Management Service Proposed Arctic Multi-Sale. Nuiqsut, Alaska. February 4, 2009. U.S. Department of the Interior.

MMS, (Minerals Management Service), and (National Oceanic and Atmospheric Administration) NOAA. 2007. Seismic Surveys in the Beaufort and Chukchi Seas, Alaska: Draft Environmental Impact Statement. Anchorage, Alaska.

Pedersen, Sverre, and Alfred Linn. 2005. Kaktovik 2000-2002 Subsistence Fishery Harvest Assessment. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program. Study No. 01-101. Anchorage, Alaska.

Richardson, W.J., and D.H. Thomson. 2002. Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information. MMS 2002-012. Anchorage, AK and Herndon, VA.

SRB&A, (Braund, Stephen R. & Associates). 2003a. Alpine Satellite Development Plan Final Environmental Impact Statement. Appendix A: Technical Report: Public Testimony / Traditional Knowledge by Resource.

SRB&A, (Braund, Stephen R. & Associates). 2003b. Point Thomson Gas Cycling Project Environmental Impact Statement. Technical Report. Public Testimony/Traditional Knowledge by Resource. Prepared for CH2M Hill. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2009. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for North Slope Borough, Department of Wildlife Management. Anchorage, Alaska. https://srbak.squarespace.com/s/SRBA-2009-Impacts-and-Benefits-of-Oil-and-Gas.pdf

SRB&A, (Braund, Stephen R. & Associates). 2010a. Mms Ocs Study No. 2009-003: Subsistence Mapping of Nuiqsut, Kaktovik, and Barrow. U.S. Department of the Interior Minerals Management Service, Alaska OCS Region, Environmental Studies Program. Anchorage, Alaska. https://www.dropbox.com/s/o1mydqods5f11zd/SRB%26A-2010-Subsistence%20mapping%20of%20Nuiqsut%2C%20Kak.pdf?dl=1

SRB&A, (Braund, Stephen R. & Associates). 2010b. Nuiqsut Caribou Subsistence Monitoring Project: Results of 2009 Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://srbak.squarespace.com/s/Nuiqsut-2009-Caribou-Monitoring-Report_Feb10.pdf

SRB&A, (Braund, Stephen R. & Associates). 2011a. Chukchi and Beaufort Seas National Pollutant Discharge Elimination System Exploration General Permits Reissuance: Report of Traditional Knowledge Workshops - Point Lay, Barrow, Nuiqsut, and Kaktovik. Prepared for Tetra Tech and U.S. Environmental Protection Agency. Anchorage, Alaska. https://www.dropbox.com/s/wbd0zsmhox9yau0/SRB%26A-2011-Chukchi%20and%20Beaufort%20Seas%20national.pdf?dl=1

SRB&A, (Braund, Stephen R. & Associates). 2011b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year Two Hunter Interviews. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://srbak.squarespace.com/s/Nuiqsut-Year-2-Caribou-Monitoring-Report_Jun11.pdf

SRB&A, (Braund, Stephen R. & Associates). 2012a. Kaktovik - Traditional Knowledge Workshop Responses. Workshops Held on March 13-14, 2012. Alaska Pipeline Project Baseline Studies. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2012b. Nuiqsut - Traditional Knowledge Workshop Responses. Workshops Held on March 15-16, 2012. Alaska Pipeline Project Baseline Studies. Anchorage, Alaska.

SRB&A, (Braund, Stephen R. & Associates). 2013. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 4 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://srbak.squarespace.com/s/Nuiqsut-Caribou-Monitoring-Y4-Report_July19.pdf

SRB&A, (Braund, Stephen R. & Associates). 2014a. Nuiqsut Caribou Subsistence Monitoring Project, Year 7 – Technical Proposal Submitted to Conocophillips Alaska, Inc.

SRB&A, (Braund, Stephen R. & Associates). 2014b. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 5 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://northslopescience.org/wp-content/uploads/Nuiqsut_Caribou_Subsistence_Monitoring_Project_Results_of_Year_5_Hunter_Interviews_and_Household_Harvest_Surveys-_July_2014.pdf

SRB&A, (Braund, Stephen R. & Associates). 2015a. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 6 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://northslopescience.org/wp-content/uploads/Nuiqsut_Caribou_Subsistence_Monitoring_Project_Results_of_Year_6_Hunter_Interviews_and_Household_Harvest_Surveys.pdf

SRB&A, (Braund, Stephen R. & Associates). 2015b. Pebble Project Supplemental Environmental Baseline Data Report: 2004-2012 - 50. Cultural Resources Cook Inlet Drainages. Prepared for Pebble Limited Partnership. Anchorage, Alaska. https://srbak.squarespace.com/s/SRBA-Braund-2015-Pebble-Project-Supplemental-fpmz.pdf

SRB&A, (Braund, Stephen R. & Associates). 2016. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 7 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. https://northslopescience.org/wp-content/uploads/Nuiqsut_Caribou_Subsistence_Monitoring_Project_Results_of_Year_7_Hunter_Interviews_and_Household_Harvest_Surveys.pdf

SRB&A, (Braund, Stephen R. & Associates). 2019. Nuiqsut Caribou Subsistence Monitoring Project: Years 1 through 10 Final Report. Prepared for Conocophillips Alaska, Inc. Anchorage, Alaska. https://northslopescience.org/wp-content/uploads/Nuiqsut_Caribou_Subsistence_Monitoring_Report_Y10.pdf

SRB&A, (Braund, Stephen R. & Associates). 2024. Nuiqsut All Resources 10-Year Subsistence Mapping Study. Submitted to ConocoPhillips Alaska, Inc. and North Slope Borough Department of Wildlife Management.

USACE, (U.S. Army Corps of Engineers). 1996. Beaufort Sea Oil and Gas Development Northstar Eis Project. Public Scoping Meeting. Kaktovik Alaska. March 26, 1996.

USACE, (U.S. Army Corps of Engineers). 2010. Point Thomson Project Eis Public Scoping Meeting. Barrow, Alaska. January 14, 2010.

Voorhees, Hannah. 2019. Iñupiaq Knowledge of Polar Bears in the Southern Beaufort Sea. Polar Bears International.

Appendix E
Laws and Regulations

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ACRONYMS AND ABBREVIATIONS

Acronym or Abbreviation	Full Phrase
AAC	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 E. 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.

E.1 INTERNATIONAL AGREEMENTS

E.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 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 Porcupine Caribou Herd 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 Porcupine Caribou Herd. 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.

E.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.

E.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.

E.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.

E.1.5 Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat

Also known as the Convention on Wetlands, the Ramsar Convention is an intergovernmental treaty that provides for the conservation and wise- use of wetlands through local and national actions and international cooperations. The convention was adopted in the Iranian city of Ramsar in 1971 and came into effect in 1975. The United States is a Contracting Party to the convention along with almost 90 percent of United Nations member states.

E.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.

E.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.
- The Energy Policy Act of 2005 (EPAct) (Public Law 109-58) includes (but is not limited to): energy efficiency, renewable energy, oil and gas, and Tribal energy. EPAct 2005 calls for the development of grant programs, demonstration and testing initiatives, and tax incentives that promote alternative fuels and advanced vehicles production and use.

E.2.2 US Fish and Wildlife Service

- The USFWS manages the Arctic Refuge (established in Public Land Order 2214), 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 within 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 Migratory Bird Convention Act is the Canadian equivalent of the Migratory Bird Treaty Act, both laws implement the original 1916 Convention for the Protection of Migratory Birds in the US and Canada, as amended.
- The Migratory Birds Convention, as amended by the Parksville Protocol in 1995, requires the Governments of Canada and the United States to establish laws, decrees, or regulations that allow the taking of migratory birds at any time of the year for specific conservation purposes under Article II. These actions are to be used as an effective means of preserving migratory birds. The Migratory Bird Convention Act is the Canadian equivalent of the Migratory Bird Treaty Act in the US.
- 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, 1) 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.
- John D. Dingell, Jr. Conservation, Management, and Recreation Act (2019) consists of more than 100 individual bills that were introduced by 50 Senators and several House members. Specific to Alaska, the program provides the opportunity for eligible Vietnam-era veterans or their heirs to select 2.5 to 160 acres of Federal Land in Alaska and removes the requirement for personal use or occupancy mandated under previous laws.

E.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.

E.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.

E.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.

E.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.

E.3 EXECUTIVE ORDERS

In addition to the statutory authorities described above, a number of Executive Orders (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), 13990 (social costs of GHG emissions), 14008 (Paris Agreement).

E.4 STATE OF ALASKA

Alaska became part of the United States via the Alaska Statehood Act of 1958 (PL 85-508). The Alaska Statehood Act authorized the transfer of approximately 105 million acres of federal land to the State of Alaska. The State presented the list of lands selected for entitlement in 1993 and the State has been able to re-prioritize their selections through time. 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.

E.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.

E.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 issued 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.

E.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.

E.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.

E.4.5 Alaska Department of Public Safety

- Fire marshal approval.

E.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.

Appendix F

ANILCA Section 810 Final Evaluation

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Appendix F. ANILCA Section 810 Final Evaluation

F.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 Supplemental Environmental Impact Statement (Leasing SEIS or SEIS). 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

In this analysis, 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 will 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 four 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. 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.

F.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 SEIS. **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 C**).

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 SEIS uses a hypothetical development scenario (see **Appendix C**) 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 SEIS, including this ANILCA 810 evaluation, necessarily reflects a more general, programmatic approach than could occur at the post-lease project-specific stage.

The SEIS 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 SEIS, 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 Porcupine Caribou Herd and Central Arctic Herd – relevant data on subsistence uses of caribou by 22 Alaskan communities, including the four subsistence study communities listed above is also included in the SEIS.

The SEIS recognizes that the Inuvialuit, Gwich'in people, and other user groups in Canada have cultural, historical, and subsistence ties to the Arctic Refuge or the Porcupine Caribou Herd 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.

The Gwich'in People, who live both in Alaska and Canada, have a unique cultural connection to the program area, as they consider the Arctic Refuge to be sacred ground and "the place where life began." Because of their high reliance on the Porcupine Caribou Herd and their identity as the "Caribou People," the Gwich'in view protection of the Arctic Refuge, home to the Porcupine Caribou Herd calving grounds, to be of the utmost importance to their cultural survival. These broader cultural impacts to the Gwich'in are discussed in the SEIS; however, this Section 810 focuses its analysis on impacts to resource abundance, availability, and subsistence access (see **Section E.1**., Subsistence Evaluation Factors).

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 3-46** through **Map 3-63** in **Appendix A**). Nuiqsut's marine mammal and furbearer use areas overlap the program area (**Map 3-58** through **Map 3-61** 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 (**Map 3-34** in **Appendix A**).

While the SEIS 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 and ringed seals), caribou, and waterfowl. Other resources such as polar bears, and furbearers are 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 3-45** and **3-46** in **Chapter 3**). Fish and large mammals (caribou and moose) make up 86 percent of the harvest for Venetie (**Table 3-48** 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. Finally, while waterfowl is harvested in lesser quantities in the study communities, it is an important subsistence and cultural activity with high rates of community participation. In addition, the program area is an important nesting ground for many waterfowl species, and residents hunt the birds as they migrate to and from the program area during the spring and fall months.

In addition to Kaktovik, Nuiqsut, Arctic Village, and Venetie, 18 communities have positive customary and traditional use determinations for the Porcupine Caribou Herd and/or the Central Arctic Herd (**Map 3-45**, Coastal Plain EIS Subsistence Study Communities, in **Appendix A**). These 22 communities, referred to in the SEIS 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 Central Arctic Herd caribou. The majority of Nuiqsut's harvest consists of Teshekpuk Lake Caribou Herd animals, although Nuiqsut also harvests caribou from the Central Arctic Herd. Anaktuvuk Pass harvests a combination of Western Arctic, Teshekpuk Lake, and Central Arctic Herd caribou. Teshekpuk Lake caribou would not be impacted by future oil and gas exploration, development, and production activities in the program area. Kaktovik, Arctic Village and Venetie rely heavily on Porcupine Caribou Herd, while Kaktovik and Nuiqsut also harvest from the Central Arctic Herd. In addition, while other communities harvest from the Porcupine Caribou Herd and Central Arctic Herd, these communities are farther removed in distance, and large-scale impacts to migration and abundance are unlikely under the alternatives. Therefore, Kaktovik, Arctic Village, and Venetie are the communities most likely to be appreciably affected by changes in the abundance or availability of Porcupine Caribou Herd, although other communities may experience indirect impacts through impacts on sharing networks. For these reasons, Porcupine Caribou Herd-related discussion in this evaluation focuses exclusively on impacts on the Porcupine Caribou Herd from future on-the-ground activities and consequent impacts on subsistence use of them by these three communities. In addition, because impacts to the Central Arctic Herd are not expected to cause large-scale changes in abundance or migration, the analysis of impacts related to the Central Arctic Herd focuses on the users closest to the program area (Kaktovik and Nuiqsut).

F.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.

F.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 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.

F.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.

F.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.

F.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.

F.2.2 Evaluation and Finding for Alternative B

Section C.8.2, Alternative B in **Appendix C**, assumes that 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 it is estimated that 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 C** under Alternative B. The entire Coastal Plain would be offered for lease sale. Compared to the other action alternatives, this alternative has the largest number of acres where only Required Operating Procedures (ROPs) would apply (**Table 2-1** in **Chapter 2**). Approximately 358,100 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 620,000 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.

F.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, caribou, and waterfowl) 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 F-2** classifies each impact as minor, moderate, or major, based on the discussion in the SEIS. **Table F-3** summarizes the extent to which impacts on access would affect subsistence users.

Abundance and Availability

Fish

Section 3.3.2, Fish and Aquatic Species, describes potential impacts on non-salmon fish, including Dolly Varden and Arctic cisco which are important subsistence resources for residents of Kaktovik and Nuiqsut

(**Table 3-45**). Impacts to fish are not likely to extend beyond Kaktovik harvesting areas, unless there is a large-scale contamination event. In this event, it is possible that Nuiqsut harvesters could experience impacts to resource availability of Arctic cisco, which migrate past the program area on their way to the Colville River Delta. It is unlikely that impacts to fishing would extend to the other study communities of Arctic Village and Venetie, as they do not harvest from waterways connected to the program area. Dolly Varden is the primary fish resource harvested within the rivers and streams of the program area by Kaktovik subsistence users (SRB&A 2010).

Impacts from future oil and gas exploration, development, and production that may affect the availability or abundance of non-salmon fish are as follows:

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

Infrastructure could result in habitat loss, increased turbidity and sedimentation, obstructions to fish passage, and changes in water quantity, affecting availability to Kaktovik subsistence users in nearshore waters and along rivers. Noise and traffic associated with future oil and gas exploration and development could potentially disturb or displace fish, causing temporary changes in harvesting success for Kaktovik harvesters. Vehicle traffic associated with seismic surveys could alter flows, and underwater shock waves could disturb, kill, or insure fish in the winter when Kaktovik residents fish through ice at inland locations. Residents in other North Slope communities have reported decreased fishing success as a result of seismic activities (SRB&A 2009). Most of these impacts would be temporary and would not have population-level effects on fish.

Spills would have the greatest potential for lasting effects to fish abundance and availability, as spills can cause direct mortality in addition to changes in egg survival and fish health. Small spills would be likely to occur throughout post-lease oil and gas activities. Although uncommon, the risk of large or very large crude oil spills would be greatest during the exploratory drilling phase of each project. Such spills pose substantial risks to fish and their habitats, depending on location and timing, and would likely affect subsistence resource availability for Kaktovik and possibly Nuiqsut harvesters. Even in the absence of large-scale spills, accumulation of small spills over time could add to the perception, particularly by Kaktovik harvesters, that species near development activities or infrastructure are contaminated or unsafe to eat. Avoiding subsistence foods due to contamination concerns is well documented (see **Section 3.4.3,** Subsistence Uses and Resources).

Ten rivers and creeks, 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. Bridges, roads, and pipelines could still be built in the setbacks. 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, 11, 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 Arctic 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 3-45** and **3-46**). Impacts from future oil and gas exploration, development, and production that may affect the abundance or availability 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. While these impacts may not have population-level effects, displacement or behavioral changes in marine mammals could affect resource availability for whaling crews and marine mammal hunters in Kaktovik and Nuiqsut. Kaktovik whaling crews and seal hunters hunt offshore from the program area, and Nuiqsut whaling crews hunt to the west of the program area from Cross Island, when bowhead whales migrate from east to west during their fall migration. Whaling crews have reported skittish behavior in whales and other marine mammals during seismic activity as well as during times of heavy air and vessel traffic. In recent years, conflict avoidance agreements (CAAs) have been effective in reducing such impacts to whaling (see **Section 3.4.3,** Subsistence Uses and Resources). CAAs are generally limited to the whaling season, and therefore some impacts to seal hunting may still occur outside the whaling season as a result of program-related barge and vessel traffic due to skittish behavior.

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 and 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 3-36 lists potential impacts on terrestrial mammals, including caribou. Impacts from future oil and gas exploration, development, and production that may affect the abundance or availability of caribou to subsistence users include:

- 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 SEIS. Oil and gas development on the Coastal Plain of the Arctic Refuge and its potential impact on the Porcupine Caribou Herd calving grounds has been the subject of much discussion for decades. As a result, Porcupine Caribou Herd habitat, movement, and population dynamics have been well studied. Studies on the Central Arctic Herd and others have shown that maternal caribou tend to avoid infrastructure by as far as 1.25 to 3.11 miles (Dau and Cameron 1986; Cameron et al. 1992; Lawhead et al. 2004). A level of displacement of approximately 2.49-3.11 miles would be expected in the program area (**Section 3.3.4,** Terrestrial Mammals), with additional displacement if subsistence hunting occurs from industry roads. The literature generally suggests that calving would most likely shift to the east or southeast if large-scale 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). Direct comparisons between the Central Arctic Herd and Porcupine Herd when predicting potential impacts are complicated by behavioral, geographic, and demographic differences between the two herds. Compared to the Central Arctic Herd, the Porcupine Caribou Herd has lower population growth rates and productivity; may be more dependent on summer forage; has a more concentrated calving density; and is currently at a historical population high (**Section 3.3.4**, Terrestrial Mammals). In addition, the Porcupine Herd has fewer options for alternative calving grounds if displaced, and, as discussed above, alternative calving grounds within the program area have suboptimal forage and higher predation rates.

The likelihood or extent to which impacts to Porcupine Caribou Herd 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 SEIS defines the most important calving grounds as the high-use Porcupine Caribou Herd 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). Of the 1,563,500 acres in the program area, 728,200 acres (46.5 percent) are in the high use calving area (area used in greater than 40 percent of years). During the 2012-2018 time period, 76,700 acres in the program area overlapped with the Porcupine Caribou Herd calving area, and 589,100 acres overlapped with the post-calving area. Calving grounds vary annually based on spring weather conditions and available vegetation, and it is important that the Porcupine Caribou Herd have a large area from which to select calving grounds each year (**Section 3.3.4**, Terrestrial Mammals). More surface development within the high-use Porcupine Caribou Herd calving 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. If calving shifts toward the west in the future as predicted (Severson et al. 2021), into areas of greater hydrocarbon potential, there would be a higher potential for displacement from infrastructure during calving (**Section 3.3.4**, Terrestrial Mammals).

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 Porcupine Caribou Herd primary calving grounds, foraging habitat is abundant across the program area. Development activities could reduce seasonally important forage in some years for calving caribou (**Section 3.3.**4, Terrestrial Mammals). Using the hypothetical scenario provided in **Appendix C** and assuming displacement of calving caribou within 3.11 miles, the BLM estimated the total acres of potential disturbance and displacement under Alternative B at 803,000 acres (**Section 3.3.4**, Terrestrial Mammals). This number would vary depending on different road and pad scenarios.

Development in the Porcupine Caribou Herd 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 Porcupine Caribou Herd 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 development activities and linear infrastructure under Alternative B. Caribou movements can be delayed or deflected by roads or pipelines. Roads with vehicle traffic elicit the greatest responses from caribou (**Section 3.3.4**, Terrestrial Mammals). 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. Longer-term delays have been documented along roads in other areas of Alaska, including along the Red Dog Mine Road in northwestern Alaska, where 30 percent of collared female caribou encountering the road experienced long delays in crossing (33.3 days versus 3.1 days; **Section 3.3.4**). However, caribou herds in other parts of Alaska encounter and successfully cross roads without delay. Because the Porcupine Caribou Herd has had less exposure to human development than many other herds in Alaska, they would likely have greater responses. According to **Section 3.3.4** (Terrestrial Mammals) Central Arctic Herd caribou exhibited large behavioral responses soon after construction of the oilfields in Prudhoe Bay, although these responses lessened over time during certain seasons. In the program area, movements in response to insect harassment between late June and mid-August would be most likely to be affected. In addition to roads and vehicle traffic, caribou also elicit strong reactions to humans on foot (Curatolo and Murphy 1986; Lawhead et al. 1993; Cronin et al. 1994). Overall, caribou show greater displacement in areas with consistently high levels of activity.

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 will likely occur, but these impacts are not expected to be of extended duration. Most impacts related to noise and traffic would be local, occurring in areas where Kaktovik subsistence use areas overlap with action areas. Even small changes in resource migration or distribution, from a biological perspective, can have larger impacts on subsistence users if resources are not in traditional use areas at expected times of the year. 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 but may not prevent delays or deflections of caribou altogether. These stipulations would affect both Porcupine Caribou Herd and Central Arctic Herd caribou during midsummer.

Porcupine Caribou Herd caribou would likely still be available to subsistence hunters along the coast during traditional timeframes, but some uncertainty regarding impacts to availability exists due to three factors that differ from the experience with the Central Arctic Herd: 1) Porcupine Caribou Herd post-calving aggregations can be greater than 100,0000 animals (Russell and Gunn 2019) and the Central Arctic Herd 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 Porcupine Caribou Herd 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. The Porcupine Caribou Herd may increase their use of mountain ridges for insect relief as a result of development, which would decrease their availability to Kaktovik hunters (see **Section 3.3.4**, Terrestrial Mammals). In recent years, caribou hunters have observed that caribou are remaining inland and not venturing to the coast; the lack of caribou along the coast, in combination with restrictions on off-road vehicle access for Kaktovik residents into the Arctic Refuge, has resulted in caribou not being available to residents. Additional obstructions to caribou movement toward the coast would likely exacerbate these recent issues. In the future, as a result of warmer temperatures, large post-calving aggregations (over 100,000 caribou) may occur more frequently in areas with higher hydrocarbon potential in the western portion of the program area (Severson et al. 2019). This would increase the possibility that there will be large disruptions to movement around roads and pipelines. Thus, it is likely that some deflections or delays in caribou movement would occur as a result of development, potentially reducing harvest success for Kaktovik hunters, particularly along the coast.

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 3-46**, 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. Still, a substantial portion of use areas with high overlapping use occur in areas that are subject only to standard terms and conditions, and infrastructure could occur in a larger area which is not subject to NSO. It is likely that the community of Kaktovik would experience impacts to resource availability, resulting in reduced harvest success for individual hunters. However, it is less likely that these activities would affect resource availability such that they reduce overall harvest amounts for the community.

In addition to impacts from infrastructure, roads, and road traffic, caribou behavior could also be altered 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 SEIS 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. Small changes in caribou behavior or distribution resulting from air or ground traffic disturbances can result in an unsuccessful hunt and require more effort to harvest adequate numbers of caribou for one's household. While overall harvests for the community of Nuiqsut have remained stable, residents have reported spending more time and effort hunting and some have shifted their hunting patterns to access more productive areas along the road system. 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). Such impacts could occur for Kaktovik harvesters as they travel along the coast by boat or four-wheeler or inland by snowmachine looking for caribou. 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 C**. If a CPF development cluster is either along the coast or in the area bounded by the Hulahula and Jago Rivers (**Map 3-47**, 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 likely not be affected by these short-term impacts; however, this could affect the availability of caribou for residents of Kaktovik.

Impacts on caribou availability resulting from infrastructure, human activity, and vehicle and air traffic would be most likely during the peak of the caribou hunting season for Kaktovik, in July and August (SRB&A 2010). While Porcupine Caribou Herd use of the program area during July and August varies annually, the Central Arctic Herd regularly uses the program area during the July and August insect relief season; therefore, impacts on resource availability for Kaktovik hunters may be more likely for the Central Arctic Herd in some years but could occur for both herds (**Section 3.4.3**, Subsistence Uses and Resources).

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 considered minor to moderate (**Table F-2**). While mitigation measures can help reduce impacts on subsistence users, they cannot eliminate them (**Section 3.4.3**, Subsistence). Mitigation measures may be less effective if not adequately enforced, communicated to local residents, or developed in consultation with local subsistence users. However, if mitigation measures are implemented effectively and in coordination with local subsistence users, it is likely that residual impacts associated with future on-the-ground activities would not significantly affect caribou availability for residents of Kaktovik.

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 K-22** in **Appendix K**; **Table F-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 803,000 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 could result in lower levels of disturbance to caribou, depending on the effectiveness of the TLs, 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 Porcupine Caribou Herd calving area. Surface disturbance associated with one CPF in the high use Porcupine Caribou Herd calving area could total up to 488 acres based on Figures B1 and B2 in **Appendix C**. These facilities do not include coastal facilities and access roads to coastal facilities that would be located outside of the high-use Porcupine Caribou Herd 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 (and 8 percent of high use calving within the program area) based on 3.11 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 Porcupine Caribou Herd calving area, is unknown. It is possible there would be very little surface disturbance within the high-use Porcupine Caribou Herd 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 Porcupine Caribou Herd 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 a linear decline in calf survival with distance of displacement from calving grounds. Under the full development scenario described by Tussing and Haley (1999) occurred, Griffith et al. (2002) predicted an 8.2 percent decline in annual calf survival, which would be large enough to halt herd growth (**Section 3.3.4**, Terrestrial Mammals). 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 scenario 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. Russell et al. (2021) modeled six different scenarios for the same two starting populations, ranging from no leasing to full leasing, and predicted a herd size decline of between 2 and 19 percent for the current herd size and between 11 and 26 percent for a starting herd size of 100,000.

While these modeling results suggest that Porcupine Caribou Herd 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, or conflicting data on, specific model assumptions in the literature limit the utility of these models when determining whether impacts to subsistence will be significant. These include assumptions about impacts on time spent foraging, a primary driver of the results. Data are not available to support assumptions on specific changes in feeding behavior and duration for areas under NSO, CSU, and TLs. 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 acres of estimated surface disturbance, approximately 57 percent of the total project area could be approximately 3.11 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 Porcupine Caribou Herd calving area; thus, the model assumes changes to caribou behavior extend beyond this distance from infrastructure, the distance of reported displacement around infrastructure on the North Slope during calving (Dau and Cameron 1986; Cameron et al. 1992; Lawhead et 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. According to **Section 3.3.4**, Terrestrial Mammals, future oil and gas infrastructure in the program area could cause a shift in calving distribution in certain years, which would likely reduce calf survival and halt herd growth in those years. **Section 3.3.4** assumes that maternal caribou would continue to avoid active infrastructure by up to 3.11 miles for the duration of drilling and operations activities.

According to the Gwich'in's knowledge, any development in the program area would have devastating effects on the population of the Porcupine Caribou Herd and other resources, such as migratory birds, which have key habitat in the Arctic Coastal Plain. In addition, there are those among the Iñupiat who report similar knowledge regarding the effects of Arctic Coastal Plain development (see **Section 3.4.3**, Subsistence Use and Resources). These concerns are based on Alaska Native observations of the sensitivity

of resources to development and change, in addition to traditional knowledge that has been passed on through generations.

While the Porcupine Caribou Herd population size would continue to fluctuate, 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. Thus, caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Waterfowl

Section 3.3.3, Birds, describes potential impacts on waterbirds (e.g., ducks and geese), including 13 species that occur in the program area and are harvested by residents of Kaktovik. Many if not most of these species are likely also harvested by residents of Nuiqsut, Arctic Village, and Venetie. According to available subsistence data (see **Appendix N**, Subsistence Uses and Resources), geese, including white-fronted geese, Canada geese, and brants, are among the top species harvested in Kaktovik and Nuiqsut. Key waterfowl species harvested in Arctic Village during one available study year were scoters, scaups, long-tailed duck, mallards, and white-fronted geese (**Appendix N, Table M-13**). Geese (white-fronted geese, Canada geese), in addition to scoters, long-tailed ducks, and mallards are the primary species harvested in Venetie (**Appendix N, Table N-17**). Much of the coastline in the area of high HCP shows high overlapping use by the community of Kaktovik for subsistence purposes, including for waterfowl. Because waterfowl are migratory, impacts on subsistence uses of these species could extend outside the program area.

Impacts from future oil and gas exploration, development, and production that may affect the availability or abundance of waterfowl are as follows:

- Habitat loss or alteration
- Disturbance or displacement
- Injury or mortality due to infrastructure or contaminants

Alteration of waterfowl habitat may occur as a result of winter seismic exploration, water withdrawals for ice roads and ice pads, contaminant spills, gravel mining, open water dredging, and ice and gravel placement. Placement of gravel for roads and pads would remove waterfowl habitat in the long-term, and dust deposition and drifted snow along gravel roads would further alter or reduce the quality of bird habitat. Loss of suitable waterfowl habitat could affect nesting rates and survival but would likely not have population-level effects. Direct loss of habitat would be minimized by reducing footprint sizes in wetlands as much as possible (**Section 3.3.3**, Birds).

Noise; human presence and activity; and ground, vessel, and air traffic associated with development of the program area may also cause temporary disturbances to or displacement of waterfowl, causing temporary and localized changes to harvester success for individual hunters; however, these disturbances would vary by species and impact source and would not likely affect overall resource availability for Kaktovik harvesters. Displacement from road traffic may occur within 0.8 miles of active roads, and displacement from air traffic may range from 1.2 and 2.5 miles, depending on the type and altitude of the aircraft (**Section 3.3.**3, Birds). Transport of modules to Camden Bay would also disturb and displace birds, such as eiders and long-tailed ducks, in the nearshore environment. Human activity is the most consistently strong

disturbance source in Prudhoe Bay, and similar disturbances within the program area would likely occur and cause displacement of birds from nests for the duration of human activity.

Direct mortality of waterfowl could result from collisions with infrastructure and vehicles, in addition to spills in nesting and feeding habitat. While unlikely, large spills on land could affect waterfowl nesting areas, destroy large numbers of birds (**Section 3.3.3**, Birds), and affect their availability to harvesters in other regions, such as those to the south of the program area. Subsistence users also might avoid waterfowl that migrate through the program area and are harvested elsewhere, particularly if there is a large spill.

Alternative B would cause habitat loss, disturbance, and displacement of waterfowl on approximately 31,600 acres, and this alternative would have the least protections for streams and coastal areas. Numerous mitigation measures would be implemented to address impacts on waterfowl and waterfowl habitat, namely Lease Stipulations 1, 4, 7, and ROPs 2, 3, 8, 9, 11, 19, 26, 27, 31, 32, 34, and 40. While potential impacts on waterfowl would be most pronounced under this alternative, it is likely that the proposed mitigation measures would effectively reduce impacts on waterfowl and minimize the likelihood of large-scale changes in abundance or migration.

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. Nuiqsut subsistence uses occur primarily to the west of and offshore from the program area, with some direct overlap associated with nearshore marine mammal hunting and isolated overland furbearer harvesting areas. Thus, direct impacts to subsistence access resulting from infrastructure or legal or regulatory barriers are relatively unlikely for this community.

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

For Kaktovik, areas of high overlapping subsistence use occur in areas of high, medium, and low hydrocarbon potential. If future development extends into areas of medium and low potential for oil and gas development, as may occur under Alternative B (see **Appendix C**), associated oil and gas infrastructure could occur in areas of high overlapping use for the community of Kaktovik and create direct loss of subsistence use areas in addition to physical obstructions between the community and highly used inland areas for caribou, fish, waterfowl, and other inland subsistence resources. Infrastructure would pose physical obstructions to subsistence users if it is not designed to account for overland travel; ROPs 18, 20, 21, and 23 would minimize but likely not eliminate potential direct obstructions to subsistence users.

Infrastructure parallel to the coast could affect Kaktovik hunters, who frequently travel to the west and east of the community by boat to search for caribou as they congregate along the coastline, in addition to hunting for other resources such as seals in nearshore areas. Residents may experience physical obstructions if they are traveling inland from the coast by four-wheeler, or their ability to shoot their targeted resources could

be hampered by the presence of pipelines or other infrastructure and hunter concerns about shooting toward areas of development.

The use of future program roads for subsistence activities would bring impacts and benefits to subsistence users in Kaktovik. It is likely that some residents would use roads to access subsistence harvest areas, particularly when overland snowmachine travel is not possible, or if they do not have access to overland forms of transportation (for example, snowmachines and off-highway vehicles). Roads can provide easy access to harvesting areas and can provide access to resources when they are unavailable closer to the community. Roads can also facilitate increased competition among hunters. Use of roads would be less frequent if the roads are not connected to the community of Kaktovik.

Exploration and development of the program area would result in some legal and regulatory barriers, including restrictions on access and firearm discharge near oil and gas facilities. Depending on the parameters of these restrictions, subsistence users may have difficulty hunting in certain areas such as along roads in areas with higher density of infrastructure, and in areas where pipelines or roads parallel the coast. Miscommunication regarding policies about hunting near oil and gas facilities may dissuade certain residents from hunting near development, constituting an impact on subsistence access. Under Alternative B, numerous lease stipulations and ROPs would ensure that impacts to Kaktovik subsistence access would be minimized. These include Lease Stipulations 1, 3, 4, 7, 9, and 11 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, in that residents would continue to be able to access subsistence harvesting areas except in the immediate vicinity of development, and the overall extent of use areas would likely remain the same.

F.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 SEIS 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.

F.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 C and D would make more land in the program area unavailable for oil and gas leasing than Alternative B. Alternative A would not allow oil and gas leasing to occur.

F.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. Porcupine Caribou Herd abundance may be affected due to minor displacement of maternal caribou, but large-scale

displacement and consequent large decreases in the abundance of Porcupine Caribou Herd available for subsistence use is unlikely. A positive determination pursuant to ANILCA Section 810 is not required.

F.2.3 Evaluation and Finding for Alternative C

Section C.8.3, Alternative C in **Appendix C** 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. This scenario estimates that two CPFs and associated airstrips, 16 satellite pads, and 135 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. An estimated 1,464 acres of surface disturbance would occur in the high and medium potential areas. Most areas with NSO stipulations would be accessible by horizontal drilling from areas where surface occupancy is permitted or from adjacent state or Native lands.

Approximately 526,300 acres would be closed to leasing to protect caribou calving habitat under Alternative C (**Table 2-1** in **Chapter 2**). Of the remaining 1,037,200 acres available for leasing, 708,200 would be subject to NSO, 123,900 would be subject to CSU, 0 would be subject to TLs, and 205,100 would be subject to ROPs only. **Map 2-3**, Alternative C and **Map 2-4**, Alternative C, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, and areas subject to only standard terms and conditions would be adopted.

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

Abundance and Availability

Fish

The types of potential impacts on subsistence fish species would be similar to those described under Alternative B, although future facility locations may differ due to the lands available for lease and surface occupancy. Under Alternative C, 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 or Nuiqsut.

Marine Mammals

Disturbance and displacement of marine mammals, such as bowhead whales and bearded and ringed seals, associated with future on-the-ground activities would be similar to that described under Alternative B, 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 bearded/ringed seal availability or abundance.

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be smaller than that described under Alternative B, as an estimated 1,464 acres of surface disturbance would occur in the program area. 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 Alternative B. ROP 23 would apply under Alternative C 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 B, 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, Porcupine Caribou Herd and Central Arctic Herd 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 C (**Table K-22** in **Appendix K**; **Table F-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. Alternative C would not allow CPFs in the Porcupine Caribou Herd post-calving area and would limit total infrastructure density in this area (Lease Stipulation 8).

One CPF and associated well pads and roads could potentially be located within the medium hydrocarbon potential area under Alternative C. This CPF would likely be sited on private lands. Displacement of maternal caribou could occur on up to 26,648 acres (less than 1 percent) of the high use calving area (2 percent of high use calving within the program 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. Alternative C would be less likely to affect calf survival and overall herd numbers compared to Alternative B. Caribou abundance for Kaktovik, Arctic Village, and Venetie would not be significantly impacted.

Waterfowl

The types of potential impacts on subsistence waterfowl species would be similar to those described under Alternative B; however, Alternative C, provides greater protections for avian habitats. Under Alternative C, 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 a larger NSO area would apply, including the entire Canning River delta. While periodic and temporary impacts on waterfowl availability could still occur from future oil and gas exploration, development, and production, they are not anticipated to cause large-scale impacts on waterfowl availability that would extend outside the program area.

Subsistence Access

The types of impacts to subsistence access would be similar to those described under Alternative B; however, the intensity of these impacts would be substantially less under Alternative C due to the decrease in expected development infrastructure and limits on the density of development. Under Alternative C, there would be a larger area of high overlapping subsistence use for Kaktovik which would subject to NSO stipulations. The area south of Kaktovik between the Okpilak and Jago rivers, an area of high overlapping use for caribou and furbearers, would continue to be available for lease sale and subject to standard terms

and conditions. In addition, an area of moderate overlapping use near the Sadlerochit River would also be subject to standard terms and conditions under Alternative C. Therefore, impacts to subsistence access would likely occur under Alternative C but at a lower intensity than under Alternative B.

F.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).

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

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

F.2.4.4 Findings

Alternative C 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.

F.2.4 Evaluation and Finding for Alternative D

Section C.8.5, Alternative D in **Appendix C** anticipates that one CPF would be built under Alternative D in either a high potential area near the Tamayarick or Katakturuk rivers, or in the medium potential area south of Kaktovik. This scenario estimates that one CPF and associated airstrips, six satellite pads, and 100 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. An estimated 1,040 acres of surface disturbance would occur in the high and medium potential areas.

Approximately 797,700 acres would be closed to leasing under Alternative D (**Table 2-1** in **Chapter 2**). Of the remaining 765,800 acres available for leasing, 726,300 would be subject to NSO, 15,900 would be subject to CSU, 1,800 would be subject to TLs, and 21,800 would be subject to standard terms and conditions only. **Map 2-5**, Alternative D, and **Map 2-6**, Alternative D, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, TLs, and areas subject to only to standard terms and conditions would be adopted.

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

Abundance and Availability

Fish

The types of potential impacts on fish would be similar to those described under Alternative C, although future facility locations may differ due to the lands available for lease and surface occupancy. Lease stipulations under Alternative D would provide more protection for fish habitat compared to Alternatives B and C. 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

The types of potential impacts on marine mammals such as whales and seals would be similar to those described under Alternative B, although future facility locations may differ due to the lands available for lease and surface occupancy. Under Alternative D, oil and gas exploration operations, including seismic activity, would not be permitted during the open water season (May 15 through November 1), thus reducing impacts on resource availability for marine mammal hunters. 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 lower under Alternative D compared to Alternatives B and C, as an estimated 1,040 acres of surface disturbance would occur in the program area. Alternative D would also require Master Development Plans for each field development, which would have the effect of reducing development footprints and encouraging joint use of infrastructure. Alternative D would have fewer acres available for leasing compared to Alternatives B and C and the largest number of acres subject to NSOs. As a result, Alternative D would have the fewer impacts on caribou than Alternatives B and C. 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 and C. ROP 23 would apply under Alternative D and would require additional measures regarding monitoring and consultation, including the development of Adaptive Research and Management Plans. Lease Stipulation 6 would be adopted as part of a suite of mitigation measures. These measures would sufficiently address collision risk and impacts to caribou during calving, post-calving, and insect-relief periods. 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 C. It is likely that roads will cross areas with NSO restrictions in order to access leased areas, and these roads would likely cause some deflection and displacement of caribou. Under Alternative D, lease sales or surface occupancy would be prohibited in areas more frequently used by the Central Arctic Herd during the summer season, thus lessening the potential for impacts to Nuiqsut hunters along the Colville River Delta. Impacts to caribou movement under Alternative D would not significantly affect the availability of caribou for subsistence use by Kaktovik residents.

Under Alternative D, no leasing would be allowed within the Porcupine Caribou Herd comprehensive calving habitat area, which includes all current Porcupine Caribou Herd calving habitat (Lease Stipulation 6). In addition, no CPFs would be allowed in the Porcupine Caribou Herd comprehensive post-calving habitat area and other infrastructure would be limited to 510 acres total. Only 100 acres of current and predicted future Porcupine Caribou Herd calving areas would be available for leasing under standard terms and conditions. Displacement of maternal caribou associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative C, 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.

Waterfowl

The types of potential impacts on waterfowl would be similar to those described under Alternative C, although future facility locations may differ due to the lands available for lease and surface occupancy. Lease stipulations under Alternative D would provide more protection for waterfowl habitat compared to Alternatives B and C. Several areas to the west of the community along the coast, including Brownlow Point, which is a waterfowl hunting area, would continue to be available for lease and subject to only standard terms and conditions. While periodic and temporary impacts on waterfowl could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect overall waterfowl availability or abundance for residents of Kaktovik or for communities outside the program area.

Subsistence Access

The types of impacts to subsistence access would be similar to those described under Alternative B; however, the intensity of these impacts would be substantially less under Alternative D due to the decrease in expected development infrastructure and limits on the density of development. Alternative D would include fewer areas of high overlapping subsistence use for Kaktovik that would allow surface occupancy. Several areas to the west of the community along the coast would continue to be available for lease and subject only to standard terms and conditions, including an area at Brownlow Point which is an important coastal caribou and waterfowl hunting and fishing area. Thus, impacts to subsistence access may still occur but would be greatly reduced under this alternative when compared with Alternatives B and C.

F.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).

F.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 SEIS, Alternative D offers the fewest number 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.

F.2.5.4 Findings

Alternative D 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.

F.2.5 Evaluation and Finding for Alternative D2

Section C.8.5, Alternative D2 in **Appendix C** anticipates that one CPF would be built under Alternative D2 in the area within the northwest portion of the program area that has the highest hydrocarbon potential. This scenario estimates that one CPF and associated airstrip, 3 satellite pads, and 110 miles of road, a seawater treatment plant, and one barge landing and storage pad would be built. An estimated 995 acres of surface disturbance would occur in the high and medium potential areas.

Approximately 1,163,500 acres would be closed to leasing under Alternative D2, the highest of any alternative (**Table 2-1** in **Chapter 2**). Of the remaining 400,000 acres available for leasing, 231,700 would be subject to NSO, 84,300 would be subject to CSU, 3,100 would be subject to TLs, and 80,900 would be subject to standard terms and conditions only. **Map 2-7**, Alternative D2, and **Map 2-8**, Alternative D, Lease Stipulations, in **Appendix A** illustrate where NSO, CSU, TLs, and areas subject to only to standard terms and conditions would be adopted.

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

Abundance and Availability

Fish

The types of potential impacts on fish would be similar to those described under Alternative D, although future facility locations may differ due to the lands available for lease and surface occupancy. Compared to the other action alternatives, Alternative D2 would reduce the number of stream miles, and watershed, lacustrine, and deep lake habitat acres available for lease sale (**Section 3.3.2**, Fish and Aquatic Species). Lease stipulations under Alternative D2 would provide more protection for fish habitat compared to Alternatives B, C, and D, as no permanent oil and gas infrastructure would be permitted between the coast up to two miles inland. Additional protections would include additional restrictions on exploratory drilling and seismic surveys, and additional timing limitations and reporting requirements. Alternative D2 includes similar setbacks to Alternative D along key subsistence drainages, although unlike Alternative D, unnamed rivers would not be protected with a 0.25 setback, and exceptions to the NSO may be granted in areas not available for lease. 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

The types of potential impacts on marine mammals such as whales and seals would be similar to those described under the other action alternatives, although future facility locations may differ due to the lands available for lease and surface occupancy. Under Alternative D2, oil and gas exploration operations, including seismic activity, would not be permitted during the open water season (May 15 through November 1), thus reducing impacts on resource availability for marine mammal hunters. In addition, nearshore impacts on marine mammal hunting would likely be reduced under Alternative D2 compared to the other action alternatives because infrastructure would not be permitted within two miles of the coast. Of all the action alternatives, Alternative D2 would close more maternal polar bear denning habitat to leasing. Despite the smaller area available for leasing and allowing surface occupancy, it is likely that roads will still cross areas with no surface occupancy in order to access leased areas, and therefore impacts may occur in these areas related to road infrastructure and traffic.

Caribou

Direct habitat loss or alteration from future oil and gas exploration, development, and production would be lowest under Alternative D2, as an estimated 995 acres of surface disturbance would occur in the program area, compared to 1,040 acres for the next lowest alternative (Alternative D). Similar to Alternative D, Alternative D2 would also require Master Development Plans for each field development, which would have the effect of reducing development footprints and encouraging joint use of infrastructure between alternatives. Alternative D2 would have the most acres unavailable for lease sale, including key caribou

subsistence use areas along the Hulahula, Okpilak, and Jago rivers, and key coastal hunting areas directly east of Kaktovik and in Camden Bay. Under Alternative D2, no areas of high or moderate overlapping use for Kaktovik would be open to surface occupancy under Alternative D2. This would substantially reduce the amount of area where direct impacts on subsistence users may occur. As a result, Alternative D2 would have the lowest impacts on caribou abundance and availability of any action 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 the other action alternatives but would occur less frequently due to the smaller road system. ROP 23 would apply under Alternative D2 and would require additional measures regarding monitoring and consultation, including an Adaptive Research and Management Plan. Lease Stipulation 6 would be adopted as part of a suite of mitigation measures. These measures would sufficiently address collision risk and impacts to caribou during calving, post-calving, and insect-relief periods. 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 D. It is likely that roads will cross areas with NSO restrictions in order to access leased areas, and these roads would likely cause some deflection and displacement of caribou. Under Alternative D2, similar to Alternative D, lease sales or surface occupancy would be prohibited in areas more frequently used by the Central Arctic Herd during the summer season, thus lessening the potential for impacts to Nuiqsut hunters along the Colville River Delta. Impacts to caribou movement under Alternative D2 would not significantly affect the availability of caribou for subsistence use by Kaktovik residents.

Under Alternative D2, no leasing or surface occupancy would be allowed in Porcupine Caribou Herd calving grounds used more than 30 percent of years, and only 8,000 acres of predicted calving habitat would be open to leasing under standard terms and conditions (**Section 3.3.4**, Terrestrial Mammals). In addition, only 1,900 acres of current or predicted Porcupine Caribou Herd post-calving habitat would be open to leasing under standard terms and conditions. Lease areas would be limited to the western and northern portions of the program area, which would reduce infrastructure and activity in primary calving and post-calving areas. However, these areas may see more use in the future due to Displacement of maternal caribou associated with future oil and gas development in the Coastal Plain would be similar to that expected under Alternative D, 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.

Alternative D2 would require additional consultation with local traditional knowledge holders regarding routes, locations, and designs for off-road travel, ice roads, snow trails, power lines, pipelines, road crossings, mine sites. Such consultation could help reduce impacts to subsistence resources and users.

Waterfowl

The types of potential impacts on waterfowl would be similar to those described under Alternative D, although future facility locations may differ due to the lands available for lease and surface occupancy.

Under Alternative D2, the fewest acres of avian habitat would be available for leasing, thus reducing potential impacts to waterfowl and other birds (**Section 3.3.3**, Birds). Lease stipulations under Alternative D2 would provide more protection for waterfowl habitat compared to the other action alternatives. Lease stipulations under Alternative D2 would provide more protection for waterfowl habitat as no permanent oil and gas infrastructure would be permitted from the coast up to two miles inland. However, exceptions to the NSO may be granted in areas not available for lease. In addition, no oil and gas activities would be permitted in coastal areas between 15 May and 1 November, overlapping with the primary waterfowl hunting season for Kaktovik (May and June). Alternative D2 includes similar setbacks to Alternative D along key subsistence drainages, but with greater setbacks along Marsh and Carter creeks. Unlike Alternative D, there would be no setback from unnamed rivers, and exceptions to the NSO may be granted in areas not available for lease. Of all the action alternatives, Alternative D2 would likely affect the fewest number of waterbirds. While periodic and temporary impacts on waterfowl could still occur from future oil and gas exploration, development, and production, they are not anticipated to affect overall waterfowl availability or abundance for residents of Kaktovik or for communities outside the program area.

Subsistence Access

The types of impacts to subsistence access would be similar to those described under the other action alternatives; however, the intensity of these impacts would be less under Alternative D2 due to the decrease in expected development infrastructure and limits on the density of development. Alternative D2 would include the least number of areas of high or moderate overlapping subsistence use for Kaktovik with areas that would allow surface occupancy and would have the most acres unavailable for lease sale, including key subsistence use areas along the Hulahula, Okpilak, and Jago rivers, and key coastal hunting areas. Thus, impacts to subsistence access may still occur but would be greatly reduced under this alternative when compared with the other action alternatives.

F.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).

F.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 SEIS, Alternative D2 offers the fewest acres of public lands for leasing, representing the statutory minimum of leasing acreage allowable under PL 115-97. Alternative A, the No Action Alternative, would not allow oil and gas leasing to occur.

F.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.

F.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 SEIS, 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 G.3.2** in **Appendix G**. 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:

- Seismic exploration
- Expansion of the CD5, Nuna, GMT1, and GMT2 developments in the Colville River Region
- Development of the Willow, Nuna, and Nanushuk Projects in the Colville River Region
- Development projects in the Beaufort Sea, including the existing Endicott and Northstar projects, and proposed Liberty project
- Continued development of the Point Thomson project
- Development of a natural gas pipeline from the North Slope to Cook Inlet (Alaska LNG Pipeline)
- Infrastructure projects including those developed through the Arctic Strategic Transportation and Resources (ASTAR) program
- Ongoing recreational activity
- Continued and increased marine vessel traffic and air traffic
- Ongoing impacts of climate change

F.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 G.2.2** in **Appendix G**. These actions fall into 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 are 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, 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. These restrictions would include physical obstructions which could affect how residents access subsistence use areas, and industry security policies which restrict access in the vicinity of oil and gas infrastructure. 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 C**). Future development associated with the Leasing SEIS 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 Alternatives B and C. 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, D, 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 in the coastal area and under Alternative D2 would prohibit permanent oil and gas infrastructure two miles inland from the coast. ROPs 18, 20, and 23 would require that roads and other infrastructure be designed 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 and would prohibit hunting, trapping, and fishing by lessees, operators, and contractors when on work status. 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. For the 10-year period (2010-2019), Kaktovik harvested an average of 2.1 polar bears/year (range 0 to 6 bears/year; Woodruff et al. 2020). ROP 40 would require development of marine mammal monitoring and mitigation plans to evaluate the effects of development on polar bears and subsistence uses of these species. All future development plans would be subject to the BLM review prior to approval and provide reports to the BLM and USFWS.

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

Public testimony indicates that residents believe conflict avoidance and subsistence access plans help to mitigate potential impacts to subsistence. However, residents also report ongoing residual impacts, particularly when mitigation is perceived to be implemented in an ineffective way (SRB&A 2013). Access patterns have changed in response to development on the North Slope, and residents still report feeling "boxed in" by existing development (SRB&A 2018). Potential impacts to subsistence access would likely be mitigated but not eliminated under Alternatives B, C, D, 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 Porcupine Caribou Herd availability would not affect Nuiqsut, as their caribou subsistence use area does not overlap with the Porcupine Caribou Herd range nor is there documented harvest of Porcupine Caribou Herd by Nuiqsut, although Nuiqsut harvesters have reported some harvesting from this herd in the past. Cumulative impacts to Porcupine Caribou Herd would not significantly impact residents of Nuiqsut under all alternatives. Nuiqsut residents harvest from the Central Arctic Herd when they migrate toward and into the Colville River Delta during the summer months; however, the Project is not expected to cause herd-level impacts on the availability or abundance of the Central Arctic Herd (**Section 3.3.4,** Terrestrial Mammals). Cumulatively, current and future oil and gas development projects west of the program area, in combination with development in the program area, could alter the behavior and movements of Central Arctic Herd caribou, resulting in energetic costs that could have demographic impacts if disturbances are frequent (**Section 3.3.4**, Terrestrial Mammals).

Ongoing and future actions along the coast may contribute to impacts to caribou availability. Availability impacts may result from changes in caribou distribution, movement, and behavior resulting from development infrastructure and activities. Impacts to caribou availability for Kaktovik resulting from aircraft and vehicle disturbance are described below in *Transportation*. Displacement of caribou around roads and other infrastructure could affect availability to Kaktovik hunters. While roads may cause deflection, Kaktovik hunters may also use the roads to access areas where caribou are located, thus providing a mitigative effect. Road use may affect overall subsistence patterns for the community, resulting in a concentration of hunting activities along the road system while also reducing opportunities to transmit traditional knowledge about traditional harvesting practices and locations.

Direct habitat loss for the Porcupine Caribou Herd is most likely to occur under Alternative B, as are impacts to calf survival and overall herd abundance. Analyses of potential impacts on the Porcupine Caribou Herd resulting from development of the program area (Russell and Gunn 2010; Russell et al. 2021) concluded that changes in caribou behavior, such as increased time running and less foraging, would lead to changes in body condition and thus affect pregnancy and calf survival rates. As a result, the models predict a population decline of between 17 and 18 percent under Alternative B; and between 7 and 9 percent under Alternative C. They also predicted a decline of between 6 and 9 percent for Alternative D2 in the Final EIS; however, Alternatives D and D2 of the SEIS have more protections for caribou and therefore any declines would likely be lower than those predicted for FEIS Alternative D2 (**Section 3.3.4**, Terrestrial Mammals). The models are based on various assumptions, some of which are not consistent with the

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

alternatives or hypothetical development scenario in the SEIS or are not consistently supported by the literature; thus, the conclusions may overestimate the effects on the Porcupine Caribou Herd. However, any decline in the abundance of the Porcupine Caribou Herd could have impacts on subsistence harvests through a reduction in hunting success or changes in resource management and harvest regulations.

Alternative B would have the greatest cumulative impacts on caribou because of the larger potential for development in Porcupine Caribou Herd calving grounds and the decreased availability of alternative calving grounds under that alternative. If Porcupine Caribou Herd primary calving habitat shifts eastward into areas with suboptimal forage and higher predation, then calf survival could decrease (Griffith et al. 2002, Russell and Gunn 2019). If calving shifts to the west in the future, as predicted due to warming temperatures, displacement of calving caribou would be even greater due to larger concentrations of infrastructure (**Section 3.3.4**, Terrestrial Mammals).

If oil and gas activities, in combination with climate change and other reasonably foreseeable actions such as changes in harvest regulations and increased sport hunting and recreation, result in a decline in Porcupine Caribou Herd abundance, then residents of Kaktovik, Arctic Village, Venetie could experience declines in Porcupine Caribou Herd harvest success and harvest amounts. Impacts would be particularly likely for communities with a high reliance on the Porcupine Caribou Herd who would not also experience economic benefits from the increased development; these would include the communities of Arctic Village and Venetie, in addition to Gwich'in and Inuvialuit communities in Canada. In addition, other Gwich'in communities who harvest from the Porcupine Caribou Herd or receive Porcupine Caribou Herd caribou through sharing networks could also experience impacts through a decline in harvests and sharing. A decline in caribou for the Gwich'in, who refer to themselves as the "Caribou People" and view the Arctic Refuge as sacred ground, could have larger cultural and spiritual impacts.

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

Cumulative impacts would also occur to the availability of other subsistence species such as fish, waterfowl, vegetation, and marine mammals. Development of the program area, in combination with future oil and gas development in surrounding onshore and offshore areas, increased marine, ground, and air traffic, and construction of new infrastructure projects could cause changes in resource behavior and distribution of these species, thus reducing their availability to subsistence users. Such cumulative impacts would be particularly likely under Alternative B where larger areas would be open to leasing and surface occupancy.

The increased risk of a large-scale oil spill in the cumulative case could affect the health and abundance of certain resources such as fish and waterfowl (see **Section 3.3.**3 and **Section 3.3.4)**, cause avoidance of subsistence foods due to real or perceived contamination, and cause cultural and spiritual impacts due to degradation of the land, water, and subsistence resources. If the cumulative case results in reduced availability of subsistence species, or reduces access to traditional harvesting areas, residents may have to spend greater amounts of time, effort, and money in order to locate and procure these species.

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, D, and D2. Increased shipping within the Beaufort Sea could affect the availability and health of marine species for Nuiqsut and Kaktovik subsistence users, as both communities have reported impacts of vessel traffic on whaling activities as well as hunting of other marine mammal species such as seals. Harvesters may adapt to such changes by traveling farther looking for marine mammal resources, at greater risk to safety, or increasing the amount of effort and time spent on harvesting land-based resources.

Under each alternative, NSOs, TLs, and ROPs would be sufficient to mitigate but not eliminate 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. Construction of additional roads and infrastructure in the future would also contribute to fragmentation of habitat for such resources as caribou, moose, and waterfowl. 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. . However, 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, although increased use of roads throughout the program area for subsistence activities could result in competition between subsistence users along these corridors and contribute to deflection of resources such as caribou away from roads.

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. If roads, such as the Dalton Highway, connect to a road system within the program area and facilitate access by non-local hunters, then residents could experience increased competition from non-local hunters harvesting caribou and other resources in traditional hunting areas. However, there is a low likelihood of industrial roads in the program area becoming open to public use. 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, D, 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, D, and D2. Caribou could be disturbed during aerial surveys, but impacts would be short-lived. Frequent disturbances during peak hunting times could cause larger impacts to harvester success on an annual basis. The availability of subsistence resources would not be significantly impacted by research activities under the cumulative case if Alternatives B, C, D, 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, D, or D2 are selected. Comparatively more projects may occur in or near Kaktovik if Alternatives C, D, 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 affects the habitat, behavior, distribution, and populations of fish and wildlife within the program area. It could impact access to these resources. Development of the program area would contribute to ongoing and future impacts of climate change. Specifically, impacts of oil and gas exploration and development on user access to subsistence harvesting areas would be compounded by climate change impacts on access, including melting permafrost and decreased snow and ice cover which affect snowmachine travel. Climate change, in combination with development of the program area and other reasonably foreseeable developments, could result in greater impacts to subsistence access and greater risks to harvester safety as residents travel farther to access subsistence resources.

Impacts on resource abundance and health from development of the program area, particularly under Alternative B which would open up greater amounts of calving grounds to leasing and development, would also be compounded by climate change effects on resources. Climate change may already have been a factor in the population declines of caribou in the Arctic over the previous two decades and is expected to change survival rates and distribution of terrestrial mammals in the future (**Section 3.3.4**, Terrestrial Mammals). Climate change may affect vegetation composition and reduce forage quality, which could be compounded by habitat loss resulting from development infrastructure. Increased rain-on-snow events could increase mortality events, and increased insect harassment and parasites could affect calving rates. Cumulative impacts on the abundance and availability of fish, waterfowl, and marine mammal species could also result from increased predation on nests, long-term to permanent loss and alteration of habitat, and increased disturbance, in combination with the ongoing impacts of climate change. Such impacts would extend

throughout the program area and to communities outside the program area who utilize these species through harvests and sharing networks.

Changes in the timing and location of resource migrations due to warmer temperatures would be compounded by oil and gas development if infrastructure further deflects or delays caribou and other resource migrations such as waterfowl and marine mammals. Changes in resource distribution resulting from changes in suitable foraging habitat, combined with decreased available habitat due to development infrastructure, may also result in changes to resource distribution. The trends in climate change that were described in the BLM 2018 are expected to continue.

F.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).

F.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).

F.2.6.4 Findings

The cumulative case, when taken in conjunction with Alternatives B, C, D, 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, D, 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, caribou, and waterfowl. A positive determination pursuant to ANILCA Section 810 is required.

F.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 it made a positive finding pursuant to ANILCA Section 810 that the cumulative case presented in the SEIS met the "may significantly restrict" threshold for Kaktovik. As a result, a public hearing was held in the potentially affected community of Kaktovik; in addition, at the request of the Gwich'in Tribes, public hearings were held in Arctic Village, Venetie, Fort Yukon and Utqiagvik despite not having a positive "may significantly restrict" findings. By holding these additional subsistence hearings, the BLM avoided having to later hold hearings in these communities in the event the final 810 evaluation made positive findings for those communities. Ultimately, a positive finding was not made for the Gwich'in communities because the final evaluation did not find population-level effects to the Porcupine Caribou Herd would occur as a result of the leasing program (see Section E.4, below). Notice of these hearings were provided in the *Federal Register* and in local media with coverage to all villages on the North Slope. The hearing dates and times were posted on BLM's website at https://eplanning.blm.gov/eplanning-ui/project/2015144/510.

F.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 final evaluation that the cumulative case considered in this Leasing SEIS may significantly restrict subsistence uses for the community of Kaktovik. Accordingly, the BLM undertook the notice and hearing procedures required by ANILCA Section 810 (a)(1) and (2), in conjunction with releasing the draft SEIS 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), and are based on BLM's preferred alternative as identified in the Final Supplemental Leasing EIS (Alternative D2).

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

BLM undertook the Supplemental 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 D2, the preferred alternative, will provide the opportunity, subject to appropriate conditions developed through the NEPA process, to conduct the second of 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.

F.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 D2 involves the minimal amount of public lands necessary to accomplish the purpose and need of the Supplemental 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 no more than 2,000 acres of public lands may be used for production and support facilities. Alternative D2 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 D2 best meets the purpose and need of the oil and gas program while ensuring that the other four, resource protection purposes of the Arctic Refuge are properly accounted for. 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.

F.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 D2.

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 D2 includes reasonable steps to minimize adverse impacts on subsistence uses and resources.

F.5 REFERENCES

BLM (Bureau of Land Management). 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 and USFWS GIS. 2022. GIS data used in the Coastal Plain Oil and Gas Leasing Program EIS alternatives, affected environment, and impact analysis.

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). 2018. Nuiqsut Paisaŋich: A 2018 Addendum. Prepared for the City of Nuiqsut. Anchorage, Alaska.

_____. 2013. Aggregate Effects of Oil Industry Operations on Iñupiaq Subsistence Activities, Nuiqsut, Alaska: A History and Analysis of Mitigation and Monitoring. OCS Study BOEM 2013-212. U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska Outer Continental Shelf Region. Anchorage, Alaska. Internet website: https://srbak.squarespace.com/s/SRBA-2013-Aggregate-Effects-of-Oil-Industry-O.pdf.

_____. 2009. Impacts and Benefits of Oil and Gas Development to Barrow, Nuiqsut, Wainwright, and Atqasuk Harvesters. Prepared for North Slope Borough, Department of Wildlife Management. Anchorage, Alaska. Internet website: https://srbak.squarespace.com/s/SRBA-2009-Impacts-and-Benefits-of-Oil-and-Gas.pdf.

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.

Woodruff, S., C. Hamilton, S. Miller, M. St. Martin, J. Wilder, and R. Wilson. 2020. U.S. Fish and Wildlife Service Polar Bear Program Annual Summary Report of Activities, 2019. U.S. Fish and Wildlife Service ,Marine Mammals Management. Anchorage, AK. 32pp.

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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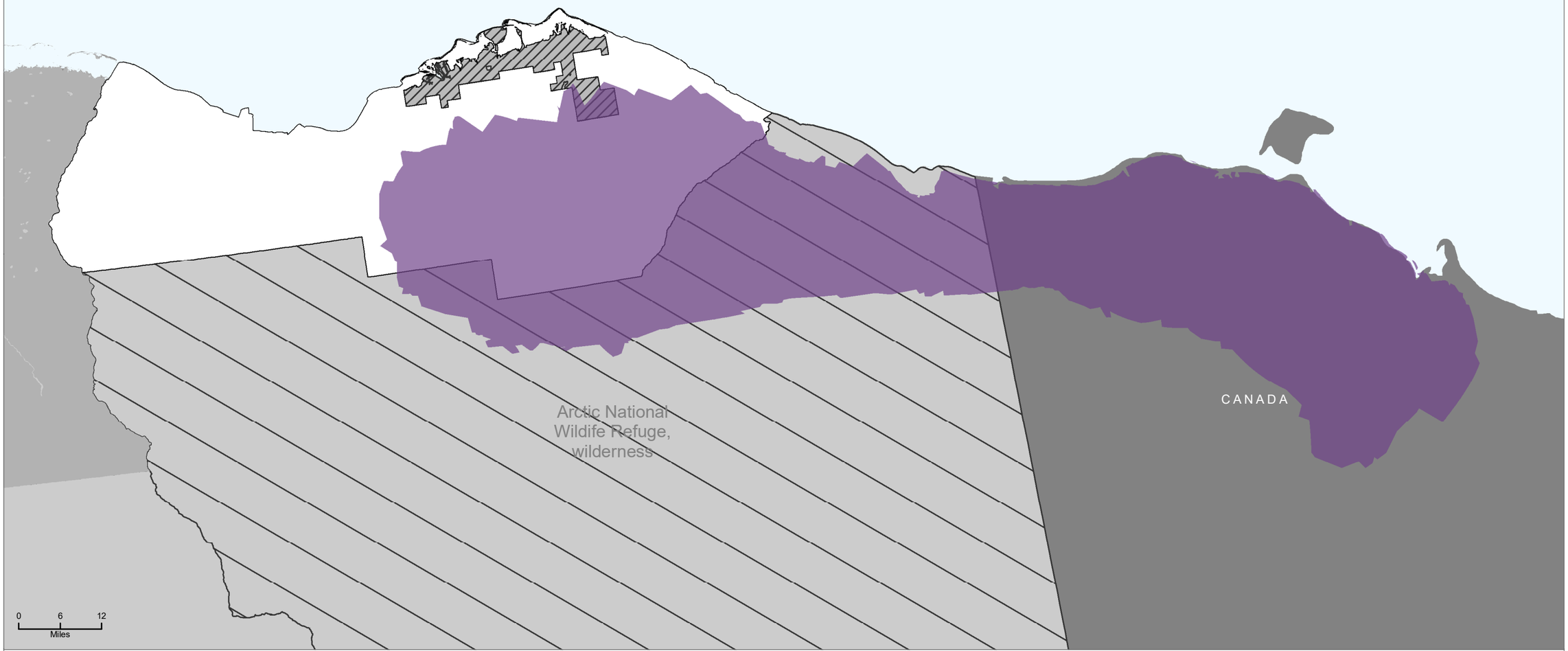
High Use Porcupine Caribou Herd Calving Area

U.S. DEPARTMENT OF THE INTERIOR | BUREAU OF LAND MANAGEMENT AND FISH AND WILDLIFE SERVICE | ALASKA |
COASTAL PLAIN OIL AND GAS LEASING PROGRAM SUPPLEMENTAL EIS |

Calving period, just cows and calves
May 26–June 10
Years of data: 37



Percent of years of caribou are present
- ≥40%

- Arctic National Wildlife Refuge, wilderness
- State
- Fish and Wildlife Service

- Coastal Plain Supplemental EIS boundary
- 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 2022, USFWS GIS 2022
Print Date: 07/21/2023

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

Lease Stipulations	Alternative A	Alternative B	Alternative C	Alternative D	Alternative D2
No surface occupancy/not offered for lease sale	728,300	135,500	713,900	714,100	728,000
Timing limitation	0	564,900	0	1,700	0
Controlled surface use	0	0	5,400	7,500	0
Subject to standard terms and conditions	0	27,900	8,900	4,900	0

Source: BLM and USFWS GIS 2022

Table F-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 D		Cumulative	
			Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability	Abundance	Availability
Fish	Habitat loss or alteration	Site-specific	0	0	1	1	0	0	0	0	1	2
Fish	Disturbance or displacement	Regional	0	0	1	1	0	0	0	0	1	2
Fish	Injury or mortality	Site-specific	0	0	1	1	0	0	0	0	1	2
Marine mammals	Injury or mortality	Site-specific	0	0	1	0	1	0	1	0	2	0
Marine mammals	Disturbance or displacement	Regional	0	0	0	1	0	1	0	1	0	2
Caribou	Habitat loss or alteration	Site-specific	0	0	0	1	0	1	0	1	0	2
Caribou	Mortality or injury	Site-specific	0	0	1	0	1	0	1	0	1	0
Caribou	Altered movement	Local	0	0	0	2	0	2	0	2	2	2
Caribou	Altered behavior	Local	0	0	0	2	0	1	0	1	2	2
Caribou	Displacement of maternal caribou	Regional	0	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.
3. Determinations are made based on discussion of impacts to resource availability and abundance in Section 3.4.3, Impacts Common to All Alternatives (Particularly Noise, Traffic, and Human activity, Infrastructure, and Contamination), and Cumulative Impacts.

Table F-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 D		Cumulative	
			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	2	3
Marine mammals	Use of traditional marine mammal hunting areas	Local	0	0	1	1	0	0	0	0	2	3
Caribou	Use of traditional caribou hunting areas	Local	0	0	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.
3. Determinations are made based on discussion of impacts to user access in Section 3.4.3, Impacts Common to All Alternatives (Particularly Infrastructure, Contamination, and Lega or Regulatory Barriers), and Cumulative Impacts.

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Appendix G

Approach to the Environmental Analysis

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Appendix G. Approach to the Environmental Analysis

G.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) 1502.16 (Environmental Consequences); 1502.23 (Methodology and Scientific Accuracy); 40 CFR 1508.1 (Definition of Effects or Impacts). CEQ regulations require that agencies evaluate the impact of all alternatives. Since the action alternatives presented in this supplemental environmental impact statement (SEIS) 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.

G.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.

G.2.1 Monetized Impacts from GHG Emissions

The "social cost of carbon", "social cost of nitrous oxide", and "social cost of methane" – together, the "social cost of greenhouse gases" (SC-GHG), are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year. This subsection provides estimates of the monetary value of changes in GHG emissions that could result from selecting each alternative. Such analysis should not be construed to mean a cost determination is necessary to address potential impacts of GHGs associated with specific alternatives. While these numbers provide a monetized measure of the net harm to society from emissions, they do not constitute a complete cost-benefit analysis of management actions under consideration and do not offer a direct comparison with other impacts discussed in this document. SC-GHG estimates are provided only as a useful measure of the benefits of GHG emissions reductions to inform agency decision-making.

The best currently available estimates of the SC-GHG for use in Department of the Interior decision-making and/or analysis are those cited in the Environmental Protection Agency's Final Rule of March 8, 2024, 89 Fed. Reg. 16820, 17018-20. These estimates reflect recent advances in the scientific literature on climate change and its economic impacts and incorporate recommendations made by the National Academies of Science, Engineering, and Medicine (National Academies 2017). Technical documentation and additional supporting documents regarding these estimates are available on the EPA webpage[1].

The EPA's SC-GHG estimates were developed using complex models that simulate how changes in GHG emissions may affect global temperatures, sea level rise, and other biophysical processes; how these changes may affect human health and infrastructure, as well as the supply of energy, food, and water; and monetize the market and nonmarket impacts associated with these effects. The modular approach employed by EPA to estimate the SC-GHG also includes a discounting module that discounts the stream of future net climate damages back to the year when the additional unit of emissions was released. EPA discounts the future costs of emissions to the emission year using three different near-term target rates (1.5%, 2.0%, and 2.5%) to reflect uncertainty over the starting rate (EPA 2023). A higher discount rate assumes that future benefits or costs are more heavily discounted than benefits or costs occurring in the present (i.e., future benefits or costs are a less significant factor in present-day decisions).

[1] https://www.epa.gov/environmental-economics/scghg

The SC-GHG associated with estimated emissions from future development of minerals leased within the Coastal Plains planning area are reported in **Table G-1**. These estimates represent the present value of future market and nonmarket societal costs associated with CO_2, CH_4, and N_2O emissions, with future costs discounted back from the emissions year to the analysis year of 2024 by applying a constant discount rate equal to the near-term target rate. Estimates are calculated using EPA's Workbook and based on estimates of future emissions developed by BLM. Although the EPA's SC-GHG Workbook discounted social costs in 2020 real dollars, the workbook rounds results to the nearest $1 million and adjusts discounted future costs for inflation (using a GDP deflator) to enable 2023 dollars. In summary, values reported in Table G-1 represent the monetized value in real 2023 dollars of future societal costs stemming from additional emissions discounted back to 2024.

Table G-1
Social Cost of GHG Associated with Future Potential Development[1]

Alternative	Present Value of Social Cost of All GHG Emission Changes (millions, 2023$)		
	2.5% near-term Ramsey discount rate	2.0% near-term Ramsey discount rate	1.5% near-term Ramsey discount rate
Alternative B	$30,751	$51,813	$91,234
Alternative C	$28,862	$48,583	$85,469
Alternative D	$12,391	$20,733	$36,276
Alternative D2	$10,094	$16,875	$29,499

[1] These values represent the monetized value in real 2023 dollars of future societal costs discounted back to 2024.

G.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 1508.1[g][3]), a cumulative impact is as follows:

> …the impact on the environment that results from the incremental effects 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 SEIS, 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 could further reduce any cumulative impacts.

G.3.1 Method

The method used for cumulative impacts analysis in this SEIS 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 timeframes, 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 SEIS, 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 C**), which is anticipated to occur approximately 50 years after the Record of Decision for this SEIS 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 G.4**, below.

G.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 SEIS, 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 SEIS. Projects and activities considered in the cumulative effects analysis are summarized in **Table G-2** and are discussed in more detail below.

Table G-2
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, including seismic exploration • Infrastructure development • Seasonal and permanent roads • Pipelines • Gravel mining • Geotechnical borehole surveys • Construction and maintenance • Exploration activities associated with drilling • Production wells • Surface, air, and marine traffic (including noise) • 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.

Category	Area	Actions/Activities	Description
Transportation (*separate from oil and gas*)	● Surface ● Air ● Marine	● Roads and vehicular traffic and noise in communities ● International marine vessel traffic ● Shipping/barging to Kaktovik ● Aircraft traffic ● Winter trail ROW for access to inholdings (ANILCA Section 1110)	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 including commercial polar bear viewing ● Wilderness experience ● 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.
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 culminated with the first oil production at Prudhoe Bay in 1977 BLM and surveys.

Both onshore and offshore reasonably foreseeable present and 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 SEIS. The following reasonably foreseeable present and future onshore oil and gas projects are included in the cumulative effects analysis:

- **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. to expand CD-5 up to its full 43-well slot capacity; the project is exceeding its original production target of 16,000 barrels of oil per day (BOPD) gross, and is currently producing approximately 37,000 BOPD gross average, year to date. The company has drilled Alaska's 10 longest wells there, with one measuring over 33,000 feet in horizontal distance.
- **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; it currently has seven wells. Recent production from GMT1 has averaged about 20,000 BOPD. The Greater Mooses Tooth-2 (GMT2) is located 8 miles southwest of GMT1. First production occurred in December 2020. The 14-acre gravel pad can support up to 48 wells. The 8.2-mile gravel road and pipeline connect through GMT1 and then on to Alpine CPF. Production is approximately 20,000 BOPD.
- **Nuna**—This project will be developed from the 3T drill site within ConocoPhillips' Kuparuk River Unit (KPU), located just east of the Colville River and approximately 5 miles southwest of the Oooguruk Field. The Nuna project will add 29 development wells, on-pad infrastructure, and pipelines that tie back to existing KPU processing facilities. Construction activities will begin in 2023 and continue in 2024 with pipeline and on-pad construction. A gravel road and pad to the site were constructed in 2019 by Caelus for drill site 3T, which transferred its Nuna acreage to ConocoPhillips in 2019. Drilling is anticipated to begin in late 2024, with first oil anticipated by early 2025. Production is expected to peak at 20,000 BOPD.

- **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 would enable applicants to construct, operate, and maintain up to three drill sites with up to 50 well on each pad, a central processing facility, an operations center pad, gravel roads, ice roads and ice pads, one to two airstrips, a module transfer island, pipelines and a gravel mine site on BLM-managed lands within the NPR-A. Production from Willow is estimated at 180,000 BOPD. A SEIS has been finalized and 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. In 2020, net crude oil production at Kuparuk averaged 52 million barrels of oil equivalent a day.
- **Point Thomson**—The Point Thomson development covers an area of approximately 150 square miles. It is located approximately 60 miles east of Prudhoe Bay on the coast of the Beaufort Sea. The Point Thomson field is estimated to hold eight trillion cubic feet of natural gas and is designed to produce up to 10,000 bpd of gas condensate. First production from the field was achieved in April 2016. Gas condensate produced at Point Thomson is shipped via a 22-mile insulated pipeline to Pump Station 1 on the Trans-Alaska pipeline system. The project includes production pads, process facilities, an infield road system, a pipeline, infield gathering lines, and an airstrip.
- **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.
- **Endicott Project—**this offshore oil and gas project is located on a 45-acres artificial island located in the Beaufort Sea, 15 miles from Prudhoe Bay and 2.5 miles from the coast. The island was constructed in 1987 and has been in production since, producing almost 20,000 barrels of oil per day. The island is connected to the mainland by a causeway, which is used to transport oil via pipeline from the island to the Trans-Alaska pipeline.
- **Liberty Project**—The Liberty Prospect (Hillcorp Alaska, LLC) is located in the Beaufort Sea, about 5.5 miles from the coast and 8 miles east of the Endicott oil field. It is estimated that the Liberty Unit contains approximately 150 million barrels of recoverable, high quality crude oil. The proposed project consists of a drilling and production island and a new pipeline linking the drilling and production island to Badami Sales Oil Pipeline. Additionally, several proposed ice roads would be constructed as part of the project, linking the drilling and production island to Endicott and the coast. One gravel mine and two potential gravel mines are also considered. The ROD for the project was published in October 2018 but the project was later paused when the Liberty Development and Production Plan (DPP) was vacated following litigation. As of 2022, Hillcorp was revising their Liberty Oil Spill Response Plan and awaiting the results of technical studies before revising their DPP.
- **Northstar Development Project**—The Northstar Development Project (Hillcorp Alaska, LLC) is located on an artificial island in the Beaufort Sea, approximately 12 miles northwest of Prudhoe Bay and nine miles north of the coast. The project is located on a joint federal/State of Alaska unit and consists of active federal and state wells. The project has been in production for almost 20 years.

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.

- **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 USFWS has received ROW application (ANILCA 1110(b)) for a snow trail across upland habitats within the program area. The application is for a 20-year period of use and requests a 200-foot-wide ROW and the annual construction of a 25-foot-wide snow trail that would allow for transportation of goods for communities and the bi-directional movement of community vehicles. The applicant identified the following initial items for transport over the ROW during the term of the permit, including but not limited to permanent school modules for Kaktovik and other building modules, movement of community vehicles, diesel fuel (transported in double-walled fuel tanks), and other consumables. The number of trips along the ROW would vary from year-to-year, depending on community needs. All products would be transported across the proposed ROW during winter using rolligon vehicles. A *Federal Register* notice announcing an extension to the timeframe for completing the EA was published on February 8, 2023.

Subsistence Activities

Subsistence activities occur throughout the program area and in the surrounding areas, including the western Canadian Arctic. Subsistence hunters primarily use boats and snowmachines for accessing subsistence resources. OHVs could be used for subsistence resource access by rural residents, subject to reasonable regulations, pursuant to ANILCA, Section 811(b). The types of subsistence uses and activities that were described in **Section 3.4.3**, Subsistence Uses and Resources, are expected to continue.

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. Since 2020, commercial polar bear viewing within the program area has been paused by Secretarial Order 3392 and community prohibition; however, commercial polar bear viewing is expected to resume. 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 is expected to remain unchanged.

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 and Infrastructure Projects

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.

The USFWS has received a ROW application for the installation, operation, and maintenance of a communication tower within the program area. The use and occupancy of Refuge lands for this or similar community development proposals will continue within the program area.

ANILCA 1310(b) allows for the establishment, operation, and maintenance of new air and water navigation aids and related facilities and facilities for national defense purposes, with conditions to minimize the adverse effects of such activities. The USFWS recently issued a ROW for specific installations within the program area under this provision.

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.

G.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.

G.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.

G.4.1 Climate and Meteorology

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Emissions of greenhouse gases from production, processing, transportation, and downstream combustion of oil. Energy substitution could reduce Green House Gas emissions.	Cumulative addition to global atmospheric concentrations of GHGs, contributing to climate change.	GHG emissions (metric tons per year) from production, processing, transportation, and downstream combustion GHG emissions (metric tons per year) from substituted energy sources. Social Cost of GHG (dollars)
Emissions of GHG from the change in foreign oil consumption	Cumulative addition to global atmospheric concentrations of GHGs, contributing to climate change.	See Row 1

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

- The BLM EnergySub Model provides a reasonable estimate of substituted energy sources and the change in foreign oil consumption from production in the Coastal Plain
- The Bureau of Ocean Energy Management's Greenhouse Gas Life Cycle Energy Emissions Model as modified for the Willow MDP SEIS provides a reasonable estimate of lifecycle GHG emissions from oil produced in the planning area
- Produced gas would not be sent to market as there is no infrastructure to do so and it would likely take beyond the project timeline construct a gas pipeline back to southern Alaska. Gas would most

likely be injected back into the formation to stimulate development, but it is possible that some could be used on site for running generators or other such uses.

G.4.2 Air Quality

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Leasing	Direct	Criteria pollutant impacts in micrograms per cubic meter relative to National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS). Hazardous air pollutant impacts in micrograms per cubic meter relative to short-term, chronic, and carcinogenic thresholds. Visibility (units of delta deciviews) Total deposition (units of kilograms per hectare per year) relative to critical loads.
Fuel combustion in construction and drilling/operations equipment, aircraft, vehicles, and machinery such as drill rigs, generators, pumps, and compressors by phase, as well as flaring of natural gas	Indirect, short term Long-term depending on source	Criteria pollutant impacts in micrograms per cubic meter relative to National Ambient Air Quality Standards (NAAQS) and Alaska Ambient Air Quality Standards (AAAQS). Hazardous air pollutant impacts in micrograms per cubic meter relative to short-term, chronic, and carcinogenic thresholds. Visibility (units of delta deciviews) Total deposition (units of kilograms per hectare per year) relative to critical loads.
Construction of ice roads and airstrips to access the processing facilities and satellite well pads, as well as construction of the processing facilities and satellite pads themselves. Development of gravel pits to provide materials for road and pad construction.	Indirect, long term Localized	See Row 2
Operation of gravel pits	Indirect, long-term Localized	Qualitative discussion
Use of roads	Indirect, long-term Localized	See Row 2

Action Affecting Resource	Type of Impact	Impact Indicators
Downstream combustion of oil produced in the Coastal Plain	Indirect, long term	Qualitative Discussion
Regional sources of air emissions	Cumulative	See Row 2

Impact Analysis Area

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

Analysis Assumptions

- While stipulations determine where and when on-the-ground actions can occur under each alternative, they do not change the overall surface disturbance or level of well development under each alternative, based on the RFD.
- Future on-the-ground actions requiring the 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.
- Willow MDP Alternative E (from the Willow Master Development Plan Final SEIS [BLM 2023]) criteria and hazardous air pollutant emissions normalized to emissions per barrel of oil produced during peak production would be representative of Coastal Plain indirect emissions per barrel of oil produced in future developments.
- Willow MDP Alternative E (from the Willow Master Development Plan Final SEIS) well pads, pad sizes, sources, layout, and connecting infrastructure to processing facilities are generally representative of typical future development in the Coastal Plain.
- Produced gas would not be sent to market as there is no infrastructure to do so and it would likely take beyond the project timeline construct a gas pipeline back to southern Alaska. Gas would most likely be injected back into the formation to stimulate development, but it is possible that some could be used on site for running generators or other such uses.

G.4.3 Acoustic Environment

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Noise disturbance caused by oil and gas-related activities, to include: ● 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 from seismic exploration ● Noise from gravel mining and blasting ● Noise from the CPF ● Noise from flaring ● Noise from coastal and offshore sources ● Noise from the use of motorized equipment such as snow machines, all-terrain vehicles, occasional small aircraft, and limited local vehicle traffic associated with scientific activities	Impacts on human receptors from noise- and vibration-generating activities—Human receptors likely to be affected by post-lease oil and gas development activities are residents of Kaktovik; subsistence users of subsistence use areas; and recreationists Impacts on sensitive species from noise- and vibration-generating activities—Sensitive species such as caribou, polar bear, seals, whales, and migratory birds *[Note that species-specific impacts and impacts on subsistence resources are introduced in the affected environmental section but evaluated in those resource sections]*	● Sound intensity index—the relationship of background noise to an introduced sound level. ● Estimated sound levels from noise-generating activities in various distances in decibels and distance to audibility ● Duration of sound (short-term or long term) ● Number of flights per day ● Acres closed to leasing and designated NSO

Impact Analysis Area

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

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.

G.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

G.4.5 Geology and Minerals

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Development could affect the risk of some geologic hazards Solifluction and slope stability Riverbank erosion/slope stabilization at crossings No impacts on mineral resources other than petroleum and aggregate resources, which are addressed in other sections	Erosion at bridge and water crossings due to development activities Slope failures and solifluction due to thawing permafrost	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.

G.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 have similar impacts to other North Slope oil and gas developments.
- There will be a pipeline available to transport oil to market during the life of the plan.
- No infrastructure for getting gas to market will exist during the life of the plan, any gas produced will be reinjected into the reservoir to stimulate production.

G.4.7 Paleontological Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground disturbance caused by facilities development including: ● Gravel fill at locations of bedrock exposures with high potential fossil yield classification (PFYC) rankings ● Gravel extraction ● Drilling ● Roads and access ● Pipelines	No direct impact from leasing. Potential for subsequent ground disturbance at levels or depths where resources may be present. 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 ● Extent of surface restrictions associated with the alternatives.

Impact Analysis Area

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

Analysis Assumption

- PFYC rankings of 3, 4, 5, and U will require further field or other investigation for individual exploration projects and other subsequent activities.
- No additional localities have been documented or studies conducted in the Program area that would change PFYC classes at this point.
- Previous PFYC ranking included ranges. The practice now is to use the higher rank of the range only.

G.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 ● Ice road construction and seismic survey ● Construction of structures, such as pipeline vertical support members, and building foundations ● Reclamation of embankments and pads	● Direct surface disturbance to vegetation ● Dust impacts ● Flooding ● 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 what is the radius or extent from the road ● 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.
- Number of access days within the development areas for each alternative, i.e. winter travel days.

G.4.9 Sand and Gravel Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Ground disturbing activities such as: ● Material resources extraction sites ● Ice access roads ● Reclamation ● Sand and gravel mining in floodplains ● Winter Blasting	● Changes in availability of sand and gravel. ● Direct surface disturbance to vegetation; removal of surface-insulating organics to cause frozen soils to thaw and destruction of surface landforms potentially resulting in slope or soil stability issues in sand and gravel extraction ● Changes in surface drainage and water impoundment in gravel pits ● Changes in erosion where surface vegetation is removed, resulting in issues for sand and gravel extraction. ● Dust and the need for dust mitigation during operation.	● Acres/volume of material removed

Impact Analysis Area

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

Analysis Assumptions

- Sand and gravel extraction could occur in both uplands and floodplains except in streams that support resident, anadromous or endemic fish populations.
- Access roads constructed from ice roads will be required to access material sources.
- Material resources are included in 2,000-acre surface disturbance limitation.

G.4.10 Water Resources

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Sand and gravel mining	● Alteration of stream morphology Alteration of surface water flow patterns and flow quality (base and peak) ● River depletion due to flood plain gravel mining. ● Creation of thaw bulbs in permafrost ● Placement of gravel fill, disrupting recharge ● Increased sedimentation ● Changes in water quality, including turbidity and potential mobilization of contaminants ● Establishment of new lakes/ponds following	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to water levels (relative elevation, ft) ● Change to surface water quality (turbidity, water chemistry) ● Change to groundwater level in the active layer and due to thaw bulb (relative elevation, ft) ● Change to total surface water (lake/pond) area (acres)
Camps and facilities	● Lower water levels from potable water, fire suppression, and maintenance activities ● Discharge of treated domestic wastewater ● Spills and contamination ● Discharge of treated domestic wastewater ● Loss of connectivity of aquatic habitat due to changes in water levels ● Increased turbidity and other changes in water chemistry ● Alteration of water flow patterns ● Seasonal changes to water quantity and quality) ● Changes in permafrost or groundwater sources	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to surface water levels (relative elevation, ft) ● Change to surface water quality (turbidity, water chemistry, contaminants) ● Changes to soil moisture (%) ● Change to total surface water area (acres)

Action Affecting Resource	Type of Impact	Impact Indicators
Construction and maintenance of gravel pads, roads, and air access facilities	● Alteration of flow patterns ● Spills and contamination ● Impacts to water quality from gravel dust and gravel spray ● Impacts to water quality from temporary turbidity and sedimentation during gravel placement, compaction, and grading	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to surface water levels (relative elevation, ft) ● Change to surface water quality (turbidity, water chemistry) ● Change to groundwater in the active layer and due to thaw bulb (relative elevation, ft) ● Change to marine water quality (turbidity, water chemistry, contaminants) ● Changes to soil moisture (%) ● Change to total surface water area (acres)
Installation of culverts and bridges	● Alteration to stream hydraulics and drainage patterns (e.g., velocity) and drainage patterns ● Inundation and starvation of areas ● Increased erosion and sedimentation ● Reduced surface water connectivity	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to surface water quality (turbidity) ● Water levels
Pipeline construction	● Increased sedimentation during construction ● Spills and contamination around bridge pilings ● Increased erosion and sedimentation	● Change to surface water flow (drainage patterns and quantity, cfs) ● Changes to surface water quality (turbidity, water chemistry, contaminants)
Snow roads	● Alteration of natural drainage patterns ● Creating thaw bulbs in permafrost from damage to tundra or ponding of water	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to total surface water area (acres)
Ice roads, bridges, pads, and airstrips	● Alteration of natural drainage patterns ● Increased erosion and sedimentation ● Lower lake levels ● Ice jamming during breakup	● Change to surface water flow (drainage patterns and quantity, cfs) ● Change to surface water quality ● Change to water levels
Barge docks and seawater treatment plant construction and operation	● Increased turbidity during construction ● Spills and contamination both inland and marine waters ● Coastal erosion from barge waves	● Change to marine water quality ● Change to surface water quality (turbidity, water chemistry, contaminants)

Action Affecting Resource	Type of Impact	Impact Indicators
Drilling and operation including injection of drilling muds and pumpable waste	● Spills and contamination ● Lower water levels from hydrostatic testing ● Fracture or alteration of groundwater flows; disrupting surface spring flow and water quality	● Change to surface water flow (drainage patterns and quantity, cfs) ● Changes to surface water quality (turbidity, water chemistry, contaminants) ● Change to groundwater level (relative elevation, ft) ● Change to marine water quality (turbidity, water chemistry, contaminants)
Seawater treatment plant (STP) construction and operation, including withdrawal, discharge, and water distribution pipeline	● Increased turbidity during construction and ice trenching ● Spills and contamination ● Impacts on water quality from discharged water and use ● Changes to local salinity	● Change to marine water quality (salinity, turbidity, water chemistry, contaminants) ● Change to surface water flow (drainage patterns and quantity, cfs) ● Changes to surface water quality (turbidity, water chemistry, contaminants) ● Footprint of ice trenching to install water intake (acres)
Drilling and operation including injection of drilling muds and pumpable waste	● Spills and contamination ● Lower water levels from hydrostatic testing ● Fracture or alteration of groundwater flows; disrupting surface spring flow and water quality ● Injection of drilling muds and pumpable waste disrupting groundwater, springs, and streams ● Contamination of springs or surface waters	● Change to surface water flow (drainage patterns and quantity, cfs) ● Changes to surface water quality (turbidity, water chemistry, contaminants) ● Change to groundwater level (relative elevation, ft) ● Change to marine water quality (turbidity, water chemistry, contaminants)
Seismic exploration	● Alternation of natural drainage patterns ● Spills and contaminants ● Lake water withdrawals ● Impacts on lake recharge ● Creating thaw bulbs in permafrost from damage to tundra or ponding of water	● Change to surface water flow (drainage patterns and quantity, cfs) ● Changes to surface water quality (turbidity, water chemistry, contaminants) ● Change to total surface water area (acres) ● Change to surface water levels (relative elevation, ft)

Action Affecting Resource	Type of Impact	Impact Indicators
Off-road vehicle activity on tundra (for operations, pipeline maintenance, and spill preparedness and planning)	• Alternation of natural drainage patterns • Spills and contaminants	• Change to surface water flow (drainage patterns and quantity, cfs) • Changes to surface water quality (turbidity, water chemistry, contaminants) • Change to total surface water area (acres) • Change to surface water levels (relative elevation, ft)

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, noting that topography and water distribution in the program area differ from other North Slope areas previously analyzed for development. 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 C**.

G.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.

G.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	Acreages of vegetation types present within accessible areas for each alternative, stratifies by oil production and EIS-specific development stipulations. 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	Permanent loss or alteration of wetland types from rolligon/ORV traffic	Acres of wetland 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	Permanent loss or alteration of wetland types from ice placement and operation of ice roads	Acres of wetland 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 loss or alteration from changing water levels	Acres of wetland types present within accessible areas for each alternative, stratified by oil potential and EIS specific development stipulations.
Project construction: Gravel mining	Permanent loss of wetlands	Acres of wetland 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	Acres of wetland 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	Alteration of wetland types from drifted snow and altered drainage patterns	Acres of wetland 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: Traffic on gravel roads	Alteration of wetland types from gravel spray and dust fallout	Acres of wetland 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	No quantitative indicator; qualitative discussion on possible plant community changes
Project construction and operations: Oil and contaminant spills	Wetland and plant community alteration from spills on tundra	No quantitative indicator; 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, specific to each alternative will be used as described in Chapter 2. 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.

G.4.13 Fish and Aquatic Species

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Seismic Surveys: Use of rolligons or other off-road vehicles (ORV) 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; cannot be quantified without an estimate of miles of off-road travel.
Establishment of camps and camp moves	Contaminants and waste from camps Stream crossings and potential increase in disturbance	Changes to water quality; disturbances to habitat; sedimentation.

Action Affecting Resource	Type of Impact	Impact Indicators
Water withdrawal from lakes or streams: ● Winter activities: ice roads, camp water supply, exploration (e.g., test wells) ● Spring activities: camp water supply, construction activities ● Summer activities: dust suppression, construction activities, camp water supply Water withdrawal from marine or brackish water (Salinity Treatment Plant)	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) Discussed in context of the scarcity of unfrozen water in winter. 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
STP facility construction including intake and discharge pipelines, and distribution pipelines	● 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 ● Habitat alteration
STP discharge to marine waters (if UIC disposal, then delete this row)	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.

Action Affecting Resource	Type of Impact	Impact Indicators
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).
Construction and maintenance of 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	Qualitative description of 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 100 m of gravel infrastructure (use linear miles of road and pads) that would be altered by dust, gravel spray. Changes resulting from erosion or thermokarst described in **Section 3.2.8**, Soils
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. Qualitative discussion of BMPs that reduce or negate invasive species introduction (ballast water exchange requirements)
Barge landing or dock (if this is not included in Alts then delete row)	Potential alteration of rearing or nearshore foraging habitat Disturbance and displacement of fishes Accidental spills in marine waters	Acres of fill required, type of infrastructure required (such as overwater structure or sea wall) Number of barge trips required

Action Affecting Resource	Type of Impact	Impact Indicators
Pipeline construction Trenching for optic cable at stream and road-crossings (assumes trenching in, under, or next to pipe)	Loss or alteration of habitat Loss or alteration of aquatic habitat from changes in water flow or ice-blockage during spring break up, water quality. Disturbance or displacement of fish during in-water 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 pipeline installation. Accidental spills in or adjacent to waterbodies Contaminants associated with drilling/construction	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.
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 Impacts to water quality	Described on broad level by habitat type (e.g., nearshore, mountain streams, and springs) and species affected Number of spills
Off-road vehicle 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.
Injection of drilling muds and pumpable waste disrupting groundwater, springs, and streams	Alteration of spring and surface water connection Contamination of springs or surface waters	Miles of perennial springs within the program area. Miles of streams within the program area.

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.

G.4.14 Birds

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Winter seismic surveys	Direct compaction of snow and vegetation, delayed snowmelt, and damage to taller tussock and low shrub tundra in seismic tracks. Disturbance to overwintering bird species?	Habitats and approximate acreages affected, if possible
Gravel placement for roads and pads	Habitat loss	Acres of habitat affected
Gravel mining for roads and pads and construction of pipeline corridors	Direct habitat loss	Acres of habitats affected
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

Action Affecting Resource	Type of Impact	Impact Indicators
Gravel mining and placement for roads and pads and construction of pipeline corridors	Habitat loss: with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site for some species Indirect habitat alteration from drifted snow and altered drainage patterns adjacent to gravel mining areas Indirect hydrological changes in drainage patterns, flow, and blockages	Acres of habitat affected (to include dust fallout buffer where applicable) Acres of habitat affected from Water Resources section.
Road traffic, air traffic, noise, and human activities	Disturbance and displacement of birds from affected areas	Acres of habitat affected (noise buffer)
Road traffic	Injury and mortality from accidental collisions	Describe potential for vehicle collisions
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 Number of spills
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)
Gravel mine site rehabilitation and infrastructure removal	Habitat change; with rehabilitation after abandonment, potential creation of avian habitats previously absent on that site(s) for some species	Qualitative discussion of habitats most likely affected.

Impact Analysis Area

- Direct/Indirect—Program area and adjacent marine habitats
- Cumulative—North Slope from NPR-A east to Program Area 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 (e.g., the locations of lease sales and specific development project area within lease areas are

unknown). 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): impact analysis will assume 1) that acreages of bird habitats affected by development would occur in the same proportions as those habitats occur within each area available for leasing, and 2) recognizing the potential for a greater use of moist tundra, apply a weighting factor to preferentially push development acreage into encompassing greater proportions of moist tundra habitat. This would be done while taking into account the lease stipulations and ROPs that restrict development in and near specific areas. An upper limit of 2,000 acres for all project development in the Program Area 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 a 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.
- The analysis for waterbirds would use the Arctic Coastal Plain-wide and spatially specific breeding densities calculated by Amundson et al. (2019; see New Data below) to estimate the number of birds of each species (pending available data) that could be affected by development in the Program Area.

G.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 km²) available for seismic activity under different alternatives (assume no seismic exploration occurs in areas not offered for lease sale?)
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 Acres of different polygons from Severson (2021) within different stipulations
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 Porcupine Caribou Herd per season.

Action Affecting Resource	Type of Impact	Impact Indicators
Roads and pipelines	Potential obstructions to caribou movements to and from insect-relief habitat Habitat loss due to spills or leaks	Proportion of Central Arctic Herd caribou using the program area alternatives by season (based on percent of seasonal use density from kernel density) or telemetry locations within Project area) Proportion of years areas are used by Porcupine Caribou Herd 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
Roads and pads	Increased or altered access for subsistence hunters, non-local hunters, and other recreationists Change in mosquito relief areas used by caribou (ridges instead of coastline)	Qualitative assessment

Impact Analysis Area

- Direct/Indirect—Program area (non-marine habitats)
- Cumulative—Annual ranges of the Porcupine Caribou Herd and Central Arctic Herd.

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 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 3.1 miles from roads and pads during and immediately after calving, spanning 3 weeks, based on research in North Slope oilfields. Areas of high-density development avoided by calving caribou. The zone of influence could be larger if off-road human activity, especially hunting, occurs along roads.

- Zone of influence during other seasons —Caribou may use areas within approximately 1.2 miles of roads less during the postcalving season based on research in North Slope oilfields. The zone of influence could be larger if off-road human activity, especially hunting, occurs along roads.
- Roads and pipelines may deflect and delay caribou movements, but those effects can be partially 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. Effects could be greater due to uncertainties regarding hunting on roads, previous levels of exposure to development, and large groups sizes in Porcupine Caribou Herd during post calving.
- Known locations of occupied grizzly bear dens will be avoided by at least 0.5 mile, as stipulated by the State of Alaska.

G.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
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

Action Affecting Resource	Type of Impact	Impact Indicators
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, which has direct effects (habitat modification) and indirect effects (loss of habitat use through disturbance from noise and activity).

G.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.
- Research ROWs and leaseholder studies ROWs would be needed.

G.4.18 Cultural Resources

Impacts and Indicators

Note: Types of impact are not mutually exclusive and may occur across all actions impacting resources.

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 ● Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory. ● Increased access to culturally sensitive areas	● Number of previously documented AHRS and TLUI sites in potentially affected area ● Indigenous place names and ethnographic resources (e.g., traditional use areas, historic travel routes. ● 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 ● Introduction of vibration, noise, or atmospheric elements, such as visual, dust, and olfactory ● Increased access 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 ● Damage from spill and cleanup activities	● Physical destruction or damage, including issues with dating damaged artifacts	● Same as above
Presence of Development in the Coastal Plain	● 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

Action Affecting Resource	Type of Impact	Impact Indicators
Scientific, Environmental, and Seismic Surveys ● Ground disturbance ● Traffic ● Human presences	● Physical destruction or damage ● Removal of the cultural resource from its original location/loss of context ● Theft/vandalism ● Increased access to culturally sensitive areas	● Same as above

Impact Analysis Area

- Direct/Indirect—Program area
- Cumulative—North Slope and Gwich'in communities who place significance on cultural resources in the program area

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.

G.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

Action Affecting Resource	Type of Impact	Impact Indicators
Contamination ● Oil spills ● Air pollution ● Release, discharge, or insecure containment of hazardous materials or wastes ● Smells	Reduced resource availability due to changes in resource abundance Reduced resource availability due to changes in distribution resulting from new smells 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
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.

G.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
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

G.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 cultural resources, 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 cultural resources, subsistence, sociocultural, economic, and/or public health and safety analyses in conjunction with community demographic information establishing minority and/or low-income population status.

G.4.22 Recreation

Impacts and Indicators

Action Affecting Resource	Type of Impact	Impact Indicators
Surface disturbance and changes in use within priority recreation areas (direct)	● Change in the quality of the recreation setting or user experiences (viewsheds, aesthetics, etc.) ● 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	● Proximity/overlap of priority recreation areas to areas available for leasing (and not subject to surface use restrictions such as NSO, CSU). ● Acres of program area not available to leasing and acres that are subject to NSO. ● Use of popular landing locations for non-recreation activities (if data available), potentially leading to changes in access and locations of recreation use. ● Changes in ORVs or characteristics for special designations as a result of disturbances (specifically, Hulahula River).
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)	● Changes in scenic values within proximity to priority recreation areas due to availability for leasing (refer to visual resource section). ● Acres where protective measures that minimize impacts on recreation would apply (acres not available for leasing or with NSO, CSU)
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	● Impacts to water quality or quantity, leading to changes in recreational use (displacement of users, change in use/location such as hunting or fishing; refer to water resource analysis). ● Impacts to water quality or quantity, leading to changes in recreational use (displacement of users, change in use/location such as hunting or fishing; refer to water resource analysis). ● 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.
- Given the trend in increasing use of federal lands for recreation over the past several years, recreational use of the program area is anticipated to increase in the coming years.
- The potential for user interactions between all types of users will increase with increasing use.
- Landing locations and frequency of use of these locations are used as a proxy to identify priority/popular recreation.
- Areas where landing is possible within areas open to leasing may be used for both recreation and oil and gas operations
- Assume commercial use recreation reporting reflects the majority of recreational activities within the program area.

G.4.23 Special Designations

Impacts and Indicators

Action Impacting Resource	Type of Impact	Impact Indicators
● Areas open and closed to fluid mineral leasing ● Marine Protected Areas: Lease Stipulation 4 – Nearshore marine, lagoon, and barrier island habitats of the Southern Beaufort Sea within the boundary of the Arctic National Wildlife Refuge and Lease Stipulation 9 – Coastal Area ● Wild and Scenic Rivers: Lease Stipulation 1 – Rivers and Streams and Lease Stipulation 3 – Springs/aufeis (and ROPs 8 and 24) also apply to WSR characteristic protections. ● Wilderness: Lease Stipulation 10 – Wilderness Boundary	● Development and activities that could affect MPA natural biodiversity/heritage, WSR characteristics: classification/ORVs/free-flowing conditions/water quality, wilderness conditions. ● Surface occupancy of infrastructure	● Acres of special designations intersected with acres open and closed to fluid mineral leasing. ● Natural Heritage, the primary conservation focus. ● River values: ORVs, tentative classification, water quality, 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.
  - WSR Value Characteristics—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, Qualities, 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.
  - WSR Value Characteristics—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 condition, ORVs, or tentative classification of any portion of the suitable river or actions that will reduce water quality to the extent that rivers would degrade the ORVs.
- The area recommended for wilderness designation would continue to be managed under the minimal management category which would protect its wilderness characteristics in a manner that would not impair the suitability of this area for preservation as wilderness.

G.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.

G.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).

G.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 • Abandonment/Reclamation phase activities	• 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), other communities outside of the NSB to include Arctic Village and Venetie, regional (NSB), State, National (qualitative discussion of potential contribution to a leasing program to the national economy and a discussion of the non-market environmental values of the Arctic Refuge).
- Cumulative—Same as direct/indirect

Analysis Assumptions

- Description of potential oil and gas activities and timeframes 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.

G.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 oil and other hazardous materials spills ● Change in quantity of water pollutants introduced from oil and gas operations ● Change in contaminants in fish used for subsistence foods
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	Changes in perception of food contamination. Changes in mental and physical health as a result of limiting subsistence harvest.	● Changes in anxiety and mental health as a result of limiting subsistence harvest due to perceived contamination.
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, Ventus 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.

G.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.

Council on Environmental Quality (CEQ). 2016. Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews. Signed August 1, 2016.

_____. 2023. National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change. Signed January 9, 2023.

EPA (U.S. Environmental Protection Agency). 2023. Greenhouse Gases Equivalencies Calculator - Calculations and References. Available at https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

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.

EO 13990. 2021. Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis. Signed January 20, 2021. *Federal Register*, Volume 86, Issue 14 (January 25, 2021).

_____. 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide: Interim Estimates under Executive Order 13990. Released February 2021.

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.

National Academies of Sciences, Engineering, and Medicine. 2017. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. National Academies Press.

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.

Appendix H

Potential Fossil Yield Classification System

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Appendix H. Potential Fossil Yield Classification System

H.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.

H.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.

H.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.

H.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.

H.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.

H.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.

H.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.

H.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.

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

H.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.

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

H.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.

H.2.1 Unconsolidated and Poorly Consolidated Surficial Deposits

PFYC: 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 assessing these deposits for 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.

H.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).

H.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).

H.2.4 Canning Formation (Cretaceous-Tertiary)

PFYC: 3

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

H.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

[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.

scales, and vertebrae (Lindsey 1986) were also found. The Arctos database listed a therapod or small bird trace fossil (footprint).

H.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).

H.2.7 Kemik Sandstone (Lower Cretaceous)

PFYC: 3

This unit 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.

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

PFYC: 3

The 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).

H.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).

H.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).

H.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).

H.2.12 Kongakut Formation (Lower Cretaceous)

PFYC: 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).

H.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.

Appendix I
Water Resources

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Appendix I. Water Resources

Table I-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**	**2019**	**2020**	**2021**	**2022**	**2023**
Jan	no data	no data	-2.3	-2.8	-14.5	-5.1	-11.9	-4
Feb	no data	no data	9.2	12.3	-14.3	-20.2	-10.4	-9.1
Mar	no data	no data	8.1	16.3	-0.3	-3.3	-0.5	no data
Apr	no data	no data	9.7	11.1	11.4	10.3	10.9	no data
May	no data	no data	29.1	38.1	32.8	24.3	28.1	no data
Jun	no data	no data	41.6	47	47.7	49.3	45.6	no data
Jul	no data	no data	51.2	54.6	45.5	52.4	49.7	no data
Aug	no data	no data	39.9	41.1	46.2	41.5	43.6	no data
Sep	no data	32.7	35.2	34.6	32.1	28.4	36.2	no data
Oct	5.2	17	22.7	19.2	17.2	15.7	15.8	no data
Nov	no data	8.9	4.9	1.4	9.2	-7.6	8.2	no data
Dec	no data	10.3	-6.1	-5.1	-2.8	-7.1	1.9	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/search

Table I-1 *(continued)*
Average Monthly Air Temperatures at Barter Island, Toolik Lake, and Kuparuk

Kuparuk Station: Average Annual Monthly Air Temp (°F)												
Month	**Years (2000 – 2011)**											
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Jan	-14.4	-11.8	-20.6	-12	-14	-11	-16	-18	-21	-18	-18.7	-14.3
Feb	-16.7	-5.7	-22.6	-17	-29	-17	-6.6	-14	-19	-17	-12.7	-9.5
Mar	-15.5	-19.7	-4.8	-14	-20	-9.3	-19	-21	-21	-22	-12.7	-8.9
Apr	-1.8	0.8	3.3	7.1	-1	1.1	-4.5	7.6	9.2	3.6	11	-2.5
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
Jun	43.9	39.2	39.3	37.7	44.7	37.5	46.6	39.6	44.6	39	38.3	no data
Jul	46	47.1	45.2	48.5	49.4	40.4	47.6	46.8	49.7	47.5	49.2	no data
Aug	41.8	41.5	43.4	40.6	48.1	44.8	40.2	45.8	41.3	45.3	47.4	no data
Sep	32.8	35.1	38.9	33.1	33.8	34.9	39.7	38	34	34.8	37.5	no data
Oct	14.5	8.6	20.2	23.9	18.8	19.2	24.9	19.2	16.9	25	22.2	no data
Nov	-2.3	-2.4	7.1	-0.3	-1.4	-13	-1	10.7	0.9	-3.2	12.1	no data
Dec	-7.2	-11.8	-3.8	-9.8	-12	-5.9	-4.3	-4.5	-3.1	-3.4	-17.1	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/search

Table I-1 *(continued)*
Average Monthly Air Temperatures at Barter Island, Toolik Lake, and Kuparuk

Kuparuk Station: Average Annual Monthly Air Temp (°F)												
Month	**Years (2012 – 2023)**											
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Jan	-26	-18	-10.1	-12.9	-4.5	-6	-9.3	-13.1	-22.1	-12.9	-21.8	-6
Feb	-14	-25	-13.5	-6.3	-5.4	-12	0.8	1.7	-29	-29.2	-24.4	no data
Mar	-29	-11	-8.2	-9.8	-7.4	-9.3	-2.2	6.6	-6.6	-14.9	-8.6	no data
Apr	2.2	-2.9	4.2	7.6	10.5	4.5	3.6	5.5	8.8	2	-0.2	no data
May	22	20.6	29.2	31	30.1	25.8	21.2	28.2	23.4	24.3	25.3	no data
Jun	41.8	44.1	38.5	48.1	43.6	38.8	34.5	40.3	40.3	41.9	42.7	no data
Jul	51.4	49.3	45.3	44.4	49.2	52.2	51.3	53	43.3	51.9	44.3	no data
Aug	no data	45.8	42.4	41.1	45.4	45.1	39	43.8	45.3	41.9	45.5	no data
Sep	no data	31.9	34.2	30.3	35.3	36.8	34.9	41.3	35	34.4	36.1	no data
Oct	23.8	22.5	22.1	20.3	24.9	21.3	23.1	26.7	23.6	19.7	22.8	no data
Nov	1	2.3	7.4	0.9	8.6	10.7	4.6	10.8	9.2	-0.9	8.8	no data
Dec	-18	no data	-10.2	-15.9	-8.2	3.9	-8.8	-9.3	-7.6	-14.9	-1.9	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/search

Table I-2
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Toolik Lake Station: Average Monthly Precipitation (Inches)							
Month	**Years**						
	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Jan	no data	0.12	no data	0.17	0.04	0.15	0.19
Feb	no data	0.44	no data	0.35	0.01	0.17	0.05
Mar	no data	0.2	no data	0.72	0.24	0.22	no data
Apr	no data	0.06	no data	1.12	0.33	0.15	no data
May	no data	0.9	no data	1.85	1.35	0.49	no data
Jun	no data	1.45	no data	1.85	1.67	1.46	no data
Jul	no data	3.41	no data	1.67	1.35	3.91	no data
Aug	no data	4.19	no data	1.17	2.01	1.7	no data
Sep	0.69	4.49	0.76	1.99	0.72	1.04	no data
Oct	0.81	no data	1.03	0.8	0.59	0.67	no data
Nov	0.62	no data	0.22	0.55	0.39	0.86	no data
Dec	0.12	no data	0.25	0.16	0.66	1.08	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/search

Table I-2 *(continued)*
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Kuparuk Station: Average Annual Monthly Precipitation (Inches)												
Month	**Years (2000 – 2011)**											
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Jan	0.09	0.01	0.21	0.09	0.01	0.2	0.19	0.45	0.04	0	0.21	0.22
Feb	0.12	0	0.15	0.13	0.3	0.09	0.11	0.02	0.19	0.17	0.11	0.26
Mar	0.06	0	0.12	0.02	0.3	0.03	0.01	0.06	0.08	0	0.21	0.03
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
May	0	0.03	0	0.19	0	0.14	0.04	0.29	0.56	0.04	0.08	0.51
Jun	0.16	0.35	1.05	0.01	0.4	0.01	0.78	0.22	0.43	0	0.05	no data
Jul	1.12	0.26	1.1	2.22	1.02	1.06	1.67	0.22	1.07	0.45	1.22	no data
Aug	0.38	1.35	1.93	0.67	0.61	0.5	1.07	0.11	0.62	2.13	0.4	no data
Sep	0.14	0.25	1.67	0.4	0.97	0.62	0.12	0.01	0.2	0.67	0	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	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	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	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/search

Table I-2 *(continued)*
Average Annual Monthly Precipitation at Toolik Lake and Kuparuk

Kuparuk Station: Average Annual Monthly Precipitation (Inches)												
Month	**Years (2012 - 2023)**											
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Jan	0.17	0.02	0.04	0.16	0.21	0.39	0.23	0.17	0.09	0.04	0.13	0.33
Feb	0.07	0.02	0.12	0.3	0.08	0.52	0.37	0.2	0.13	0.09	0	no data
Mar	0.1	0.2	0.01	0.15	0.2	0.09	0.11	0.33	0.31	0.09	0.01	no data
Apr	0.12	0.91	0.09	0.31	0.1	0.11	0.12	0.19	0.56	0.08	0.05	no data
May	0.09	0.43	0.76	0.09	0.11	0.18	0.25	0.14	0.02	0.11	0.08	no data
Jun	0.03	0.31	0.49	0.14	1.1	0.01	0.3	0.36	0.32	0.95	0.16	no data
Jul	0.1	1.77	1.09	0.28	0.81	0.67	1.59	0.89	0.8	1.15	3.19	no data
Aug	no data	0.89	0.44	2.58	1.63	2.16	1.51	2.68	0.44	0.86	1.22	no data
Sep	no data	1.02	0.5	0.33	1.63	1.02	0.71	0.65	0.61	0.67	0.13	no data
Oct	1.02	0.29	1.42	0.22	0.28	0.87	0.35	0.54	0.09	0.65	0.12	no data
Nov	0.36	0.41	0.5	0.27	0.81	0.83	0.43	0.28	0.47	0.56	0.53	no data
Dec	0.15	no data	0.76	0.05	0.13	0.74	0.33	0.19	0.22	0.32	0.2	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/search

Table I-3
Average Annual Monthly Snowfall at Kuparuk

Kuparuk Station: Average Annual Monthly Snowfall (Inches)												
Month	**Years (2000 - 2011)**											
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Jan	4.1	0.6	4	2.4	0.2	3.5	4.3	5.3	1	0.4	7.4	0.6
Feb	5.5	1	1.4	4.8	2.7	2	2.6	0.5	3.4	5.4	3	1.9
Mar	3.3	0.9	1	2.1	5.1	1	0.8	1.2	2.6	0	4.8	0.8
Apr	4	1.2	1.8	4	1.5	1.3	5.5	3.9	7.2	2.7	2.6	1.9
May	2	7.4	0	6.5	0	3.7	0.8	10.3	0.8	1.6	0.3	1.3
Jun	0	0	1.8	0	0	0.2	0.3	0	0	0	0.3	no data
Jul	0	0	0	0	0	0	0	0	0	0	0	no data
Aug	1.7	0.1	0	0	0	0	0	0	0	0	0	no data
Sep	1.5	1.9	3.4	2.8	4.4	0.3	0	0	0.5	3.5	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	no data
Nov	0.7	7.1	2.7	3.3	2	10.2	4.8	15.1	7.5	4.4	13.5	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	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/search

Table I-3 *(continued)*
Average Annual Monthly Snowfall at Kuparuk

Kuparuk Station: Average Annual Monthly Snowfall (Inches)												
Month	**Years (2012 - 2023)**											
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Jan	2.2	0.9	1	4.1	3.9	1.8	5.2	2.1	1.5	1	1	6.1
Feb	1.4	1	2	3.3	1.1	6.3	6.3	2.6	6	1.3	0	no data
Mar	1.3	4	1.5	3.4	5	3.3	1.5	3.5	2.6	2	0.1	no data
Apr	3	8.9	4.1	10.2	1.3	2.9	0.9	3.5	3	0.7	1.1	no data
May	1.6	4.7	4.4	0.2	0	0.8	4.3	0	0	0.9	0	no data
Jun	0	0	1.4	1	2.5	0	0	0	0	0	0	no data
Jul	0	0	0	0	0	0	0	0	0	0	0	no data
Aug	no data	0	0	0	0	0	0	0	0	0	0	no data
Sep	no data	6	0.6	3.1	0.2	0	0.2	0	7.8	1.5	0.2	no data
Oct	7.1	5.2	7	2.8	1.1	3	3.1	1.7	0.9	10.2	3.2	no data
Nov	3.5	5.2	5.1	4.5	17.2	11.2	5	6.2	3.6	5.6	6.1	no data
Dec	1.7	no data	11.7	1.7	2.5	5.2	5.5	1.7	2	3.3	2.5	no data

Adapted from *Normals Annual/Seasonal Station Details* by the National Centers for Environmental Information: https://www.ncdc.noaa.gov/cdo-web/search

Table I-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 I-5
Surface Water Discharge

Akutoktak River																
Recording Period	Average Daily Value (Cubic Feet/Second)									Period Measurement Summary						
	Jun			Jul			Aug			(Cubic Feet/Second)			IPF Date	(Ac-Ft)	(CFSM*)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	Instantaneous Peak Flow (IPF)		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 I-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 I-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)			IPF Date	(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF		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 I-5 *(continued)*
Surface Water Discharge

Sadlerochit River																
Recording Period	Average Daily Value (cubic ft/sec)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)			IPF Date	(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF		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 I-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)			IPF Date	(Ac-Ft)	(CFSM)	(In)	
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF		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 I-5 *(continued)*
Surface Water Discharge

Sikrelurak River																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Report						
	Jun			Jul			Aug			(Cubic Feet/Second)			IPF Date	(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF		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 I-5 *(continued)*
Surface Water Discharge

Tamayariak River																
Recording Period	Average Daily Values (Cubic Feet/Second)									Period Summary Table						
	Jun			Jul			Aug			(Cubic Feet/Second)			IPF Date	(Ac-Ft)	(CFSM)	(In)
	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Seven-Day Low Flow	IPF		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 I-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 I-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 I-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 I-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 I-5 *(continued)*
Surface Water Discharge

Recording Period	Hulahula River																
	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	12800	5/24/2011	354200	0.71	9.7	
Oct 1 2011–Sep 31 2012	1783	3930	523	2329	4940	1420	1234	2650	545	535	0	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	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	6240	7/4/2014	a*	0.82	11.2	
Oct 1 2014–Sep 31 2015	1259	2510	324	1571	3310	690	1466	3170	732	492	0	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	13500	7/8/2016	a	0.95	13	
Oct 1 2016–Sep 31 2017	1392	2440	722	2089	4950	1440	2150	3140	1380	579	0	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	5570	7/29/2018	a	0.933	12.7	
Oct 1 2018–Sep 30 2019	1990	9770	835	2603	7450	1440	1424	3200	690	685	0	16300	6/30/2019	a	0.997	13.5	
Oct 1 2019–Sep 30 2020	1650	3190	784	948	2220	414	1131	2610	563	390	0	3740	6/25/2020	a	0.568	7.73	
Oct 1 2020–Sep 30 2021	2013	4780	176	2536	10500	862	1413	4780	176	558	0	21200	7/4/2021	a	0.811	11	
Oct 1 2021–Sep 30 2022	1928	3197	1157	2213	2880	948	1436	2150	945	539	0	13000	7/4/2022	a	0.784	10.6	

*Denotes statistics not calculated by USGS. b denotes discharge due to snowmelt, ice jam, or debris breakup
Adapted from *USGS Water Report 2011–2021 15980000 Hulahula River Near Kaktovik, AK* and *USGS Water-Data Report 2018 15980000 Hulahula River Near Kaktovik, AK*

Table I-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).

I.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/.

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Appendix J

Solid and Hazardous Waste

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Appendix J. Solid and Hazardous Waste

Table J-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-M11	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 2023; ADEC GIS 2023

Table J-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 2023a

Table J-3
ADEC Identified Contaminated Sites in the Vicinity of the Coastal Plain

ADEC Hazard ID	Site Name	Status
737	Brownlow Point/DERP	Cleanup complete
752	Barter Island DEW—POL catchment	Cleanup complete
753	Barter Island DEW—old dump site (LF019)	Cleanup complete
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
1431	Waldo arms fuel	Cleanup complete
1679	Collinson Point DEW Line—Sitewide	Informational
1680	Nuvagapak Point DEW line – Sitewide	Informational
1681	Griffin Point/DERP	Cleanup complete
1686	Manning 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
4036	Barter Island DEW—air terminal (SS011)	Cleanup complete, institutional controls
4038	Barter Island DEW—dump area NW (LF009)	Cleanup complete
4222	Barter Island LRRS refueling area (CG002)	Cleanup complete
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

[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
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
25334	Nuvagapak Point DEW Line Composite Building	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
26499	Nuvagapak Point DEW Line Shop Area	Active
26827	NSB Kaktovik transformer	Active
27709	Barter Island DEW-New CERCLA Landfill (LF001)	Active

Source: ADEC 2023b, 2023c

Table J-4
ADEC 1995–2023 Database Spill Records for Areas near Kaktovik, Alaska[2]

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	3	561	Used oil and diesel
2005	1	*28 pounds*	Other
2006	1	100	Diesel
2008	4	2,065	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
2018	2	630	Diesel and gasoline
2020	3	70	Diesel and other
2021	2	659	Diesel and engine lube oil
2022	3	1,270	Diesel and process water

Source: ADEC 2023c

[2] Database search ended March 31, 2023; no spills occurred for years not included in Table J-4

Table J-5
ADEC 1995–2023 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
2019	265	174	59	23	9	0
2020	184	129	39	11	5	0
2021	166	95	49	19	3	0
2022	271	157	76	29	9	0
2023[3]	62	40	15	7	0	0

Source: ADEC 2023d
[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)

[3] Data for 2023 is January 1, 2023, to March 31, 2023

Table J-6
1.5 Billion Barrels of Oil Produced Estimated Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude Oil	194.30	3.95	0.30	198.54
Refined Oil	845.06	2.12	0.00[4]	847.17
Seawater and Produced Water	141.86	12.12	2.12	156.09
Other Hazardous Materials	579.24	4.85	0.30	584.39
Total	1,760.45	23.03	2.72	1,786.19

Source: NPR-A IAP/EIS Appendix I Table I-1 North Slope Spill Rates by Substances and Size per Billion Barrels of Oil Produced (2000-2018)

Table J-7
10.0 Billion Barrels of Oil Produced Estimated Spill Count

Substance	Spill Size			
	Small	Medium	Large	Total
Crude Oil	1,942.95	39.45	3.00	1,985.40
Refined Oil	8,450.55	21.15	0.00[4]	8,471.70
Seawater and Produced Water	1,418.55	121.20	21.15	1,560.90
Other Hazardous Materials	5,792.40	48.45	3.00	5,843.85
Total	17,604.45	230.25	27.15	17,861.85

Source: NPR-A IAP/EIS Appendix I Table I-1 North Slope Spill Rates by Substances and Size per Billion Barrels of Oil Produced (2000-2018)

[4] Large spills of refined oil for production exceeding 1 billion barrels of oil may be larger than 0.00

J.1 REFERENCES

ADEC (Alaska Department of Environmental Conservation). 2023a. Solid Waste Information Management System. Internet website: http://dec.alaska.gov/Applications/EH/SWIMS/Search.aspx. Downloaded data March 29, 2023.

_____. 2023b. Division of Spill Prevention and Response Contaminated Sites. Internet website: http://dec.alaska.gov/spar/csp.aspx. Downloaded data April 11, 2023.

_____. 2023c. ADEC Drinking Water Protection Areas. Internet website: https://www.arcgis.com/home/webmap/viewer.html?webmap=13ed2116e4094f9994775af9a62a1e85. Last updated May 2018.

_____. 2023d. ADEC Prevention Preparedness and Response Spills Database Search. Internet website: https://dec.alaska.gov/Applications/SPAR/PublicMVC/PERP/SpillSearch. Downloaded data March 31, 2023.

ADEC GIS. 2023. Contaminated sites, Alaska Department of Conservation. Internet website: https://dec.alaska.gov/spar/csp.aspx.

EPA (US Environmental Protection Agency). 2023d. EnviroMapper. Internet website: https://geopub.epa.gov/myem/efmap/index.html?ve=10&pText=. Downloaded data April 11, 2023.

Appendix K

Vegetation and Wetlands, Birds, Terrestrial Mammals, and Marine Mammals

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Appendix K. Vegetation and Wetlands, Birds, Terrestrial Mammals, and Marine Mammals

K.1 VEGETATION AND WETLANDS

The vegetation mapping used in this SEIS is based on land cover mapping of the Arctic National Wildlife Refuge prepared by ABR (Macander et al. 2020). The land cover map used existing data from 789 vegetation plots sampled in 3 previous studies as well as helicopter and ground surveys conducted in 2019. Data collected at each plot included soil stratigraphy, physiography, and other environmental variables as well as detailed information on plant cover, including vascular plants, mosses, and lichens. Soils samples were collected and analyzed for properties including texture, pH, and electrical conductivity. These data sets, combined with interpretation of remote sensing imagery, were used to develop and map 20 land cover classes, including 1 forested, 5 shrub, 10 herbaceous, 2 sparsely vegetated types, and 2 abiotic classes. The overall accuracy of the map was approximately 85%; where errors occurred, they typically involved similar classes (e.g., dryas dwarf shrub and moist sedge-dryas tundra). These land cover classes were used as the vegetation types to describe the affected environment of the program area and analyze potential impacts under each alternative.

Table K-1 provides a brief description of each land cover type, including environmental characteristics and typical species. **Table K-2** lists rare vascular plant species with documented occurrences in the program area. **Table K-3** provides a comparison across alternative of the acreage of each land cover class that would fall within each land use category. For each alternative, **Table K-4** lists the acres of each land cover class that would be directly and indirectly impacted based on the maximum development footprint scenario under each alternative (i.e., areas available for leasing under each alternative).

Table K-5 describes the wetland classes that occur in the project area and lists the specific wetland types included in each class. **Table K-6** provides a comparison across alternative of the acreage of each wetland class that would fall within each land use category. For each alternative, **Table K-7** lists the acres of each wetland class that would be directly and indirectly impacted based on the maximum development footprint for each alternative (i.e., areas available for leasing under each alternative).

Table K-1
Descriptions of Land Cover Classes[1] in the Program Area

Land Cover Class	Description	Typical Species
Poplar forest	Distribution: Very limited in extent in the project area. It occurs in small patches in riverine and upland physiography on a river bar at Sadlerochit Springs, at the east end of the Sadlerochit Mountains, and on a terrace above the Hulahula River Soils: Rocky, no additional information available Permafrost: Absent or present at a depth >2 meters Vegetation: Forested; some stands exhibit a stunted growth form	Trees: *Populus balsamifera* Shrubs: *Salix alaxensis, Dasiphora fruticosa, Arctous rubra, Dryas integrifolia* Grasses: *Festuca altaica, Leymus innovates* Other herbaceous: *Senecio lugens, Anemone parviflora, Pyrola grandiflora, Polygonum bistorta* Mosses: *Sanionia uncinate* Lichens: *Peltigera elisabethae*
Low and tall riverine willow shrub	Distribution: Riverine physiography, including active and inactive riverbanks Slope: Flat to nearly level Soils: Moderately well drained to excessively drained, alkaline, surface organic layer absent to thin Permafrost: Typically, absent Vegetation: Open and closed shrub communities dominated by low and tall willows	Shrubs: *Salix alaxensis*, *S. glauca*, *S. richardsonii, Dryas integrifolia* Herbaceous: *Equisetum variegatum, Lupinus arcticus* Mosses: *Tomenthypnum nitens, Hylocomium splendens*
Low and dwarf birch shrub	Distribution: Lowland, and upland physiography, particularly in the foothills of the Brooks Range Slope: Gently to strongly sloping Soils: Moderately well drained to well drained, acidic to circumneutral, organic layer very thin to moderately thick Permafrost: Typically present, average thaw depth 42 centimeters Vegetation: Open and closed shrub communities dominated by low and dwarf birch; willows may also be present; substantial moss component.	Shrubs: *Betula nana, Salix glauca, S. pulchra, Vaccinium vitis-idaea* Sedges: *Carex aquatilis, Eriophorum angustifolium* Other herbaceous: *Petasites frigidus, Rubus chamaemorus* Mosses*: Hylocomium splendens, Aulacomnium turgidum, A. palustre, Tomenthypnum nitens*
Ericaceous dwarf shrub	Distribution: Upland physiography, typically associated with hummocks or high-center polygons Slope: Strongly sloping to moderately steep Soils: Well-drained to excessively drained, acidic to circumneutral, surface organic layer very thin to moderately thick Permafrost: Typically present, average thaw depth 40 centimeters Vegetation: Dwarf shrub-dominated communities with substantial moss and lichen components	Shrubs: *Vaccinium vitis-idaea, Ledum decumbens, Betula nana, Cassiope tetragona* Sedges: *Eriophorum vaginatum* Other herbaceous: *Rubus chamaemorus* Mosses: *Hylocomium splendens, Tomenthypnum nitens* Lichens: *Flavocetraria cucullata, Dactylina arctica*

Land Cover Class	Description	Typical Species
Dryas dwarf shrub	Distribution: Upland, and riverine physiography, including hillsides and old river terraces Slope: Nearly level to strongly sloping Soils: Moderately well drained to excessively drained, circumneutral to alkaline, surface organic layer very thin to thin Permafrost: Typically present, average thaw depth 79 centimeters Vegetation: Dwarf shrub-dominated communities with substantial moss and lichen components	Shrubs: *Dryas integrifolia*, *Salix reticulata* Sedges: *Carex bigelowii* Other herbaceous: *Equisetum variegatum* Mosses: *Tomenthypnum nitens, Hylocomium splendens, Rhytidium rugosum* Lichens: *Flavocetraria cucullata, Cetraria islandica*
Moist sedge-dryas tundra	Distribution: Lowland, riverine, and upland physiography, typically associated with hummocks or high-center polygons Slope: Nearly level to gently sloping Soils: Poorly drained to moderately well drained, circumneutral to alkaline, surface organic layer thin to moderately thick Permafrost: Typically present, average thaw depth 50 centimeters Vegetation: Communities dominated by sedges and dwarf shrubs, with a substantial moss component	Shrubs: *Dryas integrifolia*, *Salix reticulata*, *Cassiope tetragona* Sedges: *Carex bigelowii, Eriophorum angustifolium, E. vaginatum* Mosses and liverworts: *Tomenthypnum nitens Hylocomium splendens, Ptilidum ciliare,*
Shrub tussock tundra	Distribution: Widespread in lowland and upland physiography Slope: Typically, gently sloping Soils: Somewhat poorly drained, acidic to circumneutral, surface organic layer moderately thick Permafrost: Typically present, average thaw depth 43 centimeters Vegetation: Tundra dominated by tussock cottongrass (*Eriophorum vaginatum*) and low shrubs, with a substantial moss component	Shrubs: *Betula nana, Vaccinium vitis-idaea, Salix pulchra*, *Ledum decumbens* Sedges: *Eriophorum vaginatum, E. angustifolium, Carex bigelowii* Mosses and liverworts: *Hylocomium splendens, Aulacomnium turgidum, Ptilidum ciliare, Tomenthypnum nitens*
Tussock tundra	Distribution: Widespread in lowland and upland physiography Slope: Nearly level to gently sloping Soils: Somewhat poorly drained to moderately well drained, circumneutral to alkaline, surface organic layer moderately thick Permafrost: Typically present, average thaw depth 47 centimeters Vegetation: Tundra dominated by tussock cottongrass (*Eriophorum vaginatum*), with a substantial moss component	Sedges: *Eriophorum vaginatum, E. angustifolium, Carex bigelowii* Shrubs: *Vaccinium vitis-idaea, Salix pulchra, S. reticulata, Betula nana, Dryas integrifolia* Mosses and liverworts: *Hylocomium splendens, Tomenthypnum nitens, Aulacomnium turgidum, Ptilidum ciliare*

Land Cover Class	Description	Typical Species
Moist sedge-willow tundra	Distribution: Lowland, riverine, and upland physiography Slope: Nearly level to gently sloping Soils: Somewhat poorly drained to moderately well drained, circumneutral to alkaline, surface organic layer very thin to moderately thick Permafrost: Typically present, average thaw depth 62 centimeters Vegetation: Tundra communities dominated by sedges and low and dwarf willows, with a substantial moss component	Shrubs: *Salix pulchra, S. reticulata, S. richardsonii, Dryas integrifolia* Sedges: *Eriophorum angustifolium, Carex aquatilis, C. bigelowii, E. vaginatum* Mosses: *Tomenthypnum nitens, Hylocomium splendens, Aulacomnium turgidum, A. palustre*
Sedge-willow tundra in drainage tracks	Distribution: Lowland and upland physiography; associated with water tracks (non-incised drainages) in moist tundra; often occurs as a mosaic with shrub tussock tundra Slope: Gently to strongly sloping Soils: Very poorly drained to somewhat poorly drained, typically circumneutral, surface organic layer thin to moderately thick Permafrost: Typically present, average thaw depth 61 centimeters Vegetation: Low willow communities with varying sedge components	Shrubs: *Salix pulchra, S. reticulata, Dryas integrifolia* Sedges: *Eriophorum angustifolium, Carex aquatilis* Mosses: *Hylocomium splendens, Tomenthypnum nitens, Aulacomnium palustre*
Moist sedge-shrub tundra with wet inclusions	Distribution: Lowland, riverine, and upland physiography; commonly associated with high-centered polygons and other polygonized or hummocky surface forms Slope: Level to nearly level Soils: Somewhat poorly drained to moderately well drained, circumneutral to alkaline, coarse fragments common, surface organic layer very thin to moderately thick Permafrost: Typically present, average thaw depth 69 centimeters Vegetation: Moist sedge-shrub communities with inclusions of wet sedge tundra and marsh vegetation	Shrubs: *Salix pulchra, Betula nana* Sedges: *Carex aquatilis, Eriophorum angustifolium* Mosses/Liverworts: *Tomenthypnum nitens, Ptlidium ciliare, Hylocomium splendens, Campyllium stellatum*
Wet sedge-shrub tundra with moist inclusions	Distribution: Lowland and riverine physiography; commonly associated hummocks and high-center polygons Slope: Level to nearly level Soils: Very poorly drained to moderately well drained, circumneutral to alkaline (water pH), surface organic layer thin to thick Permafrost: Common, average thaw depth 60 centimeters Vegetation: Wet sedge or sedge-shrub communities with inclusions of moist shrub or sedge-shrub vegetation	Shrubs: *Salix pulchra, Betula nana* Sedges: *Carex aquatilis, Eriophorum angustifolium* Mosses/Liverworts: *Scorpidium scorpioides*, *Campyllium stellatum, Tomenthypnum nitens,*

Land Cover Class	Description	Typical Species
Wet sedge meadow tundra	Distribution: Widespread in lacustrine, lowland, and riverine physiography Slope: Typically, level Soils: Very poorly drained to somewhat poorly drained, circumneutral to alkaline (water pH), surface organic layer thin to thick Permafrost: Common, average thaw depth 32 centimeters Vegetation: Wet sedge or sedge-shrub communities	Shrubs: *Salix ovalifoia,S. reticulata, S. pulchra, S. arctica, Dryas integrifolia* Sedges: *Carex aquatilis, Eriophorum angustifolium* Mosses: *Tomenthypnum nitens, Campyllium stellatum, Meesia triquetra,*
Freshwater marsh	Distribution: Limited distribution in lacustrine, lowland, and riverine physiography Slope: Typically, level Hydrology: Soils: Flooded to poorly drained, circumneutral to alkaline (water pH), surface organic layer typically moderately thick Permafrost: Common, average thaw depth 58 centimeters Vegetation: Sedge or grass marsh communities, typically in small patches along lake and pond margins and in beaded streams.	Sedges: *Carex aquatilis* Grasses: *Arctophila fulva* Other herbaceous: *Hippuris vulgaris*
Salt marsh	Distribution: Coastal physiography; occurs on active and inactive tidal flats in areas characterized by frequent saltwater inundation Slope: Typically, level Hydrology: Poorly drained Soils: Circumneutral to alkaline (water pH), coarse fragments absent, surface organic layer moderately thick to thick Permafrost: Common, average thaw depth 63 centimeters Vegetation: Halophytic sedge or sedge-grass wet meadows	Shrubs: *Salix ovalifolia* Sedges: *Carex subspathacea, C. ramenskii, C. ursina* Grasses: *Dupontia fisheri* Mosses: *Bryum pseudotriquetrum, Campyllium stellatum*
Water	This landcover class includes both marine and freshwater, and occurs in coastal, lowland, and riverine physiography.	Not applicable
Snowbed	This landcover class occurs in upland, and riverine physiography, on landforms and leeward slope positions with late-lying snow (snow free date is typically after July 1); vegetation commonly includes wet sedge meadow tundra, moist sedge-shrub tundra, *Cassiope* dwarf shrub tundra, and partially vegetated areas	Detailed species information not available

Land Cover Class	Description	Typical Species
Partially vegetated	Distribution: Occurs in all physiographies; most common in riverine, and uplands; commonly associated with river channels and sand dunes Slope: Level to strongly sloping Soils: Somewhat excessively drained to excessively drained, typically alkaline, surface organic layer typically absent Permafrost: Infrequent, average thaw depth 137 centimeters Vegetation: Common types include early successional riparian vegetation and *Leymus* (dunegrass) communities	Shrubs: *Salix alaxensis, S. ovalifolia, Dryas integrifolia* Grasses: *Leymus mollis, Trisetum spicatum* Mosses: *Racomitrium lanuginosum, Campyllium stellatum*
Barrens	Distribution: Coastal and riverine physiography, including channel deposits and marine beaches Soils: Well-drained to excessively well drained, typically alkaline, surface organic layer absent Permafrost: Infrequent, average thaw depth 160 centimeters Vegetation: Largely absent	Not applicable
Snow/Ice	This land cover class includes permanent patches of snow and ice, typically found in riverine physiography.	Not applciable

[1] Mapping terminology for vegetation types.

Table K-2
Rare[1] Vascular Plant Species with Documented Occurrences in the Program Area

Taxon	State Rank[3]	Global Rank[3]	Federal Status[4]
Cardamine microphylla[2]	S2	G4	BLM watch
Carex atherodes	S3S4	G5	—
Chrysosplenium rosendahlii	S1S2	G4G5Q	—
Festuca viviparoidea ssp. *viviparoidea*	S3S4	G4G5T4T5	—
Papaver gorodkovii	S2S3	G3	BLM sensitive
Poa sublanata	S2	GNR	BLM sensitive
Puccinellia andersonii	S1S2	G4G5	—
Puccinellia vaginata	S2	G5	BLM sensitive
Puccinellia vahliana	S3	G4G5	BLM watch
Symphyotrichum pygmaeum	S2	G2G4	BLM sensitive

[1] Vascular plant species with documented occurrences in the Program Area tracked through the Alaska Center for Conservation Science Rare Plant Data Portal (ACCS 2023) with a state ranking of S3 or higher and/or a global rank of G4 or higher.
[2] Unclear whether this record (1985) corresponds to the currently identified taxon *C. microphylla aff. microphylla*, which is included on the BLM watch list.
[3] State and Global rankings per ACCS and NatureServe ranking methodologies. See rare and sensitive state and global ranking descriptions below.
[4] Sensitive and watch plant species for the BLM Alaska Special Status Species List – 2019.

Rare and sensitive global and state ranking descriptions are described below.

Global Rank:

- G1: Critically imperiled globally because of extreme rarity (<5 occurrences or few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction (critically endangered throughout its range).
- G2: Imperiled globally because of rarity (6-20 occurrences) or because of other factors demonstrably making it very vulnerable to extinction throughout its range (endangered throughout its range).
- G3: Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (21 to 100 occurrences) (threatened throughout its range).
- G4: Widespread and apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- G5: Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- T#: Global rank of the described species.

- G#G#: Global rank of species uncertain, best described range lies between the two ranks.
- G3Q: Indicates some uncertainty about taxonomic status that might affect global rank.

State Rank:

- S1: Critically imperiled in state because of extreme rarity (<5 occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction (critically endangered throughout the state).
- S2: Imperiled in state because of rarity (6-20 occurrences), or because of other factors making it very vulnerable to extirpation from the state.
- S3: Rare or uncommon in state (21-100 occurrences).

Table K-3
Land Cover Class[1] Acreage Analysis by Alternative

Land Cover Class[1] in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [2]	Alternative C Area (acres)	Alternative C Area (%) [2]	Alternative D Area (acres)	Alternative D Area (%) [2]	Alternative D2 Area (acres)	Alternative D2 Area (%) [2]
No Sale (Subtotal)	**0**	**0.0**	**526,259**	**33.7**	**797,264**	**51.0**	**1,163,382**	**74.4**
Poplar forest	0	0.0	2	<0.1	2	<0.1	2	<0.1
Low and tall riverine willow shrub	0	0.0	9,135	1.7	12,906	1.6	14,762	1.3
Low and dwarf birch shrub	0	0.0	28,807	5.5	33,043	4.1	41,815	3.6
Ericaceous dwarf shrub	0	0.0	1,510	0.3	2,299	0.3	2,579	0.2
Dryas dwarf shrub	0	0.0	1,410	0.3	4,197	0.5	5,106	0.4
Moist sedge-dryas tundra	0	0.0	17,096	3.2	34,838	4.4	52,417	4.5
Shrub tussock tundra	0	0.0	96,388	18.3	142,895	17.9	179,676	15.4
Tussock tundra	0	0.0	120,705	22.9	161,638	20.3	253,197	21.8
Moist sedge-willow tundra	0	0.0	24,814	4.7	43,644	5.5	56,484	4.9
Sedge-willow tundra in drainage tracks	0	0.0	29,380	5.6	43,920	5.5	56,189	4.8
Moist sedge-shrub tundra with wet inclusions	0	0.0	84,560	16.1	151,606	19.0	240,759	20.7
Wet sedge meadow tundra with moist inclusions	0	0.0	22,753	4.3	33,061	4.1	48,436	4.2
Wet sedge meadow tundra	0	0.0	71,629	13.6	92,392	11.6	124,985	10.7
Freshwater marsh	0	0.0	48	<0.1	87	<0.1	175	<0.1
Salt marsh	0	0.0	205	<0.1	388	<0.1	1,019	0.1
Water	0	0.0	5,941	1.1	20,600	2.6	53,674	4.6
Snowbed	0	0.0	1,165	0.2	2,330	0.3	4,128	0.4
Partially vegetated	0	0.0	8,021	1.5	12,656	1.6	19,027	1.6
Barrens	0	0.0	2,526	0.5	4,523	0.6	8,565	0.7
Snow/ice	0	0.0	164	<0.1	241	<0.1	390	<0.1
Controlled Surface Use (CSU)	**0**	**0.0**	**123,867**	**7.9**	**15,870**	**1.0**	**84,320**	**5.4**
Low and tall riverine willow shrub	0	0.0	170	<0.1	0	0.0	18	<0.1
Low and dwarf birch shrub	0	0.0	4,092	3.3	235	1.5	1,506	1.8
Ericaceous dwarf shrub	0	0.0	106	0.1	25	0.2	16	<0.1

Land Cover Class[1] in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [2]	Alternative C Area (acres)	Alternative C Area (%) [2]	Alternative D Area (acres)	Alternative D Area (%) [2]	Alternative D2 Area (acres)	Alternative D2 Area (%) [2]
Dryas dwarf shrub	0	0.0	417	0.3	98	0.6	47	0.1
Moist sedge-dryas tundra	0	0.0	4,278	3.5	833	5.2	1,964	2.3
Shrub tussock tundra	0	0.0	23,917	19.3	2,331	14.7	7,006	8.3
Tussock tundra	0	0.0	52,292	42.2	4,478	28.2	43,625	51.7
Moist sedge-willow tundra	0	0.0	17,884	14.4	744	4.7	17,726	21.0
Sedge-willow tundra in drainage tracks	0	0.0	11,522	9.3	334	2.1	5,198	6.2
Moist sedge-shrub tundra with wet inclusions	0	0.0	5,128	4.1	5,276	33.2	5,305	6.3
Wet sedge meadow tundra with moist inclusions	0	0.0	643	0.5	782	4.9	155	0.2
Wet sedge meadow tundra	0	0.0	2,439	2.0	677	4.3	951	1.1
Freshwater marsh	0	0.0	0	0.0	0	0.0	2	<0.1
Water	0	0.0	113	0.1	45	0.3	18	<0.1
Snowbed	0	0.0	666	0.5	8	<0.1	628	0.7
Partially vegetated	0	0.0	118	0.1	3	<0.1	123	0.1
Barrens	0	0.0	2	<0.1	0	0.0	1	<0.1
Snow/ice	0	0.0	79	0.1	0	0.0	31	<0.1
No Surface Occupancy (NSO)	**357,951**	**22.9**	**708,170**	**45.3**	**726,298**	**45.9**	**231,624**	**14.8**
Poplar forest	2	<0.1	0	0.0	0	0.0	0	0.0
Low and tall riverine willow shrub	10,402	2.9	5,962	0.8	2,456	0.3	507	0.2
Low and dwarf birch shrub	4,964	1.4	9,068	1.3	12,207	1.7	770	0.3
Ericaceous dwarf shrub	946	0.3	985	0.1	323	<0.1	44	<0.1
Dryas dwarf shrub	5,899	1.6	10,801	1.5	8,991	1.2	7,860	3.4
Moist sedge dryas tundra	22,634	6.3	40,587	5.7	30,277	4.2	10,674	4.6
Shrub tussock tundra	25,844	7.2	63,172	8.9	58,538	8.1	9,298	4.0
Tussock tundra	38,183	10.7	114,586	16.2	175,123	24.1	22,219	9.6
Moist sedge-willow tundra	8,544	2.4	27,691	3.9	57,286	7.9	7,111	3.1
Sedge-willow tundra in drainage tracks	6,260	1.7	18,508	2.6	24,177	3.4	3,221	1.4
Moist sedge-shrub tundra with wet inclusions	31,884	8.9	145,990	20.6	117,402	16.2	28,828	12.4

Land Cover Class[1] in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [2]	Alternative C Area (acres)	Alternative C Area (%) [2]	Alternative D Area (acres)	Alternative D Area (%) [2]	Alternative D2 Area (acres)	Alternative D2 Area (%) [2]
Wet sedge meadow tundra with moist inclusions	17,967	5.0	33,446	4.7	28,428	3.9	12,817	5.5
Wet sedge meadow tundra	51,148	14.3	89,084	12.6	80,684	11.1	45,415	19.6
Freshwater marsh	79	<0.1	252	<0.1	242	<0.1	155	0.1
Salt marsh	714	0.2	1,470	0.2	1,286	0.2	654	0.3
Water	88,611	24.8	98,587	13.9	86,070	11.9	53,291	23.0
Snowbed	1,353	0.4	2,884	0.4	3,372	0.5	511	0.2
Partially vegetated	32,190	9.0	34,831	4.9	31,159	4.3	24,175	10.4
Barrens	10,054	2.8	10,070	1.4	8,078	1.1	4,054	1.8
Snow/ice	273	0.1	197	<0.1	199	<0.1	19	<0.1
Timing Limitations (TL)	**585,419**	**37.4**	**19**	**<0.1**	**1,815**	**0.1**	**3,072**	**0.2**
Low and tall riverine willow shrub	4,132	0.7	0	0.0	0	0.0	0	0.0
Low and dwarf birch shrub	27,543	4.7	<0.5	0.4	0	0.0	1	<0.1
Ericaceous dwarf shrub	1,166	0.2	0	0.0	0	0.0	0	0.0
Dryas dwarf shrub	2,190	0.4	0	0.0	3	0.2	0	0.0
Moist sedge-dryas tundra	21,391	3.7	<0.5	2.1	98	5.4	4	0.1
Shrub tussock tundra	87,486	14.9	<0.5	1.3	0	0.0	199	6.5
Tussock tundra	129,207	22.1	2	9.8	82	4.5	1,561	50.8
Moist sedge-willow tundra	26,436	4.5	<0.5	1.4	36	2.0	523	17.0
Sedge-willow tundra in drainage tracks	26,417	4.5	0	0.0	0	0.0	91	3.0
Moist sedge-shrub tundra with wet inclusions	139,496	23.8	10	52.2	1,505	82.9	564	18.4
Wet sedge meadow tundra with moist inclusions	28,010	4.8	1	6.7	1	0.1	0	0.0
Wet sedge meadow tundra	78,952	13.5	5	25.9	86	4.7	104	3.4
Freshwater marsh	96	<0.1	0	0.0	0	0.0	0	0.0
Salt marsh	288	<0.1	0	0.0	0	0.0	0	0.0
Water	4,732	0.8	0	0.0	0	0.0	3	0.1
Snowbed	1,587	0.3	<0.5	0.1	0	0.0	1	<0.1
Partially vegetated	4,581	0.8	<0.5	0.1	3	0.2	22	0.7

Land Cover Class[1] in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [2]	Alternative C Area (acres)	Alternative C Area (%) [2]	Alternative D Area (acres)	Alternative D Area (%) [2]	Alternative D2 Area (acres)	Alternative D2 Area (%) [2]
Snow/ice	41	<0.1	0	0.0	0	0.0	0	0.0
Barrens	1,667	0.3	0	0.0	0	0.0	0	0.0
Standard Terms and Conditions (STC)	**619,998**	**39.7**	**205,054**	**13.1**	**22,121**	**2.0**	**80,958**	**5.2**
Low and tall riverine willow shrub	828	0.1	96	<0.1	0	0.0	75	0.1
Low and dwarf birch shrub	12,982	2.1	3,521	1.7	3	<0.1	1,397	1.7
Ericaceous dwarf shrub	535	0.1	46	<0.1	0	0.0	8	<0.1
Dryas dwarf shrub	5,233	0.8	695	0.3	34	0.1	309	0.4
Moist sedge-dryas tundra	22,220	3.6	4,284	2.1	199	0.9	1,186	1.5
Shrub tussock tundra	90,496	14.6	20,348	9.9	62	0.2	7,649	9.4
Tussock tundra	175,330	28.3	55,135	26.9	1,398	6.3	22,118	27.3
Moist sedge-willow tundra	67,074	10.8	31,665	15.4	343	1.6	20,210	25.0
Sedge-willow tundra in drainage tracks	35,772	5.8	9,039	4.4	18	0.1	3,749	4.6
Moist sedge-shrub tundra with wet inclusions	120,823	19.5	56,515	27.6	16,423	74.2	16,747	20.7
Wet sedge meadow tundra with moist inclusions	17,526	2.8	6,659	3.2	1,231	5.6	2,095	2.6
Wet sedge meadow tundra	45,272	7.3	12,215	6.0	1,535	6.9	3,917	4.8
Freshwater marsh	164	<0.1	40	<0.1	10	<0.1	8	<0.1
Salt marsh	673	0.1	0	0.0	0	0.0	0	0.0
Water	14,207	2.3	2,908	1.4	831	3.8	560	0.7
Snowbed	2,771	0.4	996	0.5	1	<0.1	443	0.5
Partially vegetated	7,063	1.1	864	0.4	11	<0.1	485	0.6
Snow/ice	126	<0.1	1	<0.1	0	0.0	0	0.0
Barrens	906	0.1	29	<0.1	22	0.1	3	<0.1
Total	**1,563,368**	**NA**	**1,563,368**	**NA**	**1,563,356**	**NA**	**1,563,356**	**NA**

[1] Mapping terminology for vegetation types.
[2] The percentages provided in this column represent two distinct categories. The bolded Land Use Categories provide the percentage of each land use category (e.g., no sale, controlled surface use) is included in the entire program area, and under each Land Use Category, the percentages provided for Land Cover Class are how much that land cover class constitutes within each Land Use Category.

Table K-4
Maximum Direct and Indirect Impact Acreage for each Land Cover Class by Alternative

Land Cover Class	Alt B Available[1] acres (%)	Alt B Direct Impact (acres)	Alt B Indirect Impact (acres)	Alt B Total Impact (acres)	Alt C Available[1] acres (%)	Alt C Direct Impact (acres)	Alt C Indirect Impact (acres)	Alt C Total Impact (acres)	Alt D Available[1] acres (%)	Alt D Direct Impact (acres)	Alt D Indirect Impact (acres)	Alt D Total Impact (acres)	Alt D2 Available[1] acres (%)	Alt D2 Direct Impact (acres)	Alt D2 Indirect Impact (acres)	Alt D2 Total Impact (acres)
Poplar forest	2 (<0.1%)	0	0	0	0 (0.0%)	0	0	0	0 (0.0%)	0	0	0	0 (0.0%)	0	0	0
Low and tall riverine willow shrub	15,362 (1.0%)	20	173	193	6,265 (0.6%)	9	78	87	2,494 (0.3%)	3	30	33	600 (0.1%)	1	12	14
Low and dwarf birch shrub	45,489 (2.9%)	58	512	570	16,693 (1.6%)	24	207	231	12,457 (1.6%)	17	149	166	3,674 (0.9%)	9	76	85
Ericaceous dwarf shrub	2,647 (0.2%)	3	30	33	1,090 (0.1%)	2	14	15	301 (<0.1%)	0	4	4	68 (<0.1%)	0	1	2
Dryas dwarf shrub	13,323 (0.9%)	17	150	167	11,890 (1.1%)	17	148	164	9,103 (1.2%)	12	109	121	8,216 (2.1%)	19	171	190
Moist sedge-dryas tundra	66,245 (4.2%)	85	746	831	49,204 (4.7%)	69	611	680	31,462 (4.1%)	43	376	418	13,828 (3.5%)	33	288	321
Shrub tussock tundra	203,826 (13.0%)	261	2,295	2,555	107,412 (10.4%)	152	1,334	1,485	60,905 (7.9%)	83	727	810	24,151 (6.0%)	57	503	560
Tussock tundra	342,719 (21.9%)	438	3,858	4,297	221,995 (21.4%)	313	2,756	3,069	181,062 (23.6%)	246	2,161	2,407	89,522 (22.4%)	212	1,863	2,075
Moist sedge-willow tundra	102,054 (6.5%)	131	1,149	1,279	77,286 (7.4%)	109	960	1,069	58,456 (7.6%)	79	698	777	45,570 (11.4%)	108	948	1,056
Sedge-willow tundra in drainage tracks	68,449 (4.4%)	88	771	858	39,020 (3.8%)	55	484	540	24,480 (3.2%)	33	292	325	12,260 (3.1%)	29	255	284
Moist sedge-shrub tundra with wet inclusions	292,203 (18.7%)	374	3,290	3,663	207,640 (20.0%)	293	2,578	2,871	140,594 (18.3%)	191	1,678	1,869	51,444 (12.9%)	122	1,071	1,192
Wet sedge meadow tundra with moist inclusions	63,503 (4.1%)	81	715	796	40,747 (3.9%)	57	506	563	30,439 (4.0%)	41	363	405	15,067 (3.8%)	36	314	349

Land Cover Class	Alt B Available[1] acres (%)	Alt B Direct Impact (acres)	Alt B Indirect Impact (acres)	Alt B Total Impact (acres)	Alt C Available[1] acres (%)	Alt C Direct Impact (acres)	Alt C Indirect Impact (acres)	Alt C Total Impact (acres)	Alt D Available[1] acres (%)	Alt D Direct Impact (acres)	Alt D Indirect Impact (acres)	Alt D Total Impact (acres)	Alt D2 Available[1] acres (%)	Alt D2 Direct Impact (acres)	Alt D2 Indirect Impact (acres)	Alt D2 Total Impact (acres)
Wet sedge meadow tundra	175,372 (11.2%)	224	1,974	2,199	103,771 (10.0%)	146	1,288	1,435	83,008 (10.8%)	113	991	1,104	50,387 (12.6%)	119	1,049	1,168
Freshwater marsh	339 (<0.1%)	0	4	4	252 (<0.1%)	0	3	3	213 (<0.1%)	0	3	3	164 (<0.1%)	0	3	4
Salt marsh	1,674 (0.1%)	2	19	21	1,495 (0.1%)	2	19	21	1,312 (0.2%)	2	16	17	654 (0.2%)	2	14	15
Water	107,549 (6.9%)	138	1,211	1,348	101,759 (9.8%)	144	1,263	1,407	87,100 (11.4%)	118	1,040	1,158	53,872 (13.5%)	127	1,121	1,249
Snowbed	5,711 (0.4%)	7	64	72	4,535 (0.4%)	6	56	63	3,370 (0.4%)	5	40	45	1,584 (0.4%)	4	33	37
Partially vegetated	43,834 (2.8%)	56	493	550	35,879 (3.5%)	51	445	496	31,244 (4.1%)	42	373	415	24,805 (6.2%)	59	516	575
Barrens	12,627 (0.8%)	16	142	158	10,274 (1.0%)	14	128	142	8,277 (1.1%)	11	99	110	4,057 (1.0%)	10	84	94
Snow/ice	440 (<0.1%)	1	5	6	236 (<0.1%)	0	3	3	159 (<0.1%)	0	2	2	50 (<0.1%)	0	1	1
Total	**1,563,368 (100.0%)**	**2,000**	**17,600**	**19,600**	**1,037,641 (100.0%)**	**1,464**	**12,883**	**14,347**	**766,636 (100.0%)**	**1,040**	**9,152**	**10,192**	**399,972 (100.0%)**	**946**	**8,325**	**9,271**

[1] This represents the total area available for leasing under the given alternative.

Table K-5
Wetland Class Crosswalk and Descriptions[1]

Wetland and Waters Class	Wetland Types within Class	Description
Open water	NA	NA
Nearshore waters	M1UBL	Subtidal portions of the Beaufort Sea coast beyond barrier islands or where no barrier islands are present.
Estuarine open water	E1UBL	Subtidal portions of the Beaufort Sea coast between barrier islands and the mainland.
Tidal influenced palustrine waters	PUBT, PUBV	Open, shallow, and permanently flooded freshwater bodies less than 20 acres in size that receive regular or seasonal saltwater input through tidal fluctuations or seasonal storm surge events. Occurs along the Beaufort Sea coastline at the mouth of large river deltas.
Lentic freshwater	L2UBH	Permanently flooded and shallow freshwater bodies greater than 20 acres in size. Occurs in the Canning River Delta and throughout the lowlands south of Kaktovik.
Palustrine waters	PUBF, PUBH	Open, shallow, and permanently flooded freshwater bodies less than 20 acres in size. Occurs most commonly within the Canning and Jago River deltas and throughout the lowlands south of Kaktovik.
Tidal influenced lotic freshwater	R1UBT, R1UBV, R1US1Q, R1US3Q, R1USQ	Active channels and unvegetated channel deposits within the intertidal section of freshwater rivers. Occurs along the Beaufort Sea coast in large tidal riverine deltas.
Lotic freshwater	R2UB3F, R2UBF, R2UBH, R3UBH, R4SBC	Lower and upper perennial stream channels and intermittent stream beads conveying freshwater. Occurs throughout the program area from stream headwaters to the limit of tidal fluctuations.
Estuarine wetlands and mudflats	NA	NA
Estuarine mudflat	E2US2N, E2USM, E2USN, E2USP	Unvegetated and tidally flooded substrates along the Beaufort Sea coast including barrier islands, spits, and river deltas.
Estuarine salt marsh	E2EM1/USN, E2EM1/USP, E2EM1N, E2EM1P, E2EM2/SS1P, E2EM2/USN, E2EM2/USP, E2EM2N, E2SS1/EM1P, E2SS1P, E2US/EM1N, E2US/EM1P, E2US/EM2N, E2US1/EM1N	Tidally flooded vegetation along the Beaufort Sea coast. Located within riverine deltas, particularly the Hulahula and Jago rivers, and along the fringes of lagoons.

Wetland and Waters Class	Wetland Types within Class	Description
Palustrine wetlands and barrens	NA	NA
Tidal influenced emergent meadow	PEM1/SS1R, PEM1/SS1S, PEM1/SS1T, PEM1/UBT, PEM1/USR, PEM1/USS, PEM1R, PEM1S, PEM1T, PEM2T, PUB/EM1T	Flooded wetlands whose hydrology is driven by nontidal inputs, yet still influenced by tides. Primarily dominated by persistent emergent vegetation (grasses and sedges) and can form complexes with deciduous shrubs and unvegetated substrates. Located along the Beaufort Sea coast inland of estuarine waters, wetlands, and mudflats.
Tidal influenced shrub scrub	PSS1/EM1R, PSS1/EM1T, PSS1R	Flooded wetlands whose hydrology is driven by nontidal inputs, yet still influenced by tides. Primarily dominated by broadleaf deciduous shrubs (willows), can form complexes with persistent emergent vegetation and unvegetated substrates. Located along the Beaufort Sea coast inland of estuarine waters, wetlands, and mudflats, these wetlands are in relatively small and scattered patches along the margins of tidal influenced emergent meadow in the Canning and Katakturuk river deltas, Pokok Bay, and Nuvagapak Lagoon.
Littoral mudflat	L2UBV, L2US5C, PUS2R	Seasonally flooded lake and pond basins. Limited to two features within the program area: one small pond breached by coastal erosion in Camden Bay and one lake breached by the Canning River.
Littoral wetlands	L2ABF, L2EM2/UBF, L2EM2F, PAB3/UBF, PAB3F, PAB3H, PUB/EM1F	Semi-permanently to permanently flooded littoral areas, where water depths are shallow enough to support vegetative growth. These features are predominantly located in the Caning River Delta and the lowlands south and east of Kaktovik.
Flooded emergent meadow	PEM1/SS1F, PEM1/UBF, PEM1F, PEM2/SS1F, PEM2/UBF, PEM2F	Semi-permanently flooded wetlands dominated by persistent emergent vegetation (grasses and sedges), can form complexes with deciduous shrubs and unvegetated substrates. This wetland class is ubiquitous throughout the program area, extending from the Beaufort Sea coast south into the Brooks Range foothills, presumably in lower lying landscape positions than seasonally flooded emergent meadow.
Partially vegetated barrens	PUS/EM1C, PUS/EM1E, PUS/SS1A, PUS2/EM1C, PUS5/EM1C, PUS5/SS1C	Seasonally flooded unvegetated wetlands can form complexes with persistent emergent (grasses and sedges) and broadleaf deciduous (willows) vegetation. Located on gravel bars or proximal to channels of rivers within the program area, including the Staines, Canning, Katakturuk, Okpilik, and Jago rivers.
Saturated emergent meadow	PEM1/SS1B, PEM1/SS1D, PEM1B, PEM1D	Saturated wetlands that generally lack abundant surface water and are dominated by persistent emergent vegetation (grasses and sedges) but can form complexes with broadleaf deciduous shrubs (willows). This wetland class is ubiquitous throughout the program area, extending from the Beaufort Sea coast south into the Brooks Range foothills, presumably in higher landscape positions than seasonally flooded emergent meadow.

Wetland and Waters Class	Wetland Types within Class	Description
Seasonally flooded emergent meadow	PEM1/SS1A, PEM1/SS1C, PEM1/SS1E, PEM1/US5A, PEM1/US5C, PEM1/USA, PEM1/USC, PEM1/USE, PEM1A, PEM1C, PEM1E	Wetlands that flood seasonally and are dominated by persistent emergent vegetation (grasses and sedges) but can form complexes with broadleaf deciduous shrubs (willows). This wetland class is ubiquitous throughout the program area, extending from the Beaufort Sea coast south into the Brooks Range foothills, intermixed with saturated emergent meadow and flooded emergent meadow wetlands.
Flooded shrub scrub	PSS1/EM1F, PSS1/UBF, PSS1/UBT, PSS1F	Semi-permanently flooded broadleaf deciduous shrub (willow) wetlands, including those that are tidally influenced. This wetland class is predominantly located in water tracks and drainages in the foothills in the southern portion of the program area, but scattered areas of flooded shrub scrub are associated with river deltas along the Beaufort Sea coast.
Saturated shrub scrub	PSS1/EM1B, PSS1/EM1D, PSS1B, PSS1D	Saturated wetlands that generally lack abundant surface water and are dominated by broadleaf deciduous shrubs (willows and dwarf birch) but can form complexes with persistent emergent vegetation (grasses and sedges). This wetland class is located in presumably higher landscape positions in the Brooks Range foothills and is generally absent from lowland areas.
Seasonally flooded shrub scrub	PSS1/EM1A, PSS1/EM1C, PSS1/EM1E, PSS1/US5C, PSS1/US5A, PSS1/USA, PSS1/USC, PSS1A, PSS1C, PSS1E	Wetlands that flood seasonally and are dominated by broadleaf deciduous shrubs (willows) but can form complexes with persistent emergent vegetation (grasses and sedges). This wetland class is predominantly located within drainages and lower landscape positions in the Brooks Range foothills but does extend along riverine corridors to the Beaufort Sea coast and small patches are present within lowland areas.
Riverine and riparian	NA	NA
Tidal influenced riverine wetlands	R1EM2T, R1EM2V, R1UB2V	Semi-permanent to permanently flooded riverine areas dominated by nonpersistent emergent vegetation (e.g., horsetail). This wetland class is located at the mouths of Marsh Creek and two nearby unnamed creeks.
Freshwater riverine wetlands	R2EM2/UBF, R2EM2F	Lower perennial riverine areas that are semi-permanently flooded and dominated by nonpersistent emergent vegetation but can form complexes with unvegetated wetlands. This wetland class is small, beaded streams located throughout the program area.
Riverine barrens	R2US5A, R2US5C, R2USA, R2USC, R2USE	Seasonally to temporarily flooded barrens along lower perennial rivers and streams. This class includes gravel bars of lower perennial systems throughout the program area.
Seasonally flooded barrens	PUS2C, PUS5C, PUSA, PUSC	Seasonally to temporarily flooded barrens located outside of riverine channels. This class includes gravel bars of lower perennial systems throughout the program area. This wetland class is scattered throughout the program area, from scattered presumably wind scoured barrens within the lowlands south of Kaktovik to unvegetated areas within floodplains.

[1] From broad-scale land USFWS NWI mapping Knopf 2022.
[2] The classification into fine scale wetland codes follows guidance in Cowardin et al. 1979.

Table K-6
Wetland Acreage Analysis by Alternative

Wetland Type in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [1]	Alternative C Area (acres)	Alternative C Area (%) [1]	Alternative D Area (acres)	Alternative D Area (%) [1]	Alternative D2 Area (acres)	Alternative D2 Area (%) [1]
No Sale	**0**	**0.0 [1]**	**526,269**	**33.7 [1]**	**797,280**	**51.0 [1]**	**1,163,428**	**74.4**
Nearshore waters	0	0.0	0	0.0	434	0.1	1,175	0.1
Estuarine open water	0	0.0	236	<0.1	10,495	1.3	34,293	2.9
Tidal influenced palustrine waters	0	0.0	17	<0.1	50	<0.1	188	<0.1
Lentic freshwater	0	0.0	1,852	0.4	2,930	0.4	6,003	0.5
Palustrine waters	0	0.0	928	0.2	1,861	0.2	3,750	0.3
Tidal influenced lotic freshwater	0	0.0	75	<0.1	125	<0.1	1,113	0.1
Lotic freshwater	0	0.0	11,820	2.2	14,940	1.9	20,859	1.8
Estuarine salt marsh	0	0.0	0	0.0	149	<0.1	992	0.1
Estuarine mud flat	0	0.0	57	<0.1	2,215	0.3	5,848	0.5
Tidal influenced shrub scrub	0	0.0	11	<0.1	144	<0.1	146	<0.1
Tidal influenced emergent meadow	0	0.0	311	0.1	891	0.1	2,687	0.2
Littoral mud flat	0	0.0	0	0.0	44	<0.1	169	<0.1
Littoral wetlands	0	0.0	622	0.1	921	0.1	1,124	0.1
Flooded emergent meadow	0	0.0	120,167	22.8	160,055	20.1	222,493	19.7
Partially vegetated barrens	0	0.0	0	0.0	4	<0.1	50	<0.1
Saturated emergent meadow	0	0.0	94,695	18.0	153,532	19.3	234,974	20.2
Flooded shrub scrub	0	0.0	3,291	0.6	4,720	0.6	6,194	0.5
Saturated shrub scrub	0	0.0	30,997	5.9	65,602	8.2	89,774	7.7
Tidal influenced riverine wetlands	0	0.0	0	0.0	0	0.0	33	<0.1
Freshwater riverine wetlands	0	0.0	2,290	0.4	3,299	0.4	4,679	0.4
Riverine barrens	0	0.0	3,847	0.7	7,966	1.0	10,472	0.9
Seasonally flooded barrens	0	0.0	1	<0.1	38	<0.1	80	<0.1
Seasonally flooded emergent meadow	0	0.0	155,368	29.5	242,580	30.4	356,688	30.7
Seasonally flooded shrub scrub	0	0.0	75,810	14.4	97,808	12.3	123,610	10.6
Upland	0	0.0	23,875	4.5	26,476	3.3	29,035	2.5

Wetland Type in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [1]	Alternative C Area (acres)	Alternative C Area (%) [1]	Alternative D Area (acres)	Alternative D Area (%) [1]	Alternative D2 Area (acres)	Alternative D2 Area (%) [1]
Controlled Surface Use (CSU)	**0**	**0.0 [1]**	**123,867**	**7.9 [1]**	**15,870**	**1.0 [1]**	**84,320**	**5.4**
Lentic freshwater	0	0.0	77	0.1	10	0.1	0	0.0
Palustrine waters	0	0.0	29	<0.1	32	0.2	20	<0.1
Lotic freshwater	0	0.0	388	0.3	0	0.0	497	0.6
Flooded emergent meadow	0	0.0	8,465	6.8	3,571	23.0	4,202	5.0
Littoral wetlands	0	0.0	0	0.0	0	0.0	3	<0.1
Saturated emergent meadow	0	0.0	38,361	31.0	3,077	19.4	25,737	30.5
Flooded shrub scrub	0	0.0	925	0.7	0	0.0	1,280	1.5
Saturated shrub scrub	0	0.0	25,547	20.6	1,321	8.5	11,658	13.8
Freshwater riverine wetlands	0	0.0	647	0.5	0	0.0	135	0.2
Seasonally flooded emergent meadow	0	0.0	39,360	31.8	6,277	39.6	33,688	40.0
Seasonally flooded shrub scrub	0	0.0	9,177	7.4	1,162	7.3	6,525	7.7
Partially vegetated barrens	0	0.0	0	0.0	0	0.0	1	<0.1
Upland	0	0.0	890	0.7	420	2.6	573	0.7
No Surface Occupancy (NSO)	**357,982**	**22.9 [1]**	**708,215**	**45.3 [1]**	**726,351**	**46.5 [1]**	**231,648**	**14.8**
Nearshore waters	2,368	0.7	4,641	0.7	4,209	0.6	3,561	1.5
Estuarine open water	61,155	17.1	61,551	8.7	51,292	7.1	27,495	11.9
Tidal influenced palustrine waters	143	<0.1	289	<0.1	256	<0.1	117	0.1
Lentic freshwater	3,242	0.9	9,402	1.3	9,466	1.3	6,629	2.9
Palustrine waters	2,083	0.6	3,806	0.5	3,778	0.5	1,887	0.8
Tidal influenced lotic freshwater	1,912	0.5	2,406	0.3	2,356	0.3	1,368	0.6
Lotic freshwater	31,256	8.7	29,160	4.1	28,302	3.9	20,882	9.0
Estuarine mud flat	11,938	3.3	13,601	1.9	11,443	1.6	7,832	3.4
Estuarine salt marsh	1,464	0.4	2,123	0.3	1,974	0.3	1,131	0.5
Tidal influenced emergent meadow	2,548	0.7	7,187	1.0	6,607	0.9	4,812	2.1
Tidal influenced shrub scrub	29	<0.1	358	0.1	225	<0.1	223	0.1
Littoral mud flat	124	<0.1	191	<0.1	147	<0.1	22	<0.1
Littoral wetlands	358	0.1	779	0.1	562	0.1	328	0.1

Wetland Type in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [1]	Alternative C Area (acres)	Alternative C Area (%) [1]	Alternative D Area (acres)	Alternative D Area (%) [1]	Alternative D2 Area (acres)	Alternative D2 Area (%) [1]
Flooded emergent meadow	53,192	14.9	119,924	16.9	104,018	14.3	33,844	14.6
Partially vegetated barrens	82	<0.1	107	<0.1	107	<0.1	58	<0.1
Saturated emergent meadow	44,210	12.3	136,059	19.2	159,611	22.0	33,794	14.6
Flooded shrub scrub	1,070	0.3	1,961	0.3	5,349	0.7	750	0.3
Saturated shrub scrub	14,114	3.9	53,309	7.5	61,433	8.5	18,906	8.2
Tidal influenced riverine wetlands	34	<0.1	39	<0.1	39	<0.1	6	<0.1
Freshwater riverine wetlands	413	0.1	1,693	0.2	1,886	0.3	225	0.1
Riverine barrens	16,323	4.6	15,305	2.2	11,185	1.5	8,679	3.7
Seasonally flooded barrens	88	<0.1	148	<0.1	111	<0.1	70	<0.1
Seasonally flooded emergent meadow	72,100	20.1	186,265	26.3	203,850	28.2	43,547	18.8
Seasonally flooded shrub scrub	31,571	8.8	51,855	7.3	53,953	7.4	14,009	6.0
Upland	6,163	1.7	6,056	0.9	4,194	0.6	1,474	0.6
Timing Limitations (TL)	**585,424**	**37.4 [1]**	**19**	**<0.1**	**1,802**	**0.1**	**3,072**	**0.2**
Nearshore waters	24	<0.1	0	0.0	0	0.0	0	0.0
Estuarine open water	119	<0.1	0	0.0	0	0.0	0	0.0
Tidal influenced palustrine waters	34	<0.1	0	0.0	0	0.0	0	0.0
Lentic freshwater	2,541	0.4	0	0.0	0	0.0	0	0.0
Palustrine waters	1,551	0.3	0	0.0	0	0.0	1	<0.1
Tidal influenced lotic freshwater	88	<0.1	0	0.0	0	0.0	0	0.0
Lotic freshwater	5,258	0.9	<0.5	0.3	0	0.0	59	1.9
Estuarine mud flat	151	<0.1	0	0.0	0	0.0	0	0.0
Estuarine salt marsh	115	<0.1	0	0.0	0	0.0	0	0.0
Tidal influenced emergent meadow	587	0.1	0	0.0	0	0.0	0	0.0
Tidal influenced shrub scrub	69	<0.1	0	0.0	0	0.0	0	0.0
Littoral wetlands	877	0.1	0	0.0	0	0.0	0	0.0
Flooded emergent meadow	141,407	24.2	8	43.1	602	33.4	144	4.7

Wetland Type in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [1]	Alternative C Area (acres)	Alternative C Area (%) [1]	Alternative D Area (acres)	Alternative D Area (%) [1]	Alternative D2 Area (acres)	Alternative D2 Area (%) [1]
Partially vegetated barrens	9	<0.1	0	0.0	0	0.0	0	0.0
Saturated emergent meadow	112,057	19.1	2	9.4	264	14.6	1,019	33.2
Flooded shrub scrub	2,970	0.5	0	0.0	0	0.0	2	0.1
Saturated shrub scrub	29,437	5.0	<0.5	0.8	78	4.3	757	24.7
Freshwater riverine wetlands	2,450	0.4	<0.5	0.2	0	0.0	4	0.1
Riverine barrens	1,929	0.3	0	0.0	0	0.0	0	0.0
Seasonally flooded barrens	11	<0.1	0	0.0	0	0.0	0	0.0
Seasonally flooded emergent meadow	194,854	33.3	9	46.1	857	47.6	851	27.7
Seasonally flooded shrub scrub	68,483	11.7	0	0.0	1	0.1	234	7.6
Uplands	20,405	3.5	0	0.0	0	0.0	0	0.0
Standard Terms and Conditions (STC)	**620,021**	**39.7 [1]**	**205,058**	**13.1 [1]**	**22,124**	**1.4**	**80,959**	**5.2**
Nearshore waters	2,614	0.4	365	0.2	363	1.6	271	0.3
Estuarine open water	515	0.1	2	<0.1	2	<0.1	1	<0.1
Tidal influenced palustrine waters	129	<0.1	0	0.0	0	0.0	0	0.0
Lentic freshwater	6,946	1.1	1,398	0.7	323	1.5	97	0.1
Palustrine waters	2,139	0.3	1,010	0.5	103	0.5	115	0.1
Tidal influenced lotic freshwater	481	0.1	0	0.0	0	0.0	0	0.0
Lotic freshwater	6,729	1.1	1,874	0.9	0	0.0	946	1.2
Estuarine mud flat	1,642	0.3	74	<0.1	74	0.3	51	0.1
Estuarine salt marsh	544	0.1	0	0.0	0	0.0	0	0.0
Tidal influenced emergent meadow	4,363	0.7	0	0.0	0	0.0	0	0.0
Tidal influenced shrub scrub	270	<0.1	0	0.0	0	0.0	0	0.0
Littoral mud flat	67	<0.1	0	0.0	0	0.0	0	0.0
Littoral wetlands	248	<0.1	82	<0.1	0	0.0	28	<0.1
Flooded emergent meadow	80,160	12.9	26,194	12.8	6,512	29.4	7,076	8.7
Partially vegetated barrens	21	<0.1	4	<0.1	0	0.0	3	<0.1
Saturated emergent meadow	161,629	26.1	48,780	23.8	1,413	6.4	22,372	27.6

Wetland Type in Land Use Categories	Alternative B Area (acres)	Alternative B Area (%) [1]	Alternative C Area (acres)	Alternative C Area (%) [1]	Alternative D Area (acres)	Alternative D Area (%) [1]	Alternative D2 Area (acres)	Alternative D2 Area (%) [1]
Flooded shrub scrub	6,028	1.0	3,891	1.9	0	0.0	1,842	2.3
Saturated shrub scrub	84,969	13.7	18,666	9.1	86	0.4	7,425	9.2
Tidal influenced riverine wetlands	5	<0.1	0	0.0	0	0.0	0	0.0
Freshwater riverine wetlands	2,321	0.4	555	0.3	0	0.0	142	0.2
Riverine barrens	899	0.1	0	0.0	0	0.0	0	0.0
Seasonally flooded barrens	51	<0.1	0	0.0	0	0.0	0	0.0
Seasonally flooded emergent meadow	199,791	32.2	85,743	41.8	13,180	59.6	31,969	39.5
Seasonally flooded shrub scrub	52,938	8.5	16,150	7.9	68	0.3	8,614	10.6
Uplands	4,498	0.7	269	0.1	0	0	7	<0.1
Total	**1,563,427**	**NA**	**1,563,427**	**NA**	**1,563,427**	**NA**	**1,563,427**	**NA**

[2] The percentages provided in this column represent two distinct categories. The bolded Land Use Categories provide the percentage of each land use category (e.g., no sale, controlled surface use) is included in the entire program area, and under each Land Use Category, the percentages provided for Land Cover Class are how much that land cover class constitutes within each Land Use Category.

Table K-7
Maximum Direct and Indirect Impact Acreage for each Wetland Class by Alternative

Wetland Class	Alt B Available[1] acres (%)	Alt B Direct Impact (acres)	Alt B Indirect Impact (acres)	Alt B Total Impact (acres)	Alt C Available[1] acres (%)	Alt C Direct Impact (acres)	Alt C Indirect Impact (acres)	Alt C Total Impact (acres)	Alt D Available[1] acres (%)	Alt D Direct Impact (acres)	Alt D Indirect Impact (acres)	Alt D Total Impact (acres)	Alt D2 Available[1] acres (%)	Alt D2 Direct Impact (acres)	Alt D2 Indirect Impact (acres)	Alt D2 Total Impact (acres)
Nearshore waters	5,006 (0.3%)	6	56	63	5,006 (0.5%)	7	62	69	4,572 (0.6%)	6	55	61	3,832 (1.0%)	9	80	89
Estuarine open water	61,789 (4.0%)	79	696	775	61,552 (5.9%)	87	764	851	51,294 (6.7%)	70	612	682	27,496 (6.9%)	65	572	637
Tidal influenced palustrine waters	306 (<0.1%)	0	3	4	289 (<0.1%)	0	4	4	256 (<0.1%)	0	3	3	117 (<0.1%)	0	2	3
Lentic freshwater	12,729 (0.8%)	16	143	160	10,877 (1.0%)	15	135	150	9,799 (1.3%)	13	117	130	6,726 (1.7%)	16	140	156
Palustrine waters	5,774 (0.4%)	7	65	72	4,845 (0.5%)	7	60	67	3,913 (0.5%)	5	47	52	2,024 (0.5%)	5	42	47
Tidal influenced lotic freshwater	2,481 (0.2%)	3	28	31	2,406 (0.2%)	3	30	33	2,356 (0.3%)	3	28	31	1,368 (0.3%)	3	28	32
Lotic freshwater	43,242 (2.8%)	55	487	542	31,422 (3.0%)	44	390	434	28,302 (3.7%)	38	338	376	22,384 (5.6%)	53	466	519
Estuarine salt marsh	2,123 (0.1%)	3	24	27	2,123 (0.2%)	3	26	29	1,974 (0.3%)	3	24	26	1,131 (0.3%)	3	24	26
Estuarine mud flat	13,732 (0.9%)	18	155	172	13,675 (1.3%)	19	170	189	11,517 (1.5%)	16	137	153	7,884 (2.0%)	19	164	183
Tidal influenced shrub scrub	369 (<0.1%)	0	4	5	358 (<0.1%)	1	4	5	225 (<0.1%)	0	3	3	223 (0.1%)	1	5	5
Tidal influenced emergent meadow	7,498 (0.5%)	10	84	94	7,187 (0.7%)	10	89	99	6,607 (0.9%)	9	79	88	4,812 (1.2%)	11	100	112
Littoral mud flat	191 (<0.1%)	0	2	2	191 (<0.1%)	0	2	3	147 (<0.1%)	0	2	2	22 (<0.1%)	0	0	1
Littoral wetlands	1,483 (0.1%)	2	17	19	861 (0.1%)	1	11	12	562 (0.1%)	1	7	7	359 (0.1%)	1	7	8
Flooded emergent meadow	274,759 (17.6%)	351	3,093	3,445	154,592 (14.9%)	218	1,919	2,137	114,703 (15.0%)	156	1,369	1,525	45,265 (11.3%)	107	942	1,049

Wetland Class	Alt B Available[1] acres (%)	Alt B Direct Impact (acres)	Alt B Indirect Impact (acres)	Alt B Total Impact (acres)	Alt C Available[1] acres (%)	Alt C Direct Impact (acres)	Alt C Indirect Impact (acres)	Alt C Total Impact (acres)	Alt D Available[1] acres (%)	Alt D Direct Impact (acres)	Alt D Indirect Impact (acres)	Alt D Total Impact (acres)	Alt D2 Available[1] acres (%)	Alt D2 Direct Impact (acres)	Alt D2 Indirect Impact (acres)	Alt D2 Total Impact (acres)
Partially vegetated barrens	111 (<0.1%)	0	1	1	111 (<0.1%)	0	1	2	107 (<0.1%)	0	1	1	61 (<0.1%)	0	1	1
Saturated emergent meadow	317,897 (20.3%)	407	3,579	3,986	223,202 (21.5%)	315	2,771	3,086	164,365 (21.4%)	223	1,962	2,185	82,923 (20.7%)	196	1,726	1,922
Flooded shrub scrub	10,069 (0.6%)	13	113	126	6,778 (0.7%)	10	84	94	5,349 (0.7%)	7	64	71	3,874 (1.0%)	9	81	90
Saturated shrub scrub	128,519 (8.2%)	164	1,447	1,611	97,522 (9.4%)	138	1,211	1,348	62,918 (8.2 %)	85	751	836	38,745 (9.7%)	92	806	898
Tidal influenced riverine wetlands	39 (<0.1%)	0	0	0	39 (<0.1%)	0	0	1	39 (<0.1%)	0	0	1	6 (<0.1%)	0	0	0
Freshwater riverine wetlands	5,185 (0.3%)	7	58	65	2,895 (0.3%)	4	36	40	1,886 (0.2%)	3	23	25	506 (0.1%)	1	11	12
Riverine barrens	19,151 (1.2%)	25	216	240	15,305 (1.5%)	22	190	212	11,185 (1.5%)	15	134	149	8,679 (2.2%)	21	181	201
Seasonally flooded barrens	149 (<0.1%)	0	2	2	148 (<0.1%)	0	2	2	111 (<0.1%)	0	1	1	70 (<0.1%)	0	1	2
Seasonally flooded emergent meadow	466,744 (29.9%)	597	5,255	5,852	311,376 (30.0%)	439	3,866	4,305	224.164 (29.2%)	304	2,676	2,980	110,056 (27.5%)	260	2,291	2,551
Seasonally flooded shrub scrub	152,992 (9.8%)	196	1,722	1,918	77,182 (7.4%)	109	658	1,067	55,183 (7.2%)	75	659	734	29,382 (7.3%)	69	612	681
Uplands	31,090 (2.0%)	40	349	389	7,215 (0.7%)	10	90	100	4,614 (0.6%)	7	61	68	2,054 (0.5%)	5	43	48
Total	**1,563,427 (100.0%)**	**2,000**	**17,600**	**19,600**	**1,037,158 (100.0%)**	**1,464**	**12,883**	**14,347**	**766,147 (100.0%)**	**1,040**	**9,152**	**10,192**	**399,999 (100.0%)**	**946**	**8,325**	**9,271**

[1] This represents the total area available for leasing under the given alternative.

K.2 FISH AND AQUATIC SPECIES

Table K-8
Winter Liquid Water Volumes (acre-feet) of Lakes in the 1002 Area at Different Ice Thickness Levels and Fish Presence by Lake

Lake No.	Surface Area (acres)	Maximum Depth (feet)	Ice Thickness (Average Measurement Date)								Fish Observed
			0 feet	1 foot (Oct 31)	2 feet (Nov 13)	3 feet (Dec 11)	4 feet (Jan 4)	5 feet (Feb 20)	6 feet (April 5)	7 feet (April 16)[a]	
1[b]	33	1.5	57	24	0	0	0	0	0	0	NS[c]
2	131	13.1	912	784	668	564	465	372	284	204	NS
3[d]	0	0	0	0	0	0	0	0	0	0	NS
4	100	4.8	235	143	67	16		0	0	0	NS
5	58	6.8	279	222	167	117	72	34	9	0	NS
6	94	12.1	824	730	637	543	449	358	272	196	Yes
7	113	10	720	607	494	381	273	171	89	35	Yes
8	44	3.8	93	55	25	4	0	0	0	0	Yes
9	23	2.9	44	22	4	0	0	0	0	0	No
10	32	5.1	120	89	57	29	8	<1	0	0	No
11	22	4.3	75	53	31	11	<1	0	0	0	No
12	31	7.7	122	91	60	34	17	8	3	<1	Yes
13	40	3.1	85	45	11	<1	0	0	0	0	Yes
14	46	13.4	328	282	236	190	146	111	79	51	No
15	96	8.2	379	283	187	97	37	9	3	<1	No
16	257	3.8	668	427	221	67	0	0	0	0	NS
17	100	7.4	342	246	162	95	46	16	2	0	NS
18[b]	32	2	74	42	18	0	0	0	0	0	NS
19[b]	181	2	419	238	102	0	0	0	0	0	NS
20	81	9.2	457	377	301	230	167	110	59	18	NS
21	56	4.2	128	77	37	10	0	0	0	0	NS
22	77	9.3	352	276	206	145	95	54	20	3	NS
23	35	10.7	240	206	173	142	112	85	61	40	NS
24	133	7.5	709	578	457	345	240	141	50	7	NS
25	131	2.3	182	67	3	0	0	0	0	0	Yes
26	64	8.3	321	258	199	144	94	50	13	0	NS
27	303	17.9	3,212	2,009	1,706	1,414	1,138	878	639	432	Yes
28	79	3.4	216	141	72	14	0	0	0	0	NS
29	300	7.5	1,190	914	688	497	321	162	36	<1	NS
30[b]	0	0	0	0	0	0	0	0	0	0	NS
31	104	8.7	557	452	348	249	161	90	39	10	Yes
32	34	10.9	208	174	142	112	84	59	36	18	NS
33	29	6.3	94	66	39	17	5		0	0	NS

Lake No.	Surface Area (acres)	Maximum Depth (feet)	Ice Thickness (Average Measurement Date)								Fish Observed
			0 feet	1 foot (Oct 31)	2 feet (Nov 13)	3 feet (Dec 11)	4 feet (Jan 4)	5 feet (Feb 20)	6 feet (April 5)	7 feet (April 16)[a]	
34	1,533	9	9,285	7,753	6,220	4,756	3,416	2,220	1,169	340	NS
35	89	8.4	523	435	351	273	200	131	69	18	NS
36	1,316	11	9,198	7,882	6,565	5,305	4,138	3,067	2,097	1,282	NS
37	342	8.3	1,804	1,462	1,120	793	500	245	70	10	Yes
38	44	7.8	250	206	164	124	85	50	19	3	NS
39	58	4.9	224	167	112	62	23	0	0	0	NS
40	26	3.5	58	33	9	<1	0	0	0	0	No
41	30	5.9	116	85	56	28	2	0	0	0	NS
42	96	5.9	441	346	250	159	79	20	0	0	No
43[b]	0	0	0	0	0	0	0	0	0	0	NS
44	21	2.7	44	25	8	0	0	0	0	0	NS
45	51	8	295	244	193	142	93	55	27	6	No
46	56	8.8	373	317	260	205	152	104	62	29	No
47	75	4.6	274	199	124	54	7	0	0	0	No
48	32	8.4	155	124	95	69	47	29	15	6	NS
49	53	5.7	195	142	92	48	17	2	0	0	No
50	36	7.2	181	145	111	78	48	23	7	0	NS
51	155	6.4	624	469	325	203	101	31	1	0	Yes
52	69	7.9	417	348	280	212	148	88	33	4	Yes
53	17	6.7	89	72	56	40	25	12	3	0	NS
54	83	4.1	263	180	97	28	<1	0	0	0	No
55	36	5.9	166	131	96	64	36	12	0	0	NS
56[b]	28	2.5	65	37	17	0	0	0	0	0	NS
57	59	6.9	304	246	189	136	87	43	13	0	NS
58	31	8.4	156	126	98	73	50	29	12	2	NS
59	24	10.5	117	94	72	53	37	23	11	3	NS
60	50	7.9	280	231	183	137	92	52	20	3	NS
61	24	7.8	125	102	80	59	40	23	8	1	NS
62	84	3.9	248	164	83	17	0	0	0	0	Yes
63	48	7.7	269	222	177	137	95	58	25	5	NS
64	128	8. 1	766	638	510	382	259	151	66	13	Yes
65	87	8.6	477	390	302	215	141	89	49	16	Yes
66	43	6.5	193	150	109	70	34	7	0	0	NS
67	190	3.6	530	340	168	21	0	0	0	0	Yes
68	65	8.9	393	327	262	197	137	82	38	8	Yes
69	33	8.1	173	140	109	80	52	28	7	0	NS
70[b]	20	2	46	26	11	0	0	0	0	0	NS
71	43	8.2	190	147	106	69	40	19	4	0	NS
72	33	9.1	68	41	22	12	7	4	2	1	NS

Lake No.	Surface Area (acres)	Maximum Depth (feet)	Ice Thickness (Average Measurement Date)								Fish Observed
			0 feet	1 foot (Oct 31)	2 feet (Nov 13)	3 feet (Dec 11)	4 feet (Jan 4)	5 feet (Feb 20)	6 feet (April 5)	7 feet (April 16)[a]	
73	168	8.6	788	620	453	299	174	76	25	7	Yes
74	69	11	429	361	292	223	158	98	46	11	Yes
75	102	8.7	679	576	474	371	270	174	88	23	Yes
76	63	11.6	454	392	329	267	206	149	98	53	Yes
77	26	8.7	105	80	56	35	19	8	2	0	NS
78	36	8.7	149	113	79	49	24	9	2	1	NS
79	97	3.3	216	119	31	<1	0	0	0	0	Yes
80	164	8.5	1,045	881	717	558	412	280	159	53	Yes
81	41	6.7	155	115	77	44	19	5	1	0	NS
82	32	5.5	96	65	35	12	2	0	0	0	NS
83	32	7.9	184	153	122	92	64	39	16	3	NS
84	46	7.5	262	215	169	127	90	57	28	4	Yes
85	31	8.2	140	109	80	53	28	8	1	0	NS
86	41	7.1	226	185	144	106	70	36	10	<1	Yes
87	33	6.8	128	96	66	41	19	4	0	0	NS
88	27	5.6	75	49	26	10	2	0	0	0	NS
89	60	7.8	375	315	254	196	141	91	48	10	Yes
90	36	6.9	187	151	115	81	50	24	5	0	Yes
91[b]	77	1.5	77	33	0	0	0	0	0	0	NS
92	68	3.6	148	81	20	0	0	0	0	0	NS
93	58	8.2	261	203	145	92	50	20	6	1	Yes
94	181	7.7	1,003	823	642	475	330	200	79	8	No
95	29	3.5	79	50	24	4	0	0	0	0	NS
96	89	5.9	284	195	112	49	15	2	0	0	Yes
97	99	7.8	610	511	412	313	218	131	56	7	Yes
98	33	8.3	165	132	101	71	44	20	6	1	NS
99	38	7.9	195	157	121	88	58	32	12	2	NS
100	43	1.7	25	2	0	0	0	0	0	0	No
101	29	5.7	130	100	73	47	24	6	0	0	NS
102	30	7.4	131	101	73	47	23	7	1	0	NS
103	35	6.8	147	113	81	52	29	13	4	0	NS
104	50	6.2	226	176	127	80	41	11	<1	0	No
105	34	5.8	112	81	53	29	9	2	0	0	NS
106	36	5.7	84	52	26	10	2	0	0	0	NS
107	55	6.8	207	152	102	62	33	11	1	0	No
108[b]	20	2	46	26	11	0	0	0	0	0	NS
109	142	9.2	952	810	669	527	390	262	147	49	Yes
110	54	4.8	179	125	71	24	<1	0	0	0	No
111	25	4.8	76	52	29	9	1	0	0	0	NS

Lake No.	Surface Area (acres)	Maximum Depth (feet)	Ice Thickness (Average Measurement Date)								Fish Observed
			0 feet	1 foot (Oct 31)	2 feet (Nov 13)	3 feet (Dec 11)	4 feet (Jan 4)	5 feet (Feb 20)	6 feet (April 5)	7 feet (April 16)[a]	
112	88	3.3	189	102	34	2	0	0	0	0	No
113	26	3.8	75	50	27	8	0	0	0	0	NS
114[b]	0	0	0	0	0	0	0	0	0	0	NS
115	41	7.5	221	180	139	99	64	33	11	<1	Yes
116	45	7.9	148	103	58	22	6	3	1	<1	Yes
117	25	3.1	48	24	6	<1	0	0	0	0	Yes
118	18	2.7	32	15	4	0	0	0	0	0	NS
119	68	24.8	819	751	683	615	548	484	422	363	Yes
Total	**NA**	**NA**	**55,379**	**43,359**	**33,962**	**25,061**	**17,755**	**11,702**	**6,797**	**3,366**	**NA**

Source: Trawicki et al. 1991

Notes: NA (not applicable); NS (not sampled). Highlighted rows indicate lakes that contain some level of liquid water in April (i.e., lakes that do not freeze to the bottom). One acre foot equals 325,851 gallons.

[a] Seven feet of ice reported during one year of record only.

[b] Lake was too shallow for fathometer readings. Volumes are estimated based on surface area from U.S. Geological Survey topographic maps and maximum depth estimates.

[c] Lake was not sampled for fish.

[d] Lake is directly connected to the Beaufort Sea.

K.3 BIRDS

Table K-9
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	—	—	W	—	—	—	—	—
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. degland*	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	*G. 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	—	—	W —	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. pugnax*	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	*C. 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: rare 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	*St. parasiticus*	Breeder: uncommon Summer resident: common	—	—	—	—	—	—	—	—
Long-tailed jaeger	*St. 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	—
Short-billed gull	*Larus brachyrhynchus*	Breeder: rare 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	—	—	W	A	—	—	—	—
Snowy owl	*Bubo scandiacus*	Breeder: common (in high microtine rodent years) to rare	—	C	—	A	—	C	—	VU
Short-eared owl	*Asio flammeus*	Breeder: common (in high microtine rodent years) to uncommon	—	C	W	A	—	—	—	—
American kestrel	*Falco sparverius*	Visitor: casual	—	—	—	A	—	—	—	—
Merlin	*F. columbarius*	Possible breeder: rare Visitor: rare	—	—	—	—	—	—	—	—
Gyrfalcon	*F. rusticolus*	Permanent resident and breeder: uncommon (inland) Visitor: rare on coast	—	—	W	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: common Breeder: common	—	—	—	—	—	—	—	—
Common nighthawk	*Chordeiles minor*	Visitor: casual	—	—	—	—	—	—	—	—
Rufous hummingbird	*Selasphorus rufus*	Visitor: accidental	—	C	W	A	—	C	R	NT
Belted kingfisher	*Megaceryle alcyon*	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: rare (inland) 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	—	—	W	A	—	—	R	—
Cliff swallow	*Petrochelidon pyrrhonota*	Possible breeder: rare Visitor: rare	—	—	—	—	—	—	—	—
Barn swallow	*Hirundo rustica*	Visitor: casual	—	—	—	A	—	—	—	—
American dipper	*Cinclus mexicanus*	Permanent resident: uncommon (inland) Breeder: uncommon (inland)	—	—	—	—	—	—	—	—
Bluethroat	*Cyanecula 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)	—	—	—	—	—	—	—	—

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]
Varied thrush	*Ixoreus naevius*	Visitor: casual	—	—	C	A	—	—	—	—
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	*Calcarius 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	*Leiothlypis 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)	—	C	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)	—	C[m]	—	—	—	—	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; W = Watchlist 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 K-10
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 K-11
Conservation Listings of Bird Species Occurring Along Marine 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*	—	—	W	A	Y	NT
Snow goose	*A. caerulescens*	—	—	—	—	—	—
Brant	*Branta bernicla*	—	—	—	—	Y	—
Cackling goose (Aleutian, Taverner's, minima)	*B. hutchinsii*	—	—	S	—	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*	—	—	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*	—	C	S	—	Y	—
Least sandpiper	*C. minutilla*	—	—	—	—	—	—
Pectoral sandpiper	*C. melanotos*	—	C	—	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*	—	C	—	A	—	—
Cassin's auklet	*Ptychoramphus aleuticus*	—	C[g]	—	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*	—	C[g]	—	—	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; W = Watchlist 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
[g]Listed as a species of conservation concern for Bird Conservation Region 5 only.

Table K-12
Crosswalk of Ecotypes Mapped in Northwest Alaska to Land Cover Types Mapped in the Arctic Refuge Program Area[b]

Marcot Ecotype	Primary Arctic Refuge Land Cover Type	Secondary Arctic Refuge Land Cover Type
Alpine acidic barrens	Barrens	Partially vegetated
Alpine acidic dryas dwarf shrub	Dryas dwarf shrub	—
Alpine alkaline barrens	Barrens	Partially vegetated
Alpine alkaline dryas dwarf shrub	Dryas dwarf shrub	—
Alpine ericaceous dwarf shrub	Ericaceous dwarf shrub	Snowbed
Alpine lake	Water	—
Alpine mafic barrens	Barrens	Partially vegetated
Alpine snowfields and glaciers	Snow/Ice	—
Alpine wet sedge meadow	Wet sedge meadow tundra	Snowbed
Coastal barrens	Barrens	Partially vegetated
Coastal brackish sedge-grass meadow	Salt marsh	—
Coastal crowberry dwarf shrub	Ericaceous dwarf shrub	—
Coastal dunegrass meadow	—	—
Coastal water	Water	—
Human modified barrens	Barrens	Partially vegetated
Lacustrine barrens	Barrens	Partially vegetated
Lacustrine bluejoint meadow	—	—
Lacustrine wet sedge meadow	Wet sedge meadow tundra	Wet sedge meadow tundra with moist inclusions
Lacustrine willow shrub	—	—
Lowland alder tall shrub	—	—
Lowland barrens-burned	—	—
Lowland birch forest	—	—
Lowland birch-ericaceous-willow low shrub	Low and dwarf birch shrub	—
Lowland black spruce forest	—	—
Lowland ericaceous shrub bog	Ericaceous dwarf shrub	Low and dwarf birch shrub
Lowland lake	Water	—
Lowland sedge fen	Wet sedge meadow tundra	Wet sedge meadow tundra with moist inclusions
Lowland sedge-dryas meadow	Moist sedge-dryas tundra	Moist sedge-shrub tundra with wet inclusions
Lowland spruce-birch forest	—	—
Lowland willow low shrub	Low and dwarf birch shrub	Moist sedge-willow tundra
Riverine alder-willow tall shrub	Low and tall riverine willow shrub	—
Riverine barrens	Barrens	Partially vegetated
Riverine birch-willow low shrub	Low and tall riverine willow shrub	—
Riverine dryas dwarf shrub	Dryas dwarf shrub	Moist sedge-shrub tundra with wet inclusions
Riverine poplar forest	Poplar forest	—
Riverine water	Water	—
Riverine wet sedge meadow	Wet sedge meadow tundra	Wet sedge meadow tundra with moist inclusions

Marcot Ecotype	Primary Arctic Refuge Land Cover Type	Secondary Arctic Refuge Land Cover Type
Riverine white spruce-poplar forest	—	—
Riverine white spruce-willow forest	—	—
Riverine willow low shrub	Low and tall riverine willow shrub	—
Shadow/Indeterminate	—	—
Upland alder-willow tall shrub	—	—
Upland aspen forest	—	—
Upland barrens-burned	—	—
Upland barrens-landslides	Barrens	Partially vegetated
Upland barrens-thermokarst	Barrens	Partially vegetated

[a] Ecotypes in northwest Alaska from Marcot et al. (2015).
[B] Land cover types on the Refuge Coastal Plain from Macander et al. (2020).

Table K-13
Categorical Habitat-use Rankings for Bird Species Occurring Regularly on the Arctic Refuge Coastal Plain

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Waterbirds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Greater white-fronted goose	0	1	2	2	1	2	1	1	0	0	2	0	1	1	1	3	1	3	3	3
Snow goose	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	3
Brant	0	0	1	0	0	1	0	0	0	0	3	0	0	0	3	3	0	1	1	3
Cackling goose	0	1	1	0	0	2	1	0	0	0	2	0	1	1	1	3	1	3	3	3
Tundra swan	0	1	2	2	1	2	1	1	0	0	1	0	1	1	1	3	2	3	3	3
Northern shoveler	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	3	2	3	3	3
American wigeon	0	1	0	0	1	1	1	0	0	0	1	0	0	0	1	3	2	3	3	3
Mallard	0	1	0	0	0	1	1	0	0	0	1	0	0	0	1	3	2	3	3	3
Northern pintail	0	0	0	0	0	1	1	0	0	0	3	0	0	0	0	3	2	3	3	3
Green-winged teal	0	1	0	0	1	1	1	0	0	0	3	0	0	0	1	3	2	3	3	3
Greater scaup	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1	3	1	3	3	3
Lesser scaup	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3	1	3	3	3
Steller's eider	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	3
Spectacled eider	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	3
King eider	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	3
Common eider	1	0	1	0	0	0	0	0	1	0	3	0	0	0	3	0	0	0	0	0
Harlequin duck	0	2	0	0	1	0	1	0	0	0	0	0	0	0	1	0	3	0	0	1

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Surf scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	2
White-winged scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	3
Black scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	1	1	2
Long-tailed duck	0	1	1	0	0	2	1	0	0	0	2	0	0	0	3	3	2	3	3	3
Common goldeneye	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1	1	0	0	
Red-breasted merganser	0	0	0	0	1	0	0	0	0	1	1	0	0	0	1	3	3	1	1	2
Horned grebe	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1
Sandhill crane	0	2	3	1	0	2	2	1	0	0	1	0	1	1	0	0	0	3	3	2
Red-throated loon	0	0	0	0	0	0	0	0	0	0	3	0	0	0	2	3	2	3	3	3
Pacific loon	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	3	2	3	3	3
Common loon	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	2	1	1	3
Yellow-billed loon	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	3	2	1	1	2
Shorebirds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Black-bellied plover	1	3	1	1	0	2	2	1	1	0	2	0	1	1	0	0	0	3	3	1
American golden-plover	1	3	2	1	0	3	3	1	1	0	2	1	3	3	0	0	0	2	2	1
Semipalmated plover	1	1	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	1
Upland sandpiper	0	0	0	0	0	1	1	0	0	0	0	0	3	3	0	0	0	0	0	0
Whimbrel	0	3	2	1	0	3	3	1	0	0	1	1	3	3	0	0	0	1	1	1
Bar-tailed godwit	0	3	1	1	0	3	3	1	0	0	1	1	3	3	0	0	0	1	1	1
Ruddy turnstone	1	1	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0
Red knot	0	0	0	0	0	1	1	0	0	0	0	0	2	2	0	0	0	1	1	1
Stilt sandpiper	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Sanderling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dunlin	0	1	1	0	0	1	1	0	0	0	2	0	0	0	0	0	0	3	3	1
Baird's sandpiper	1	3	1	0	0	2	2	0	1	0	1	0	0	0	0	0	0	1	1	0
Least sandpiper	0	2	1	1	1	2	2	0	0	0	1	0	3	3	0	0	0	2	2	1
White-rumped sandpiper	0	0	0	0	0	2	1	0	0	0	2	0	0	0	0	1	0	2	2	0
Buff-breasted sandpiper	0	1	1	0	0	1	1	0	0	0	1	0	1	1	0	0	0	1	1	0
Pectoral sandpiper	0	2	1	0	0	2	2	0	0	0	2	0	3	3	0	0	0	3	3	1
Semipalmated sandpiper	0	2	2	0	0	3	2	0	0	0	3	0	2	2	0	0	0	2	2	1
Western sandpiper	0	3	2	0	0	3	3	0	0	0	1	0	3	3	0	0	0	2	2	1
Long-billed dowitcher	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	3	2
Wilson's snipe	0	1	2	2	1	2	1	2	0	0	2	2	2	2	0	0	0	2	2	2
Spotted sandpiper	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Wandering tattler	1	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Red-necked phalarope	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	3	1	3	3	3
Red phalarope	0	0	0	0	0	0	0	0	0	0	3	0	0	0	1	3	0	2	2	3
Larids	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pomarine jaeger	0	0	1	0	0	1	0	0	0	0	2	0	0	0	3	0	0	2	2	0
Parasitic jaeger	0	2	1	0	0	2	2	0	0	0	2	0	2	2	1	0	0	2	2	0
Long-tailed jaeger	0	2	1	2	0	2	2	1	0	0	1	1	2	2	1	0	0	2	2	0
Black-legged kittiwake	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Ivory gull	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Sabine's gull	1	0	1	0	0	1	0	0	1	0	3	0	0	0	2	3	2	3	3	2
Ross's gull	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Short-billed gull	1	0	2	1	2	0	0	0	1	0	3	0	0	0	3	3	2	3	3	2
Herring gull	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Thayer's gull	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Glaucous gull	1	1	1	0	1	1	1	0	1	0	3	0	1	1	3	3	2	3	3	2
Arctic tern	1	0	1	0	0	0	0	0	1	0	3	0	0	0	3	3	2	3	3	3
Raptors and Owls	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Northern harrier	0	3	0	1	1	3	3	2	0	0	0	1	2	2	0	0	0	1	1	0
Rough-legged hawk	0	1	1	1	1	2	2	2	0	0	0	2	3	3	0	0	0	0	0	0
Golden eagle	0	1	1	1	1	2	2	2	0	0	0	2	3	3	0	0	0	0	0	0
Snowy owl	0	2	1	1	1	3	2	1	0	0	1	1	3	3	0	0	0	2	2	0
Short-eared owl	0	3	2	1	1	3	3	1	0	0	2	1	3	3	0	0	0	2	2	0
Merlin	0	2	2	2	2	2	2	1	0	0	0	1	2	2	0	0	0	0	0	0
Gyrfalcon	0	1	0	1	1	1	1	2	0	0	0	2	1	1	0	0	0	0	0	0
Peregrine falcon	0	2	1	1	1	2	2	1	0	0	1	1	2	2	0	0	0	1	1	0
Landbirds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Willow ptarmigan	0	0	1	2	3	2	1	3	0	0	0	3	3	3	0	0	0	0	0	0
Rock ptarmigan	0	3	0	2	2	1	1	2	0	0	0	2	2	2	0	0	0	0	0	0
Say's phoebe	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Northern shrike	0	0	1	1	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Common raven	1	0	0	0	0	0	0	0	1	3	0	0	0	0	0	0	0	0	0	0
Horned lark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cliff swallow	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0
American dipper	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0
Bluethroat	0	1	0	2	3	0	0	3	0	0	0	3	2	2	0	0	0	0	0	0
Northern wheatear	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Gray-cheeked thrush	0	0	0	1	2	0	0	1	0	2	0	1	0	0	0	0	0	0	0	0
American robin	0	1	1	1	2	0	0	1	0	2	0	1	1	1	0	0	0	0	0	0
Eastern yellow wagtail	0	1	0	2	2	1	1	2	0	0	0	2	3	3	0	0	0	0	0	0
American pipit	0	2	0	0	0	2	2	0	0	0	0	0	2	2	0	0	0	0	0	0
Common redpoll	0	0	1	3	3	0	0	3	0	0	0	3	1	1	0	0	0	0	0	0
Hoary redpoll	0	0	1	3	3	0	0	3	0	0	0	3	1	1	0	0	0	0	0	0
Lapland longspur	0	3	2	1	0	3	3	1	0	0	2	1	3	3	0	0	0	2	2	0
Smith's longspur	0	2	0	0	1	1	1	1	0	0	0	1	3	3	0	0	0	1	1	0
Snow bunting	1	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0
Yellow warbler	0	1	0	1	2	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Wilson's warbler	0	0	0	1	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0
American tree sparrow	0	0	1	3	3	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0
Savannah sparrow	0	3	1	3	2	3	3	3	0	0	0	3	3	3	0	0	0	2	2	0
Fox sparrow	0	0	1	1	2	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0
White-crowned sparrow	0	0	1	3	3	0	0	3	0	1	0	3	1	1	0	0	0	0	0	0

Species	Land Cover Class/Habitat-use Ranking[b,c]																			
	Barrens	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Low and Tall Riverine Willow Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Partially Vegetated	Poplar Forest	Salt Marsh	Sedge-Willow Tundra in Drainage Tracks	Shrub Tussock Tundra	Tussock Tundra	Coastal Water	Lowland Lake	Riverine Water	Wet Sedge Meadow Tundra	Wet Sedge Meadow Tundra with Moist Inclusions	Freshwater Marsh
Dark-eyed junco	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Seabirds	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thick-billed murre	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Kittlitz's murrelet[n]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Black guillemot	1	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0
Horned puffin	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Northern fulmar	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Short-tailed shearwater	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0
Total med-high rank	**0**	**24**	**12**	**14**	**17**	**29**	**22**	**14**	**0**	**4**	**28**	**13**	**27**	**27**	**15**	**26**	**19**	**37**	**37**	**35**
Total no-low rank	**95**	**71**	**84**	**82**	**78**	**67**	**73**	**81**	**95**	**91**	**68**	**82**	**68**	**68**	**80**	**70**	**76**	**59**	**59**	**69**

[a] Species not occurring annually (casual visitors and accidentals) are not included because those species occur singly or in very low numbers and they do not breed in the area, resulting in negligible impacts from development.
[b] 0 = not used, not important for that species; 1 = low use, rarely occurring or occurring in low numbers annually; 2 = medium use, regularly occurring, regular use in moderate numbers; 3 = high use, regularly occurring, regular use in high numbers.
[c] Habitat-use rankings from Marcot et al. (2015). For the Freshwater Marsh land cover class, which is not represented in Marcot et al.'s ecotypes, rankings were derived using professional judgment based on over 20 years of tundra breeding bird observations on the North Slope of Alaska.
[d] Dash indicates the species was not assessed by Marcot et al. (2015).

Table K-14
Bird Species for Which Moist Tundra Habitats are Ranked as High or Medium Value During the Breeding Season[a] and Would be Expected to Experience Greater Impacts from Development on the Arctic Refuge Coastal Plain

Species	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Shrub Tussock Tundra	Tussock Tundra
Waterbirds	—	—	—	—	—	—	—	—
Greater white-fronted goose	—	X[b]	X	X	—	—	—	—
Cackling goose	—	—	—	X	—	—	—	—
Tundra swan	—	X	X	X	—	—	—	—
Long-tailed duck	—	—	—	X	—	—	—	—
Sandhill crane	X	X	—	X	X	—	—	—
Shorebirds	—	—	—	—	—	—	—	—
Black-bellied plover	X	—	—	X	X	—	—	—
American golden-plover	X	X	—	X	X	—	X	X
Upland sandpiper	—	—	—	—	—	—	X	X
Whimbrel	X	X	—	X	X	—	X	X
Bar-tailed godwit	X	—	—	X	X	—	X	X
Baird's sandpiper	X	—	—	X	X	—	—	—
White-rumped sandpiper	—	—	—	X	—	—	—	—
Pectoral sandpiper	X	—	—	X	X	—	X	X
Semipalmated sandpiper	X	X	—	X	X	—	X	X
Western sandpiper	X	X	—	X	X	—	X	X
Wilson's snipe	—	X	X	X	—	X	X	X
Wandering tattler	X	—	—	—	—	—	—	—
Larids	—	—	—	—	—	—	—	—
Parasitic jaeger	X	—	—	X	X	—	X	X
Long-tailed jaeger	X	—	X	X	X	—	X	X
Short-billed gull	—	X	—	—	—	—	—	—
Raptors and owls	—	—	—	—	—	—	—	—
Golden eagle	—	—	—	X	X	X	X	X
Northern harrier	X	—	—	X	X	X	X	X
Rough-legged hawk	—	—	—	X	X	X	X	X

Species	Dryas Dwarf Shrub	Ericaceous Dwarf Shrub	Low and Dwarf Birch Shrub	Moist Sedge-Dryas Tundra	Moist Sedge-Shrub Tundra with Wet Inclusions	Moist Sedge-Willow Tundra	Shrub Tussock Tundra	Tussock Tundra
Snowy owl	X	—	—	X	X	—	X	X
Short-eared owl	X	X	—	X	X	—	X	X
Merlin	X	X	X	X	X	—	X	X
Gyrfalcon	—	—	—	—	—	X	—	—
Peregrine falcon	X	—	—	X	X	—	X	X
Landbirds	—	—	—	—	—	—	—	—
Willow ptarmigan	—	—	X	X	—	X	X	X
Rock ptarmigan	X	—	X	—	—	X	X	X
Bluethroat	—	—	X	—	—	X	X	X
Eastern yellow wagtail	—	—	X	—	—	X	X	X
American pipit	X	—	—	X	X	—	X	X
Common redpoll	—	—	X	—	—	X	—	—
Hoary redpoll	—	—	X	—	—	X	—	—
Lapland longspur	X	X	—	X	X	—	X	X
Smith's longspur	X	—	—	—	—	—	X	X
American tree sparrow	—	—	X	—	—	X	—	—
White-crowned sparrow	—	—	X	—	—	X	—	—
Savannah sparrow	—	—	X	X	X	X	X	X

[a] Habitat rankings from Marcot et al. (2015) cross-walked to the land cover (habitat) types on the Coastal Plain from Macander et al. (2020) are listed in Table K-17. Species not known to breed on the Coastal Plain and species known to use moist tundra habitats in riverine/floodplain areas are omitted because development in riverine habitats is restricted by lease stipulation.

[b] An "X" indicates a high use or medium use habitat ranking, "—" indicate a low-use or not-used ranking.

Table K-15
Acreages of Habitat Types Available in All Areas Open to Leasing under Alternative B and Estimated to Occur in a Hypothetical Development Area[a], by Hydrocarbon Potential (HCP)

Habitat Type	High HCP		Medium HCP		Low HCP	
	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area
Barrens	231.39	17.27	5,167.77	247.99	2,857.72	189.24
Dryas dwarf shrub	8,605.83	642.41	1,738.84	83.44	2,978.29	197.23
Ericaceous dwarf shrub	68.18	5.09	361.08	17.33	2,217.73	146.86
Freshwater marsh	186.73	13.94	131.53	6.31	21.03	1.39
Low and dwarf birch shrub	3,676.01	274.41	14,033.01	673.42	27,779.85	1,839.63
Low and Tall Riverine Willow Shrub	601.82	44.93	4,156.64	199.47	10,603.62	702.19
Moist sedge-dryas tundra	15,684.75	1,170.84	30,282.61	1,453.21	20,277.72	1,342.83
Moist sedge-shrub tundra with wet inclusions	58,573.01	4,372.37	193,419.15	9,281.83	40,210.41	2,662.81
Moist sedge-willow tundra	47,180.36	3,521.93	32,151.49	1,542.89	22,722.15	1,504.70
Partially vegetated	27,346.61	2,041.38	9,013.52	432.54	7,473.47	494.91
Poplar forest	0.00	0.00	0.00	0.00	1.63	0.11
Salt marsh	1,245.04	92.94	215.63	10.35	213.74	14.15
Sedge-willow tundra in drainage tracks	12,464.69	930.47	15,989.02	767.28	39,994.89	2,648.53
Shrub tussock tundra	24,150.56	1,802.80	63,070.64	3,026.65	116,604.99	7,721.79
Snow/Ice	63.27	4.72	195.02	9.36	181.88	12.04
Snowbed	1,688.15	126.02	3,022.91	145.06	1,000.24	66.24
Tussock tundra	92,502.33	6,905.14	143,034.03	6,863.94	107,182.89	7,097.84
Water	56,935.31	4,250.12	43,102.88	2,068.43	7,511.00	497.39
Wet sedge meadow tundra	54,706.68	4,083.76	69,935.86	3,356.09	50,729.82	3,359.42
Wet sedge meadow tundra with moist inclusions	17,407.96	1,299.47	29,473.81	1,414.39	16,621.13	1,100.68
Total	**423,318.69**	**31,600.00**	**658,794.46**	**31,600.00**	**477,184.21**	**31,600.00**

Moist tundra habitats are in bold.

[a] Proportions of habitats in a hypothetical oil development area of a maximum of 31,600 acres assumed to be the same as in all areas open to leasing (see section 3.3.3: Direct and Indirect Impacts: Alternative B.).

Table K-16
Acreages of Habitat Types Available in All Areas Open to Leasing under Alternative C and Estimated to Occur in a Hypothetical Development Area[a], by Hydrocarbon Potential (HCP)

Habitat Type	High HCP		Medium HCP		Low HCP	
	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area
Barrens	4,540.31	249.84	4,524.53	194.59	1,036.06	303.65
Dryas dwarf shrub	8,392.96	461.84	1,403.89	60.38	2,116.55	620.32
Ericaceous dwarf shrub	68.18	3.75	342.68	14.74	726.49	212.92
Freshwater marsh	186.39	10.26	104.82	4.51	1,196.55	350.68
Low and dwarf birch shrub	3,676.01	202.28	11,808.90	507.86	2,463.70	722.06
Low and tall riverine willow shrub	599.67	33.00	3,163.65	136.06	17.46	5.12
Moist sedge-dryas tundra	15,216.37	837.31	26,637.21	1,145.58	7,295.35	2,138.12
Moist sedge-shrub tundra with wet inclusions	56,592.94	3,114.13	149,706.77	6,438.42	1,342.81	393.55
Moist sedge-willow tundra	46,573.90	2,562.81	28,099.04	1,208.45	2,567.17	752.39
Partially vegetated	26,650.71	1,466.50	6,996.97	300.92	2,164.46	634.36
Salt marsh	1,245.04	68.51	215.63	9.27	9.01	2.64
Sedge-willow tundra in drainage tracks	12,442.81	684.69	15,548.84	668.71	11,076.81	3,246.39
Shrub tussock tundra	24,150.56	1,328.93	57,635.16	2,478.71	25,652.14	7,518.12
Snow/Ice	61.63	3.39	180.35	7.76	34.61	10.14
Snowbed	1,640.28	90.26	2,533.76	108.97	371.95	109.01
Tussock tundra	91,299.16	5,023.90	117,727.80	5,063.11	12,987.55	3,806.39
Water	56,860.89	3,128.87	40,359.33	1,735.73	4,387.94	1,286.02
Wet sedge meadow tundra	53,202.16	2,927.55	48,294.49	2,077.00	2,246.35	658.36
Wet sedge meadow tundra with Moist inclusions	16,958.62	933.18	22,560.04	970.24	1,230.94	360.76
Total	**420,358.62**	**23,131.00**	**537,843.88**	**23,131.00**	**78,923.91**	**23,131.00**

Moist tundra habitats are in bold.
[a] Proportions of habitats in a hypothetical oil development area of a maximum of 23,131 acres assumed to be the same as in all areas open to leasing (see section 3.3.3: Direct and Indirect Impacts: Alternative C.).

Table K-17
Acreages of Habitat Types Available in All Areas Open to Leasing under Alternative D and Estimated to Occur in a Hypothetical Development Area[a], by Hydrocarbon Potential (HCP)

Habitat Type	High HCP		Medium HCP		Low HCP[b]	
	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area
Barrens	4,532.37	188.58	3,566.23	157.89	1.00	1.00
Dryas dwarf shrub	7,877.03	327.75	1,248.52	55.28	0.00	0.00
Ericaceous dwarf shrub	68.14	2.84	279.72	12.38	0.02	0.02
Freshwater Marsh	186.39	7.76	66.04	2.92	0.00	0.00
Low and dwarf birch shrub	3,617.42	150.51	8,828.29	390.85	1.15	1.15
Low and Tall Riverine Willow Shrub	586.15	24.39	1,868.43	82.72	0.00	0.00
Moist sedge-dryas tundra	14,761.98	614.22	16,644.70	736.91	2.51	2.51
Moist sedge-shrub tundra with wet inclusions	50,420.96	2,097.93	90,175.72	3,992.33	0.77	0.77
Moist sedge-willow tundra	38,238.36	1,591.03	20,169.42	892.96	1.03	1.03
Partially vegetated	26,190.50	1,089.74	4,984.38	220.67	9.13	9.13
Salt marsh	1,244.42	51.78	41.38	1.83	0.65	0.65
Sedge-willow tundra in drainage tracks	12,095.58	503.28	12,432.45	550.42	1.03	1.03
Shrub tussock tundra	24,150.56	1,004.86	36,771.75	1,627.99	0.01	0.01
Snow/Ice	61.63	2.56	137.49	6.09	1.00	1.00
Snowbed	1,535.68	63.90	1,845.74	81.72	0.00	0.00
Tussock tundra	85,589.57	3,561.24	95,491.19	4,227.66	0.02	0.02
Water	56,720.86	2,360.06	30,223.83	1,338.09	0.00	0.00
Wet sedge meadow tundra	51,232.13	2,131.68	31,747.32	1,405.54	1.15	1.15
Wet sedge meadow tundra with Moist inclusions	15,811.23	657.88	14,630.98	647.75	0.00	0.00
Total	**394,920.96**	**16,432.00**	**371,153.57**	**16,432.00**	**17.30**	**17.30**

Moist tundra habitats are in bold.

[a] Proportions of habitats in a hypothetical oil development area of a maximum of 16,432 acres assumed to be the same as in all areas open to leasing (see section 3.3.3: Direct and Indirect Impacts: Alternative D).

[b] Area available for leasing in the low HCP area is far below a hypothetical development area in size, so any development in that area is likely to encompass all acres of each habitat.

Table K-18
Acreages of Habitat Types Available in All Areas Open to Leasing under Alternative D2 and Estimated to Occur in a Hypothetical Development Area[a], by Hydrocarbon Potential (HCP)

Habitat Type	High HCP		Medium HCP		Low HCP[b]	
	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area	All Areas Open to Leasing	Hypothetical Development Area
Barrens	4,057.61	151.63	0	0	0	0
Dryas dwarf shrub	8,216.56	307.05	0	0	0	0
Ericaceous dwarf shrub	68.14	2.55	0	0	0	0
Freshwater Marsh	164.23	6.14	0	0	0	0
Low and dwarf birch shrub	3,673.91	137.29	0	0	0	0
Low and Tall Riverine Willow Shrub	599.57	22.41	0	0	0	0
Moist sedge-dryas tundra	13,828.00	516.75	0	0	0	0
Moist sedge-shrub tundra with wet inclusions	51,443.59	1,922.42	0	0	0	0
Moist sedge-willow tundra	45,569.66	1,702.92	0	0	0	0
Partially vegetated	24,805.08	926.95	0	0	0	0
Salt marsh	654.45	24.46	0	0	0	0
Sedge-willow tundra in drainage tracks	12,259.91	458.15	0	0	0	0
Shrub tussock tundra	24,150.56	902.49	0	0	0	0
Snow/Ice	50.11	1.87	0	0	0	0
Snowbed	1,583.54	59.18	0	0	0	0
Tussock tundra	89,522.33	3,345.40	0	0	0	0
Water	53,871.82	2,013.16	0	0	0	0
Wet sedge meadow tundra	50,387.03	1,882.94	0	0	0	0
Wet sedge meadow tundra with Moist inclusions	15,067.17	563.05	0	0	0	0
Total	**399,973.29**	**14,946.80**	**0**	**0**	**0**	**0**

Moist tundra habitats are in bold.
[a] Proportions of habitats in a hypothetical oil development area of a maximum of 14,946.8 acres assumed to be the same as in all areas open to leasing (see Section 3.3.3: Direct and Indirect Impacts: Alternative D2).
[b] No medium or low HCP areas are available for lease under Alternative D2.

K.4 TERRESTRIAL MAMMALS

Table K-19
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*	Unknown; expanding range
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 K-20
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 surface occupancy	<20	92,200	15,000	900	108,100
		20–30	3,500	14,600	3,100	21,200
		30–40	0	10,800	500	11,300
		>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	263,900	69,100	1,900	334,900
		20–30	19,300	76,300	31,000	126,600
		30–40	0	114,900	10,400	125,300
		>40	0	26,100	1,800	27,900
C	No sale/no surface occupancy	<20	7,300	0	0	7,300
		20–30	0	0	200	200
		30–40	0	0	1,000	1,000
		>40	0	120,600	391,100	511,700
	No surface occupancy	<20	184,900	44,200	2,800	231,900
		20–30	22,400	57,100	27,400	106,900
		30–40	0	68,200	15,800	84,000
		>40	0	184,900	17,300	202,200
	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	13,500	0	145,000
		20–30	400	12,500	0	12,900
		30–40	0	38,000	0	38,000
		>40	0	8,900	0	8,900
D	No sale	<20	32,800	9,200	2,800	44,800
		20–30	0	8,400	34,600	43,100
		30–40	0	42,000	19,800	61,700
		>40	0	221,500	409,300	630,800
	No surface occupancy	<20	319,100	69,800	0	388,900
		20–30	22,800	78,600	0	101,400
		30–40	0	80,500	0	80,500
		>40	0	83,300	0	83,300
	Controlled surface use	<20	1,300	5,100	0	6,400
		20–30	0	1,100	0	1,100
		30–40	0	900	0	900
		>40	0	7,500	0	7,500
	Timing Limitations	<20	100	0	0	100
		20–30	0	0	0	0
		30–40	0	0	0	0
		>40	0	1,700	0	1,700
	Standard terms and conditions only	<20	2,800	0	0	2,800
		20–30	0	3,100	0	3,100
		30–40	0	10,800	0	10,800
		>40	0	4,900	0	4,900

PCH Calving Table

Alternative	Lease Type	Percent of Years Present	Oil Potential			
			High	Medium	Low	Total
D2	No sale	<20	19,500	84,100	2,800	106,400
		20–30	4,300	91,200	34,700	130,200
		30–40	0	134,100	19,800	153,900
		>40	0	318,900	409,300	728,200
	No surface occupancy	<20	171,800	0	0	171,800
		20–30	15,300	0	0	15,300
		30–40	0	0	0	0
		>40	0	0	0	0
	Controlled surface use	<20	81,300	0	0	81,300
		20–30	3,000	0	0	3,000
		30–40	0	0	0	0
		>40	0	0	0	0
	Timing Limitations	<20	3,100	0	0	3,100
		20–30	0	0	0	0
		30–40	0	0	0	0
		>40	0	0	0	0
	Standard terms and conditions only	<20	80,500	0	0	80,500
		20–30	200	0	0	200
		30–40	0	0	0	0
		>40	0	0	0	0

Source: BLM GIS 2018

Table K-21
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		Percent of Years Present	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
B	No surface occupancy	<20	63,700	4,900	700	69,300
		20–30	11,500	18,700	400	30,600
		30–40	11,700	38,500	5,700	55,900
		>40	2,200	30,000	81,500	113,700
	Timing limitations	<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
	Standard terms and conditions only	<20	112,000	54,000	0	166,000
		20–30	77,300	84,400	1,800	163,500
		30–40	69,800	106,300	35,400	211,500
		>40	24,100	41,600	7,900	73,600
C	No sale	<20	0	1,800	3,600	5,400
		20–30	4,600	13,200	14,400	32,200
		30–40	2,800	58,600	11,900	73,300
		>40	0	47,000	362,400	409,400
	No surface occupancy	<20	124,000	67,800	1,900	193,700
		20–30	41,500	100,200	2,000	143,700
		30–40	49,600	121,300	37,000	207,900
		>40	4,800	65,000	22,300	92,100
	Controlled surface use	<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
	Standard terms and conditions only	<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
D	No sale	<20	0	58,500	5,500	64,000
		20–30	20,600	44,400	16,300	81,300
		30–40	12,200	87,600	57,200	157,000
		>40	0	90,500	387,500	478,000
	No surface occupancy	<20	194,800	28,900	0	223,700
		20–30	65,600	96,100	0	161,700
		30–40	68,000	136,200	0	204,200
		>40	26,100	50,900	0	77,000
	Controlled surface use	<20	0	0	0	0
		20–30	0	4,200	0	4,200
		30–40	1,100	7,100	0	8,200
		>40	200	3,300	0	3,500
	Timing limitations	<20	0	0	0	0
		20–30	0	1,700	0	1,700
		30–40	100	0	0	100
		>40	0	0	0	0
	Standard terms and conditions only	<20	100	500	0	600
		20–30	2,700	17,700	0	20,400
		30–40	100	700	0	800
		>40	0	0	0	0

PCH Post-calving Table

Acres		Percent of Years Present	Oil Potential			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
D2	No sale	<20	11,300	87,900	5,500	104,700
		20–30	5,900	164,200	16,300	186,400
		30–40	9,300	231,600	57,200	298,100
		>40	0	144,700	387,500	532,200
	No surface occupancy	<20	112,800	28,900	0	223,700
		20–30	42,100	96,100	0	161,700
		30–40	38,300	136,200	0	204,200
		>40	3,900	50,900	0	77,000
	Controlled surface use	<20	23,900	0	0	0
		20–30	12,500	4,200	0	4,200
		30–40	25,400	7,100	0	8,200
		>40	22,400	3,300	0	3,500
	Timing limitations	<20	3,000	0	0	0
		20–30	0	1,700	0	1,700
		30–40	100	0	0	100
		>40	0	0	0	0
	Standard terms and conditions only	<20	44,000	500	0	600
		20–30	28,300	17,700	0	20,400
		30–40	8,400	700	0	800
		>40	0	0	0	0

Source: BLM GIS 2018

Table K-22
Acres within Different Calving use and Predicted Calving Areas (Defined by Severson et al. 2021) for the Porcupine Caribou Herd, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Calving Table

Acres		Years of Use or Prediction	Oil Potential			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
B	No surface occupancy	2012–2018	0	0	17,500	17,500
		2030–2039	0	9,400	38,900	48,300
		2040–2049	3,500	12,100	54,100	69,700
		2050–2059	3,800	13,000	57,200	74,000
	Timing limitations	2012–2018	0	0	59,200	59,200
		2030–2039	0	11,100	109,500	120,600
		2040–2049	0	39,900	193,800	233,700
		2050–2059	0	16,500	197,400	213,900
	Standard terms and conditions only	2012–2018	0	0	0	0
		2030–2039	0	50,000	5,100	55,100
		2040–2049	23,800	36,600	6,800	67,200
		2050–2059	39,800	71,400	7,800	119,000
C	No sale	2012–2018	0	0	76,700	76,700
		2030–2039	0	4,800	135,600	140,400
		2040–2049	0	14,800	242,600	257,400
		2050–2059	0	7,400	249,900	257,300
	No surface occupancy	2012–2018	0	0	0	0
		2030–2039	0	30600	15600	46,200
		2040–2049	13800	59500	9300	82,600
		2050–2059	27100	65900	9700	102,700
	Controlled surface use	2012–2018	0			0
		2030–2039	0	35,100	2,300	37,400
		2040–2049	3,500	14,200	2,800	20,500
		2050–2059	5,600	25,400	2,800	33,800
	Standard terms and conditions only	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	10,000	0	0	10,000
		2050–2059	10,800	2,300	0	13,100
D	No sale	2012–2018	0	0	76,700	76,700
		2030–2039	0	39,600	153,600	193,200
		2040–2049	100	39,500	254,800	294,400
		2050–2059	0	39,500	262,400	301,900
	No surface occupancy	2012–2018	0	0	0	0
		2030–2039	0	30,500	0	30,500
		2040–2049	26,900	45,300	0	72,200
		2050–2059	43,100	57,400	0	100,500
	Controlled surface use	2012–2018	0	0	0	0
		2030–2039	0	400	0	400
		2040–2049	400	3,700	0	4,100
		2050–2059	400	2,400	0	2,800
	Timing limitations	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	0	0	0	0
		2050–2059	100	1,700	0	1,800
	Standard terms and conditions only	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	0	100	0	100
		2050–2059	0	0	0	0

PCH Calving Table

Acres		Years of Use or Prediction	Oil Potential			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
D2	No sale	2012–2018	0	0	76,700	76,700
		2030–2039	0	70,500	153,600	224,100
		2040–2049	0	88,600	254,800	343,400
		2050–2059	600	101,000	262,400	364,000
	No surface occupancy	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	13,600	0	0	13,600
		2050–2059	24,000	0	0	24,000
	Controlled surface use	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	4,900	0	0	4,900
		2050–2059	15,900	0	0	15,900
	Timing limitations	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	800	0	0	800
		2050–2059	3,100	0	0	3,100
	Standard terms and conditions only	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	8,000	0	0	8,000
		2050–2059	0	0	0	0

Source: Severson et al. 2021

Table K-23
Acres within Different Post-calving use and Predicted Post-calving Areas (Defined by Severson et al. 2021) for the Porcupine Caribou Herd, by Different Lease Restriction Categories, Alternatives, and Areas of Expected Oil Potential

PCH Post-calving Table

Acres		Years of Use or Prediction	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
B	No surface occupancy	2012–2018	9,800	54,100	49,500	113,400
		2030–2039	2,200	42,100	50,000	94,300
		2040–2049	12,700	64,500	60,700	137,900
		2050–2059	11,600	70,400	55,100	137,100
	Timing limitations	2012–2018	0	73,100	145,300	218,400
		2030–2039	0	56,800	119,000	175,800
		2040–2049	0	114,200	211,700	325,900
		2050–2059	0	140,400	194,700	335,100
	Standard terms and conditions only	2012–2018	79,700	158,800	18,800	257,300
		2030–2039	15,600	148,700	45,400	209,700
		2040–2049	110,300	168,400	42,200	320,900
		2050–2059	112,000	169,300	42,000	323,300
C	No sale	2012–2018	700	43,800	179,900	224,400
		2030–2039	0	28,500	141,400	169,900
		2040–2049	3,000	86,400	254,800	344,200
		2050–2059	3,200	85,000	237,400	325,600
	No surface occupancy	2012–2018	37,600	151,200	27,100	215,900
		2030–2039	8,800	131,100	62,000	201,900
		2040–2049	43,000	164,400	49,000	256,400
		2050–2059	42,000	197,900	43,600	283,500
	Controlled surface use	2012–2018	21,800	74,100	6,700	102,600
		2030–2039	8,900	80,100	11,000	100,000
		2040–2049	28,900	80,500	10,800	120,200
		2050–2059	30,700	80,500	10,800	122,000
	Standard terms and conditions only	2012–2018	29,400	16,900	0	46,300
		2030–2039	0	7,800	0	7,800
		2040–2049	48,200	16,000	0	64,200
		2050–2059	47,700	16,700	0	64,400
D	No Sale	2012–2018	6,600	104,400	213,600	324,600
		2030–2039	0	92,200	214,400	306,600
		2040–2049	11,900	159,200	314,600	485,700
		2050–2059	12,100	159,700	291,900	463,700
	No surface occupancy	2012–2018	82,700	174,900	0	257,600
		2030–2039	17,700	147,900	0	165,600
		2040–2049	110,400	179,400	0	289,800
		2050–2059	109,900	205,900	0	315,800
	Controlled surface use	2012–2018	100	6,400	0	6,500
		2030–2039	100	7,400	0	7,500
		2040–2049	800	8,600	0	9,400
		2050–2059	1,600	14,500	0	16,100
	Timing limitations	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	0	0	0	0
		2050–2059	0	0	0	0
	Standard terms and conditions only	2012–2018	100	300	0	400
		2030–2039	0	0	0	0
		2040–2049	0	0	0	0
		2050–2059	0	0	0	0

PCH Post-calving Table

Acres		Years of Use or Prediction	Oil Potential			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
D2	No Sale	2012–2018	6,500	286,000	213,600	506,100
		2030–2039	0	247,500	214,400	461,900
		2040–2049	6,800	347,200	314,600	668,600
		2050–2059	7,400	380,100	291,900	679,400
	No surface occupancy	2012–2018	26,200	0	0	26,200
		2030–2039	4,700	0	0	4,700
		2040–2049	33,300	0	0	33,300
		2050–2059	31,900	0	0	31,900
	Controlled surface use	2012–2018	56,600	0	0	56,600
		2030–2039	13,000	0	0	13,000
		2040–2049	81,200	0	0	81,200
		2050–2059	84,300	0	0	84,300
	Timing limitations	2012–2018	0	0	0	0
		2030–2039	0	0	0	0
		2040–2049	0	0	0	0
		2050–2059	0	0	0	0
	Standard terms and conditions only	2012–2018	300	0	0	300
		2030–2039	0	0	0	0
		2040–2049	1,600	0	0	1,600
		2050–2059	0	0	0	0

Source: Severson et al. 2021

Table K-24
Estimated Percentage of Central Arctic Caribou Herd Seasonal Range (Based on the Utilization Distribution of Kernel Density Estimate) by Different Lease Restriction Categories, Alternatives, and Oil Potential

CAH Acres of Seasonal Range Table

Percent of CAH		Season	Oil Potential			
Alternative	Lease Type		High	Medium	Low	Total
B	No surface occupancy	Post-calving	0.90	0.03	0.05	0.98
		Mosquito	3.27	0.23	0.06	3.56
		Oestrid fly	1.08	0.30	0.13	1.51
		Late summer	0.31	0.08	0.11	0.50
	Timing limitations	Post-calving	0	0.05	0.17	0.22
		Mosquito	0	0.25	0.18	0.43
		Oestrid fly	0	0.41	0.39	0.80
		Late summer	0	0.09	0.31	0.40
	Standard terms and conditions only	Post-calving	1.67	0.13	0.03	1.83
		Mosquito	6.22	0.97	0.12	7.31
		Oestrid fly	3.07	1.20	0.14	4.41
		Late summer	0.96	0.32	0.07	1.34
C	No sale	Post-calving	0.05	0.05	0.21	0.30
		Mosquito	0.28	0.08	0.20	0.56
		Oestrid fly	0.10	0.18	0.44	0.73
		Late summer	0.02	0.06	0.38	0.46
	No surface occupancy	Post-calving	1.44	0.09	0.03	1.56
		Mosquito	5.34	0.85	0.14	6.32
		Oestrid fly	2.15	1.14	0.19	3.48
		Late summer	0.61	0.25	0.10	0.96
	Controlled surface use	Post-calving	0.11	0.06	0.01	0.18
		Mosquito	0.63	0.30	0.02	0.94
		Oestrid fly	0.31	0.38	0.03	0.72
		Late summer	0.06	0.13	0.02	0.21
	Standard terms and conditions only	Post-calving	0.97	0.02	0	0.99
		Mosquito	3.24	0.22	0	3.46
		Oestrid fly	1.59	0.20	0	1.79
		Late summer	0.58	0.04	0	0.62
D	No sale	Post-calving	0.22	0.09	0.24	0.55
		Mosquito	1.20	0.30	0.36	1.86
		Oestrid fly	0.44	0.52	0.66	1.62
		Late summer	0.11	0.16	0.49	0.75
	No surface occupancy	Post-calving	2.32	0.12	0	2.45
		Mosquito	8.14	1.07	0	9.21
		Oestrid fly	3.65	1.31	0	4.96
		Late summer	1.15	0.31	0	1.47
	Controlled surface use	Post-calving	0.00	0.01	0	0.01
		Mosquito	0.03	0.04	0	0.07
		Oestrid fly	0.01	0.05	0	0.06
		Late summer	0.00	0.01	0	0.01
	Standard terms and conditions only	Post-calving	0.02	0.00	0	0.02
		Mosquito	0.12	0.03	0	0.15
		Oestrid fly	0.04	0.03	0	0.07
		Late summer	0.01	0.00	0	0.01

CAH Acres of Seasonal Range Table

Percent of CAH		Season	Oil Potential			
Alternative	**Lease Type**		**High**	**Medium**	**Low**	**Total**
D2	No sale	Post-calving	0.11	0.22	0.24	0.57
		Mosquito	0.52	1.45	0.36	2.34
		Oestrid fly	0.20	1.91	0.66	2.76
		Late summer	0.04	0.48	0.49	1.02
	No surface occupancy	Post-calving	2.30	0	0	2.30
		Mosquito	8.20	0	0	8.20
		Oestrid fly	3.65	0	0	3.65
		Late summer	1.15	0	0	1.15
	Controlled surface use	Post-calving	0.04	0	0	0.04
		Mosquito	0.19	0	0	0.19
		Oestrid fly	0.10	0	0	0.10
		Late summer	0.02	0	0	0.02
	Standard terms and conditions only	Post-calving	0.12	0	0	0.12
		Mosquito	0.57	0	0	0.57
		Oestrid fly	0.21	0	0	0.21
		Late summer	0.06	0	0	0.06

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 K-25
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	443,000	30.1
20–30	148,600	10.1
30–40	153,900	10.4
>40	728,200	49.4

Percent of Years that Post-Calving Caribou are Present	Area (acres)	Percent of Coastal Plain
<20	269,100	18.3
20–30	269,300	18.3
30–40	370,300	25.2
>40	558,500	38.1

Source: BLM and USFWS GIS 2022

Table K-26
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 Days in Program Area per Animal	Percent of all collar-days in Program Area [c]
2003[b]	23	52	8	4
2004	45	89	11	10
2005	31	55	7	4
2006	27	44	5	2
2007	1	100	16	16
2008	1	100	16	16
2009	13	100	25	25
2010	13	92	21	19
2011	11	82	16	13
2012	8	88	17	15
2013	8	75	16	12
2014	14	57	13	7
2015	15	47	7	3
2016	13	46	5	2
2017	13	38	9	3
2018	24	54	5	3
2019	37	38	7	3
2020	57	33	6	2
2021	50	16	4	1
2022	68	25	4	1

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 Central Arctic Herd caribou were collared June–August, 52 percent were in the program area at least once and the average percent of days animals were in the program area for those 23 animals was 8 percent.
[c] Collar-day = cne animal collared for one day.

K.5 MARINE MAMMALS

K.5.1 Standard Mitigation Measures for Polar Bears Under MMPA Incidental Take Regulations (ITRs)

Many ongoing oil and gas activities occurring elsewhere on and adjacent to Alaska's North Slope (to the west of the program area) are conducted pursuant to the requirements of FWS-issued incidental take authorizations concerning polar bears and, in some cases, walruses. Some of these activities are also conducted pursuant to NMFS-issued incidental take authorizations concerning certain species of seals and whales. MMPA incidental take authorizations can take two forms. Pursuant to 16 USC § 1371(a)(5)(A), the Services issue incidental take regulations (ITRs) and associated letters of authorization (LOAs). Pursuant to 16 USC § 1371(a)(5)(D), the Services issue incidental harassment authorizations (IHAs). These processes are applicant-driven in that the Services issue such authorizations only upon the request of the entities that plan to conduct the activities anticipated to incidentally take marine mammals. Prior to issuing the requested authorization, the Services must first confirm that certain MMPA standards (e.g., "small numbers" and "negligible impact") are met. As part of its authorizations, the Services must prescribe, where applicable, permissible means of taking and other means of effecting the "least practicable" impact on the species or stock concerned and its habitat. The Services must also prescribe requirements pertaining to monitoring and reporting takes. Incidental take authorizations do not authorize the activities specified in the request, they simply authorize incidental take that results from such activities assuming the activities are conducted in compliance with all ITR/LOA or IHA requirements.

Listed below are provisions from a recent FWS-issued ITR for various oil and gas activities conducted outside of the program area but within the Beaufort Sea region. These provisions helped inform the development of proposed lease stipulations and ROPs for the leasing program. These provisions also provide a general sense of the types of mitigation, monitoring, and reporting requirements that could be required pursuant to any future incidental take authorizations concerning program-related activities. However, the specific requirements of any future incidental take authorizations cannot be known at this time. This is because the nature, location, and scope of any on-the-ground activities to be proposed in the future are unknown, the practicability of potential mitigation measures is assessed on an activity-specific basis, and the Services update their mitigation, monitoring, and reporting requirements to account for new scientific information and any improvements in technology and methodologies.

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 during the denning season (November–April) must conduct two surveys for occupied polar bear dens in all denning habitat within 1.6 km (1 mi) of proposed activities using aerial infrared (AIR) imagery. All observed or suspected polar bear dens must be reported to the USFWS before beginning activities under the LOA.
    - The first survey should be conducted between 25 November and 15 December and the second between 5 and 31 December. For areas of proposed seismic surveys, there must be a third survey conducted with AIR technology between 15 December and 15 January.

  - AIR surveys will be conducted under clear, calm conditions during darkness or civil twilight and not during daylight hours. Flight crews will record and report environmental parameters including air temperature, dew point, wind speed and direction, cloud ceiling, and percent humidity, and a flight log will be provided to the Service within 48 hours of the flight.
  - A scientist with experience in the in-air interpretation of AIR imagery will be on board the survey aircraft to analyze the AIR data in real-time. The data (infrared video) will be made available for viewing by the Service immediately upon return of the survey aircraft to the base of operations.
- Observe the exclusion zone around known polar bear dens—Operators must observe a 1.6-km (1-mile) operational exclusion zone around all putative 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, including putative and known 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 805-m (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 operations will maintain an altitude of 1,500 ft above ground level when safe and operationally possible.
- 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 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.

F) 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.

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.
- 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 of bears (if known)
    - 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

K.5.2 Estimated Number of Maternal Polar Bear Dens likely to occur Annually in the Coastal Plain Program Area

Biometricians at the USGS Alaska Science Center developed a Bayesian hierarchical model of annual abundance of polar bear dens within the 1002 area using data collected in 1982–2015 (Patil et al. 2022). The

analysis used location records of 287 dens associated with females that were initially captured and radio-tagged within the boundary of the Southern Beaufort Sea (SBS) subpopulation. Of the 122 dens located on land, 31 dens were in the 1002 area, including one located on a barrier island. For each year, the observed number of dens (*Ndens_obs*$_i$), the number of dens detected on land including barrier islands (*Ldens_obs*$_i$), and the number of land dens within the 1002 area (*1002_obs*$_i$) were used to estimate:

- Probability of a den occurring on land (*pLand*)
- Probability of a den occurring in the 1002 area (*pAreas*)
- Probability of a den occurring on a barrier island within the 1002 area (*pBarrisl_1002*)

A series of equations was used to estimate the annual probabilities:

Ldens obs$_i$_ ~ binomial(p = *pLand*, n = *Ndens_obs*$_i$)
1002_obs$_i$ ~ multinomial(p = *pAreas*, n = *Ldens obs*$_i$)
BI dens_1002 ~ binomial (p = *pBarrisl*_1002, n = Ldens_1002$_i$)

Den abundance modelling also required estimating several demographic parameters using data from previous long-term studies. The total population size of the SBS subpopulation (*Nbears*) was estimated to be stable from 2006 to at least 2015, with a mean = 908 bears and standard deviation = 163.8 bears (Bromaghin et al. 2015). That same mark-recapture study also provided information on the total number of bears captured in each year 2001–2010 (*Nbears_obsi*) and the number of adult females captured in each year (*NAFC0_obsi*). An analysis of denning propensity and den success based on temperature data from satellite-collared denning bears (USFS Alaska Science Center 2018) provided the number of successful dens per year (*Ndens_success*$_i$) and the total number of dens per year (*Ndens_obs*$_i$). These numbers were used to estimate:

- Probability that a bear in the SBS subpopulation was an adult female with cubs of the year (*pAFC0*; Bromaghin 2015)
- Probability of denning success (*pDensuccess*; USGS Alaska Science Center 2018)

The expected number of adult females with cubs (*NAFC0*) was estimated from a binomial process

Nbears ~ Normal(μ = 908, σ = 163.8)*NAFC0* ~ binomial(p = *pAFC0,* n = *Nbears*)

The number of failed dens was modeled as a negative binomial process where p = *pDensuccess* and the value was constrained not to exceed the number of adult females that did not have age zero cubs. The expected number of dens per year was the sum of the estimated number of failed and successful dens:

Number of failed dens ~ negative binomial(*pDensuccess, NAFC0*) bounded [0, *Nbears – pAFC0*]
Number of dens per year in population = Number of failed dens + *NAFC0*

The number of dens on land was modeled as a binomial process, where *p = pLand*, and the number of land dens in the 1002 region as a multinomial process, where p = *pAreas*.

Number of dens on land ~ binomial(p = *pLand, n* = Number of dens per year in population)
Number of land dens in 1002 region ~ multinomial(p = *p1002*, m = Number of dens on land)

Finally, the number of dens on barrier islands was modeled as a binomial process, where p = the probability of occurring on a barrier island in the 1002 region:

> Number of dens on barrier islands ~ binomial($p = pBarrisl$, n = Number of dens on land)
>
> Number of barrier island dens in 1002 region ~ multinomial(p = *p1002*, n = Number of dens on barrier islands)

The model ran with 3 chains for 50,000 iterations, discarding the first 5,000 iterations as a burn-in period. The best model included random annual variation in *pLand* and a fixed effect of time-block indicating that the average probability of denning on land was 23% lower in 1982–1999 (posterior median = 0.32, posterior credible interval [0.2, 0.48]) than in 2000–2015 (posterior median = 0.56, posterior credible interval [0.5, 0.71]). The probability of a den occurring on a barrier island in the 1002 area was 0.1 [0.04, 0.2]. The probability of a bear being an adult female with cubs of the year had a posterior median value of 9.4% [7.7%, 11.3%] and the posterior median of den success was 0.69 [0.54, 0.82].

The median estimated number of polar bear dens on land annually in the 1002 region was 14 dens with a posterior credible interval [5,30].

K.6 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.

Patil, V. P., G. M. Durner, D. C. Douglas, and T. C. Atwood. 2022. "Modeling the spatial and temporal dynamics of land-based polar bear denning in Alaska." *Journal of Wildlife Management* 86: 1–22. https://doi.org/10.1002/jwmg.22302

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.

Trawicki, John M., Lyons, Steve M., and Elliott, George V. 1991. Distribution and Quantification of Water Within the Lakes of the 1002 Area, Arctic National Wildlife Refuge. U.S. Fish and Wildlife Service, Alaska Fisheries Technical Report Number 10. Anchorage, Alaska.

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.

USGS (US Geological Survey) Alaska Science Center. 2018. "Denning phenology, den substrate, and reproductive success of female polar bears (*Ursus maritimus*) in the southern Beaufort Sea 1986–2013 and the Chukchi Sea 1987–1994" (Version 1.1, July 2021). U.S. Geological Survey data release, Anchorage, Alaska, USA. https://doi.org/10.5066/ F7DF6PC9Viereck, 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.

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Appendix L
Fish and Aquatic Species

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Appendix L. Fish and Aquatic Species

L.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 2020). **Table L-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. 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.

L.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 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. 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 rivers (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.

L.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 2020).

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 in the 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 L-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 in 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, and 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) and 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) and 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, and 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, and 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, and 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, and some fish	Limited

L.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). 2020. National Petroleum Reserve–Alaska (NPR-A) Final Integrated Activity Plan/Environmental Impact Statement. In cooperation with the North Slope Borough, U.S. Bureau of Ocean Energy Management, and U.S. Fish and Wildlife Service. Anchorage, Alaska: U.S. Department of Interior, Bureau of Land Management.

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.

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Appendix M. Cultural Resources

Table M-1
Documented Alaska Heritage Resources Survey (AHRS) Sites in Program Area

AHRS #	Site Name	Period	Resource Description
BRL-00001	Elupak ("Old Village")	Prehistoric	Sod house ruins
BRL-00004	Igluqpaaluk	Historic	—
BRL-00005	Uqsruqtalik	Historic	Camp, hunting, sod houses, cabins, ice cellars
BRL-00007	Naalagiagvik	Prehistoric, Historic, Protohistoric	Settlement, sod houses, burials
BRL-00009	—	Historic	Burials
BRL-00012	—	Historic	Residential, cabin, log, sod house
BRL-00013	—	Historic	—
BRL-00017	Uqsruqtalik	Historic	Burials
BRL-00018	Kapiluuraq	Historic	Camp, fishing, sod house
BRL-00020	—	Historic	Residential, sod house
BRL-00021	—	Historic	—
BRL-00022	Puukak	Historic	Camp, sod houses, cemetery
BRL-00023	(Doe) BAR-M (AHRS) Barter Island	Historic	Defense, DEW Line
BRL-00044	Gravel structures, Barter Island Airfield	Historic	Defense, DEW Line, transportation
BRL-00051	Barter Island seawall	Historic	Military, seawall, defense, DEW Line
BRL-00052	Browers Camp	Historic, Modern	Camp, tent floors, drying racks, windbreaks
XDP-00001	Angun	Historic	Sod house ruins, foundations
XDP-00021	—	Historic	—
XDP-00022	—	Historic	—
XDP-00024	Atchalik	Historic	Sod house ruins, sod quarry, cache pots
XDP-00026	—	Historic	Burials
XDP-00027	—	Historic	Sod house ruins, sod quarry
XDP-00028	—	Historic	Burials, box coffins
XDP-00029	—	Historic	—
XDP-00030	—	Historic	—
XDP-00031	—	Prehistoric	Lithic scatter
XDP-00032	—	Prehistoric	—
XDP-00033	—	Historic	—
XDP-00034	—	Historic	—
XDP-00035	—	Prehistoric	—
XDP-00045	Beaufort Lagoon (AHRS) Demarcation Point	Historic	Defense, DEW Line
XDP-00046	Nuvagapak Jacobson and Wentworth's Traditional Land Use Inventory (TLUI) Site 32	—	—

AHRS #	Site Name	Period	Resource Description
XDP-00048	Nuvagapak reburial	Historic	Reburied human remains
XFI-00003	Anderson Point	Prehistoric	Settlement, bone and wood artifacts
XFI-00009	Brownlow Point, Agliguagruk	Historic	House ruins, burials
XFI-00011	Sanniqsaaluk	Historic	Cabin, ice cellar, camp
XFI-00013	—	Historic	Ice cellar
XFI-00014	—	Historic	Lookout tower
XFI-00015	—	Historic	Single dwelling, sod house
XFI-00016	—	Historic	Settlement, sod houses, sod quarry
XFI-00017	Kanigniivik	Historic	Burials
XFI-00018	—	Historic	Single dwelling, sod house, artifacts
XFI-00019	—	Historic	Single dwelling, sod house
XFI-00020	—	Historic	Single dwelling, sod house
XFI-00030	Flaxman Island-Brownlow Point Historic District	—	—
XFI-00033	Brownlow cemetery	Historic	Cemetery
XFI-00034	Brownlow southern grave	Historic	Isolated grave
XFI-00035	—	Prehistoric	Artifact scatter
XMM-00001	Camden Bay	Prehistoric	House pit, midden, organic artifacts
XMM-00004	—	Historic	Sod houses, cellar
XMM-00005	—	Historic	Sod house ruin
XMM-00006	—	Historic	Sod house ruin, ice cellar, tent frame remains
XMM-00007	—	Prehistoric	Tent ring
XMM-00008	—	Prehistoric	—
XMM-00009	—	Prehistoric	Tent ring, scattered stones of other features
XMM-00010	—	Prehistoric	—
XMM-00011	—	Prehistoric	—
XMM-00012	—	Prehistoric	Tent ring, hearth(?)
XMM-00013	—	Prehistoric	—
XMM-00014	—	Prehistoric	—
XMM-00015	—	Prehistoric	—
XMM-00016	—	Prehistoric	—
XMM-00017	—	Prehistoric	—
XMM-00018	—	Historic	Sod house ruins, log cabin, historic debris
XMM-00019	—	Historic	Sod house, quarry
XMM-00020	—	Prehistoric	—
XMM-00021	—	Historic	—
XMM-00022	—	Prehistoric	—
XMM-00023	—	Prehistoric	—
XMM-00024	—	Prehistoric	—
XMM-00025	—	Prehistoric	—
XMM-00026	—	Prehistoric	—
XMM-00027	—	Prehistoric	—
XMM-00028	—	Prehistoric	Tent ring, scattered stones of other features
XMM-00029	—	Historic	—
XMM-00030	—	Prehistoric	—

AHRS #	Site Name	Period	Resource Description
XMM-00031	—	Historic	—
XMM-00032	—	Historic	—
XMM-00033	—	Historic	—
XMM-00034	—	Prehistoric	—
XMM-00035	—	Prehistoric, Historic	—
XMM-00037	—	Prehistoric	—
XMM-00038	—	Prehistoric	Tent rings
XMM-00039	—	Historic	—
XMM-00040	—	Historic	—
XMM-00041	—	Historic	Fish camp, tent rings(?)
XMM-00042	—	Historic	Settlement, winter, reindeer herding
XMM-00043	—	Historic	Settlement, winter, reindeer herding
XMM-00044	—	Historic	—
XMM-00045	—	Historic	Cemetery
XMM-00046	—	Historic	—
XMM-00114	(Doe) Camden Bay (AHRS) POW-D	Historic	Building, structure, defense, DEW Line
XMM-00117	Sivugag	—	—

Source: (ADNR OHA 2023)
— = no information provided in AHRS database. Information provided in this table is verbatim from the AHRS database.

Table M-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
None Given	Aanaalaaq	None given
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
None Given	Nuvugaq	None given
None Given	Nuvugaq Sigluaq	None given
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
TLUIXFI015	Salliġutchit	House ruins, fishing area, and hunting and camping area
None Given	Salliġutchit	None given
TLUIXFI013	Sanniqsaaluk	House ruins and graves
TLUIXFI012	Aanalaaq	House ruins, cabin, and graves
None Given	Aanalaaq	House ruins, cabin, and graves
None Given	Aanalaaq	House ruin
None Given	Aanalaaq	None given
None Given	Aanalaaq	None given
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
None Given	Igluġruatchiat graves	Grave
None Given	Igluġruatchiat grave	Grave
TLUIXDP009	Imaiġeauraq	House ruins, ice cellar ruins, and graves
TLUIXDP008	Anŋun	House ruins and oil seep
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
None Given	Anŋun	House ruin
TLUIXDP007	Atchalik	House ruins and fishing area
None Given	Atchalik	House ruin
None Given	Atchalik	None given
None Given	Atchalik	None given
None Given	Atchalik	None given
None Given	Atchalik	House ruin

TLUI #	Site Name	Resource Description
TLUIBRL012	Uqsruqtalik	House ruins, cabin, and graves
TLUIBRL011	Puukak	House ruins
None Given	Puukak	None given
None Given	Puukak	None given
TLUIBRL(44)	Kapiłġuurak	House ruin and ice cellar ruins
None Given	Kapiłġuurak (2)	House ruin
None Given	Uqsruqtalik Ijuvvivik	None given
None Given	Nuvugapak	House ruins
None Given	None Given	Disturbed grave
None Given	None Given	Grave
None Given	None Given	None given

Source: (IHLC 2023)

Table M-3
Documented Place Names in Program Area

Place Name #	USGS Name	Name	Translation	Type	Origin
1	Barter Island	Łeerideedal	we meet	Island	Gwich'in
2	Canning River	Vyàhk'it Gwinjik	camping areas trail	Stream	Gwich'in
3	Coastal Plain	Iizhik Gwats'an Gwandaii Goodlit	The Sacred Place Where Life Begins	Locale	Gwich'in
4	Collinson Point	Iñupiaq: Nuvuġaq, Gwich'in: Sallute	Iñupiaq: point on land or on an open lead	Locale	Iñupiaq, Gwich'in
5	1st Fish Hole	—	—	Site	Iñupiaq
6	Aichilik River	—	—	Stream	Iñupiaq
7	Akootchook House Site	Tikluk	—	Site	Iñupiaq
8	Akutoktak River	—	food mixture of seal oil, caribou fat, and snow	Stream	Iñupiaq
9	Anderson Point	Aanalaaq	—	Site	Iñupiaq
10	Angun Lagoon	Anŋun	—	Lagoon	Iñupiaq
11	Angun Point	Anŋun	—	Site	Iñupiaq
12	Angun River	—	—	Stream	Iñupiaq
13	Arctic Creek	—	—	Site	Iñupiaq
14	Arey Island	Naalagiagvik	—	Island	Iñupiaq
15	Arey Lagoon	Aŋayuqaksrakuvik	place to keep old man	Bay	Iñupiaq
16	Bernard Spit	Tapkak	—	Site	Iñupiaq
17	Brownlow Point	Agliġuaġruk	—	Site	Iñupiaq
18	Egaksrak Entrance	—	—	Channel	Iñupiaq
19	Egaksrak Lagoon	—	—	Lagoon	Iñupiaq
20	Egaksrak River	—	—	Stream	Iñupiaq
21	Ekaluakat River	—	—	Stream	Iñupiaq
22	Flaxman Island	Sirak	—	Island	Iñupiaq
23	Griffin Point	Uqsruqtalik	—	Site	Iñupiaq
	127 Hulahula River	Chuu Choh Vee' Taii	shore of big water trail	Stream	Gwich'in
24	Humphrey Point	Imiagnaurak	—	Site	Iñupiaq
25	Igilatvik Creek	—	place where parts of a house are found	Stream	Iñupiaq
26	Itkilyariak Creek	—	indian's route	Stream	Iñupiaq
27	Itkilyariak Valley	—	indian's route	Valley	Iñupiaq

Place Name #	USGS Name	Name	Translation	Type	Origin
28	Kajutakrok Creek	—	—	Stream	Iñupiaq
29	Kaktovik	Qaaktugvik	—	Village	Iñupiaq
30	Kaktovik (1st location)	Qaaktuġvik	—	Village	Iñupiaq
31	Kaktovik (2nd location)	Qaaktuġvik	—	Village	Iñupiaq
32	Kaktovik (3rd location)	Qaaktuġvik	—	Village	Iñupiaq
33	Kaktovik Lagoon	Uqpillaq	willowless lake	Lagoon	Iñupiaq
34	Katakturak	Katakturak	a narrow place, many falls	Site	Iñupiaq
35	Katakturuk River	Katakturak	a narrow place, many falls	Stream	Iñupiaq
36	Kimikpaurauk River	Iġġiguq	big hill	Stream	Iñupiaq
37	Kingak Hill	—	nose	Summit	Iñupiaq
38	Kogotpak River	—	—	Stream	Iñupiaq
39	Konganevik Point	Kaŋiññiivik	—	Site	Iñupiaq
40	Kuvritovik Entrance	—	—	Channel	Iñupiaq
41	Manning Point	Qikiqtaq	island	Site	Iñupiaq
42	Martin Point	Tapqauraq	—	Site	Iñupiaq
43	Matsutnak River	—	—	Stream	Iñupiaq
44	Nataroarok Creek	—	—	Stream	Iñupiaq
45	Nelsaluk	—	—	Locale	Iñupiaq
46	Nelsaluk Pass	—	—	Channel	Iñupiaq
47	Niguanak Ridge	—	attempt to see animals	Ridge	Iñupiaq
48	Niguanak River	—	attempt to see animals	Stream	Iñupiaq
49	Nularvik River	—	camping place	Stream	Iñupiaq
50	Nuvagapak Entrance	Tikiġayuġruaq	big point	Channel	Iñupiaq
51	Nuvagapak Lagoon	Tikiġayuġruaq	big point	Lagoon	Iñupiaq
52	Nuvagapak Point	Nuvagapaq	—	Site	Iñupiaq
53	Nuwuak (historical)	Siŋik	point of land	Locale	Iñupiaq
54	Okerokovik River	—	place where there is a blubber cache	Stream	Iñupiaq
55	Okerokovik River	—	place where there is a blubber cache	Stream	Iñupiaq
56	Okpilak River	—	no willows	Stream	Iñupiaq
57	Okpirourak Creek	—	a few willows	Stream	Iñupiaq
58	Oruktalik Entrance	—	—	Channel	Iñupiaq
59	Oruktalik Lagoon	—	—	Lagoon	Iñupiaq
60	Pipsuk Bight	—	—	Bay	Iñupiaq
61	Pipsuk Point	Pipsuk	—	Site	Iñupiaq
62	Pokok Bay	—	—	Lagoon	Iñupiaq

Place Name #	USGS Name	Name	Translation	Type	Origin
63	Pokok Creek	—	—	Stream	Iñupiaq
64	Pokok Lagoon	—	—	Lagoon	Iñupiaq
65	Sadlerochit River	—	area outside of the mountains	Stream	Iñupiaq
66	Sadlerochit Spring	Salliġutchich	—	Site	Iñupiaq
67	Sikrelurak River	—	place where ice is found	Stream	Iñupiaq
68	Siksik River	Siksrik	ground squirrel	Stream	Iñupiaq
69	Tamayariak River	—	route where some people were lost	Stream	Iñupiaq
70	Tapkaurak Entrance	—	little narrow spit	Channel	Iñupiaq
71	Tapkaurak Lagoon	—	little narrow spit	Lagoon	Iñupiaq
72	Tapkaurak Point	—	little narrow spit	Cape	Iñupiaq
73	Tapkaurak Spit	—	—	Site	Iñupiaq
74	—	Aaquaksrakuvik	place to keep old woman	Site	Iñupiaq
75	—	Aġviġuraq	little whale	Site	Iñupiaq
76	—	Aġviġuraq	little whale	Site	Iñupiaq
77	—	Aniġaġaniq	place to be outside	Site	Iñupiaq
78	—	Aniġaġaniq	place to be outside	Site	Iñupiaq
79	—	Aŋayuqaksrakuvik	place to keep old man	Site	Iñupiaq
80	—	Aŋayuqaksrakuvik	place to keep old man	Site	Iñupiaq
81	—	Aŋayuqaksrakuvik	place to keep old man	Site	Iñupiaq
82	—	Atchalik	place with skin tents	Site	Iñupiaq
83	—	Iglugruatchiat	—	Site	Iñupiaq
84	—	Igluqpaaluk	—	Site	Iñupiaq
85	—	Igluqpauraq	little big house	Site	Iñupiaq
86	—	Kanugrak	—	Site	Iñupiaq
87	—	Kaŋi	end	Site	Iñupiaq
88	—	Kaŋi	end	Site	Iñupiaq
89	—	Kayutak	—	Site	Iñupiaq

Place Name #	USGS Name	Name	Translation	Type	Origin
90	—	Name not known	—	Site	Iñupiaq
91	—	Name not known	—	Site	Iñupiaq
92	—	Name not known	—	Mouth	Iñupiaq
93	—	Name not known	—	Site	Iñupiaq
94	—	Name not known	—	Village	Iñupiaq
95	—	Name not known	—	Village	Iñupiaq
96	—	Name not known	—	Site	Iñupiaq
97	—	Name not known	—	Site	Iñupiaq
98	—	Name not known	—	Site	Iñupiaq
99	—	Name not known	—	Site	Iñupiaq
100	—	Name not known	—	Site	Iñupiaq
101	—	Name not known	—	Site	Iñupiaq
102	—	Niaquqtuġuiqsaaġvik	place where the heads are eaten for the last time	Site	Iñupiaq
103	—	Nuvuġaq	point on land or on an open lead	Site	Iñupiaq
104	—	Nuvuġaq	point on land or on an open lead	Site	Iñupiaq
105	—	Nuvuġaq	point on land or on an open lead	Site	Iñupiaq
106	—	Nuvuġaq	point on land or on an open lead	Site	Iñupiaq
107	—	Nuvuġaq	point on land or on an open lead	Site	Iñupiaq
108	—	Paaqta	Pass by and meet	Site	Iñupiaq
109	—	Patkotak	Paul Patkutaq's place	Site	Iñupiaq
110	—	Pukak	—	Site	Iñupiaq
111	—	Qayyaaq	kayak	Site	Iñupiaq
112	—	Sallitchit Iqaluitch	most northernly fish hole	Site	Iñupiaq
113	—	Sanniqsaaluk	—	Site	Iñupiaq
114	—	Siiqsiññiq	glacier	Site	Iñupiaq
115	—	Sivugaq	first	Site	Iñupiaq

Place Name #	USGS Name	Name	Translation	Type	Origin
116	—	Tapqauraq	little sand spit	Site	Iñupiaq
117	—	Tapqauraq	little sand spit	Village	Iñupiaq
118	—	Tianŋuraq	named after Danny Gordon, Sr. (his Eskimo name)	Site	Iñupiaq
119	—	Tigutaaq	—	Site	Iñupiaq
120	—	Uqpillam Paaŋa	—	Site	Iñupiaq
121	—	Uqpillaq	willowless lake	Site	Iñupiaq
122	—	Uqpillaq	willowless lake	Site	Iñupiaq
123	—	Uqpillaq	willowless lake	Site	Iñupiaq
124	—	Uqsruqtalik	place with some oil	Village	Iñupiaq
125	—	Uqsruqtalik	place with some oil	Village	Iñupiaq
126	—	Yaigum Tapqaŋa	Jago spit	Site	Iñupiaq

Source: (Smith 2017; Gilbert, Williams, Fields, Williams, Flitt, Savage, Francis, John, Salmon, Salmon, Tritt, Martin, Herbert, Frank, Frank, James, Alexander, and Roberts 2017; Pedersen, Coffing, and Thompson 1985; Jacobson and Wentworth 1982; Nielson 1977; Gwich'in Steering Committee 2004, Gwich'in Knowledge Workshop 2023)

M.1 REFERENCES

ADNR OHA, (Alaska Department of Natural Resources Office of History and Archaeology). 2023. Alaska Heritage Resources Survey (AHRS) / Integrated Business Suite (IBS). Anchorage, Alaska.

Caufield, Richard A., T. Gilbert, G. James, C. Tritt, I. Tritt, and L. Tritt. 1981. Arctic Village Place Names and Land Use Interviews. Alaska Native Language Archives Identifier: KU979C1981. Electronic document, https://www.uaf.edu/anla/record.php?identifier=KU979C1981, accessed September 22, 2022. Cited by CATG et al. 2022.

Caulfield, Richard A., W.J. Peter, C. Alexaner, and K. Peter. 1983. Gwich'in Athabaskan Place Names of the Upper Yukon-Porcupine Region, Alaska: A Preliminary Report. Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 83. Electronic document, https://ou-webserver01.alaska.edu/anla/record.php?identifier=KU983CPA1983, accessed September 22, 2022. Cited by CATG et al. 2022.

Gilbert, T., P. Williams, M. Fields, L. Williams, W. Flitt, M. Savage, S. Francis, C. John, P. Salmon, D. Salmon, I. Tritt, R. Martin, P. Herbert, H. Frank, D. Frank, D. James, C. Alexander, and I. Roberts. 2017. Gwich'in Nąįį Googindi' K'ìT / Gwich'in Place Names Atlas. National Snow and Ice Data Center. Boulder, Colorado. https://eloka-arctic.org/product/atlas/gwichin-place-names-atlas

Gwich'in Steering Committee. 2004. Protect the Sacred Place Where Life Begins, *Iizhik Gwats'an Gwandaii Goodlit*. Fairbanks, Alaska.

Hadleigh-West, Frederick. 1963. The Netsi Kutchin: An Essay in Human Ecology. PhD dissertation, Anthropology Department, Louisana State University. Electronic document, https://digitalcommons.lsu.edu/gradschool_disstheses/861/, accessed September 22, 2022. Cited by CATG et al. 2022.

IHLC, (Iñupiat History, Language, and Cultural Division). 2023. Traditional Land Use Inventory Sites. Utqiaġvik, Alaska.

Jacobson, Michael J., and Cynthia Wentworth. 1982. Kaktovik Subsistence: Land Use Values through Time in the Arctic National Wildlife Refuge Area. U.S. Fish and Wildlife Service, Northern Alaska Ecological Services. 82-01. Fairbanks, Alaska.

Nielson, Jonathan M. 1977. Beaufort Sea Study - Historic and Subsistence Site Inventory: A Preliminary Cultural Resource Assessment. North Slope Borough. Barrow.

Pedersen, Sverre, Michael Coffing, and Jane Thompson. 1985. Subsistence Land Use and Place Names Maps for Kaktovik, Alaska. Alaska Department of Fish and Game, Division of Subsistence. Technical Paper No. 109. Fairbanks, Alaska. http://www.adfg.alaska.gov/techpap/tp109.pdf

Smith, G. 2017. Alaska Native Place Names: A Comprehensive Geodatabase of Alaska Native Place Names. Published February 1, 2017. https://blm-egis.maps.arcgis.com/home/item.html?id=f8228386669545c8aef1829c16c24414

Vuntut Gwich'in Government. Nd. *Plunge into Vuntut Gwich'inWaters: Gwich'in Vocabulary*. Electronic document, http://plunge.oldcrow.ca/tools/vocab/, accessed September 22, 2022. CATG et al. 2022.

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Appendix N

Subsistence Uses and Resources

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Appendix N. Subsistence Uses and Resources

N.1 KAKTOVIK

N.1.1 Harvest Data

Table N-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					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
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					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
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.

Table N-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.

Table N-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
2014	Caribou	—	—	—	—	—	248	29,016	363	—	—
2015	Caribou	—	52	—	—	—	303	35,451	445	—	—

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	
2016	Caribou	—	—	—	—	—	133	15,561	199	—	—
2017	Caribou	—	—	—	—	—	119	13,923	176	—	—
2018	Caribou	—	—	—	—	—	108	12,636	164	—	—
2019	Caribou	—	—	—	—	—	125	14,625	—	—	—

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); 2014-2018 (Person, Kayotuk, and Olemaun 2019), 2019 ((NSB 2020).

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.

N.1.2 Seasonal Round

Table N-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

N.1.3 Travel Method

Table N-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.

N.1.4 Resource Importance

Table N-6
Material and Cultural Importance of Subsistence Resources, Kaktovik

Resource Level	Resource[1]	Cultural Importance: Percent of Households		Material Importance: Percent of Total Harvest
		Try to Harvest	Receive	
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		Material Importance
		Percent of Households		Percent of Total Harvest
		Try to Harvest	Receive	
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.

N.2 NUIQSUT

N.2.1 Harvest Data

Table N-7
Nuiqsut 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	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					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[1]	Total Pounds[2]	Average HH Pounds	Per Capita Pounds	
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.

Table N-8
Nuiqsut Subsistence Harvest Estimates[6] 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	
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					Estimated Harvest				Percent of Total Harvest
		Use	Try to Harvest	Harvest	Give	Receive	Number[2]	Total Pounds[3]	Average HH Pounds	Per Capita Pounds	
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	—
2016	Caribou	96	76	67	79	81	481	56,277	592	132	-
2017	Caribou	96	72	60	74	85	635	74,338	715	164	-
2018	Caribou	99	84	74	88	88	608	71,113	658	157	-
2019	Caribou	100	98	91	87	78	636	74,439	658	153	-
2020	Caribou	98	88	79	82	76	629	73,639	657	160	-

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); 2016 (SRB&A 2018); 2017 (SRB&A 2019); 2018 (SRB&A 2020); 2019 (SRB&A 2021); 2020 (SRB&A 2022)

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.

7 This study year had a low response rate due to COVID-19; thus, results and community wide estimates should be viewed with this in mind 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 Braem et al. 2011.

N.2.2 Seasonal Round

Table N-9
Nuiqsut 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												
Muskox												
Furbearers												
Small land mammals												
Marine mammals												
Upland birds												
Waterfowl												
Eggs												
Plants and berries												
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); 2008–2020 (SRB&A 2022)

Limited activity and/or harvests Moderate activity and/or harvests High activity and/or harvests

N.2.3 Travel Method

Table N-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), 2008–2020 () (SRB&A 2022)
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.

N.2.4 Resource Importance

Table N-11
Material and Cultural Importance of Subsistence Resources, Nuiqsut

Resource Level	Resource	Cultural Importance		Material Importance
		Percent of Households		
		Trying to Harvest	Receiving	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	76	77	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		Material Importance
		Percent of Households		
		Trying to Harvest	Receiving	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); 2015-2020(SRB&A 2022)

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.

N.3 ARCTIC VILLAGE

N.3.1 Harvest Data

Table N-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 (Adams et 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.

Table N-13
Arctic Village Subsistence Harvest Estimates[4] 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	
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.

N.3.2 Seasonal Round

Table N-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

N.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.

N.4 VENETIE

N.4.1 Harvest Data

Table N-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.

Table N-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)

Table N-17
Venetie Subsistence Harvest Estimates[4] 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	
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.

N.4.2 Seasonal Round

Table N-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

N.4.3 Resource Importance

Table N-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.

N.5 CARIBOU STUDY COMMUNITIES

Table N-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	1981-82[1]	—	—	6	—	6	6	724	19	5	0.5
	1982-83[1]	—	—	0	—	—	0	0	0	0	—
	1983-84[1]	—	—	4	—	—	4	471	8	3	0.4
	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	1981-82[1]	—	—	6	—	6	6	724	19	5	0.5
	1982-83[1]	—	—	0	—	—	0	0	0	0	—
	1983-84[1]	—	—	4	—	—	4	471	8	3	0.4
	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***	***—***
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

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	
Anaktuvuk Pass *(continued)*	2001–02	—	—	—	—	—	271	36,910	—	—	75.6
	2000–01	—	—	—	—	—	732	99,579	—	—	89.1
	2014	89	45	40	47	68	770	104,664	1057	330	84.2
	2015	—	—	—	—	—	1,165	136,305	—	—	—
	2016	—	—	—	—	—	859	100,503	936	—	—
	2017	—	—	—	—	—	548	64,116	1,135	—	—
	2019	—	—	—	—	—	918	107,406	—	—	—
	Average	***92***	***61***	***49***	***49***	***68***	***594***	***73,762***	***967***	***261***	***84.0***
Arctic Village	***No Comparable Caribou Harvest Data***										
Atqasuk	1994	—	—	—	—	—	266	36,176	613	152	65.3
	1996	—	—	—	—	—	398	54,182	860	241	65.0
	1997	—	—	—	—	—	282	38,352	685	167	61.7
	2003	93	66	61	66	66	189	—	—	—	—
	2004	100	79	79	69	74	314	—	—	—	—
	2005	96	70	59	74	63	203	—	—	—	—
	2006	95	67	60	76	57	170	—	—	—	—
	2014	—	—	—	—	—	173	20,241	316	—	—
	2015	—	—	—	—	—	186	21,762	—	—	—
	2016	—	—	—	—	—	269	31,473	480	—	—
	2017	—	—	—	—	—	145	16,965	257	—	—
	2018	—	—	—	—	—	380	44,460	679	—	—
	2019	—	—	—	—	—	179	20,943	—	—	—
	Average	***96***	***70***	***65***	***71***	***65***	***247***	—	***—***	***—***	***—***
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***

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	
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	—
	2018	17	0	0	0	17	0	—	0	0	0.0
	Average	***27***	***2***	***0***	***15***	***23***	***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	—
	2017	70	15	10	25	60	5	624	20	8	2.0
	Average	***54***	***11***	***5***	***7.5***	***38***	***2***	***289***	***20***	***4***	***2.0***
Coldfoot	***2011***	***75***	***50***	***25***	***50***	***50***	***2***	***325***	***65***	***33***	***85.3***
Eagle	2017 (Eagle)	55	45	31	26	22	40	5,178	74	32	4.7
	2017 (Eagle Village)	69	62	0	69	31	0	0	0	0	0.0
	2004	61	61	14	15	52	19	1,957	28.8	15.2	15.7
	Average	***62***	***56***	***15***	***37***	***35***	***20***	***2,378***	***34***	***16***	***6.8%***
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	—
	2017	44	5	5	17	42	31	4,170	21	9	1.8
	Average	***37***	***8***	***6***	***12***	***32***	***56***	***5,907***	***47***	***11***	***2.2***

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	
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
	2007	—	—	—	—	—	181	21,168	258	—	27.1
	2008	—	—	—	—	—	185	21,586	263	—	21.3
	2009	—	—	—	—	—	170	19,872	231	—	15.7
	2010	—	—	—	—	—	115	13,458	168	—	17.0
	2010–11	94	53	46	51	93	429	58,305	686	203	28.7
	2011	—	—	—	—	—	170	19,909	249	—	20.1
	2012	—	—	—	—	—	155	18,145	227	—	—
	2014	—	52	—	—	—	248	29,016	363	—	—
	2015	—	—	—	—	—	303	35,451	445	—	—
	2016	—	—	—	—	—	133	15,561	199	—	—
	2017	—	—	—	—	—	119	13,923	176	—	—
	2018	—	—	—	—	—	108	12,636	164	—	—
	2019	—	—	—	—	—	125	14,625	—	—	—
	Average	***96***	***66***	***55***	***56***	***87***	***170***	***22,613***	***410***	***118***	***20.3***

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	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	—
	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	—
	2016	96	76	67	79	81	481	56,277	592	132	—
	2017	96	72	60	74	85	635	74,338	715	164	—
	2018	99	84	74	88	88	608	71,113	658	157	—
	2019	100	98	91	87	78	636	74,439	658	153	—
	2020	98	88	79	82	76	629	73,639	657	160	—
	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
	1994	—	—	—	—	—	223	30,260	522	171	31.3
	2002	—	—	—	—	—	154	20,944	322	85	22.1
	2012	93	64	60	71	76	356	48,380	705	186	31.3
	2014	—	—	—	—	—	951	111,267	1,486	—	—
	2015	—	63	—	—	—	224	28,548	1,182	—	—
	2016	—	—	—	—	—	215	25,155	339	—	—
	2017	—	—	—	—	—	290	33,930	456	—	—
	2018	—	—	—	—	—	191	22,347	293	—	—
	2019	—	—	—	—	—	223	26,091	—	—	—
	Average	***94***	***66***	***66***	***67***	***75***	***326***	***39,267***	***698***	***169***	***24.2***

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	
Stevens Village	2009–10	5	0	0	5	5	0	—	—	0	—
	2008–09	—	0	0	0	10	0	—	—	0	—
	2014	0	0	0	0	0	0	0	0	0	0.0
	Average	***3***	***0***	***0***	***2***	***5***	***0***	***0***	***0***	***0***	***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
	2003	—	—	—	—	—	2,092	284,444	—	—	22.8
	2014	70	38	33	38	52	4,323	587,897	371	111	30.6
	2015	—	—	—	—	—	3,000	351,000	293	—	—
	2016	—	—	—	—	—	3,246	379,782	316	—	—
	2017	—	—	—	—	—	2,636	308,412	257	—	—
	2018	—	—	—	—	—	3,829	447,993	374	—	—
	2019	—	—	—	—	—	3,273	382,941	—	—	—
	Average	***86***	***51***	***42***	***67***	***68***	***3,055***	***371,650***	***276***	***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***
Wainwright	1988	—	—	57	—	—	505	59,085	476.49	117	23.0
	1989	—	—	66	—	—	711	83,187	699.05	177.75	23.7
	1992	—	68	—	—	—	947	110,851	—	—	34.3
	2002	—	—	—	—	—	866	117,749	806	221	19.1
	2009	97	64	61	62	84	1,231	167,356	1,073	284	41.7
	2014	—	—	—	—	—	951	111,267	725	—	—
	2015	—	70	—	—	—	756	88,452	573	—	—
	2016	—	—	—	—	—	914	106938	690	—	—
	2017	—	—	—	—	—	806	94,302	608	—	—
	2018	—	—	—	—	—	1012	118,404	772	—	—
	2019	—	—	—	—	—	804	94,068	—	—	—
	Average	***97***	***64***	***61***	***62***	***84***	***816***	***103,209***	***749***	***193***	***29.5***

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	
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: (ADF&G 2023, SRB&A 2022, NSB 2020, Person et al. 2019, Bacon, Hepa, Brower, Pederson, Olemaun, George, and Corrigan 2011, Van Lanen, Stevens, Brown, Maracle, and Koster 2012, Fuller and George 1999, McGee, McIntosh, and Strong 1984, Marcotte and Haynes 1985, Strong and McIntosh 1985, Brown, Walker, and Vanek 2004, Harcharek, Kayotuk, George, and Pederson 2018, Pedersen 1990, Kofinas, BurnSilver, Magdanz, Stotts, and Okada 2016, Stevens and Maracle n.d.)
1 Data are for Alatna and Allakaket combined
2 Data are for Bettles and Evansville combined

Table N-21
Total Annual Harvest Summary of Porcupine Caribou, Available Study Years

Canadian User Group	Estimated Harvest							
	Inuvialuit (NWT)[1]	NWT Gwich'in[2]	Vuntut Gwichin[3]	Tr'ondek Hwech'in[4]	Nacho Nayak Dun[5]	Yukon licensed[6]	NWT licensed[7]	Total (all user groups)
1985/86	—	—	347	—	—	414	—	—
1986/87	—	—	638	—	—	33	—	—
1987/88	—	—	829	—	—	152	—	—
1988/89	—	—	1,164	—	—	148	—	—
1989/90	—	—	532	—	—	92	—	—
1990-91	—	—	421	—	—	194	—	—
1991-92	—	—	593	—	—	185	—	—
1992-93	—	—	522	—	—	35	—	—
1993-94	—	—	236	—	—	215	—	—
1994-95	—	—	453	—	—	270	—	—
1995-96	—	1,906	—	—	—	—	—	—
1996-97	—	1,638	—	—	—	—	—	—
1997-98	—	2,206	—	—	—	—	—	—
1998-99	—	1,093	—	—	—	—	—	—
1999-00	—	452	—	—	—	—	—	—
2000-01	—	2,054	—	—	—	—	—	—
2010–11	121	1,197	265	1	0	38	98	1,720
2011–12	294	939	511	3	0	13	90	1,850
2012–13	176	615	403	1	0	8	80	1,283
2013–14	368	1,936	473	2	3	81	57	2,920
2014–15	123	451	114	0	0	3	58	749
2015–16	345	2,558	148	12	5	232	67	3,367
2016-17[8]	—	—	—	—	—	—	—	1,083
2017-18	314	302	193	0	0	2	34	845
2018-19	—	—	—	—	—	—	—	—
2019-20	—	2,579	222	3	6	239	—	—
2020-21	—	1,743	413	—	—	143	—	—
2021-22	35	43	188	0	0	10	21	297
Average Across Available Study Years	222	1,357	433	2	2	125	63	1,568

Sources: Porcupine Caribou Management Board 2023, GRRB 2009

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. In some years and for some communities, harvests are likely underreported.

"—" means data not available.

[1]Including Inuvialuit in and around Aklavik, Inuvik, and Tuktoyaktuk. Minimum count harvest. Due to low sample sizes, accurate Inuvik harvest estimates would likely double the reported harvest amount in the Inuvialuit region (Porcupine Caribou Management Board 2024)

[2]Including Gwich'in in and around Aklavik, Inuvik, Fort McPherson, and Tsiigehtchic. Minimum count harvest. NWT Gwich'in Data for the 1995-96, 1996-97, and 1997-98 time periods are for the calendar year 1995, 1996, and 1997. Due to low sample sizes in Inuvik, harvest estimates are likely not representative of Gwich'in harvesters from that community region (Porcupine Caribou Management Board 2024).

[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.

[8] Data for the 2016-17 study year are based on incomplete data and are considered to be low compared to what was actually harvested by all Parties in Canada.

N.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.

_____. 2023. "Community Subsistence Information System: Csis. Harvest by Community.", Accessed December 2022. 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.

_____. 2011. Estimates of Subsistence Harvest for Villages on the North Slope of Alaska, 1994-2003. North Slope Borough, Department of Wildlife Management. Barrow, Alaska. Available online at http://www.north-slope.org/assets/images/uploads/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., Robert Walker, and Susan B. Vanek. 2004. The 2002-2003 Harvest of Moose, Caribou, Bear, and Wolves in the Lower-Middle Yukon River Communities of Grayling, Anvik, Shageluk, and Holy Cross. Technical Paper No. 281. Division of Subsistence, Alaska Dept. of Fish and Game. Juneau. Available online at http://www.subsistence.adfg.state.ak.us/TechPap/tp281.pdf.

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 mysticetus*) 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.

Marcotte, James R., and Terry L. Haynes. 1985. Contemporary Resource Use Patterns in the Upper Koyukuk Region, Alaska. Technical Paper No. 93. Alaska Department of Fish and Game, Division of Subsistence. Fairbanks, Alaska. Available online at http://www.subsistence.adfg.state.ak.us/TechPap/tp093.pdf.

McGee, R., E. McIntosh, and B. Strong. 1984. Resource Harvest by Local Residents of the Upper Koyukuk Region, Progress Report 1983. Department of the Interior, Fish and Wildlife Service, Kanuti National Wildlife Refuge. Fairbanks, AK.

NSB (North Slope Borough). 2020. 2019 Economic Profile and Census Report.

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.

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.

Person, B., C. Kayotuk, and F. Olemaun. 2019. Subsistence Harvest of Caribou in Eight North Slope Villages, Alaska: 2014-2018. North Slope Borough Department of Wildlife Management. Barrow, AK.

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.

_____.2018. Nuiqsut Caribou Subsistence Monitoring Project: Results of Year 9 Hunter Interviews and Household Harvest Surveys. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. Available online at https://northslopescience.org/wp-content/uploads/2018_Nuiqsut_Caribou_Monitoring_Y9_Report.pdf.

_____.2019. Nuiqsut Caribou Subsistence Monitoring Project: Years 1 through 10 Final Report. Prepared for Conocophillips Alaska, Inc. Anchorage, Alaska. Available online at https://northslopescience.org/wp-content/uploads/Nuiqsut_Caribou_Subsistence_Monitoring_Report_Y10.pdf.

_____.2020. Nuiqsut Caribou Subsistence Monitoring Project: 2018 (Year 11) Report. Prepared for ConocoPhillips Alaska, Inc. Anchorage, Alaska. Available online at https://northslopescience.org/wp-content/uploads/Nuiqsut-Caribou-Subsistence-Monitoring-Project_Y11.pdf.

_____.2021. Nuiqsut Caribou Subsistence Monitoring Project: 2019 (Year 12) Report. Prepared for ConocoPhillips Alaska, Inc. and North Slope Borough Department of Wildlife Management. Anchorage, Alaska. Available online at https://northslopescience.org/wp-content/uploads/Nuiqsut-Caribou-Subsistence-Monitoring-Y12-Report.pdf

_____.2022. Nuiqsut Caribou Subsistence Monitoring Project: 2020 (Year 13) Report. Prepared for ConocoPhillips Alaska, Inc. and North Slope Borough Department of Wildlife Management. 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.

Strong, B., and E. McIntosh. 1985. Progress Report 1984 Resource Harvests by Local Residents of the Upper Koyukuk Region. U.S. Fish and Wildlife Service, U.S. Department of the Interior, Kanuti Wildlife Refuge. Fairbanks, Alaska.

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 O
Environmental Justice

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Table O-1
Minority and Low-Income Populations and Tribal Entities in the Study Area Communities

Region	Total Population	White (Percent)[1]	American Indian or Alaska Native (Percent)[2]	Asian (Percent)[2]	Black or African American (Percent)[2]	Pacific Islander (Percent)[2]	Other (Percent)	Two or More Races (Percent)	Hispanic or Latino (Percent)[3]	Minority[4] (Percent)	Minority Population Exceeds 50%	Minority Population Meaningfully Greater[5]	Median Household Income (Dollars)	Individuals Below Poverty Level (Percent)	Poverty Rate Meaningfully Greater[5]	Associated with Alaska Native Tribe
Alaska	733,391	59.4	15.2	6.0	3.0	1.7	2.5	12.2	6.8	40.6	–	–	80,287	10.4	–	–
North Slope Borough	11,031	27.9	52.1	5.8	1.5	2.9	1.1	8.7	5.0	72.1	Yes	Yes	83,992	8.6	No	–
Anaktuvuk Pass	425	16.7	74.1	0.0	0.0	0.0	0.0	9.2	1.6	83.3	Yes	Yes	62,788	35.5	Yes	Yes
Atqasuk	276	7.6	87.0	0.0	0.4	0.0	0.0	5.1	0.4	92.4	Yes	Yes	91,875	23.8	Yes	Yes
Kaktovik	283	4.2	95.1	0.0	0.0	0.0	0.0	0.7	0.0	95.8	Yes	Yes	78,250	17.4	Yes	Yes
Nuiqsut	512	6.8	92.6	0.0	0.2	0.0	0.0	0.4	0.0	93.2	Yes	Yes	68,393	6.7	No	Yes
Point Lay	330	5.8	92.1	0.0	0.0	0.0	0.0	2.1	0.3	94.2	Yes	Yes	78,750	20.1	Yes	Yes
Utqiagvik	4,927	14.1	53.8	12.1	1.5	5.8	0.6	12.0	3.5	85.9	Yes	Yes	93,661	8.2	No	Yes
Wainwright	628	3.3	95.5	0.0	0.6	0.0	0.0	0.5	0.5	96.7	Yes	Yes	84,000	8.4	No	Yes
Southeast Fairbanks Census Area	6,808	74.7	12.0	1.3	1.1	0.2	2.0	8.7	5.5	25.3	No	No	68,634	11.4	Yes	–
Eagle	83	97.6	0.0	0.0	0.0	0.0	0.0	2.4	1.2	2.4	No	No	48,750	6.5	No	Yes
Yukon-Koyukuk Census Area	5,343	21.1	71.7	0.1	0.1	0.1	0.5	6.3	1.3	78.9	Yes	Yes	43,405	23.2	Yes	–
Alatna	15	6.7	93.3	0.0	0.0	0.0	0.0	0.0	0.0	93.3	Yes	Yes	46,250	12.2	Yes	Yes
Allakaket	177	11.3	84.2	0.6	0.0	0.0	0.0	4.0	0.0	88.7	Yes	Yes	22,000	59.2	Yes	Yes
Arctic Village	151	4.0	92.7	0.0	0.0	0.0	0.0	3.3	0.0	96.0	Yes	Yes	37,708	45.8	Yes	Yes
Beaver	48	2.1	95.8	0.0	0.0	0.0	0.0	2.1	2.1	97.9	Yes	Yes	33,036	24.4	Yes	Yes
Bettles	23	73.9	17.4	0.0	0.0	0.0	0.0	8.7	4.3	26.1	No	No	N/A	0	No	No
Birch Creek	35	8.6	88.6	0.0	0.0	0.0	0.0	2.9	0.0	91.4	Yes	Yes	N/A	100	Yes	Yes
Chalkyitsik	56	1.8	92.9	0.0	0.0	0.0	0.0	5.4	1.8	98.2	Yes	Yes	28,333	52.7	Yes	Yes
Circle	91	7.7	92.3	0.0	0.0	0.0	0.0	0.0	0.0	92.3	Yes	Yes	26,875	13.8	Yes	Yes
Coldfoot	34	64.7	8.8	0.0	0.0	0.0	5.9	20.6	11.8	35.3	No	No	N/A	0	No	No
Evansville	12	50.0	41.7	0.0	0.0	0.0	8.3	0.0	8.3	50.0	Yes	Yes	82,083	0	No	Yes
Fort Yukon	428	8.6	83.9	0.0	0.0	0.0	0.0	7.5	0.7	91.4	Yes	Yes	36,250	12.1	Yes	Yes
Stevens Village	37	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	Yes	Yes	N/A	22.2	Yes	Yes
Venetie	205	5.9	93.2	0.0	0.0	0.0	0.0	1.0	0.5	94.1	Yes	Yes	45,625	31.2	Yes	Yes
Wiseman	5	80.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	No	No	N/A	0	No	No

Source: U.S. Census Bureau 2022a; 2022b; 2022c

– = Not applicable

N/A = Data not available

[1]Alone, non-Hispanic or Latino

[2]Alone or in combination with one or more other races

[3]Hispanic or Latino; can be of any race
[4]100 percent, minus White, non-Hispanic, or Latino
[5]Consistent with BLM (2022) guidelines, the meaningfully greater threshold is defined as follows: if the minority and/or low-income population percentage in a given community is equal to or greater than 110 percent of the minority and/or low-income population percentage in a geographic reference area. For the purposes of this analysis, Alaska is the reference area.

O.1 REFERENCES

U.S. Census Bureau. 2022a. Explore Census Data. 2020 Census Race and Population Data, Table P1. Internet website: https://data.census.gov/

_____. 2022b. Explore Census Data. 2021 American Community Survey 5-year estimates, Table S1701. Internet website: https://data.census.gov/

_____. 2022c. Explore Census Data. 2021 American Community Survey 5-year estimates, Table DP03. Internet website: https://data.census.gov/

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Table P-1
Populations of the Potentially Affected Communities and Areas, 2013 to 2022

Area	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	% Change
Communities											
Anaktuvuk Pass	381	352	395	384	408	433	401	425	411	412	8%
Atqasuk	268	255	277	247	267	284	286	276	290	283	5%
Utqiaġvik	4,587	4,580	4,672	4,425	4,652	4,672	4,754	4,927	4,889	4,707	3%
Kaktovik	282	277	274	267	274	283	279	283	267	265	-6%
Nuiqsut	468	468	476	483	523	544	535	512	526	492	5%
Point Hope	729	712	755	731	782	812	803	830	881	841	13%
Point Lay	236	215	248	246	288	292	310	330	330	309	24%
Wainwright	572	595	605	593	644	643	658	628	640	623	8%
Venetie	214	208	217	225	219	215	207	205	185	194	-10%
Arctic Village	161	173	157	153	158	156	151	151	140	137	-18%
North Slope Borough	10,135	10,071	10,322	10,316	10,466	10,595	10,668	11,031	11,033	10,746	6%

Source: Alaska Department of Labor and Workforce Development (ADOLWD) 2022

Table P-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
Utqiaġvik	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 2018

Table P-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 2018

Table P-4
City of Kaktovik Fiscal Year 2021 Sources and Uses of Funds

Source of Revenues	Amount
Locally Generated Revenues	**$1,393,325**
Tax Revenues	$54,278
Service Charges	$24,182
Enterprise Revenues	$901,733
Rentals	$60,270
Leases	$129,508
Sales	$33,321
Other Local Revenues	$190,034
State of Alaska Revenues	**$75,079**
Other Outside Revenues	**$895,992**
Total Operating Revenues	**$2,364,396**

Uses of Funds (Expenditures)	Amount
Administration and Finance	$204,480
Council	$12,018
Pull Tabs	$685,115
Bingo	$289,692
Recreation	$48,835
ASRC Summer Youth Program	$4,815
Others	$754,661
Total Operating Expenditures	**$1,999,617**

Source: Alaska Department of Commerce, Community, and Economic Development (ADCCED 2023)

Table P-5
North Slope Borough Employment and Total Wages by Sector, by Place of Work 2021

Sector	Number of Jobs	Total Wages ($)
Federal Government	16	1,063,255
State Government	64	5,181,116
Local Government	1,957	124,442,454
Mining	4,404	684,985,994
Retail Trade	287	11,019,977
Transportation and Warehousing	210	22,260,466
Educational and Health Services	489	49,073,467
Leisure and Hospitality	457	20,643,189
All Other Private	1,981	279,036,236
Total	**9,865**	**1,197,706,154**

Source: ADOLWD 2022. Quarterly Census of Employment and Wages (QCEW): Annual Employment and Wages, 2021.

P.1 REFERENCES

ADCCED (Alaska Department of Commerce, Community, and Economic Development, Division of Community and Regional Affairs). 2023. Financial Documents Delivery System. City of Kaktovik Fiscal Year 2021 Certified Financial Statement. Internet website: https://www.commerce.alaska.gov/dcra/admin/Financial.

ADOLWD (Alaska Department of Labor and Workforce Development, Research and Analysis Division). 2018. Alaska Labor and Regional Information (ALARI), employment and total wages information. Internet website: http://live.laborstats.alaska.gov/alari/.

ADOLWD (Alaska Department of Labor and Workforce Development, Research and Analysis Division). 2022. Quarterly Census of Employment and Wages (QCEW): Annual Employment and Wages, 2021. Internet website. http://live.laborstats.alaska.gov/qcew/.

ADOLWD (Alaska Department of Labor and Workforce Development, Research and Analysis Division). 2023. Population estimates, Cities and Census Designated Places, 2013 to 2022. Internet website: http://live.laborstats.alaska.gov/pop/index.cfm.

Appendix Q
Essential Fish Habitat

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ACRONYMS AND ABBREVIATIONS

	Full Phrase
Anadromous Waters Catalog	Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes
Arctic Fishery Management	Fishery Management Plan for Fish Resources of the Arctic Plan Management Area
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
ROP	Required Operating Procedure
Salmon Fishery Management	Fishery Management Plan for the Salmon Fisheries in the EEZ Plan off the Coast of Alaska
SEIS	Supplemental Environmental Impact Statement
USFWS	U.S. Fish and Wildlife Service

Appendix Q. Essential Fish Habitat

Q.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 Code of Federal Regulations (CFR) Part 600. For this supplemental environmental impact statement (SEIS), 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 Federal Register 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. NMFS is responsible for implementing the EFH requirements of the Magnuson-Stevens Act.

Q.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 2021). 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 – Arctic Region, Effective June 1, 2023* (Anadromous Waters Catalog; Giefer and Graziano 2023). 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 EFH Mapper maintained by the NMFS (2023).

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*).

Q.2.1 Pacific Salmon

A new methodology was initiated in 2012 by the NMFS Alaska Fisheries Science Center to refine the EFH distribution of Pacific salmon in marine waters off Alaska. Previously, the marine EFH distribution of all five Pacific salmon species was designated broadly by the NPFMC (2006) as encompassing all waters in the U.S. EEZ, which extends 200 nautical miles offshore. Using catch, maturity, salinity, temperature, and station depth data from the Bering Sea and the Gulf of Alaska, Echave et al. (2012) modeled the distributions of all five Pacific salmon species in marine waters off Alaska and mapped the 95 percent spatial distributions for each species. This information was used along with additional habitat preference analyses of available biophysical data and catch information to substantially refine the EFH distributions for all life history stages of all Pacific salmon species in marine waters off Alaska.

On average, the spatial extent of EFH in marine waters of the EEZ off Alaska was reduced by 71 percent across all species and life-history stages. Distribution modeling data are not available for the Beaufort Sea (where no commercial fishing occurs), and for areas "Where information is insufficient and a suitable proxy cannot be inferred, EFH is not described." (p. A-40 in NPFMC 2018). For areas adjacent to the Coastal Plain, the result is that EFH is no longer designated for any life history stages of any Pacific salmon species in the marine and estuarine waters of the Beaufort Sea (Simpson et al. 2017; NPFMC 2018; NMFS 2023).

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 several 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 Q-1**. More detailed life-history information can be found in Mecklenburg et al. (2002) and Quinn (2005).

Table Q-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	2 to 5 years

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 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 Q-2**. In all cases, only adult salmon have been recorded as present in these waterbodies. The segments of the streams in which EFH for pink and chum salmon has been designated are illustrated on **Map 3-21** 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 Q-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: Giefer and Graziano 2023

Q.2.2 Arctic Cod

Arctic cod are one of the most abundant fish species in coastal waters of the Beaufort Sea where they occur in a diversity of habitats, including nearshore and offshore waters, brackish lagoons and inlets, and river mouths (Moulton and Tarbox 1987; Johnson et al. 2010). They are considered semi-pelagic because of their common occurrence in both demersal (seabed) and pelagic (open water) habitats. Fish mature from 2 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 2023). The spatial extent of EFH for arctic cod in waters in and adjacent to the Coastal Plain is illustrated on **Map 3-21** in **Appendix A**.

Q.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 previous 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 meter) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel." (NPFMC 2009, p. 81).

Climate change and the warming of Arctic marine waters has led to the process of borealization for some nearby fish communities (von Biela et al. 2023). In this case, borealization is a process whereby Arctic species are being displaced by species with more boreal region distributions as their ranges expand. Increases in saffron cod have been observed in Kaktovik and Jago lagoons over three distinct sampling periods (1998–1991, 2003–2005, and 2017–2019), which corresponds to declining sea ice at these locations. Between the first and last sampling periods, saffron cod catch rates increased in Kaktovik and Jago lagoons 18-fold and 19-fold, respectively. For these same time periods, the saffron cod community proportions in these lagoons increased 6- and 18-fold (von Biela et al. 2023).

Q.2.4 Snow Crab

Snow crab are found in seabed 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 2023). 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.

Q.3 PROPOSED ACTION

Federal legislation (Public Law 115-97) was passed in December 2017, lifting the prohibition on oil and gas development imposed by Section 1003 of the Alaska National Interest Lands Conservation Act and requiring the Bureau of Land Management (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, BLM must evaluate the potential impacts of likely subsequent oil and gas development activities on

biological resources through the National Environmental Policy Act (NEPA) process (this Leasing SEIS). 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, 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, BLM will require adherence to oil and gas leasing stipulations and required operation procedures (ROPs) developed specifically for the Coastal Plain and will also require special protections for specific habitats and resources (see **Section P.5** below). Post-leasing, 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.

Q.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 the Leasing SEIS **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 waters and seabed habitats resulting from 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, 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, contaminant spills); and barriers to fish movements.

The primary differences among the Leasing SEIS action alternatives with respect to potential impacts on EFH are the variable setback distances from waterbodies required for infrastructure development under each alternative (with case-by-case exceptions for road and pipeline crossings and gravel mines). For example, the required setback distances for the construction of infrastructure from waterbodies increase from Alternative B (the least restrictive) to Alternative C (moderate restrictions), Alternative D (moderate restrictions), and Alternative 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, D, and 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, D, and D2 (with exceptions for barge landings, barge docks, and pipelines). Alternatives C, D, and D2 also include 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 Alternatives C and D, and the least risk under Alternative D2.

Q.5 PROPOSED MITIGATION MEASURES

A set of specific lease stipulations and ROPs prepared for this Leasing SEIS 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 Leasing SEIS **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 would be prohibited in the streambed, and variable setback distances from stream banks are required for the construction of those facilities (with case-by-case exceptions for essential road and pipeline crossings and gravel mines). Setback distances increase for specific streams and rivers and are smallest under Alternative B, intermediate for Alternative C, and largest under Alternatives D and D2.
- **Lease Stipulation 2—Canning River Delta and Lakes:** (No Surface Occupancy) Permanent oil and gas facilities including gravel pads, roads, airstrips, and pipelines would be prohibited within 0.5 miles of any waterbody in the delta areas of the Canning and Tamyariak rivers (with case-by-case exceptions for essential road and pipeline crossings).
- **Lease Stipulation 3—Spring/Aufeis:** Before drilling, the operator would be required to conduct studies to ensure drilling will not disrupt flow to or from perennial springs and that waste injection wells would not contaminate any perennial springs. For Alternatives C, D, and D2, selected springs and aufeis areas would not be offered for lease sale or would be protected with infrastructure setback distances.
- **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 would 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 would be 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 D2, No Surface Occupancy restrictions would apply: exploratory well drill pads, production well drill pads, or a central processing facility would not be permitted within 2 miles inland of the coast. On a case-by-case basis, barge landings, docks, spill response staging and storage areas, and pipelines may be permitted.

- **ROP 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.
- **ROP 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.
- **ROP 3—**Refueling equipment within 100 feet of the active floodplain of any waterbody would be prohibited (Alternative B). The refueling buffer distance is increased to 500 feet under Alternatives C, D, and D2.
- **ROP 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 (Alternatives C, D, and D2).
- **ROP 8—**Withdrawal of unfrozen water from springs, rivers, and streams during winter (from the onset of freeze-up to break-up) would be prohibited. The removal of ice aggregate from grounded areas 4 feet deep or less may be authorized from rivers on a site-specific. Alternatives D and D2 would further restrict water withdrawals on select rivers and creeks during summer.
- **ROP 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 Alternatives C, D, and D2, additional modeling and monitoring of lake recharge may be required to ensure natural hydrologic regime, water quality, and aquatic habitat for birds.
- **ROP 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 of and damage to vegetation. Slightly more stringent measures would be implemented under Alternatives D and D2.
- **ROP 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 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. Alternatives D and D2 would require additional applicant data collection and monitoring.
- **ROP 13—**Avoids additional freeze-down of aquatic habitat harboring overwintering fish and their aquatic invertebrate prey. Travel along streambeds would be 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).
- **ROP 14—**When conducting vibroseis-based surveys above potential fish overwintering areas (water 6 feet deep or greater, ice plus liquid depth), 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. Seismic surveys would not be conducted over unfrozen water with fish overwintering potential (water 6 feet deep or greater).

- **ROP 16—**Exploratory drilling would be prohibited in fish-bearing rivers and streams and other fish-bearing waterbodies to maintain water quality and minimize alteration of riparian habitat. On a case-by-case basis, the BLM Authorized Officer may consider exploratory drilling in the floodplains of rivers and streams. Under Alternatives D and D2, this would only apply to rivers or streams that do not support resident, anadromous, or endemic fish populations.
- **ROP 17—**To minimize surface impacts from exploratory drilling, construction of gravel roads to support exploration would be prohibited. Use of a previously constructed road or pad may be permitted if it is environmentally preferred.
- **ROP 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 waterbodies (unless further setbacks are stipulated under Lease Stipulations 1, 2, or 3); pipeline and road crossings would be permitted on a case-by-case basis. Temporary winter exploration and construction camps would be prohibited on frozen lakes and river ice but would be allowed on river sand and gravel bars.
- **ROP 20—**Causeways and docks would be prohibited in river mouths and deltas. Artificial gravel islands and bottom-founded structures would be 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.
- **ROP 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.
- **ROP 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 (USFWS) and U.S. Forest Service (McDonald & Associates 1994; USFS 2008) to facilitate fish passage at road crossings of streams.
- **ROP 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. Alternatives D and D2 would prohibit gravel mine sites from specific rivers and creeks.
- **ROP 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.
- **ROP 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.
- **ROP 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 would be certified to be free of nonnative invasive species before transiting into the Coastal Plain.

- **ROP 45—**Minimize 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.

Q.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 ROPs 20 and 21.

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 possibly gravel mines could be permitted within the setback buffers). Also, since streams and rivers comprising freshwater EFH are listed in the Anadromous Waters Catalog, they are granted further regulatory protection under the Anadromous Fish Act (AS 16.05.871), which requires additional review and permitting of development activities by the Alaska Department of Fish and Game. 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**.

Q.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.

Cohen, D.M., T. Inada, T. Iwamoto, N. Scialabba. FAO species catalogue. Vol 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fisheries Synopsis. No. 125, Vol. 10. Rome, FAO. p 442.

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.

Giefer, J., and S. Graziano. 2023. Catalog of waters important for spawning, rearing, or migration of anadromous fishes – Arctic Region, effective June 1, 2023. Alaska Department of Fish and Game, Special Publication No. 23-01, Anchorage. Internet website: https://www.adfg.alaska.gov/static-sf/AWC/PDFs/2023arc_CATALOG.pdf.

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). 2023. 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-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, Appendix A, Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC). North Pacific Fishery Management Council, National Marine Fisheries Service – Alaska Region, and State of Alaska Department of Fish and Game, Anchorage, Alaska. Internet website: https://www.npfmc.org/wp-content/PDFdocuments/fmp/Salmon/SalmonFMPAppendix.pdf.

_____. 2021. Fishery Management Plan for the Salmon Fisheries in the EEZ off Alaska. North Pacific Fishery Management Council, National Marine Fisheries Service - Alaska Region, and State of Alaska Department of Fish and Game, Anchorage, Alaska. Internet website: https://www.npfmc.org/wp-content/PDFdocuments/fmp/Salmon/SalmonFMP.pdf.

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.

von Biela, V. R., S.M. Laske, A. E. Stanek, R. J. Brown, and K. H. Dunton. 2023. Borealization of nearshore fishes on an interior Arctic shelf over multiple decades. Global Change Biology, 29, 1822-1838. Internet website: https://doi.org/10.1111/gcb.16576.

Appendix R

Air Resources Technical Support Document

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April 2024

Air Resources Technical Support Document

BLM Coastal Plain Oil and Gas Leasing Program Draft Supplemental Environmental Impact Statement

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1.0 Air Quality

1.1 Supporting Information for Affected Environment

1.1.1 Ambient Air Quality Standards

The U.S. Environmental Protection Agency (EPA) and the state of Alaska have set time-averaged ambient air quality standards for criteria air pollutants, including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), and two categories of particulate matter (less than 10 microns in diameter [PM_{10}] and less than 2.5 microns in diameter [$PM_{2.5}$]). These standards are listed in Table 1-1.

Table 1-1. National and Alaska Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS – Primary	NAAQS – Secondary	AAAQS	Form
CO	1 hour	35 ppm	N/A	40 mg/m^3	Not to be exceeded more than once per year
CO	8 hours	9 ppm	N/A	10 mg/m^3	Not to be exceeded more than once per year
NO_2	1 hour	100 ppb	N/A	188µg/m^3	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
NO_2	Annual	53 ppb	53 ppb	100 µg/m^3	Annual mean, not to be exceeded
SO_2	1 hour	75 ppb	N/A	196 µg/m^3	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
SO_2	3 hours	N/A	0.5 ppm	1300 µg/m^3	Not to be exceeded more than once per year
SO_2	24 hours	N/A	N/A	365 µg/m^3	Not to be exceeded more than once per year
SO_2	Annual	N/A	N/A	80 µg/m^3	Annual mean, not to be exceeded
PM_{10}	24 hours	150 µg/m^3	150 µg/m^3	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
$PM_{2.5}$	24 hours	35 µg/m^3	35 µg/m^3	35 µg/m^3	98th percentile, averaged over 3 years
$PM_{2.5}$	Annual	9 µg/m^3	15 µg/m^3	12 µg/m^3	Annual mean, averaged over 3 years

Pollutant	Averaging Period	NAAQS – Primary	NAAQS – Secondary	AAAQS	Form
O_3	8 hours	0.070 ppm	0.070 ppm	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years

Source: EPA 2023a (40 CFR 50); ADEC 2022 (18 AAC 50.010)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; mg/m^3 = milligrams per cubic meter; $\mu g/m^3$ = micrograms per cubic meter; All AAAQS are primary except for 3-hour SO_2.

1.1.2 Ambient Air Quality Monitoring Data

Five air quality monitoring stations are located within approximately 100 miles of the Coastal Plain and have verified data in the last 5 years or at least 3 years of data within the past 10 years. These stations are Kaktovik, Point Thomson, Nuiqsut, A-Pad, and CCP, and are shown in Figure 1-1. Kaktovik and Nuiqsut are the only two monitors that have current data through 2022. Table 1-2 through Table 1-6 summarize measurements of criteria pollutants at these stations. Three years of data are shown where available since the form of some NAAQS requires a 3-year average.

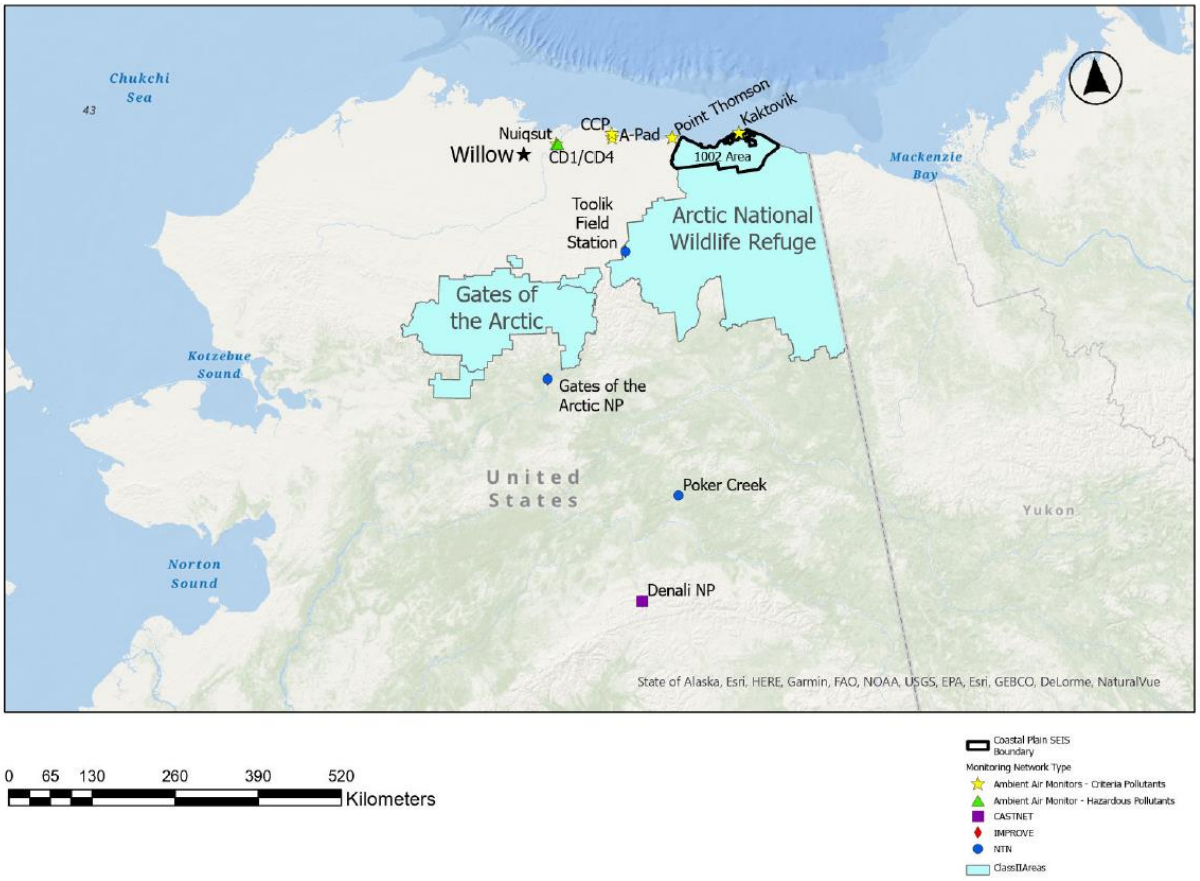


Figure 1-1. Map of monitoring stations for air quality and air quality related values.

Table 1-2. Criteria Air Pollutant Monitoring Values at the Kaktovik Monitor

Pollutant (Units)	Avg. Period	Rank	Q4 2021 – Q3 2022	NAAQS	Below NAAQS?
CO (ppm)	1 hour	2nd highest daily maximum	0.25	35	Yes
CO (ppm)	8 hour	2nd highest daily maximum	0.24	8	Yes
NO_2 (ppb)	1 hour	98th percentile of daily maximum	9.78	100	Yes [1]
NO_2 (ppb)	Annual	Annual average	0.41	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily maximum	1.46	75	Yes [1]
SO_2 (ppb)	3 hour	2nd highest daily maximum	2.49	500	Yes
SO_2 (ppb)	24 hour	2nd highest	1.56	140	Yes
SO_2 (ppb)	Annual	Average	0.30	30	Yes
PM_{10} (µg/m^3)	24 hour	2nd highest	53.64	150	Yes [1]
$PM_{2.5}$ (µg/m^3)	24 hour	98th percentile	7.80	35	Yes [1]
$PM_{2.5}$ (µg/m^3)	Annual	Average	2.77	9	Yes [1]
O_3 (ppb)	8 hour	4th highest daily maximum	42	70	Yes [1]

Source: Air Sciences, Inc.

Notes: NAAQS = National Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter; NAAQS and measurement values for O_3 were converted from ppm to ppb. Air Sciences, Inc. provided hourly concentration measurements which were put into the form of the NAAQS. Annual averages are reported in AirSci (2022).

[1]Compliance with NAAQS requires a 3-year average. Comparison here is for informational purposes only.

Table 1-3. Criteria Air Pollutant Monitoring Values at the Point Thomson Monitor

Pollutant (Units)	Avg. Period	Rank	2016 - 2017	NAAQS	Below NAAQS?
CO (ppm)	1 hour	2nd highest daily maximum	1	35	Yes
CO (ppm)	8 hour	2nd highest daily maximum	<1	8	Yes
NO_2 (ppb)	1 hour	98th percentile of daily maximum	14	100	Yes [1]
NO_2 (ppb)	Annual	Annual average	1.0	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily maximum	1	75	Yes [1]
SO_2 (ppb)	3 hour	2nd highest daily maximum	<1	500	Yes
SO_2 (ppb)	24 hour	2nd highest	<1	140	Yes
SO_2 (ppb)	Annual	Average	<1	30	Yes
PM_{10} (µg/m^3)	24 hour	2nd highest	20.0	150	Yes [1]
$PM_{2.5}$ (µg/m^3)	24 hour	98th percentile	9.0	35	Yes [1]

Pollutant (Units)	Avg. Period	Rank	2016 - 2017	NAAQS	Below NAAQS?
$PM_{2.5}$ (µg/m^3)	Annual	Average	2.8	9	Yes [1]
O_3 (ppb)	8 hour	4th highest daily maximum	46	70	Yes [1]

Source: ADEC 2018.

Notes: NAAQS = National Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter; NAAQS and measurement values for O_3 were converted from ppm to ppb.

[1]Compliance with NAAQS requires a 3-year average. Comparison here is for informational purposes.

Table 1-4. Criteria Air Pollutant Monitoring Values at the Nuiqsut Monitor

Pollutant (Units)	Avg. Period	Rank	2020	2021	2022	Avg. [1]	NAAQS	Below NAAQS?
CO (ppm)	1 hour	2nd highest daily maximum	9	1	1	3.7	35	Yes
CO (ppm)	8 hour	2nd highest daily maximum	3	1	<1	1.3	8	Yes
NO_2 (ppb)	1 hour	98th percentile of daily maximum	32.4	28.2	25.6	28.7	100	Yes
NO_2 (ppb)	Annual	Annual average	2	2	2	2	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily maximum	4.2	0.9	2.5	2.5	75	Yes
SO_2 (ppb)	3 hour	2nd highest daily maximum	3.8	<0.1	<0.1	1.3	500	Yes
SO_2 (ppb)	24 hour	2nd highest	3.6	<0.01	<0.01	1.2	140	Yes
SO_2 (ppb)	Annual	Average	<0.001	<0.001	<0.001	<0.001	30	Yes
PM_{10} (µg/m^3)	24 hour	2nd highest	60	70	60	63.3	150	Yes
$PM_{2.5}$ (µg/m^3)	24 hour	98th percentile	6	8	7	7	35	Yes
$PM_{2.5}$ (µg/m^3)	Annual	Average	1.2	2.3	2.6	2.0	9	Yes
O_3 (ppb)	8 hour	4th highest daily maximum	41	42	42	41.7	70	Yes

Source: SLR 2023; SLR 2022a; SLR 2021; ADEC 2018

Notes: NAAQS = National Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter; NAAQS and measurement values for O_3 were converted from ppm to ppb.

[1]Average calculated over the most recent 3 years of data.

Table 1-5. Criteria Air Pollutant Monitoring Values at the A-Pad Monitor

Pollutant (Units)	Avg. Period	Rank	2014	2015	2016	Avg. [1]	NAAQS	Below NAAQS?
NO_2 (ppb)	1 hour	98th percentile of daily maximum	33.3	36.4	24.8	31.5	100	Yes
NO_2 (ppb)	Annual	Annual average	3.0	3.0	2.0	2.7	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily maximum	4.3	4.3	3.3	4.0	75	Yes
SO_2 (ppb)	3 hour	2nd highest daily maximum	5	4	<1	3.0	500	Yes
SO_2 (ppb)	24 hour	2nd highest	1.7	2.1	<0.1	1.3	140	Yes
SO_2 (ppb)	Annual	Average	0.50	0.10	<.01	0.20	30	Yes
O_3 (ppb)	8 hour	4th highest daily maximum	51	44	43	46	70	Yes

Source: ADEC 2018.

Notes: NAAQS = National Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; $\mu g/m^3$ = micrograms per cubic meter; NAAQS and measurement values for O_3 were converted from ppm to ppb.

[1]Average calculated over the most recent 3 years of data.

Table 1-6. Criteria Air Pollutant Monitoring Values at the CCP Monitor

Pollutant (Units)	Avg. Period	Rank	2014	2015	2016	Avg. [1]	NAAQS	Below NAAQS?
CO (ppm)	1 hour	2nd highest daily maximum	1.0	1.0	1.0	1.0	35	Yes
CO (ppm)	8 hour	2nd highest daily maximum	1	1	1	1	8	Yes
NO_2 (ppb)	1 hour	98th percentile of daily maximum	84.0	78.0	89.0	83.7	100	Yes
NO_2 (ppb)	Annual	Annual average	9.0	10.0	11.0	10	53	Yes
SO_2 (ppb)	1 hour	99th percentile of daily maximum	10	8.7	9.3	9.3	75	Yes
SO_2 (ppb)	3 hour	2nd highest daily maximum	10	9	<1	6.3	500	Yes
SO_2 (ppb)	24 hour	2nd highest	8.6	7.7	10	8.8	140	Yes
SO_2 (ppb)	Annual	Average	1.2	3.4	10	4.9	30	Yes
PM_{10} ($\mu g/m^3$)	24 hour	2nd highest	30	60	40	43.3	150	Yes
$PM_{2.5}$ ($\mu g/m^3$)	24 hour	98th percentile	11	9.0	16	12	35	Yes
$PM_{2.5}$ ($\mu g/m^3$)	Annual	Average	3.7	3.2	3.0	3.3	9	Yes

Pollutant (Units)	Avg. Period	Rank	2014	2015	2016	Avg. [1]	NAAQS	Below NAAQS?
O_3 (ppb)	8 hour	4th highest daily maximum	54	42	42	46	70	Yes

Source: ADEC 2018.

Notes: NAAQS = National Ambient Air Quality Standards; ppm = parts per million; ppb = parts per billion; µg/m^3 = micrograms per cubic meter; NAAQS and measurement values for O_3 were converted from ppm to ppb.

[1]Average calculated over the most recent 3 years of data.

A number of VOCs (including HAPs) have been measured on a monthly basis at the CPAI Nuiqsut monitoring station since April 2014. Sampling at a nearby site, CD4, also began in 2014 and was moved to the CD1 monitoring station in April 2017. The CD4 and CD1 data sets have been combined to characterize VOC concentrations at the closest active oilfield site to Nuiqsut. Since March 2022, continuous VOC monitoring was added to the monthly sampling at both locations. Table 1-7 and Table 1-8 provide a summary of historical concentrations for benzene, ethylbenzene, n-hexane, toluene, and xylene. Formaldehyde measurements are not available at either site. A short-term VOC monitoring program was also conducted from February 2018 through April 2018 at the Putu monitoring station, approximately 3 km northeast of Nuiqsut. Data from this station is not shown due to the short collection period. More information can be found in SLR (2022b).

Table 1-7. HAP Concentrations at the Nuiqsut Monitor

Pollutant	Number of Samples Above Detection Limit Since 2014	Avg. of Measurements Above Detection Limit (µg/m^3) [1]	Maximum of Measurements Above Detection Limit (µg/m^3) [1]	Acute REL or AEGL (µg/m^3)
Benzene	4	0.94	1.20	27
Ethylbenzene	3	1.19	1.98	140,000 [2]
n-Hexane	1	2.93	2.93	10,000,000 [2]
Toluene	13	4.59	16.64	5,000
Xylene	8 (m/p-xylene), 5 (o-xylene)	4.06	10.82	22,000

Source: SLR 2022b; EPA 2021a

Notes: µg/m^3 = micrograms per cubic meter; REL = Reference Exposure Level; AEGL = Acute Exposure Guideline Level; Benzene, ethylbenzene, toluene, and xylene measurements reported from toxic organic (TO) method TO-12; n-hexane by TO-15; Xylene is the sum of o-xylene and m/p-xylene

[1]Values converted from ppb to µg/m^3 at standard temperature and pressure

[2]AEGL reported here since RELs are not available for these pollutants

Table 1-8. HAP Concentrations at the CD1/CD4 Monitor

Pollutant	Number of Samples Above Detection Limit Since 2014	Avg. of Measurements Above Detection Limit (µg/m^3) [1]	Maximum of Measurements Above Detection Limit (µg/m^3) [1]	Acute REL or AEGL (µg/m^3)
Benzene	5	1.30	1.91	27
Ethylbenzene	2	1.23	1.12	140,000 [2]
n-Hexane	-	-	-	10,000,000 [2]
Toluene	7	3.90	10.91	5,000
Xylene	11 (m/p-xylene), 3 (o-xylene)	3.09	1.34	22,000

Source: SLR 2022b; EPA 2021a

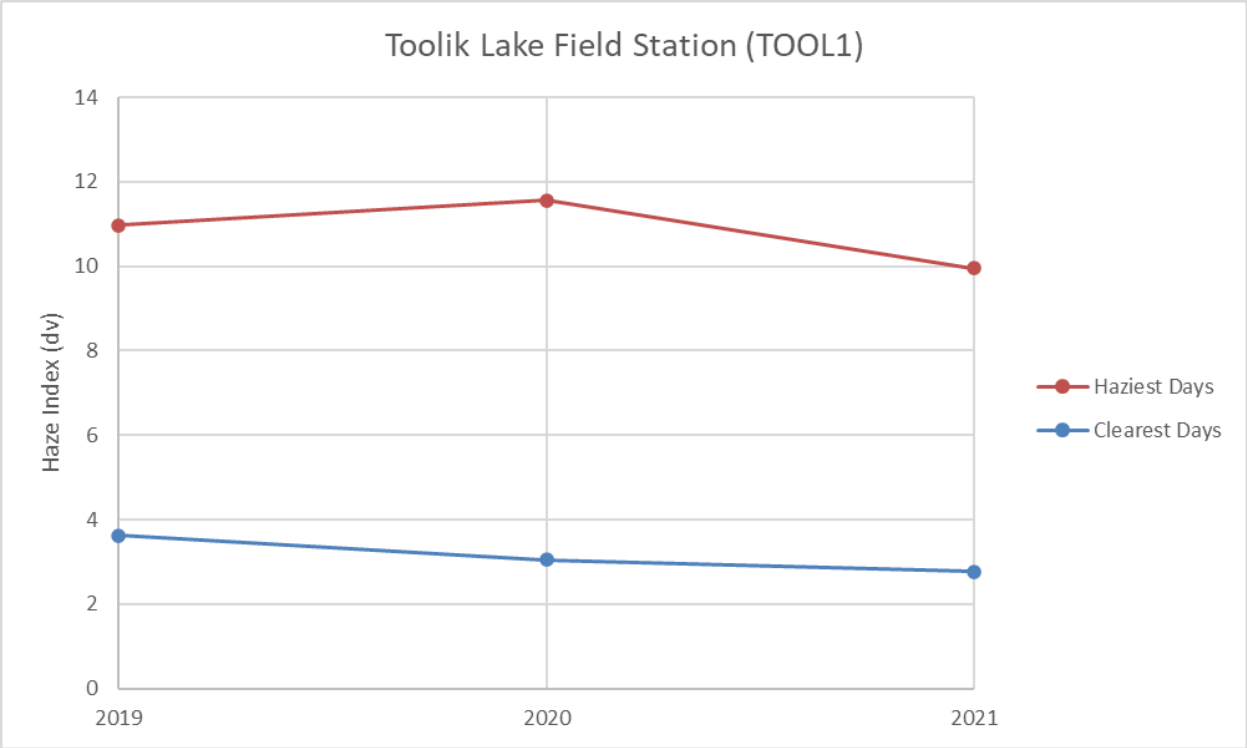
Notes: µg/m^3 = micrograms per cubic meter; REL = Reference Exposure Level; AEGL = Acute Exposure Guideline Level; Benzene, ethylbenzene, toluene, and xylene measurements reported from toxic organic (TO) method TO-12; n-hexane by TO-15; Xylene is the sum of o-xylene and m/p-xylene

[1]Values converted from ppb to µg/m^3 at standard temperature and pressure

[2]AEGL reported here since RELs are not available for these pollutants

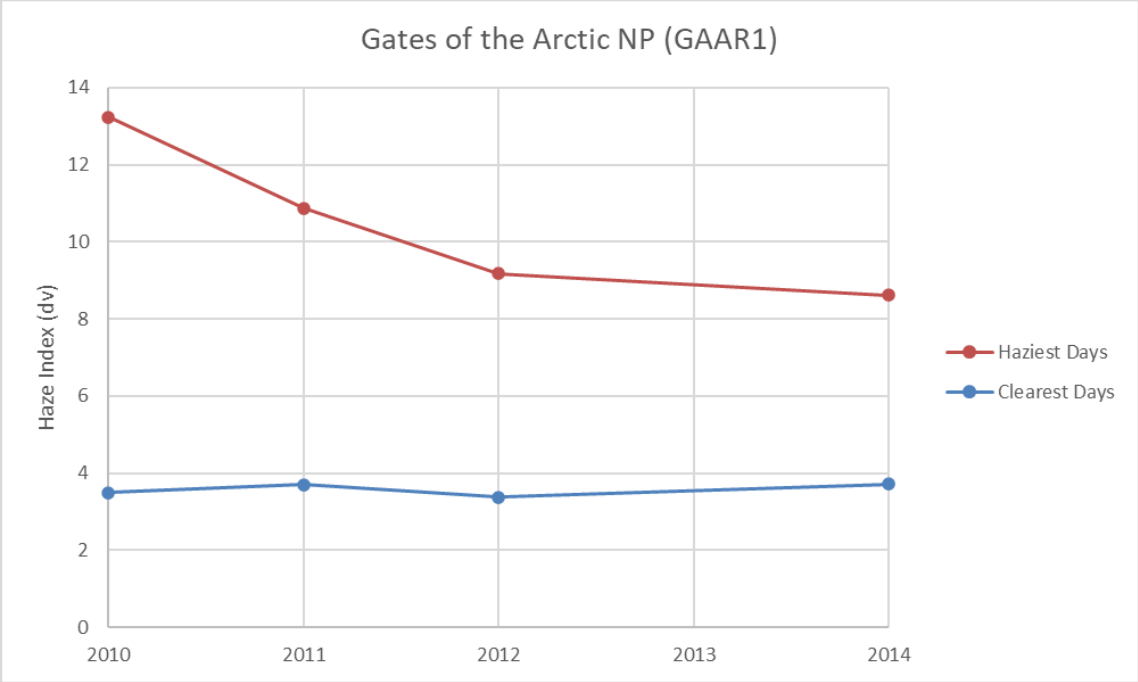
1.1.3 Visibility Monitoring Data

Visibility trends on the 20% haziest days and 20% clearest days are shown in Figure 1-2 through Figure 1-4 for the Toolik Field Station, Bettles Field Station (Gates of the Arctic National Park) and Denali National Park. Trends on the 20% most impaired days are also shown for Denali National Park.



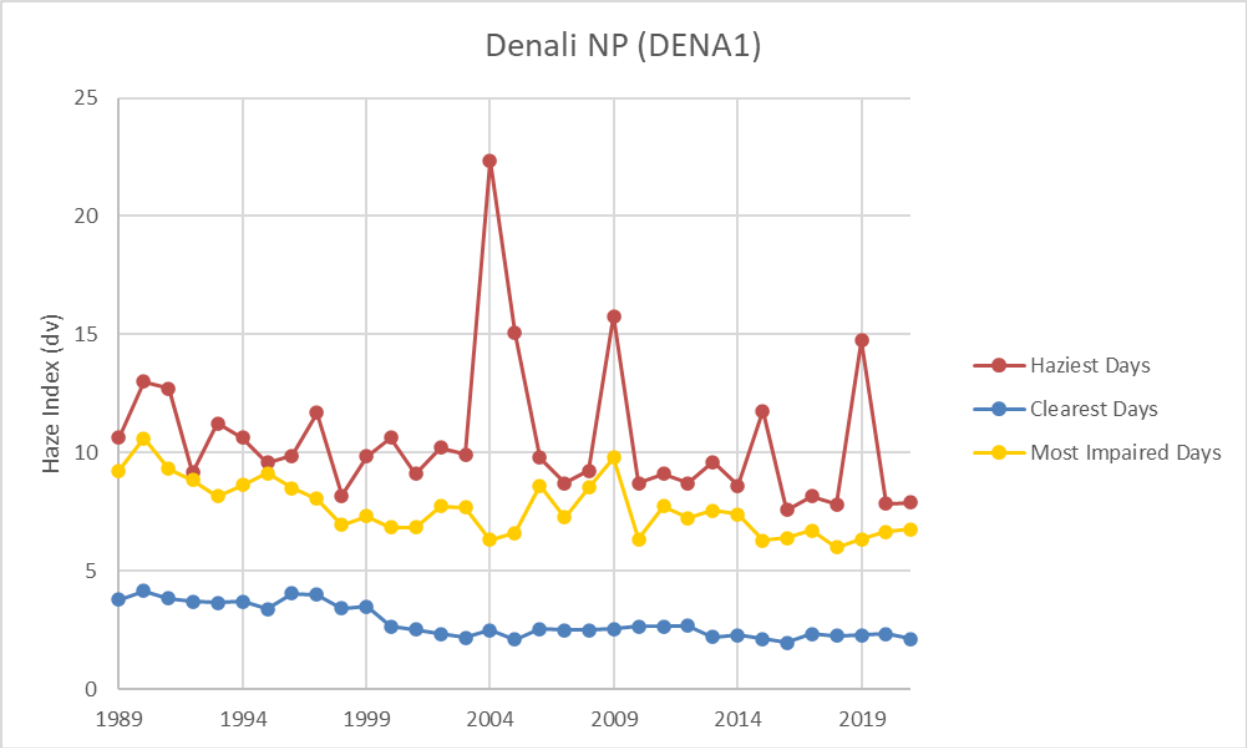
Source: FED 2023

Figure 1-2. Visibility on the Haziest and Clearest Days for Toolik Field Station.



Source: FED 2023

Figure 1-3. Visibility on the Haziest and Clearest Days for Bettles Field Station (Gates of the Arctic National Park).

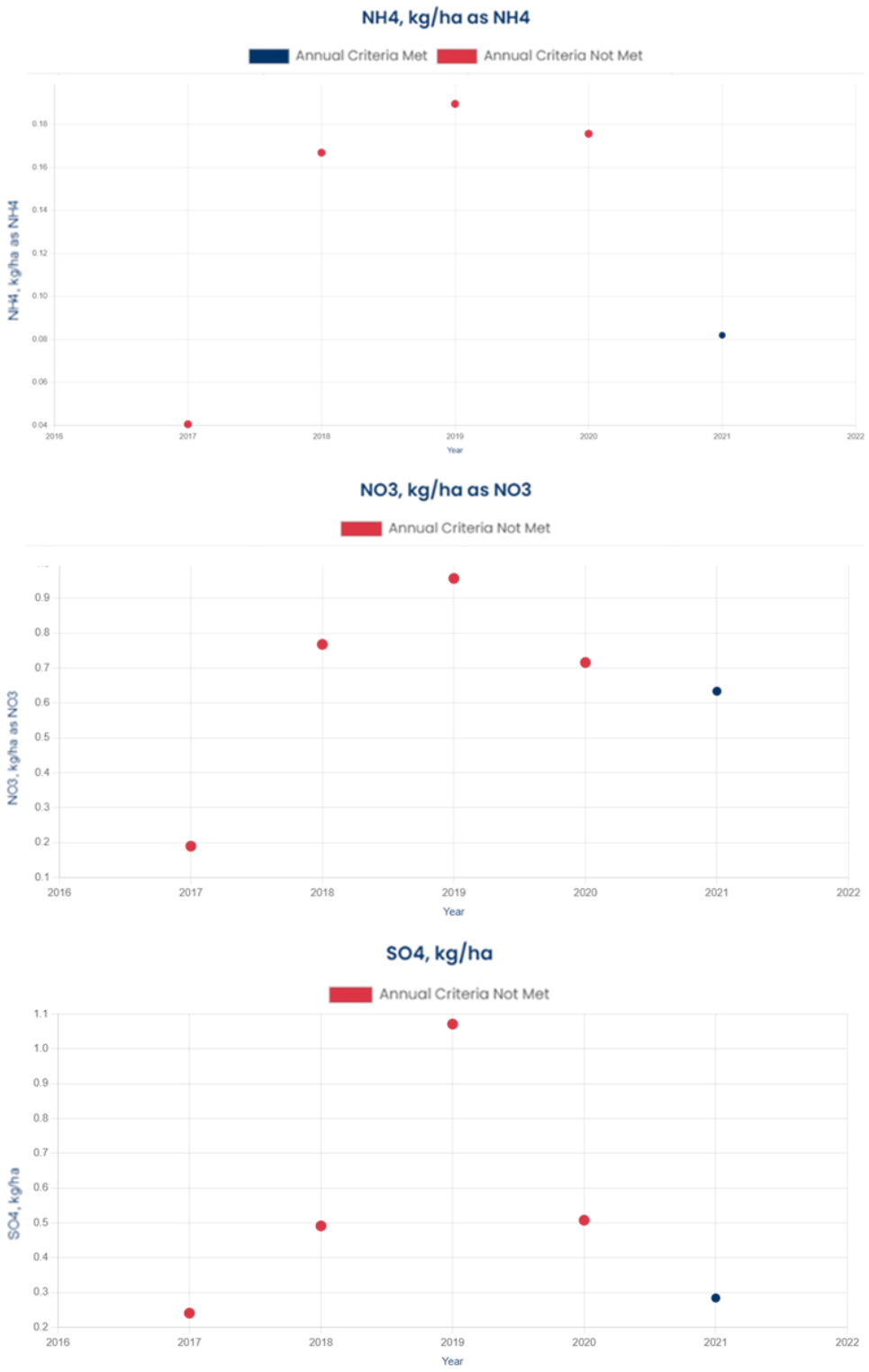


Source: FED 2023

Figure 1-4. Visibility on the Haziest, Most Impaired, and Clearest Days for Denali National Park.

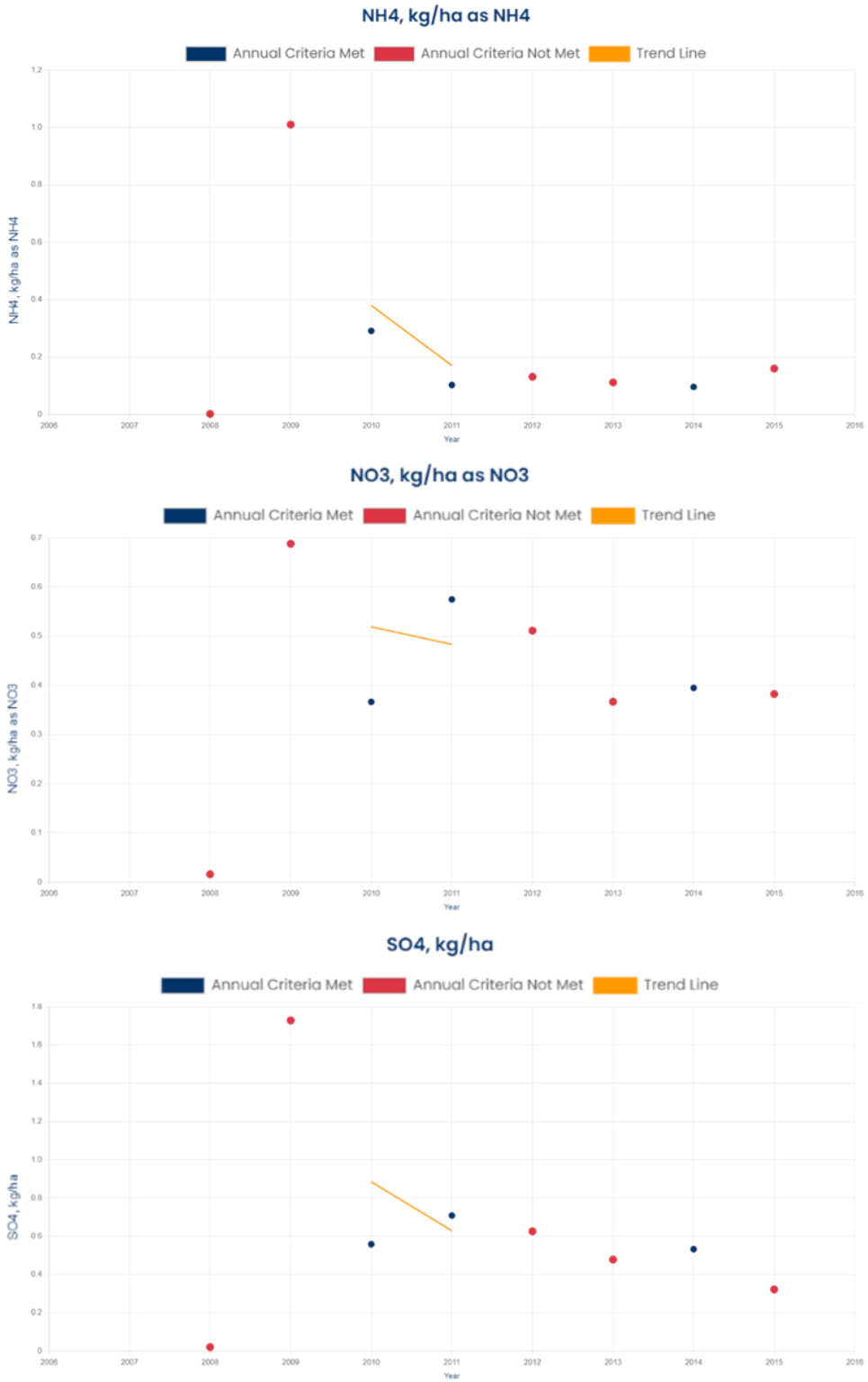
1.1.4 Deposition Monitoring Data

The closest active monitoring stations to the program area are Toolik Field Station (NTN Site AK96), Gates of the Arctic National Park (NTN Site AK06), Poker Creek (NTN Site AK01), and Denali National Park (NTN Site AK03). Trends for ammonium (NH_4^-), nitrate (NO_3^-), and sulfate (SO_4^{-2}) at Toolik Field Station (NTN Site AK96), Gates of the Arctic National Park (NTN Site AK06), Poker Creek (NTN Site AK01), and Denali National Park (NTN Site AK03) are shown in Figure 1-5 through Figure 1-8. The blue dots on the graphs indicate yearly concentrations that met the annual completeness criteria, while the red dots indicate yearly concentrations that did not meet the annual completeness criteria. The trendlines shown in yellow represent a 3-year moving average where the minimum data completeness criteria are met for that 3-year period.



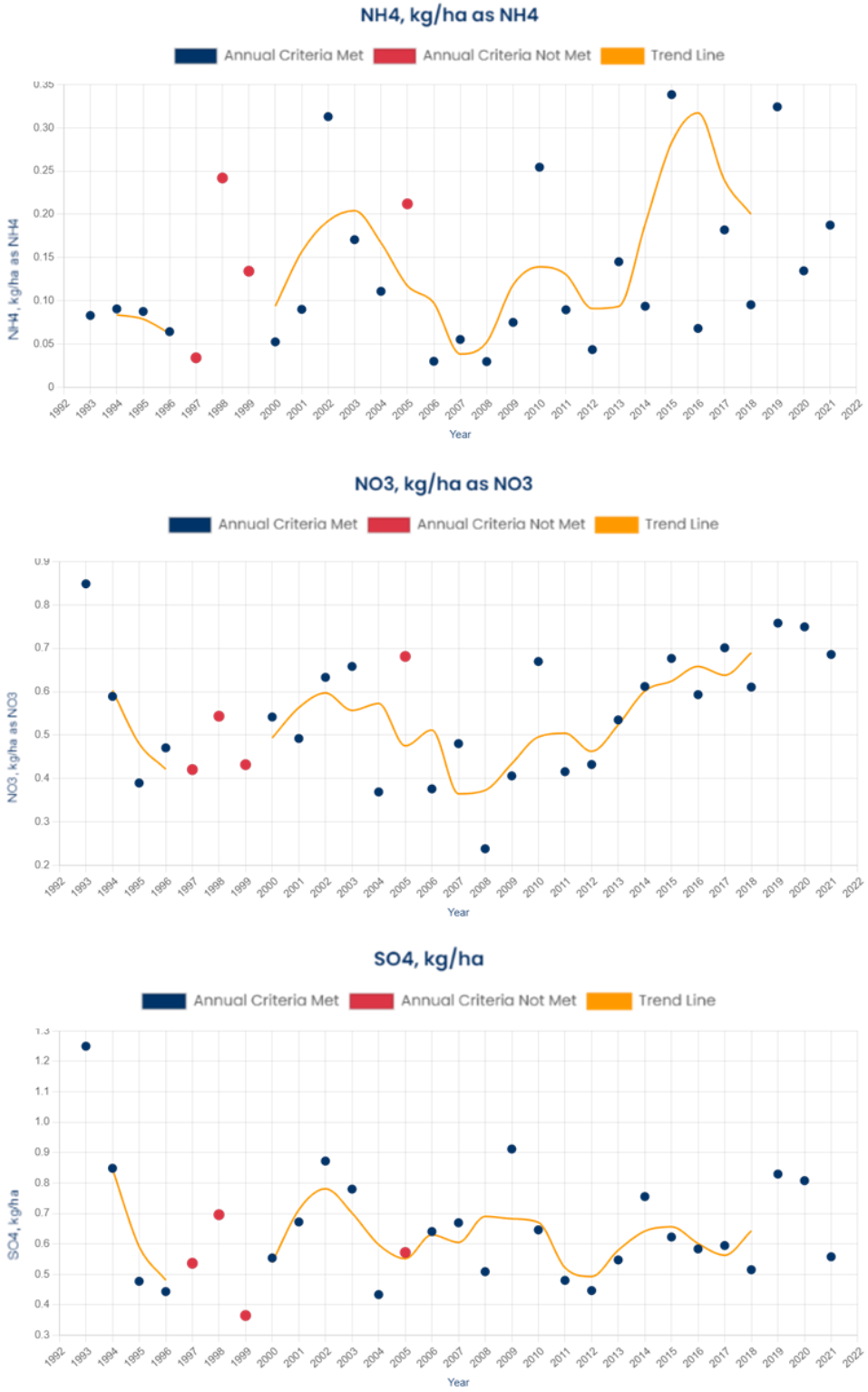
Source: NADP 2023

Figure 1-5. Trends in Wet Deposition of Ammonium (NH_4^-), Nitrate (NO_3^-), and Sulfate (SO_4^{-2}) at Toolik Field Station.



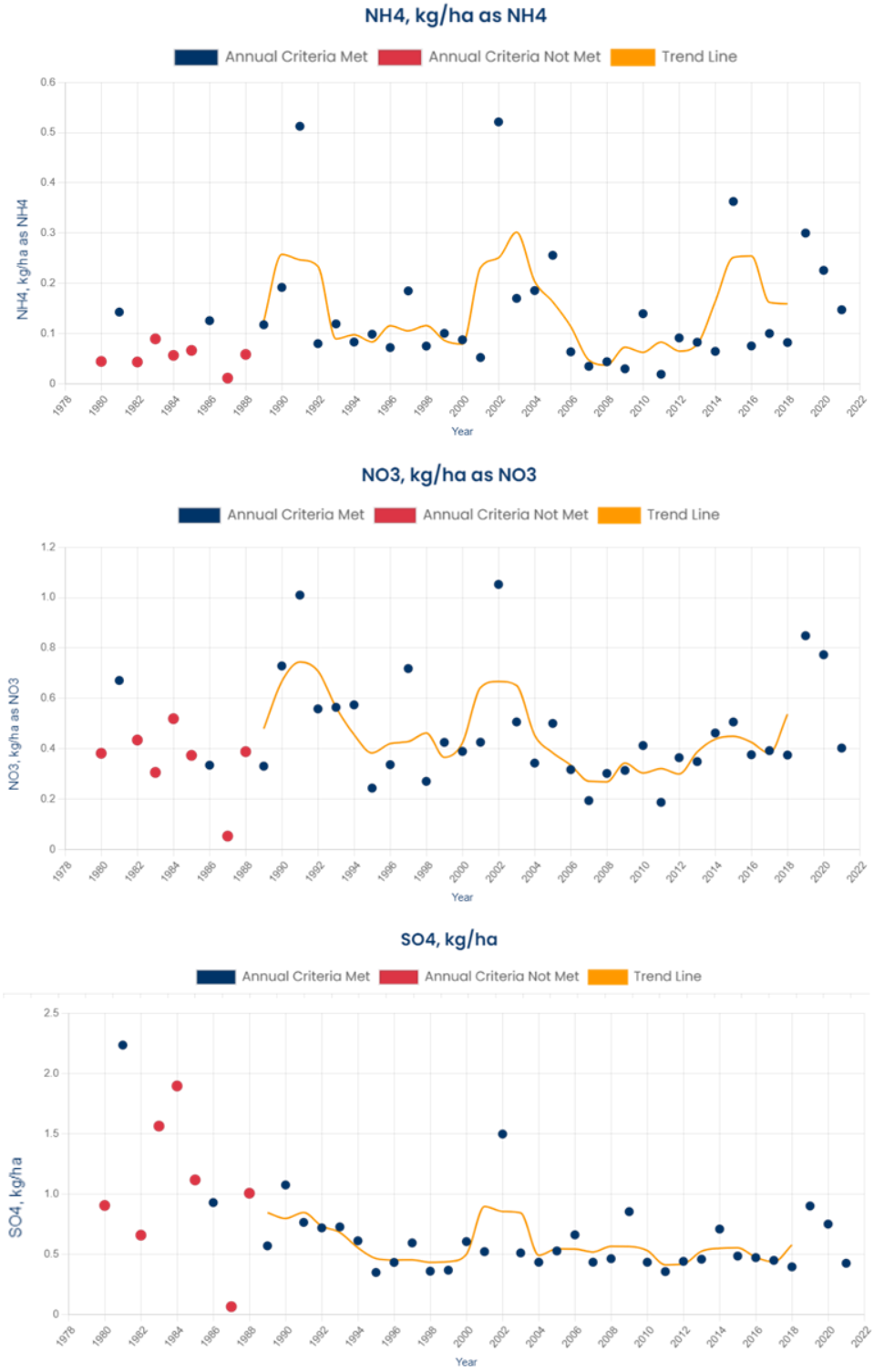
Source: NADP 2023

Figure 1-6. Trends in Wet Deposition of Ammonium (NH_4^-), Nitrate (NO_3^-), and Sulfate (SO_4^{-2}) at Gates of the Arctic National Park.



Source: NADP 2023

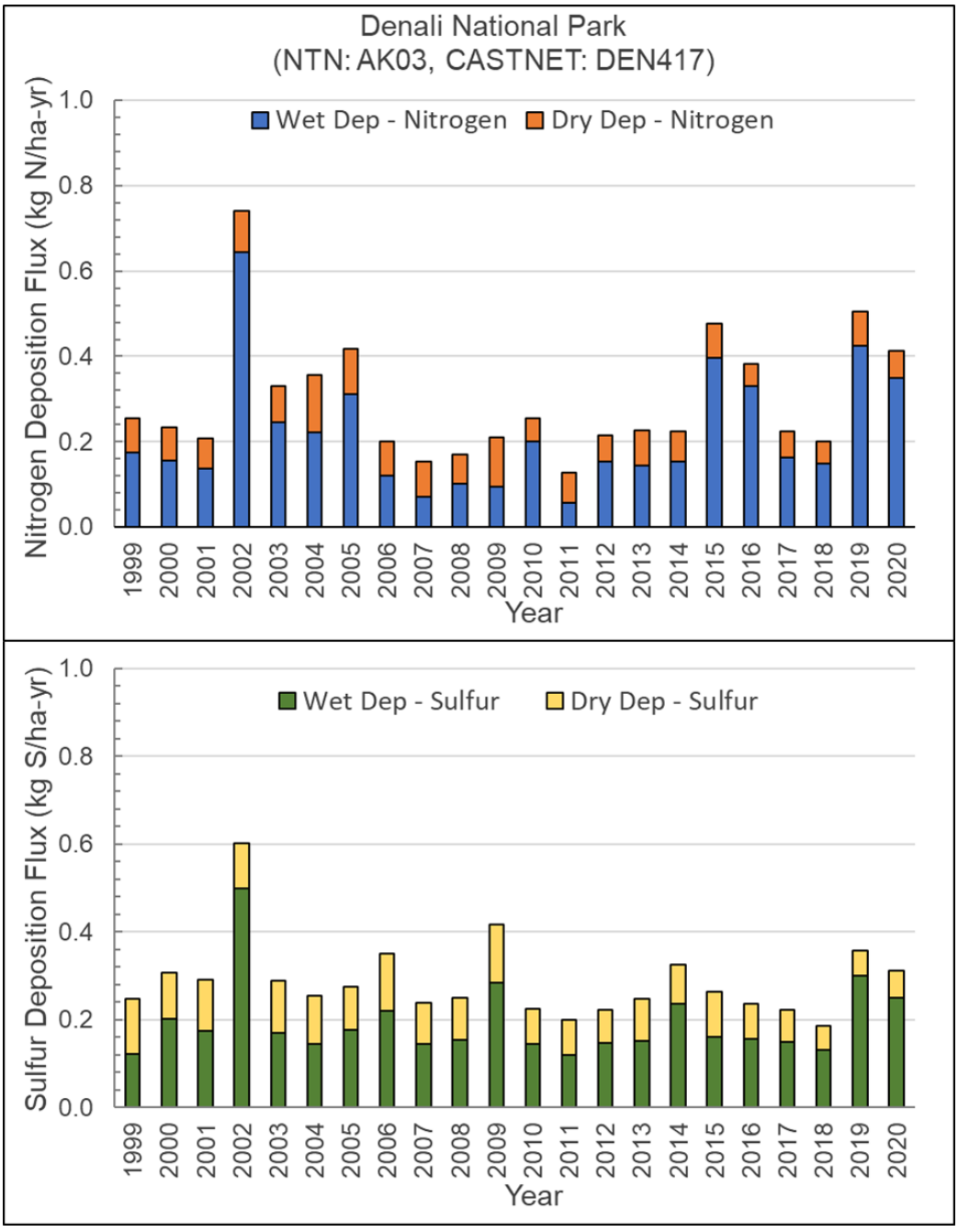
Figure 1-7. Trends in Wet Deposition of Ammonium (NH_4^-), Nitrate (NO_3^-), and Sulfate (SO_4^{-2}) at Poker Creek.



Source: NADP 2023

Figure 1-8. Trends in Wet Deposition of Ammonium (NH_4^-), Nitrate (NO_3^-), and Sulfate (SO_4^{-2}) at Denali National Park.

Total (wet and dry) nitrogen and sulfur deposition fluxes are shown in Figure 1-9. Total nitrogen deposition fluxes in all years are well below the critical load for the tundra ecoregion of Alaska of 1.0 to 3.0 kg N/ha/yr (Sullivan 2016). A critical load is the level of deposition below which no harmful effects are expected to an ecosystem.



Source: EPA 2023b

Figure 1-9. Total Nitrogen and Sulfur Deposition Flux at Denali National Park.

1.2 Supporting Information for Environmental Consequences

1.2.1 Oil and Gas Emissions in the Program Area

An emission inventory of criteria and hazardous air pollutants and greenhouse gases (GHGs) is developed for each action alternative (i.e., Alternatives B, C, D, and D2). The inventory includes emissions from construction, drilling and completion of new wells, operation and maintenance activities, and processing, storage, and transfer of produced oil and gas from hypothetical developments in the program area. The Reasonably Foreseeable Development (RFD) scenario for oil and gas resources in the Coastal Plain (Appendix C of the Draft SEIS) provides annual estimates of the oil production from hypothetical developments under each alternative. The RFD notes that there are currently no gas pipelines connecting the North Slope to potential markets and any future gas pipelines would likely first connect to better characterized and established gas fields. It assumes that natural gas would re-inject into the formation to maintain reservoir pressure and enhance oil recovery. Thus, estimated emissions from natural gas are limited to use within the program area as discussed below.

1.2.1.1 Emission Inventory Development Methodology

Emission inventories are prepared for the oil and gas RFD scenarios for Alternatives B, C, D, and D2 described in Appendix C of the Draft SEIS. The RFD includes projected oil production from one to four hypothetical developments depending on the action alternative; the RFD assumes that each individual hypothetical development has the same annual production schedule. Emissions are calculated using year-specific estimates for each action alternative of (i) oil production from the RFD scenario and (ii) emission rates per unit of oil production.

Emission rates per unit of oil production are developed using data from the Willow project oil and gas emission inventory for Alternative E in the Willow Master Development Plan Final SEIS (BLM 2023). The Willow project represents a future large development on Alaska's North Slope (Figure 1-1), which includes one CPF, three to five well pads, and associated infrastructure. To support development of Alternative B, C, D, and D2 emissions, annual emissions per barrel of oil production are estimated from Willow Alternative E, which is a 3-pad development with a deferred fourth pad. The Willow Alternative E-based emission rates include emissions associated with reinjection of natural gas into producing oil formations and use for fueling plant and facility equipment.

Four representative developments are developed using the emissions from Willow Alternative E to develop the emissions inventory for the various hypothetical CPF and well pad combinations under each action alternative described in the RFD:

- Alternative B: The RFD scenario for Alternative B includes four hypothetical developments with four total CPFs and 14 total satellite pads (Appendix C of the SEIS). The emissions inventory for Alternative B is developed assuming two hypothetical developments with one CPF with three pads each and two hypothetical developments with one CPF with four pads each. The emission rates per unit of oil production for the 3-pad developments are developed using the 3-pad production and emissions from Willow Alternative E. The emission rates for the 4-pad development are estimated using the Willow Alternative E production rate with the 4-pad emissions (i.e., including emissions from the deferred fourth pad).

- Alternative C: The RFD scenario for Alternative C includes three hypothetical developments with two CPFs and 9 pads in total (Appendix C of the SEIS). The emissions inventory for Alternative C is conservatively developed using three

hypothetical developments with a CPF and three satellite pads each using the 3-pad production and emissions from Willow Alternative E.

- Alternative D: The RFD scenario for Alternative D includes one hypothetical development with a single CPF and 6 pads. The emission rates per unit of oil production for the 6-pad development are developed using the Willow Alternative E 3-pad production with the 3-pad emissions plus the emissions from three additional pads.

- Alternative D2: The RFD scenario for Alternative D includes one hypothetical development with a single CPF and 3 pads. The emission rates per unit of oil production for the 3-pad development are developed using the Willow Alternative E 3-pad production with the 3-pad emissions.

The 3-pad production values are used to develop the representative emission factors because the production schedule of each hypothetical development for each action alternative is the same regardless of the number of well-pads. Thus, these representative development emission factors are conservatively high.

For each hypothetical development, annual emissions are estimated for pre-development years (i.e., years with construction and development before first oil production) as the product of Willow Alterative E annual emissions and the ratio of the peak annual oil production of the Coastal Plain action alternative and the peak annual production from Willow Alternative E. Annual emissions for each hypothetical development are estimated for production years (i.e., years with oil production) as the product of Willow Alternative E annual emissions per barrel and the annual barrels of oil projected for each hypothetical development.

For each action alternative, the peak year of emissions are reported. The peak emission year is selected by finding the maximum emission year for each pollutant. The peak emission years are as follows: Alternative B, Year 37 (2059); Alternative C, Year 37 (2059); Alternative D, Year 31 (2053), and Alternative D2, Year 31 (2053). For each action alternative, the maximum emission year is the same for all pollutants, except PM_{10}, benzene, and formaldehyde in Alternative B which peak in Year 33 (2055); formaldehyde in Alternative C which peaks in Year 20 (2042); formaldehyde in Alternative D which peaks in year 14 (2036); and PM_{10}, benzene, and formaldehyde in Alternative D2 which peak in Year 13 (2035).

The temporal scope, pollutants, and source categories for the emissions inventory are listed below.

<u>Temporal Scope</u>

- Years: Peak Emission Year for each action alternative
- Period: Annual

<u>Pollutants</u>

- Criteria air pollutants and precursors: NO_x, SO_2, PM_{10}, $PM_{2.5}$, VOC, CO
- Greenhouse gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), 100-year and 20-year carbon dioxide equivalents (CO_2e)

- Hazardous air pollutants: formaldehyde, n-hexane, benzene, toluene, ethylbenzene, xylenes

Source Categories

- Construction
  - Drill Pads
  - Gravel Roads, Valve Pads, and Water Access Pads
  - Ice Pads
  - Ice Roads
  - Pipelines
  - Central Processing Facility (CPF)
  - Airstrip construction (at CPF)
  - Air and ground transport for personnel and supplies
  - Power generation for construction
- Drilling
  - Well Drilling
  - Air and ground transport for personnel and supplies
- Operation
  - Drill Pads
  - Central Processing Facility
  - Support equipment (turbines/generators, heaters, incinerators, flares, etc.)
  - Power generation and injection turbines
  - Air and ground transport for personnel and supplies

1.2.1.2 Results

Oil and gas emission inventory results for the peak emission year for each action alternative are summarized in Table 1-9. GHG emissions are calculated annually and are reported in Section 2.2.1.

Table 1-9. Peak Annual Emissions of Criteria and Hazardous Air Pollutants under Alternatives B, C, D, and D2

Pollutant	Alternative B	Alternative C	Alternative D	Alternative D2
Criteria Air Pollutants and Precursors (short tons/year)				
NO_x	3,074	2,488	1,011	735
CO	2,915	2,360	956	697
VOC	2,646	2,018	1,154	596
SO_2	246	200	79	59
PM_{10}	795	645	258	190
$PM_{2.5}$	374	303	121	89

Pollutant	Alternative B	Alternative C	Alternative D	Alternative D2
Hazardous Air Pollutants (short tons/year)				
Total HAPs[1]	335	254	151	75
Benzene	4	3	2	1
Toluene	11	9	4	3
Ethylbenzene	44	33	22	10
Xylenes	87	64	43	19
n-Hexane	135	101	62	30
Formaldehyde	54	44	17	13

[1] Estimated as the sum of emissions of benzene, toluene, ethylbenzene, xylenes, formaldehyde, and n-hexane.

1.2.2 Regional Photochemical Modeling

Regional photochemical modeling is conducted with the Comprehensive Air quality Model with Extensions (CAMx)[1] to assess impacts of hypothetical development scenarios in the program area on air quality and AQRVs. CAMx is a state-of-the-science photochemical grid model with a "one-atmosphere" treatment of tropospheric air pollution (ozone, particulates, and precursors) over spatial scales ranging from neighborhoods to continents. CAMx has been used to analyze air quality impacts in other modeling studies in the U.S., including State Implementation Plans and other actions related to EISs by BLM and other agencies under NEPA and programmatic NEPA assessments, and by the EPA to support federal rulemaking.

CAMx modeling was previously performed for the Willow Master Development Plan EIS (BLM 2023), a proposed oil and gas development located west of the Coastal Plain. The Willow base case simulation at 4 km resolution was evaluated for maximum daily 8-hour ozone, and 24-hr averaged $PM_{2.5}$ and $PM_{2.5}$ species (sulfate, nitrate, ammonium, elemental carbon, organic carbon, crustal soil, and sodium). Overall, the model was shown to perform reasonably well. Details of the model performance evaluation are provided in Attachment B of the ARTSD for the Willow EIS (BLM 2023). The Willow future year (2025) photochemical modeling database includes Willow and other existing and reasonably foreseeable cumulative sources on the North Slope as described in Section 1.2.2.3 below

In the Coastal Plain EIS, the Willow CAMx modeling platform is supplemented with emissions from hypothetical development scenarios in the program area to assess a range of potential air quality and AQRV impacts resulting from oil and gas development. Impacts are assessed throughout the 4 km resolution modeling domain and specifically at the areas shown in Figure 1-10. The 4 km domain is centered on the North Slope of Alaska. The meteorology, boundary conditions, and other modeling configuration parameters are discussed in BLM (2023). The emissions applied in the modeling are discussed below.

[1] https://www.camx.com/

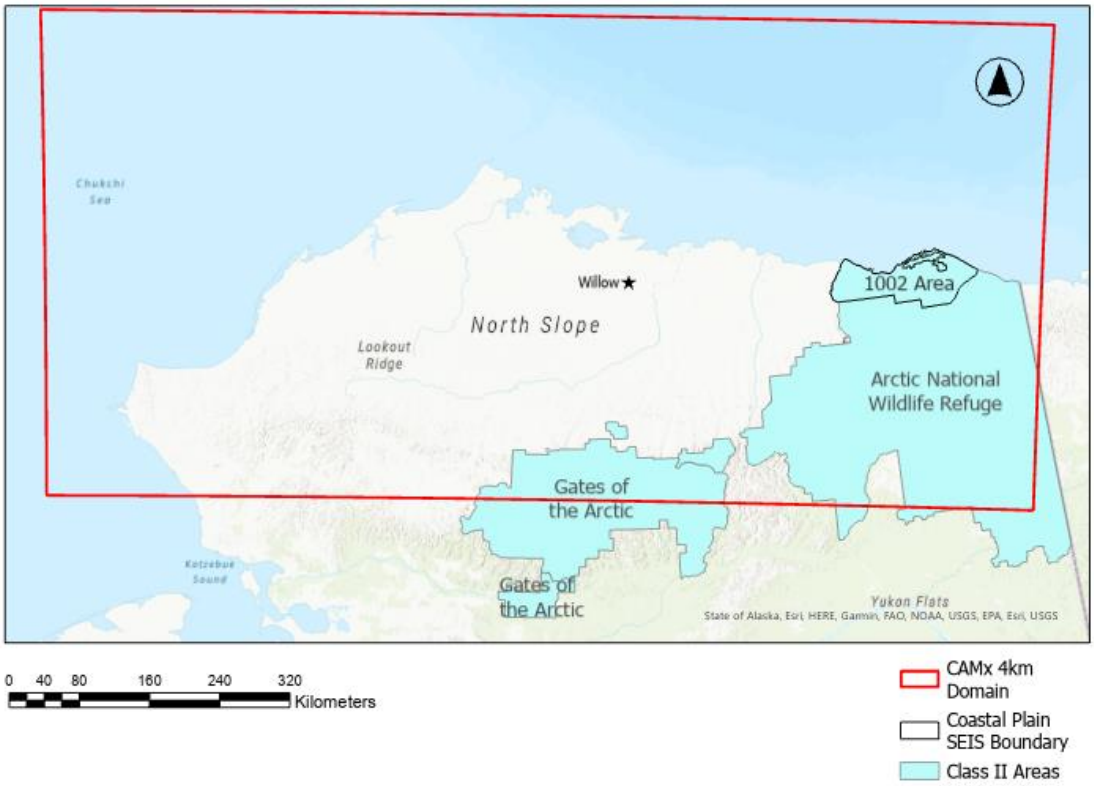


Figure 1-10. Regional CAMx modeling domain and assessment areas.

Air quality impacts are assessed by comparing modeled criteria air pollutant (CAP) levels (including O_3, $PM_{2.5}$, PM_{10}, NO_2, SO_2, and CO) to the applicable NAAQS and AAAQS listed in Table 1-1. AQRV impacts include changes in visibility and atmospheric deposition. Modeled visibility is compared to natural background conditions and modeled cumulative nitrogen deposition is compared to critical load thresholds of 1.0 to 3.0 kg/ha-yr for the Alaska tundra region (Pardo et al. 2011, Sullivan 2016). Sulfur deposition is also modeled.

1.2.2.1 Modeling Scenarios

Three CAMx model runs are performed:

- Run 1 is the No Action Alternative scenario (also named base case scenario) which includes the regional cumulative emissions in the North Slope and the Willow project development (BLM 2023) but without the oil and gas RFD in the program area. This run serves as the base case cumulative scenario.
- Run 2 is a high oil and gas development scenario that is consistent with the oil and gas RFD for Alternative B. It includes the base case cumulative emissions and additional emissions from four hypothetical future developments in the program including four CPFs, 14 well pads, and associated infrastructure. Each development has one CPF. Out of the 14 well pads, two of the developments are assumed to have 3 well pads and two others are assumed to have 4 well pads.
- Run 3 is a low oil and gas development scenario, which includes the base case cumulative emissions and additional emissions from one potential future development in the program area that includes one CPF, four well pads, and

associated infrastructure. Regional air quality impacts due to hypothetical oil and gas development under Alternative D2 are estimated to be lower than the low oil and gas development scenario due to the difference in well pads.

1.2.2.2 Development of Oil and Gas Emissions for Modeling High and Hypothetical low Development Scenarios

This section provides an overview of oil and gas emissions included in the CAMx modeling of hypothetical development in the Coastal Plain.

For the high and low development scenarios, peak annual emissions are modeled for four hypothetical developments and one hypothetical development, respectively, using the emissions for Alternative B from Section 1.2.1.2, and therefore the analysis is generally conservative. The modeled oil and gas emissions for the high development scenario are the same as those shown in Table 1-9 for Alternative B. Table 1-10 presents the modeled oil and gas emissions for the low development scenario.

Each alternative has lease stipulations and Required Operating Procedures (ROPs) which restrict where future developments can occur in the program area. Developments would only occur on lands open for leasing. The CPFs for each hypothetical future development modeled are located only in areas subject to standard terms and conditions. The well pads are placed in areas subject to standard terms and conditions or subject to controlled surface use or subject to timing limitations. No developments are modeled in areas of no surface occupancy (NSO) or on Kaktovik Inupiat Corporation native lands.

Table 1-10. Modeled Oil and Gas Emissions for the Hypothetical low Development Scenario

Pollutant	Annual Emissions (short tons/year)
NO_x	771
CO	731
VOC	712
SO_2	61
PM_{10}	199
$PM_{2.5}$	93

1.2.2.3 Other Cumulative Regional Emissions for CAMx Modeling

An emissions inventory for all sources within the modeling domain is required for the CAMx regional modeling. This section provides a brief overview of the regional emissions (other than the program area oil and gas inventory) for the far-field CAMx modeling. These cumulative emissions are from regional CAMx modeling performed for the Willow EIS and are described in detail in BLM (2023).

The SMOKE (Sparse Matrix Operator Kerner Emissions) modeling system was used to prepare and process emissions inputs into the format required by CAMx. A complete emissions inventory for photochemical modeling including point sources, area sources, non-road and on-road mobile sources, sea salt, dust, biogenic emissions, lightning-related emissions, and fire emissions was applied in the modeling.

Regional emissions for the CAMx far-field modeling for sources other than the future hypothetical developments in the program area are based on the Bureau of Ocean Energy

Management (BOEM) Arctic Air Quality Modeling Study (Fields Simms 2018; Stoeckenius 2017) with revisions for the Willow EIS (BLM 2023) to account for known future projects. A summary of existing regional emissions for the North Slope and adjacent waters (the Beaufort Sea and Chukchi Sea planning areas) is available from the BOEM modeling study (Fields Simms 2018) and the BLM Willow EIS (BLM 2023). Existing emissions from onshore sources (e.g., oil and gas production and exploration, airports, pipelines, and non-oil and gas-related stationary and mobile sources) comprise most of the total regional emissions; emissions from offshore sources (e.g., drilling rigs, survey/drilling vessels and aircraft, and commercial vessels) are small in comparison. Overall, onshore oil and gas sources comprise the largest fraction of existing emissions for all CAPs in the 4 km domain except for PM from unpaved roads.

1.2.2.4 Air Quality Impacts Analysis Approach

Modeled concentrations are processed in the form of the NAAQS and AAAQS for CAPs and are compared to these standards. CAMx hourly concentrations for each model grid cell are averaged to the appropriate period (see Table 1-1). This process is performed for the entire 4 km modeling domain. The modeled impacts from the hypothetical high and low development scenarios are derived by difference of modeled concentrations between the scenarios that include additional development (Run 2 and Run 3 described in Section 1.2.2.1) and the base case cumulative scenario (Run 1). This difference is calculated using modeled concentrations in the form of the NAAQS.

1.2.2.5 Air Quality Related Values Impacts Analysis Approach

Air quality related value (AQRV) impacts for atmospheric deposition and visibility impairment are assessed. Atmospheric nitrogen and sulfur deposition are evaluated at two federally managed Class II areas: the Arctic National Wildlife Refuge and Gates of the Arctic National Park. Visibility impairment is assessed at the nearest Class I area, Denali National Park. The visibility impairment calculation requires data on background extinction and other visibility parameters in the IMPROVE equation; these data are available only for Class I areas. Since Denali is outside the modeling domain, modeled visibility impacts at Gates of the Arctic (the closest area to Denali within the domain) are used as a surrogate for evaluation using background extinction and other visibility parameters for Denali.

Total nitrogen and sulfur deposition, including both wet and dry deposition fluxes, are derived in CAMx by aggregating the hourly model output to annual totals for each grid cell. Both the maximum and the average total deposition from all cells within the assessment areas are reported for the sum of all nitrogen containing compounds and likewise for sulfur. Cumulative modeled total nitrogen deposition fluxes are compared to critical loads for atmospheric nitrogen deposition. The critical load for nitrogen deposition in the Alaska tundra ecoregion is 1.0 to 3.0 kg N/ha-yr (Pardo et al. 2011, Sullivan 2016).

Visibility impacts due to oil and gas development in the program area for the high and low development scenarios are determined by calculating the incremental changes in the visibility extinction from background concentrations due to the oil and gas emissions under each scenario. The quantity that measures the extinction changes in the Haze Index is referred to as "delta deciview" (Δdv). The modeled visibility impacts from high and low oil and gas development scenarios are compared to 0.5 Δdv and 1.0 Δdv thresholds consistent with Federal Land Manager Air Quality Related Values Work group (FLAG) guidance (2010).

1.2.2.6 Photochemical Modeling Results

Table 1-11 and Table 1-13 provide a summary of modeled maximum cumulative ambient air quality concentrations in the hypothetical high and low development scenarios, respectively, for all criteria pollutants in the modeling domain and assessment areas. The modeled cumulative air quality concentrations for all criteria pollutants are below the NAAQS and AAAQS in both hypothetical development scenarios (the ambient air quality standards are shown in Table 1-11). There is a modeled exceedance of the annual $PM_{2.5}$ NAAQS approximately 320 miles west of the program area near Wainwright, Alaska with a modeled impact of 0.001 µg/m^3 due to the hypothetical oil and gas development in program area. Therefore, the contribution of program area development to the exceedance is very low.

Figure 1-11 shows the spatial distribution of modeled impacts to ambient air NO_2 concentrations due to oil and gas development in the program area in the hypothetical high and low development scenarios. Modeled peak impacts to NO_2 concentrations are over 10 ppb (12.8 ppb) in the high development scenario and 6.8 ppb in the low development scenario. Similar figures with the spatial distribution of modeled impacts for other criteria pollutants and different forms of the NAAQS are presented in Appendix A.

The results presented in the figures in Appendix A indicate that the maximum impacts for all pollutants due to hypothetical oil and gas development are located within the program area, except for ozone whose peak impacts are located just outside the program area; ozone is a secondary pollutant formed from precursor emissions of NO_x and VOC in the program area. Peak ozone impacts due to high and low hypothetical development scenarios are 2.2 ppb and 0.8 ppb, respectively. Maximum CO impacts in the high scenario are 0.005 ppm and 0.003 ppm for the low scenario. Peak $PM_{2.5}$ impacts for the high scenario are 2.1 µg/m^3 and 1.5 µg/m^3 for the low scenario. Maximum PM_{10} impacts for the high scenarios are 23.4 µg/m^3 and 16.4 µg/m^3, for the low scenario. Finally, peak SO_2 impacts for the high and low development scenarios are 0.56 ppb and 0.46 ppb, respectively.

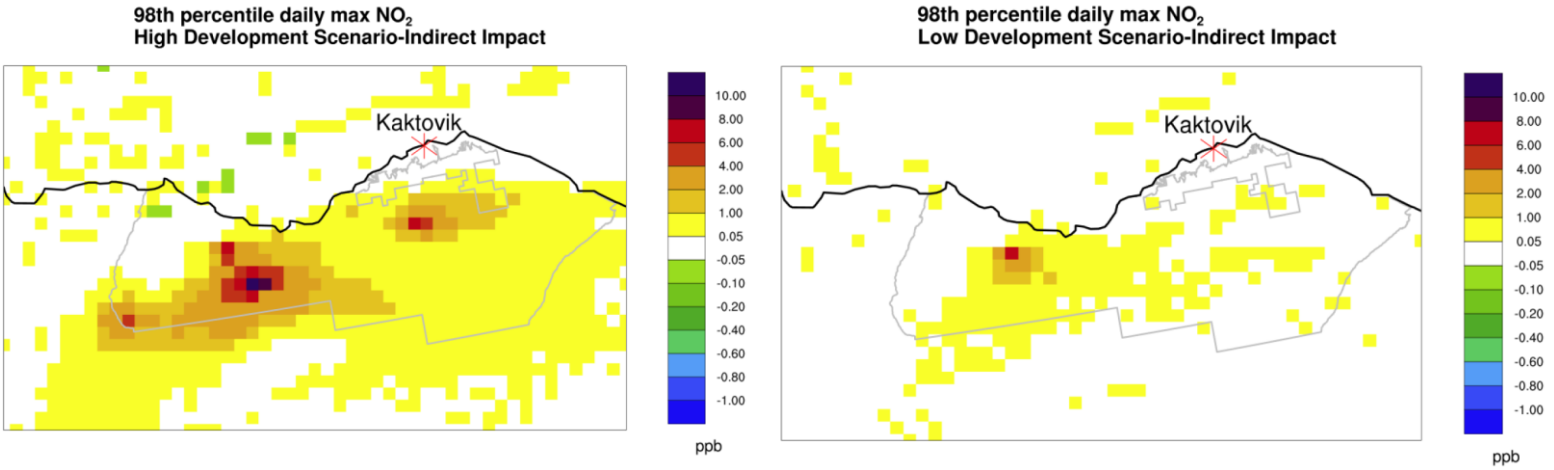


Figure 1-11. Modeled Spatial Distribution of NO_2 impacts due to the Hypothetical High (left) and Low (right) Oil and Gas Development scenarios.

Table 1-12 shows modeled impacts under the hypothetical high development scenario for all criteria pollutants in terms of the standards; the values shown are the oil and gas development impacts at the location and time of the peak cumulative impacts in each area. In the program area, modeled oil and gas development impacts under the high development

scenario represent 84% of the cumulative annual average NO_2 concentrations, 0.6% of the cumulative 1-hour NO_2 peak concentrations, 17% of the cumulative annual $PM_{2.5}$ concentrations, 13% of the cumulative 24-hour $PM_{2.5}$ concentrations and 63% of the cumulative 24-hour PM_{10} concentrations. In general, at other assessment areas and in the modeling domain because the peak cumulative impacts due to all regional emission sources on the North Slope occur in locations that are far from the program area, the peak impacts from the hypothetical high development are small at those locations (also see figures titled "High Development Scenario-Cumulative" and "High Development Scenario-Indirect Impact" in Appendix A) and the cumulative concentrations are largely the result of other regional sources. At Kaktovik, modeled oil and gas development impacts under the high development scenario represent 25% of the cumulative annual average NO_2 concentrations, 2% of the cumulative annual $PM_{2.5}$ concentrations, 0.2% of the cumulative 24-hour $PM_{2.5}$ concentrations and 3% of the cumulative 1-hour SO_2 concentrations. Modeled impacts at Kaktovik for other pollutants and forms of the NAAQS are close to zero.

Table 1-14 shows the modeled impacts under the hypothetical low development scenario for all criteria pollutants in terms of the standards. In the program area, modeled oil and gas development impacts under the low development scenario represent 79% of the cumulative annual average NO_2 concentrations, 0.1% of the cumulative 1-hour NO_2 peak concentration, 12% of the cumulative annual $PM_{2.5}$ concentration, 12% of the cumulative 24-hour $PM_{2.5}$ concentration and 54% of the cumulative 24-hour PM_{10} concentrations. In general, at other assessment areas and in the modeling domain because the peak cumulative impacts due to all regional emission sources on the North Slope occur in locations that are far from the program area, the peak impacts from the hypothetical low development are small at those locations (also see figures titled "Low Development Scenario-Cumulative" and "Low Development Scenario-Indirect Impact" in Appendix A) and the cumulative concentrations are largely the result of other regional sources. At Kaktovik, modeled oil and gas development impacts under the low development scenario represent 9% of the cumulative annual average NO_2 concentrations, 1% of the cumulative annual $PM_{2.5}$ concentration and 0.02% of the cumulative 24-hour $PM_{2.5}$. Modeled impacts at Kaktovik for other pollutants and forms of the NAAQS are close to zero. Overall, as expected, impacts are lower in the low development scenario compared to the high development scenario.

Figures of cumulative concentrations for all pollutants and each modeling scenario's indirect impacts are provided under separate cover as part of Appendix A.

Table 1-11 Modeled Cumulative Concentrations under the Hypothetical High Development Scenario

	CO		NO_2		O_3	$PM_{2.5}$		PM_{10}	SO_2	
	8 hours	1 hour	1 hour	Annual	8 hours	Annual	24 hours	24 hours	1 hour	3 hours
	ppm	ppm	ppb	ppb	ppb	µg/m³	µg/m³	µg/m³	ppb	ppm
Primary NAAQS and AAAQS[a]	**9**	**35**	**100**	**53**	**70**	**9**	**35**	**150**	**75**	**0.5**
Secondary NAAQS	**NA**	**NA**	**NA**	**53**	**70**	**15**	**35**	**150**	**NA**	**0.5**
Modeled Concentrations										
Program Area	0.18	0.18	18.24	3.53	43.47	2.91	6.74	29.30	0.85	0.0008
Arctic National Wildlife Refuge (excluding Program Area)	0.44	0.62	3.86	0.61	56.29	2.51	5.92	30.48	0.74	0.0021
Gates of the Arctic	0.17	0.18	1.23	0.19	53.44	1.44	3.92	9.88	0.68	0.0009
Kaktovik	0.17	0.17	5.22	0.57	39.26	2.25	7.26	14.29	0.29	0.0003
Full Domain[1]	0.90	3.08	72.39	22.02	56.29	10.05	31.35	121.33	58.07	0.0574

NA indicates "not applicable"

1 Full Domain values represent the maximum modeled concentration in the numerical form of the air quality standard in the entire modeling domain.

[a] AAAQS are presented in units consistent with the Primary NAAQS to assist with comparison to modeled impacts.

Table 1-12 Modeled Concentrations in the Hypothetical High Oil and Gas Development Scenario at the location and time of the peak cumulative impact in each area.

	CO		NO_2		O_3	$PM_{2.5}$		PM_{10}	SO_2	
	8 hours	1 hour	1 hour	Annual	8 hours	Annual	24 hours	24 hours	1 hour	3 hours
	ppm	ppm	ppb	ppb	ppb	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	ppb	ppm
Primary NAAQS and AAAQS[a]	**9**	**35**	**100**	**53**	**70**	**9**	**35**	**150**	**75**	**0.5**
Secondary NAAQS	**NA**	**NA**	**NA**	**53**	**70**	**15**	**35**	**150**	**NA**	**0.5**
Modeled Concentrations										
Program Area	0.000	0.000	0.090	2.947	0.004	0.487	0.873	18.435	0.386	0.00026
Arctic National Wildlife Refuge (excluding Program Area)	0.000	0.000	0.894	0.003	0.001	0.029	0.014	0.000	0.000	0.00000
Gates of the Arctic	0.000	0.000	0.000	0.002	0.005	0.002	0.000	0.001	0.000	0.00000
Kaktovik	0.000	0.000	0.000	0.137	0.000	0.050	0.006	0.003	0.007	0.00003
Full Domain[1]	0.000	0.000	0.000	0.003	0.001	0.001	0.000	0.000	0.000	0.00000

NA indicates "not applicable"

1 Full Domain values represent the program area oil and gas impacts at the location and time of the peak cumulative impact anywhere in the North Slope modeling domain and happen to be zero here.

[a] AAAQS are presented in units consistent with the Primary NAAQS to assist with comparison to modeled impacts.

Table 1-13 Modeled Cumulative Concentrations under the Hypothetical Low Development Scenario

	CO		NO_2		O_3	$PM_{2.5}$		PM_{10}	SO_2	
	8 hours	1 hour	1 hour	Annual	8 hours	Annual	24 hours	24 hours	1 hour	3 hours
	ppm	ppm	ppb	ppb	ppb	µg/m³	µg/m³	µg/m³	ppb	ppm
Primary NAAQS and AAAQS[a]	**9**	**35**	**100**	**53**	**70**	**9**	**35**	**150**	**75**	**0.5**
Secondary NAAQS	**NA**	**NA**	**NA**	**53**	**70**	**15**	**35**	**150**	**NA**	**0.5**
Modeled Concentrations										
Program Area	0.18	0.18	18.18	2.72	43.46	2.75	6.70	23.41	0.68	0.0007
Arctic National Wildlife Refuge (excluding Program Area)	0.44	0.62	2.97	0.61	56.29	2.49	5.91	30.48	0.74	0.0021
Gates of the Arctic	0.17	0.18	1.23	0.19	53.43	1.43	3.92	9.88	0.68	0.0009
Kaktovik	0.17	0.17	5.22	0.48	39.26	2.22	7.26	14.29	0.28	0.0003
Full Domain[1]	0.90	3.08	72.39	22.02	56.29	10.05	31.35	121.33	58.07	0.0574

NA indicates "not applicable"

1 Full Domain values represent the maximum modeled concentration in the numerical form of the air quality standard in the entire domain.

[a] AAAQS are presented in units consistent with the Primary NAAQS to assist with comparison to modeled impacts.

Table 1-14 Modeled Concentrations in the Hypothetical Low Oil and Gas Development Scenario at the location and time of the peak cumulative impact in each area.

	CO		NO_2		O_3	$PM_{2.5}$		PM_{10}	SO_2	
	8 hours	1 hour	1 hour	Annual	8 hours	Annual	24 hours	24 hours	1 hour	3 hours
	ppm	ppm	ppb	ppb	ppb	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	ppb	ppm
Primary NAAQS and AAAQS[a]	**9**	**35**	**100**	**53**	**70**	**9**	**35**	**150**	**75**	**0.5**
Secondary NAAQS	**NA**	**NA**	**NA**	**53**	**70**	**15**	**35**	**150**	**NA**	**0.5**
Modeled Concentrations										
Program Area	0.000	0.000	0.025	2.141	0.001	0.323	0.837	12.545	0.219	0.00019
Arctic National Wildlife Refuge (excluding Program Area)	0.000	0.000	0.000	0.001	0.000	0.006	0.002	0.000	0.000	0.00000
Gates of the Arctic	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.00000
Kaktovik	0.000	0.000	0.000	0.045	0.000	0.015	0.001	0.001	0.000	0.00000
Full Domain[1]	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.00000

NA indicates "not applicable"

1 Full Domain values represent the program area oil and gas impacts at the location and time of the peak cumulative impact anywhere in the North Slope modeling domain and happen to be zero here.

[a] AAAQS are presented in units consistent with the Primary NAAQS to assist with comparison to modeled impacts.

Modeled total annual nitrogen (N) and sulfur (S) fluxes are evaluated in the following areas: Arctic National Wildlife Refuge (excluding the program area), the program area, and Gates of the Arctic. Table 1-15 presents the spatial maximum and average of cumulative modeled nitrogen and sulfur deposition across each of these three areas in the hypothetical high development scenario. Similarly, Table 1-16 presents the cumulative deposition in the hypothetical low development scenario. Spatial maps of modeled cumulative nitrogen and sulfur deposition are provided in Appendix A.

The cumulative nitrogen deposition impacts shown in Table 1-15 for the hypothetical high development scenario are below or within the critical load range at the three areas assessed. Across these areas, maximum annual cumulative nitrogen deposition in the hypothetical high development scenario ranges from approximately 0.6 to 2.1 kg N/ha-yr while average nitrogen deposition ranges from approximately 0.3 to 0.6 kg N/ha-yr. The average nitrogen deposition values are below the critical loads in all three areas. Maximum annual cumulative sulfur deposition varies from approximately 0.6 to 0.7 kg S/ha-yr while average sulfur deposition varies from 0.3 to 0.4 kg S/ha-yr.

Table 1-15. Cumulative Deposition in the Hypothetical High Development Scenario: Spatial Maximum and Average

Assessment Area	Nitrogen (kg N/ha-yr)			Sulfur (kg S/ha-yr)	
	Maximum	Average	Below/Within/Above Critical Load Range (1.0-3.0 kg/ha-yr)	Maximum	Average
Arctic National Wildlife Refuge (excluding Program Area)	0.67	0.33	Below	0.71	0.32
Program Area	2.05	0.63	Within	0.58	0.28
Gates of the Arctic	0.59	0.38	Below	0.68	0.37

Cumulative nitrogen deposition fluxes shown in Table 1-16 for the hypothetical low development scenario are below or within the critical load range at all areas assessed. Maximum annual cumulative nitrogen deposition varies from 0.6 to 1.4 kg N/ha-yr across these three assessment areas while average nitrogen deposition varies from 0.3 to 0.5 kg N/ha-yr. Maximum annual cumulative sulfur deposition varies from 0.4 to 0.7 kg S/ha-yr while average sulfur deposition varies from 0.3 to 0.4 kg S/ha-yr.

Table 1-16. Cumulative Deposition in the Hypothetical Low Development Scenario: Spatial Maximum and Average

Assessment Area	Nitrogen (kg N/ha-yr)			Sulfur (kg S/ha-yr)	
	Maximum	Average	Below/Within/Above Critical Load Range (1.0-3.0 kg/ha-yr)	Maximum	Average
Arctic National Wildlife Refuge (excluding Program Area)	0.66	0.33	Below	0.71	0.32
Program Area	1.44	0.51	Within	0.43	0.26
Gates of the Arctic	0.59	0.38	Below	0.68	0.37

Table 1-17 shows the modeled impacts of the hypothetical high development scenario on visibility. The values shown were determined by difference between the high development scenario and the No Action Alternative scenario. Table 1-18 similarly shows modeled visibility impacts in the hypothetical low development scenario. The 1 and 0.5 Δdv thresholds are never exceeded in the low development scenario. The 1 Δdv threshold is not exceeded in the high development scenario but the 0.5 Δdv threshold is exceeded for three days (out of 365). The maximum expected visibility impacts are 0.936 Δdv and 0.243 Δdv in the high and low development scenarios, respectively. The visibility impacts during the 20 percent worst days (W20) are generally an order of magnitude lower than the maximum values. The visibility impacts at Denali NP would be lower than those shown here as it is farther away from any oil and gas development that would occur in the program area compared to the Gates of the Arctic.

Table 1-17. Modeled Visibility Impacts in the High Development Scenario

Assessment Area	Δdv (Max)	Δdv (98th percentile)	Δdv (W20[a])	Δdv (B20[b])	Number of Days	
					Δdv > 1	Δdv > 0.5
Gates of the Arctic[c]	0.936	0.280	0.072	0.000	0	3

[a] Average of the Delta-deciview values for days in a full year above the 80th percentile (20% worst visibility days).
[b] Average of the Delta-deciview values for days in a full year below the 20th percentile (20% best visibility days).
[c] Gates of the Arctic is the closest area to Denali NP that is within the 4 km modeling domain and its impacts serve as surrogate impacts for Denali NP

Table 1-18. Modeled Visibility Impacts in the Low Development Scenario

Assessment Area	Δdv (Max)	Δdv (98th percentile)	Δdv (W20[a])	Δdv (B20[b])	Number of Days	
					Δdv > 1	Δdv > 0.5
Gates of the Arctic[a]	0.243	0.074	0.018	0.000	0	0

[a] Average of the Delta-deciview values for days in a full year above the 80th percentile (20% worst visibility days).
[b] Average of the Delta-deciview values for days in a full year below the 20th percentile (20% best visibility days).
[c] Gates of the Arctic is the closest area to Denali NP that is within the 4 km modeling domain and its impacts serve as surrogate impacts for Denali NP

1.2.3 Near-field Model Tiering

The near-field air quality impacts of a potential development in the Coastal Plain were estimated by incorporating by reference a near-field modeling analysis conducted for the Willow EIS (BLM 2023). Results from the near-field analysis conducted for Alternative E the Willow project are provided below and used as a surrogate for the near-field analysis for the Coastal Plain SEIS. Near-field impacts from a future development in the Coastal Plain of the same scale as Willow with similar nearby RFFAs are expected to be generally similar to those modeled for the Willow project as discussed below.

The EPA regulatory air dispersion model AERMOD was used to assess concentrations of CAPs (excluding O_3 and Pb) and select HAPs within 31 miles (50 km) of the project for five development scenarios – construction, two pre-drilling scenarios, developmental drilling, and routine operations:

- The construction scenario included the construction of drill sites, a processing facility, an operations center, an airstrip, gravel access roads, pipelines, communications facilities, living quarters, temporary facilities (seasonal ice roads to gravel mines, ice pads, etc.), and additional infrastructure.

- Pre-drilling activities occur before the processing facility is fully functional so electricity would not be available for electric drill rigs to operate. Diesel-fired drill rigs, hydraulic fracturing units, and associated ancillary support equipment would be used until highline power is available. Two pre-drilling scenarios were modeled, one for pre-drilling activities occurring with two diesel-fired drill rigs, and a second with one diesel-fired drill rig.

- The developmental drilling scenario included drilling and hydraulic fracturing operations occurring at the same time as localized construction and operational activities throughout the Willow project area.

- The routine operations scenario involves the production and processing of oil, gas, and produced water after temporary and transient activities associated with construction and drilling are complete.

Flare emissions were included in the developmental drilling and routine operations scenarios using two different operating conditions, typical operations and emergency or upset conditions. Maximum flaring emissions occur during emergency/upset conditions. The modeled short-term impacts included flares operating at upset conditions with maximum hourly rates for all hours of the year. Long term impacts included upset conditions for up to 10 hours per year. In addition to Willow project sources, emissions from Reasonably Foreseeable Future Action (RFFA) sources within 31 miles of the Willow project area were also included for the developmental drilling and routine operations scenarios to assess expected cumulative long-term CAPs and HAPs impacts. A detailed description of the emissions inventory development for the Willow near-field modeling analysis is provided in BLM (2023).

Meteorology data used in the near-field modeling was prepared using the AERMET meteorological processor with five years of National Weather Service (NWS) surface and upper air observations. Observed data was obtained from nearby monitoring stations and was assumed to represent meteorological conditions in the Willow project area. Differences in meteorology and terrain at the Willow project site compared to the Coastal Plain potential future development site may cause differences in air quality impacts between the two.

Model results were assessed within the modeling domain and at a nearby community (Nuiqsut) located approximately 25 miles from the Willow project site. Modeled CAPs concentrations, in the form of the applicable standards, were added to background concentrations and the totals were compared to the NAAQS and AAAQS. Ambient air quality monitoring data from a nearby monitoring station (Nuiqsut Monitoring Station, approximately 25 miles from Willow project site) was used as representative ambient air background concentrations. Three years of data, from 2018-2020, were used to calculate background concentrations in the form of the NAAQS. The background concentrations used for the Willow project are not necessarily representative of background concentrations at the Coastal Plain potential future development site which may cause differences in air quality impacts between the two projects. AERMOD does not include the necessary chemical reactions to model O_3 or secondary $PM_{2.5}$ and these were instead assessed with regional CAMx modeling. Secondary $PM_{2.5}$ concentrations resulting from Willow project sources were estimated from the Willow CAMx analysis and the concentrations were added to the AERMOD $PM_{2.5}$ and PM_{10} modeled concentrations. More details on this process are provided in BLM (2023).

Select HAPs, including benzene, toluene, ethylbenzene, xylenes, n-hexane, and formaldehyde, were modeled for the routine operations scenario only since emissions are substantially higher compared to other scenarios. These select HAPs are commonly emitted from oil and gas development. As mentioned above, the routine operations scenario included Willow project sources and RFFAs so the modeling results represent cumulative HAPs impacts. Modeled 1-hour and 8-hour cumulative HAP concentrations were compared to Acute Reference Exposure Limits (RELs) and Acute Exposure Guideline Levels (AEGLs). Annual cumulative HAPs concentrations were compared to non-cancer reference concentration thresholds (RfCs) and a cancer risk assessment was performed at a nearby community, comparing annual concentrations of carcinogenic HAPs (benzene, ethylbenzene, and formaldehyde) to a 1-in-1 million cancer threshold. Monitored HAPs in the North Slope of Alaska are frequently below the measurement detection limit, indicating that ambient air concentrations are typically low (see Section 1.1.2, Table 1-7 and Table 1-8). Background ambient air concentrations were therefore not added to the modeled results.

All CAPs and HAPs results are below the applicable standards and thresholds. Table 1-19 through Table 1-32 provide results within the modeling domain and at a nearby community (Nuiqsut) for each of the modeling scenarios.

Separate model runs were performed for the two flare operating conditions (typical and emergency/upset) and results are presented in Table 1-22 through Table 1-25 for cumulative CAPs impacts and Table 1-29 and Table 1-30 for HAPs cumulative impacts. The impacts of emergency flares were also modeled without other Willow project or RFFA sources for the routine operations scenario (Table 1-26 and Table 1-32Table 1-32). Emergency flares contributed a small portion of the total cumulative CAPs impacts from all sources, ranging from less than 1% to 7% depending on the pollutant. Emergency flaring HAPs impacts were substantially lower than the cumulative HAPs impacts except for formaldehyde, both in the model domain and at the nearby community, and n-hexane at the nearby community. The impact of RFFA sources during the routine operations scenario was also determined and compared to the total cumulative CAPs impacts from all sources. RFFAs contribute significantly, ranging from 3% to 74% of the total cumulative impacts within the modeling domain and from 1% to 34% at the nearby community.

Table 1-19. Near-field Impacts During Construction

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	10,828.2	27%	10,346.5	26%
CO	8 hours	3,863.6	39%	3,446.2	34%
NO_2	1 hour	131.5	70%	54.7	29%
NO_2	Annual	21.2	21%	4.0	4%
SO_2	1 hour	12.8	7%	9.7	5%
SO_2	3 hours	15.1	1%	10.4	1%
SO_2	24 hours	10.5	3%	9.4	3%
SO_2	Annual	1.9	2%	1.8	2%
PM_{10}	24 hours	49.9	33%	50.8	34%
$PM_{2.5}$	24 hours	18.5	53%	7.7	22%
$PM_{2.5}$	Annual	4.1	46%	1.7	19%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-20. Near-field Impacts During Pre-Drilling Activity with Two Diesel-Fired Drill Rigs

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,735.8	29%	10,326.5	26%
CO	8 hours	4,449.0	46%	3,438.4	34%
NO_2	1 hour	91.0	48%	28.9	15%
NO_2	Annual	14.0	14%	3.8	4%
SO_2	1 hour	12.8	7%	9.0	5%
SO_2	3 hours	13.5	1%	10.1	1%
SO_2	24 hours	11.4	3%	9.3	3%
SO_2	Annual	2.0	3%	1.8	2%
PM_{10}	24 hours	49.3	33%	10.5	7%
$PM_{2.5}$	24 hours	16.4	47%	7.5	21%
$PM_{2.5}$	Annual	3.6	40%	1.6	18%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2

which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-21. Near-field Impacts During Pre-Drilling Activity with One Diesel-Fired Drill Rig

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,117.1	28%	10,317.7	26%
CO	8 hours	4,067.8	41%	3,436.6	34%
NO_2	1 hour	82.3	44%	30.2	16%
NO_2	Annual	10.3	10%	3.8	4%
SO_2	1 hour	12.1	6%	9.0	5%
SO_2	3 hours	12.7	1%	10.1	1%
SO_2	24 hours	10.7	3%	9.3	3%
SO_2	Annual	1.9	2%	1.8	2%
PM_{10}	24 hours	41.8	28%	30.5	20%
$PM_{2.5}$	24 hours	13.0	37%	7.5	21%
$PM_{2.5}$	Annual	2.7	30%	1.6	18%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-22. Near-field Cumulative Impacts During Developmental Drilling With Typical Flare Activity

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,591.2	29%	10,326.8	26%
CO	8 hours	4,321.5	43%	3,442.9	34%
NO_2	1 hour	157.9	84%	41.2	22%
NO_2	Annual	28.6	29%	4.0	4%
SO_2	1 hour	34.5	18%	13.2	7%
SO_2	3 hours	36.5	3%	13.7	1%
SO_2	24 hours	22.4	6%	9.9	3%
SO_2	Annual	2.7	3%	1.8	2%
PM_{10}	24 hours	84.2	56%	10.9	7%
$PM_{2.5}$	24 hours	29.3	84%	7.7	22%

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
$PM_{2.5}$	Annual	6.1	68%	1.7	19%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-23. Near-field Cumulative Impacts During Developmental Drilling with Emergency Flare Activity

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,591.2	29%	10,330.6	26%
CO	8 hours	4,321.5	43%	3,444.7	34%
NO_2	1 hour	157.9	84%	41.2	22%
NO_2	Annual	28.6	29%	4.0	4%
SO_2	1 hour	34.5	18%	13.2	7%
SO_2	3 hours	36.5	3%	13.7	1%
SO_2	24 hours	22.4	6%	9.9	3%
SO_2	Annual	2.7	3%	1.8	2%
PM_{10}	24 hours	84.2	56%	10.9	7%
$PM_{2.5}$	24 hours	29.3	84%	7.7	22%
$PM_{2.5}$	Annual	6.1	68%	1.7	19%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-24. Near-field Cumulative Impacts During Routine Operations with Typical Flare Activity

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,591.0	29%	10,326.5	26%
CO	8 hours	4,350.7	44%	3,442.6	34%
NO_2	1 hour	162.1	86%	40.5	22%
NO_2	Annual	28.6	29%	4.0	4%
SO_2	1 hour	34.5	18%	13.2	7%
SO_2	3 hours	36.5	3%	13.7	1%
SO_2	24 hours	22.4	6%	9.9	3%
SO_2	Annual	2.7	3%	1.8	2%
PM_{10}	24 hours	83.1	55%	10.9	7%
$PM_{2.5}$	24 hours	29.5	84%	7.7	22%
$PM_{2.5}$	Annual	6.2	69%	1.7	19%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-25. Near-field Cumulative Impacts During Routine Operations with Emergency Flare Activity

Pollutant	Averaging Period	Total Concentration in Model Domain (µg/m³)	Percent of NAAQS/ AAAQS	Total Concentration at Nearby Community (µg/m³)	Percent of NAAQS/ AAAQS
CO	1 hour	11,591.0	29%	10,326.5	26%
CO	8 hours	4,350.7	44%	3,442.6	34%
NO_2	1 hour	162.1	86%	40.5	22%
NO_2	Annual	28.6	29%	4.0	4%
SO_2	1 hour	34.5	18%	13.2	7%
SO_2	3 hours	36.5	3%	13.7	1%
SO_2	24 hours	22.4	6%	9.9	3%
SO_2	Annual	2.7	3%	1.8	2%
PM_{10}	24 hours	83.1	55%	10.9	7%
$PM_{2.5}$	24 hours	29.5	84%	7.7	22%
$PM_{2.5}$	Annual	6.2	69%	1.7	19%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m^3 = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; NAAQS and AAAQS are the same for all pollutants except for 24-hour and annual SO_2 which do not have defined NAAQS. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-26. Near-field Impacts from Emergency Flaring Only During Routine Operations

Pollutant	Averaging Period	Maximum Modeled Concentration in Model Domain (µg/m^3)	Percent of Total Concen-tration	Maximum Modeled Concentration at Nearby Community (µg/m^3)	Percent of Total Concen-tration
CO	1 hour	124.0	1%	26.8	0%
CO	8 hours	33.7	1%	8.1	0%
NO_2	1 hour	8.9	6%	2.9	7%
NO_2	Annual	1.1E-04	0.0004%	3.0E-05	0.0008%
SO_2	1 hour	1.2	4%	0.3	3%
SO_2	3 hours	1.2	3%	0.3	2%
SO_2	24 hours	0.3	1%	0.1	1%
SO_2	Annual	1.0E-05	0.0004%	3.0E-06	0.0002%
PM_{10}	24 hours	0.7	1%	0.2	2%
$PM_{2.5}$	24 hours	3.8E-01	1%	0.1	1%
$PM_{2.5}$	Annual	4.0E-05	0.001%	1.0E-05	0.001%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m^3 = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; Maximum modeled concentration is from emergency flaring only. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-27. Near-field Impacts from Reasonably Foreseeable Future Action (RFFA) Sources Only During Routine Operations

Pollutant	Averaging Period	Maximum Modeled Concentration in Model Domain (µg/m³)	Percent of Total Concen-tration	Maximum Modeled Concentration at Nearby Community (µg/m³)	Percent of Total Concen-tration
CO	1 hour	352.3	3%	23.6	0.2%
CO	8 hours	237.5	5%	8.1	0.2%
NO_2	1 hour	65.2	41%	13.9	34%
NO_2	Annual	4.3	15%	0.1	3%
SO_2	1 hour	25.5	74%	4.2	32%
SO_2	3 hours	26.4	73%	3.7	27%
SO_2	24 hours	13.0	58%	0.6	6%
SO_2	Annual	0.9	32%	1.1E-02	0.6%
PM_{10}	24 hours	5.0	6%	0.5	4%
$PM_{2.5}$	24 hours	3.4	11%	0.2	2%
$PM_{2.5}$	Annual	0.4	7%	9.0E-03	0.5%

Source: BLM (2023)

Notes: NAAQS = National Ambient Air Quality Standards; AAAQS = Alaska Ambient Air Quality Standards; µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; Maximum modeled concentration is from RFFA sources only. Total concentration includes the maximum modeled concentration in the form of the NAAQS/AAAQS plus the background concentration. PM_{10} and $PM_{2.5}$ total concentrations also include secondary $PM_{2.5}$ impacts from CAMx modeling.

Table 1-28. Hazardous Air Pollutant (HAP) Thresholds

Pollutant	Acute REL (µg/m3)	AEGLs (µg/m3)	RfC (µg/m3)	Cancer Unit Risk Factor Thresholds (1/(µg/m3))
Benzene	27	29,000	30.0	7.80E-06
Ethylbenzene	--	140,000	260.0	2.50E-06
Formaldehyde	55	1,100	9.8	1.30E-05
n-Hexane	--	10,000,000	700.0	--
Toluene	5,000	250,000	5,000.0	--
Xylene	22,000	560,000	100.0	--

Source: EPA 2021a; EPA 2021b

Notes: REL = Reference Exposure Limit; AEGL = Acute Exposure Guideline Level; RfC = non-cancer reference concentration; µg/m³ = micrograms per cubic meter;

Table 1-29. Near-field Cumulative HAPs Impacts During Routine Operations with Typical Flare Activity

Pollutant	Max 1-hour Modeled Conc. In Model Domain (µg/m³)	Max 8-hour Modeled Conc. In Model Domain (µg/m³)	Max Annual Modeled Conc. In Model Domain (µg/m³)	Max 1-hour Modeled Conc. At Nearby Community (µg/m³)	Max 8-hour Modeled Conc. At Nearby Community (µg/m³)	Max Annual Modeled Conc. At Nearby Community (µg/m³)
Benzene	9.9	7.0	0.3	0.8	0.1	0.002
Ethylbenzene	258.4	181.1	6.8	0.7	0.3	0.014
Formaldehyde	5.9	4.2	0.2	1.0	0.3	0.004
n-Hexane	632.2	443.1	16.7	3.3	0.7	0.040
Toluene	29.1	20.4	0.8	0.3	0.04	0.002
Xylene	508.9	356.7	13.4	1.3	0.6	0.028

Source: BLM (2023)

Notes: HAPs = Hazardous Air Pollutants; µg/m^3 = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area

Table 1-30. Near-field Cumulative HAPs Impacts During Routine Operations with Emergency Flare Activity

Pollutant	Max 1-hour Modeled Conc. In Model Domain (µg/m³)	Max 8-hour Modeled Conc. In Model Domain (µg/m³)	Max Annual Modeled Conc. In Model Domain (µg/m³)	Max 1-hour Modeled Conc. At Nearby Community (µg/m³)	Max 8-hour Modeled Conc. At Nearby Community (µg/m³)	Max Annual Modeled Conc. At Nearby Community (µg/m³)
Benzene	9.9	7.0	0.3	0.8	0.1	0.002
Ethylbenzene	258.4	181.1	6.8	0.7	0.3	0.014
Formaldehyde	46.2	11.2	0.2	6.9	4.1	0.004
n-Hexane	632.2	443.1	16.7	4.2	2.5	0.040
Toluene	29.1	20.4	0.8	0.3	0.1	0.002
Xylene	508.9	356.7	13.4	1.3	0.6	0.028

Source: BLM (2023)

Notes: HAPs = Hazardous Air Pollutants; µg/m^3 = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area

Table 1-31. Estimated Cancer Risk at a Nearby Community Due to Routine Operations Activity

Pollutant	Exposure Adjustment Factor	Max Annual Modeled Conc., Typical Flare Activity (µg/m³)	Cancer Risk, Typical Flare Activity	Max Annual Modeled Conc., Emergency Flare Activity (µg/m³)	Cancer Risk, Emergency Flare Activity
Benzene	4.30E-01	1.58E-03	5.30E-09	1.58E-03	5.30E-09
Ethylbenzene	4.30E-01	1.40E-02	1.70E-09	1.40E-02	1.70E-09
Formaldehyde	4.30E-01	3.62E-03	8.83E-09	3.65E-03	8.83E-09
		Total:	1.58E-08	Total:	1.58E-08

Source: BLM (2023)

Notes: µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area

Table 1-32. Near-field HAPs Impacts from Emergency Flaring Only During Routine Operations

Pollutant	Max 1-hour Modeled Conc. In Model Domain (µg/m³)	Max 8-hour Modeled Conc. In Model Domain (µg/m³)	Max Annual Modeled Conc. In Model Domain (µg/m³)	Max 1-hour Modeled Conc. At Nearby Community (µg/m³)	Max 8-hour Modeled Conc. At Nearby Community (µg/m³)	Max Annual Modeled Conc. At Nearby Community (µg/m³)
Benzene	1.7	0.4	4.7E-06	0.2	0.1	1.3E-06
Ethylbenzene	0.1	0.02	2.7E-07	0.01	0.01	8.0E-08
Formaldehyde	46.2	11.2	1.3E-04	6.9	4.1	4.0E-05
n-Hexane	27.9	6.8	8.0E-05	4.2	2.5	2.0E-05
Toluene	1.5	0.4	4.2E-06	0.2	0.1	1.2E-06
Xylene	0.4	0.1	1.2E-06	0.1	0.04	3.4E-07

Source: BLM (2023)

Notes: µg/m³ = micrograms per cubic meter; The nearby community is approximately 25 miles from the Willow project area; Maximum modeled concentration is from emergency flaring only.

1.3 Supporting Information for Cumulative Impacts

Emissions for reasonably foreseeable present and future onshore oil and gas projects are quantified, where information is available, and included in the cumulative effects analysis. Applicable RFFA emissions in tons per year for oil and gas exploration, development, and production are presented in Table 1-33. Alpine CD-5 expansion project emissions are estimated using tons of pollutant per million barrels of oil (tons/MMBO) emission factors multiplied by the estimated barrels of oil per day. Daily emissions are then multiplied by 365 to get an annual total. The emission factors are estimated based on the Willow Project Alternative E (BLM 2023). Greater Mooses Tooth 1 and Greater Mooses Tooth 2 emissions are based on potential-to-emit (PTE) for stationary sources, as provided in their respective permit applications (Hirsch 2021). Willow emissions are obtained and presented for the selected Alternative E peak year (year 7) annual emissions prepared by BLM (2023). Nanushuk (Pikka) emissions are based on the maximum PTE emissions during overlapping

drilling and operations phases (USACE 2018). The Alaska LNG project emissions are based on potential impact of construction emissions as estimated in the FSEIS prepared by the U.S. Department of Energy (2023). Nuna Drill Site 3T project emissions are estimated using tons per acre (tons/acre) emission factors multiplied by the estimated project acreage. Liberty Development and Project Plan emissions are obtained from the Liberty Development and Project Plan Final Environmental Impact Statement (BOEM 2018). Northstar Development Project emissions are based on Title V operating permit for the Northstar Production Facility (ADEC 2023). Endicott Project emissions are based on the Minor – Source Specific permit maximum PTE emissions for construction and drilling operations (ADEC 2023).

Table 1-33. Emissions from Selected Reasonably Foreseeable Future Oil and Gas Projects Included in the Cumulative Effects Analysis.

Pollutant	Alpine CD-5 (tpy)	Greater Mooses Tooth 1 (tpy)[1]	Greater Mooses Tooth 2 (tpy)[2]	Willow (tpy)[3]	Nanushuk (tpy)[4]	Alaska LNG Project (tpy)[5]	Nuna Drill Site 3T (tpy)	Liberty Development and Project Plan (tpy)	Northstar Development Project (tpy)	Endicott Project (tpy)
NOx	435.8	74.6	67.9	835.0	1,089	7,591	3.2	--	584.7	3,370.5
CO	417.2	67.0	63.3	839.9	1,108	4,184	1.2	--	1,442	922.4
VOC	29.9	98.7	72	599.1	126.6	1,687	0.5	--	583.1	102.5
PM_{10}	145.1	4.49	4.3	545.7	52.2	1,101	0.2	--	62.0	60.1
$PM_{2.5}$	52.4	4.49	4.3	126.9	52.5	665	0.2	--	62.0	60.1
SO_2	340.4	5.7	5.8	54.9	267.2	2,160	0.0	--	206.4	537.2
CO_2	555,959	--	--	1,027,703	--	--	--	--	--	--
CH_4	205.0	--	--	356.2	--	--	--	--	--	--
N_2O	1.3	--	--	2.4	--	--	--	--	--	--
CO_2e	573,227	--	--	1,057,755	638,852	--	--	517,325	1,106,050	--
Total HAPs	43.2	0.8	8.5	73.8	5.95	--	0.2	--	21.7	--
Benzene	0.6	--	0.2	1.3	--	--	--	--	--	--
Toluene	1.4	--	0.2	2.6	--	--	--	--	--	--
Ethyl-Benzene	5.6	--	0.0	8.6	--	--	--	--	--	--
Xylene	11.2	--	0.0	17.2	--	--	--	--	--	--
n-Hexane	17.1	--	3.6	28.6	--	--	--	--	--	--
Formaldehyde	7.2	--	4.5	15.5	--	--	--	--	--	--

Source: ConocoPhillips Alaska (2019),[1] Hirsch (2021)[2], BLM (2023)[3], USACE (2018)[4], U.S. Department of Energy (2023)[5]

Note: Total HAPs is based on the sum of the six individual HAPs listed

CO2e values are based on the IPCC Sixth Assessment 20-year GWP

CO2e value for previously published Nanushuk EIS is based on IPCC Fifth Assessment 20-year GWP

The additional RFFAs listed in Appendix G of the SEIS (e.g., Greater Prudhoe Bay/Kuparuk, Arctic Strategic Transportation and Resources, and Endicott Project) would also result in emissions of GHGs that would contribute to climate change as well as criteria and hazardous air pollutants that would affect ambient air concentrations and air quality related values.

The near-field modeling tiering is described in Section 1.2.3 for a large hypothetical development in the North Slope including both project sources and other RFFA sources within approximately 50 kilometers of the development. Therefore, the results shown in Table 1-24 and Table 1-29 are representative of cumulative near-field criteria and hazardous air pollutant impacts.

The regional photochemical modeling discussed in Section 1.2.2 includes emissions from both hypothetical oil and gas developments in the program area as well as other cumulative sources within the modeling domain (Figure 1-10). This includes current and future anthropogenic onshore sources (e.g., oil and gas production and exploration, airports, pipelines, and non-oil and gas-related stationary and mobile sources) and offshore sources (e.g., drilling rigs, survey/drilling vessels and aircraft, and commercial vessels) as well as natural sources (e.g., sea salt, wildfire). The effects of long-range transport are also accounted for through the use of boundary conditions (background concentrations).

Modeled cumulative impacts on regional air quality and AQRVs are discussed in Section 1.2.2.6 and spatial maps are provided in Appendix A. In summary, the modeled cumulative air quality concentrations for all criteria pollutants are below the NAAQS and AAAQS in the program area, Kaktovik, nearby Class II areas, and across the entire modeling domain under both the hypothetical high and low development scenarios. There is a modeled exceedance of the annual $PM_{2.5}$ NAAQS approximately 320 miles west of the program area near Wainwright, Alaska with a modeled impact of 0.001 $\mu g/m^3$ due to the hypothetical oil and gas development in program area. Therefore, the contribution of program area development to the exceedance is very low. The cumulative nitrogen deposition impacts under both hypothetical development scenarios are below the range of critical loads (1.0 to 3.0 kg N/ha-yr) in the Arctic National Wildfire Refuge (excluding the program area) and Gates of the Arctic and within the range of critical loads in the program area. The modeled maximum cumulative sulfur deposition impacts in the program area and nearby Class II areas range from 0.6 to 0.7 kg S/ha-yr while average sulfur deposition impacts range from 0.3 to 0.4 kg S/ha-yr. Potential visibility impacts in Denali National Park (the closest Class I area to the program area) from hypothetical oil and gas developments in the program area were assessed using modeled impacts at Gates of the Arctic as a surrogate, as it is the closest area to Denali within the modeling domain. The modeling indicates that cumulative visibility impairment in Denali National Park would potentially increase in the future due to the impacts from oil and gas development shown in Table 1-17 and Table 1-18. The visibility impacts at Denali NP would be lower than those shown as it is farther away than Gates of the Arctic from any oil and gas development that would occur in the program area.

2.0 Greenhouse Gases and Climate Change

2.1 Supporting Information for Affected Environment

2.1.1 Wind Rose from Kaktovik Ambient Air Monitoring Project (KAAMP) station

The Bureau of Land Management (BLM) Kaktovik Ambient Air Monitoring Project (KAAMP) station, a new monitoring station in Kaktovik, began collecting meteorology data in October 2021. The annual wind rose adapted from the Kaktovik, Alaska Ambient Air Monitoring Station: Annual Data Summary Report for October 15, 2021–September 30, 2022, is shown in Figure 3-1 (BLM 2022). Winds are primarily out of the east and the west.

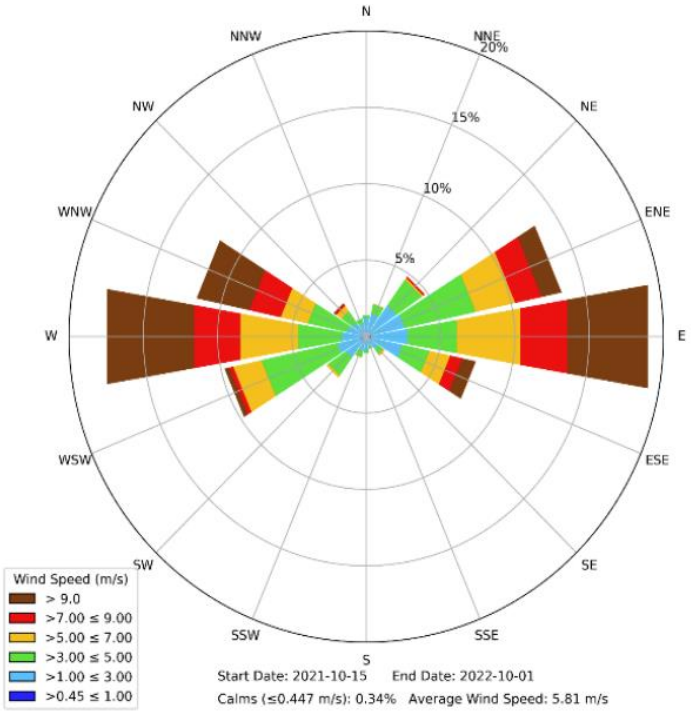


Figure 2-1. Wind rose showing historical wind observations on data collected at the Kaktovik Ambient Air Monitoring Project (KAAMP) station from October 2021 to September 2022.

2.1.2 Global Warming Potentials

GHGs differ in how effectively they absorb energy (radiative efficiency) and how long they stay in the atmosphere (atmospheric lifetime). Thus, the emission of the same mass of two different GHGs will result in different amounts of radiative forcing (i.e., the difference between the amount of incoming solar radiation and the amount of outgoing radiation) over a given period. Global warming potentials (GWPs) were developed to account for differences in the warming impacts of individual GHGs relative to CO_2. GWP is a measure of how much energy the emission of a given mass (e.g., 1 metric ton) of a GHG will absorb over a period of time relative to the emission of the same mass of CO_2. Thus, by definition, CO_2 has a GWP of 1 for all time periods. The GWPs of CH_4 and N_2O are estimated to be 29.8 and 273 over a 100-year time horizon, respectively, according to the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC 2021). This means that a metric ton of CH_4 has approximately 29.8 times the GWP of a metric ton of CO_2 over a 100-year period. Over a 20-year period, the GWP of CH_4 is higher (i.e., 82.5) than the 100-year time

horizon because the average atmospheric lifetime of CH_4 is approximately 12 years while CO_2 can remain in the atmosphere for hundreds of years (IPCC 2021). Thus, the warming effect of CH_4 is stronger in the short term relative to CO_2 and diminishes over time as it is removed from the atmosphere.

Carbon dioxide equivalents (CO_2e) are calculated by multiplying the emitted mass of each GHG by its GWP. The analysis presents emissions in CO_2e using both the 100-year and 20-year GWPs. The 20-year CO_2e is included to estimate the shorter-term impacts of CH_4. Table 3-1 shows the 100-year and 20-year time horizon GWPs adapted from IPCC AR6 (IPCC 2021).

Table 2-1. 100-year and 20-year global warming potentials.

Time horizon	CO_2	CH_4*	N_2O
100 Year	1	29.8	273
20 Year	1	82.5	273

Source: IPCC 2021
Note:
* IPCC provides different GWP estimates for CH_4 depending on whether or not the source originates from fossil carbon. The fossil GWPs are used for CH_4 here and are higher than the non-fossil values as they account for the indirect radiative forcing caused by impacts to the carbon cycle.

2.2 Supporting Information for Environmental Consequences

Annual GHG emissions are estimated for the hypothetical development scenarios described in the RFD document (Appendix B of the SEIS) for each action alternative. Emissions are estimated for construction, drilling, routine operations, well workovers and interventions, diesel shipments to developments, and personnel transport as well as for the transportation, processing, and downstream combustion of produced oil. As noted in the RFD scenario, any produced natural gas is expected to be reinjected into producing oil formations. For this reason, natural gas emissions are accounted for in the development and production emissions but not in the transportation, processing, and downstream combustion emissions.

Descriptions of methods applied and the estimated annual emissions of CO_2, CH_4, and N_2O from development and production and transportation, processing, and downstream combustion are provided in Section 2.2.1 and Section 2.2.2, respectively. Emissions are also presented as 100-year and 20-year CO_2e using GWPs from IPCC AR6 (see Section 2.1.2).

2.2.1 GHG Emissions from Oil and Gas Development and Production in the Program Area

Annual emissions from construction, development, and production activities under each action alternative are estimated using annual oil production from the RFD scenario (Appendix B of the SEIS) and annual emission rates per unit of oil production developed using emissions data from the Willow Master Development Plan Final SEIS (BLM 2023). Consistent with the oil and gas emission inventory for Alternative E in the Willow Master Development Plan Final SEIS (BLM 2023), six years of pre-development construction emissions were assumed prior to which no construction associated activities are assumed to occur. A more detailed description of the approaches used to develop the oil and gas emissions for the RFD scenarios is provided in Section 1.2.1.

Annual GHG emissions for commuting of personnel from Anchorage to the North Slope by aircraft and shipments of diesel fuel via barge, rail and truck to the developments are also estimated using a similar methodology. Emission rates are developed using data from the

oil and gas emission inventory for Alternative E of the Willow Master Development Plan Final SEIS (BLM 2023). A detailed description of the methods originally used to estimate these emissions in the Willow project is provided in Appendix E.2A of BLM (2023). For each hypothetical development, annual air travel and diesel shipment emissions for each development year are estimated as the product of the associated Willow Alterative E annual emissions per barrel and the annual oil production from the RFD scenario for each action alternative.

The annual GHG emissions from development and production activities under Alternative B, Alternative C, Alternative D, and Alternative D2 are provided in Table 2-2, Table 2-3,

Table 2-4, and Table 2-5, respectively.

Table 2-2. Annual Greenhouse Gases Emissions (in metric tons) from Oil and Gas Development and Production under Alternative B

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	1,523	0.04	0.00	1,524	1,527
5	70,563	2.64	0.42	70,755	70,894
6	69,012	2.69	0.43	69,210	69,352
7	86,443	3.31	0.46	86,668	86,842
8	141,121	11.18	0.87	141,693	142,282
9	224,472	42.00	0.83	225,951	228,164
10	143,639	43.70	0.35	145,035	147,338
11	324,849	90.80	1.02	327,834	332,619
12	611,056	194.97	1.67	617,323	627,598
13	684,114	215.76	1.83	691,042	702,413
14	790,850	242.19	2.36	798,711	811,474
15	901,113	284.71	2.29	910,223	925,228
16	843,239	294.65	1.86	852,527	868,055
17	1,054,299	352.46	2.60	1,065,511	1,084,086
18	1,367,032	466.14	3.31	1,381,825	1,406,391
19	1,452,502	491.39	3.49	1,468,097	1,493,993
20	1,558,072	517.40	4.02	1,574,587	1,601,854
21	1,684,972	565.89	3.99	1,702,924	1,732,746
22	1,638,335	580.36	3.58	1,656,607	1,687,192
23	1,868,331	666.11	4.09	1,889,297	1,924,401
24	2,284,095	793.74	5.27	2,309,187	2,351,018
25	2,441,741	851.83	5.63	2,468,663	2,513,554
26	2,550,055	904.11	5.87	2,578,599	2,626,246
27	2,719,103	956.43	6.45	2,749,365	2,799,769
28	2,861,477	1,009.12	6.53	2,893,332	2,946,513
29	2,913,985	1,060.06	6.34	2,947,306	3,003,171

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
30	3,099,885	1,131.30	6.76	3,135,442	3,195,062
31	3,616,166	1,317.53	7.89	3,657,583	3,727,016
32	3,602,576	1,313.55	7.86	3,643,867	3,713,091
33	3,770,734	1,393.44	8.24	3,814,506	3,887,940
34	3,876,432	1,435.17	8.38	3,921,489	3,997,123
35	3,903,952	1,448.31	8.44	3,949,417	4,025,743
36	3,886,892	1,444.05	8.41	3,932,220	4,008,321
37	4,043,871	1,504.00	8.75	4,091,078	4,170,339
38	3,912,199	1,458.28	8.46	3,957,967	4,034,819
39	3,936,221	1,469.01	8.52	3,982,322	4,059,739
40	3,952,408	1,476.02	8.55	3,998,728	4,076,515
41	3,823,450	1,430.76	8.27	3,868,345	3,943,746
42	3,773,725	1,415.92	8.17	3,818,148	3,892,767
43	3,790,865	1,426.72	8.20	3,835,621	3,910,809
44	3,654,671	1,377.56	7.91	3,697,881	3,770,478
45	3,603,115	1,361.01	7.80	3,645,802	3,717,527
46	3,610,115	1,366.95	7.81	3,652,984	3,725,022
47	3,434,142	1,301.48	7.43	3,474,955	3,543,543
48	3,270,887	1,240.72	7.08	3,309,793	3,375,179
49	3,116,170	1,183.05	6.75	3,153,266	3,215,613
50	3,083,351	1,172.60	6.68	3,120,116	3,181,912
51	2,836,683	1,078.79	6.14	2,870,507	2,927,359
52	2,731,897	1,039.99	5.91	2,764,504	2,819,311
53	2,653,817	1,011.42	5.75	2,685,526	2,738,828
54	2,441,512	930.51	5.29	2,470,684	2,519,722
55	2,246,191	856.07	4.86	2,273,030	2,318,144
56	2,066,496	787.58	4.47	2,091,187	2,132,693
57	1,901,176	724.58	4.12	1,923,892	1,962,077
58	1,749,082	666.61	3.79	1,769,981	1,805,111
59	1,609,155	613.28	3.48	1,628,382	1,660,702
60	1,480,423	564.22	3.21	1,498,112	1,527,846
61	1,361,989	519.08	2.95	1,378,263	1,405,618
62	1,253,030	477.55	2.71	1,268,002	1,293,169
63	1,152,788	439.35	2.50	1,166,562	1,189,715
64	1,060,565	404.20	2.30	1,073,237	1,094,538
65	975,719	371.87	2.11	987,378	1,006,975
66	897,662	342.12	1.94	908,388	926,417
67	825,849	314.75	1.79	835,717	852,304
68	759,781	289.57	1.65	768,859	784,119
69	698,999	266.40	1.51	707,350	721,390
Total	**138,750,633**	**51,009.07**	**308**	**140,354,891**	**143,043,069**

Table 2-3. Annual Greenhouse Gases Emissions (in metric tons) from Oil and Gas Development and Production under Alternative C

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	1,523	0.04	0.00	1,524	1,527
5	70,563	2.64	0.42	70,755	70,894
6	69,012	2.69	0.43	69,210	69,352
7	86,443	3.31	0.46	86,668	86,842
8	141,121	11.18	0.87	141,693	142,282
9	224,472	42.00	0.83	225,951	228,164
10	143,639	43.70	0.35	145,035	147,338
11	324,849	90.80	1.02	327,834	332,619
12	611,056	194.97	1.67	617,323	627,598
13	684,114	215.76	1.83	691,042	702,413
14	790,850	242.19	2.36	798,711	811,474
15	901,113	284.71	2.29	910,223	925,228
16	843,239	294.65	1.86	852,527	868,055
17	1,054,299	352.46	2.60	1,065,511	1,084,086
18	1,367,032	466.14	3.31	1,381,825	1,406,391
19	1,452,502	491.39	3.49	1,468,097	1,493,993
20	1,558,072	517.40	4.02	1,574,587	1,601,854
21	1,684,972	565.89	3.99	1,702,924	1,732,746
22	1,638,335	580.36	3.58	1,656,607	1,687,192
23	1,865,254	666.03	4.09	1,886,217	1,921,317
24	2,211,190	791.01	4.84	2,236,084	2,277,771
25	2,372,612	849.13	5.20	2,399,336	2,444,086
26	2,461,197	880.80	5.40	2,488,918	2,535,337
27	2,575,394	923.81	5.56	2,604,442	2,653,127
28	2,634,328	944.95	5.69	2,664,041	2,713,840
29	2,769,079	993.29	5.98	2,800,313	2,852,659
30	2,841,153	1,019.14	6.14	2,873,200	2,926,908
31	3,068,839	1,100.81	6.63	3,103,454	3,161,467
32	3,001,854	1,076.78	6.49	3,035,713	3,092,460
33	3,115,592	1,117.58	6.73	3,150,734	3,209,630
34	3,194,156	1,145.76	6.90	3,230,184	3,290,566
35	3,198,303	1,147.25	6.91	3,234,378	3,294,838
36	3,151,158	1,130.34	6.81	3,186,701	3,246,270
37	3,281,153	1,176.97	7.09	3,318,162	3,380,189
38	3,136,877	1,125.22	6.78	3,172,259	3,231,558

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
39	3,161,799	1,134.16	6.83	3,197,461	3,257,231
40	3,161,197	1,133.94	6.83	3,196,853	3,256,612
41	3,019,353	1,083.06	6.52	3,053,409	3,110,486
42	2,884,351	1,034.63	6.23	2,916,884	2,971,410
43	2,869,252	1,029.22	6.20	2,901,616	2,955,855
44	2,639,712	946.88	5.70	2,669,486	2,719,387
45	2,550,219	914.78	5.51	2,578,984	2,627,193
46	2,486,138	891.79	5.37	2,514,180	2,561,177
47	2,287,247	820.45	4.94	2,313,046	2,356,283
48	2,104,267	754.81	4.55	2,128,002	2,167,781
49	1,935,926	694.43	4.18	1,957,762	1,994,358
50	1,781,052	638.87	3.85	1,801,141	1,834,810
51	1,638,568	587.76	3.54	1,657,050	1,688,025
52	1,507,482	540.74	3.26	1,524,486	1,552,983
53	1,386,884	497.48	3.00	1,402,527	1,428,744
54	1,275,933	457.69	2.76	1,290,325	1,314,445
55	1,173,858	421.07	2.54	1,187,099	1,209,289
56	1,079,950	387.38	2.33	1,092,131	1,112,546
57	993,554	356.39	2.15	1,004,760	1,023,542
58	914,069	327.88	1.97	924,379	941,659
59	840,944	301.65	1.82	850,429	866,326
60	773,668	277.52	1.67	782,395	797,020
61	711,775	255.32	1.54	719,803	733,258
62	654,833	234.89	1.41	662,219	674,598
63	602,446	216.10	1.30	609,241	620,630
Total	**102,959,824**	**36,430.11**	**229**	**104,107,852**	**106,027,718**

Table 2-4. Annual Greenhouse Gases Emissions (in metric tons) from Oil and Gas Development and Production under Alternative D

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	1,523	0.04	0.00	1,524	1,527
5	70,563	2.64	0.42	70,755	70,894
6	69,012	2.69	0.43	69,210	69,352
7	86,443	3.31	0.46	86,668	86,842
8	141,121	11.18	0.87	141,693	142,282
9	224,472	42.00	0.83	225,951	228,164
10	142,115	43.66	0.35	143,511	145,812
11	258,946	88.30	0.61	261,744	266,398

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
12	549,072	192.53	1.27	555,157	565,303
13	598,020	212.47	1.37	604,724	615,921
14	656,972	291.02	1.51	666,057	681,393
15	684,406	307.04	1.49	693,963	710,144
16	707,629	317.46	1.54	717,510	734,241
17	737,821	331.01	1.61	748,124	765,568
18	764,651	343.04	1.67	775,329	793,407
19	777,206	348.67	1.69	788,059	806,434
20	776,028	348.15	1.69	786,864	805,211
21	792,855	355.70	1.73	803,926	822,671
22	805,762	361.49	1.76	817,014	836,064
23	891,635	400.01	1.94	904,085	925,166
24	923,649	414.37	2.01	936,547	958,385
25	1,018,106	456.75	2.22	1,032,322	1,056,393
26	1,056,230	473.85	2.30	1,070,979	1,095,951
27	1,127,689	505.91	2.46	1,143,436	1,170,097
28	1,151,170	516.44	2.51	1,167,244	1,194,461
29	1,171,402	525.52	2.55	1,187,760	1,215,455
30	1,185,459	531.83	2.58	1,202,013	1,230,040
31	1,308,747	587.14	2.85	1,327,022	1,357,964
32	1,204,047	540.17	2.62	1,220,860	1,249,327
33	1,230,804	552.17	2.68	1,247,990	1,277,090
34	1,273,882	571.50	2.78	1,291,670	1,321,788
35	1,171,971	525.78	2.55	1,188,337	1,216,045
36	1,078,214	483.71	2.35	1,093,270	1,118,761
37	991,957	445.02	2.16	1,005,808	1,029,260
38	912,600	409.42	1.99	925,343	946,920
39	839,592	376.66	1.83	851,316	871,166
40	772,425	346.53	1.68	783,211	801,473
41	710,631	318.81	1.55	720,554	737,355
42	653,780	293.30	1.42	662,909	678,367
43	601,478	269.84	1.31	609,877	624,097
44	553,360	248.25	1.21	561,087	574,169
45	509,091	228.39	1.11	516,200	528,236
46	468,364	210.12	1.02	474,904	485,977
47	430,894	193.31	0.94	436,911	447,099
48	396,423	177.85	0.86	401,958	411,331
49	364,709	163.62	0.79	369,802	378,424
50	335,532	150.53	0.73	340,218	348,151
51	308,690	138.49	0.67	313,000	320,298
Total	**33,487,148**	**14,657.67**	**75**	**33,944,416**	**34,716,875**

Table 2-5. Annual Greenhouse Gases Emissions (in metric tons) from Oil and Gas Development and Production under Alternative D2

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	1,523	0	0	1,524	1,527
5	70,563	3	0	70,755	70,894
6	69,012	3	0	69,210	69,352
7	86,443	3	0	86,668	86,842
8	141,121	11	1	141,693	142,282
9	224,472	42	1	225,951	228,164
10	142,115	44	0	143,511	145,812
11	254,286	88	1	257,079	261,725
12	542,045	192	1	548,113	558,246
13	597,671	212	1	604,374	615,571
14	577,008	205	1	583,481	594,293
15	506,887	182	1	512,605	522,187
16	524,087	188	1	529,998	539,905
17	546,448	196	1	552,611	562,941
18	566,319	203	1	572,706	583,412
19	575,617	206	1	582,110	592,991
20	574,744	206	1	581,227	592,092
21	587,207	211	1	593,830	604,931
22	596,766	214	1	603,497	614,779
23	660,366	237	1	667,814	680,298
24	684,077	245	1	691,792	704,724
25	754,033	270	2	762,538	776,792
26	782,269	281	2	791,093	805,881
27	835,193	300	2	844,613	860,402
28	852,583	306	2	862,200	878,317
29	867,568	311	2	877,354	893,754
30	877,979	315	2	887,882	904,479
31	969,289	348	2	980,222	998,545
32	891,746	320	2	901,804	918,661
33	911,562	327	2	921,844	939,076
34	943,467	338	2	954,109	971,944
35	867,990	311	2	877,780	894,188
36	798,550	286	2	807,558	822,653
37	734,666	264	2	742,953	756,841
38	675,893	242	1	683,517	696,294

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
39	621,822	223	1	628,835	640,590
40	572,076	205	1	578,529	589,343
41	526,310	189	1	532,246	542,196
42	484,205	174	1	489,667	498,820
43	445,469	160	1	450,493	458,914
44	409,831	147	1	414,454	422,201
45	377,045	135	1	381,297	388,425
46	346,881	124	1	350,794	357,351
47	319,131	114	1	322,730	328,763
48	293,600	105	1	296,912	302,462
Total	**24,687,935**	**8,688.54**	**55**	**24,961,973**	**25,419,859**

2.2.2 GHG Emissions from Transportation, Processing, and Downstream Combustion of Oil from the Program Area

Annual GHG emissions from the transportation, processing, and downstream combustion of oil produced in the program area are estimated using the Bureau of Ocean Energy Management's (BOEM's) 2022 Greenhouse Gas Life Cycle Energy Emissions Model (GLEEM; Wolvovsky 2022) with updates. GLEEM estimates emissions from domestic processing, storage, transportation, and downstream combustion using U.S. national emissions data and emission factors from EPA (2023d, 2023e) and national fossil fuel throughput and consumption data from the Energy Information Administration (EIA 2023). A description of the model's capabilities and methodology can be found in Wolvovsky (2022). The 2022 version of GLEEM was downloaded from BOEM's website[2] and updated as follows:

- Input data are updated to use a 5-year average of recent years (2017-2021) instead of a single year.

- The national emission rates used in the standard release of GLEEM for crude oil refining are from the 'Petroleum Systems' source category of the EPA (2022a) national GHG inventory. This category excludes all combustion emissions of CO_2 from refineries except for flaring; these emissions are included in the industrial sector emissions of the Fossil Fuel Combustion source category instead. GLEEM was updated to use the total U.S. refinery GHG emissions reported under the GHGRP (Subpart Y of 40 CFR 98) and published by EPA (2022b). The emissions reported under GHGRP include both stationary fuel combustion emissions as well as process emissions from flares, vents, blowdowns, leaks, and other sources. Thus, this allows for a more comprehensive accounting of refinery emissions.

- GLEEM was updated to assume all oil from the program area is combusted. GLEEM accounts for the portion of fuels that are used in non-combustible products (e.g., fertilizer and plastics) and not combusted. Assuming that all oil is combusted results in a conservatively high estimate of combustion emissions.

[2] https://www.boem.gov/environment/greenhouse-gas-life-cycle-energy-emissions-model#:~:text=GLEEM%20is%20a%20Linux%2Dbased,contact%20boemgleem%40boem.gov.

As discussed in the RFD scenario report (Appendix B of the SEIS), it is expected that production pipelines would be constructed to connect developments in the program area to the Trans-Alaska Pipeline System (TAPS), which transports oil from the North Slope to the Valdez Marine Terminal in southern Alaska. Crude oil is then transported from the Valdez Marine Terminal to refineries in the US on polar tankers. Emissions from the transport of crude oil from the North Slope to U.S. refineries via the TAPS and polar tankers are estimated and added to the transportation emissions from GLEEM.

Emissions from the transport of crude oil produced in the program area through TAPS are estimated using the oil production under Alternatives B, C, D, and D2 and the historical emissions intensities (i.e., metric tons of CO_2, N_2O, and CH_4 emitted per million barrels of oil transported) of TAPS and the Valdez Marine Terminal. The emission intensities are estimated as the ratio of the average annual GHGs emissions reported for TAPS pump stations and the Valdez Marine Terminal in the EPA (2023c) Facility Level Information on Greenhouse Gases tool and the average annual TAPS throughput (Alyeska Pipeline Service Company 2023) from 2017 to 2021. The five-year average emissions intensities are then multiplied by the projected annual oil production under each action alternative to estimate the annual GHGs emissions from oil transportation through TAPS to Valdez.

Emissions intensities for the polar tanker transport are obtained from the Willow Final SEIS (BLM 2023) and applied to the annual oil production under each action alternative to estimate GHGs from the transport from Valdez Marine Terminal to US refineries. The emissions intensities used for transport through TAPS and on polar tankers are provided in Table 2-6.

Table 2-6. Greenhouse Gases Emissions Intensities (in metric tons per million barrels of oil) used for Crude Oil Transport

Type	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
Trans-Alaska Pipeline System	1,183.41	0.03	0.004	1,185	1,187
Polar Tanker Transport	3,250.00	2.53	0.146	3,365	3,499

Annual GHGs emissions from oil transportation and processing under Alternatives B, C, D, and D2 are provided in Table 2-7,
Table 2-8,
Table 2-9, and Table 2-10, respectively. Emissions from year 1 to year 7 are zero because production is not projected to start until year 8 (Appendix B of the SEIS).

Table 2-7. Annual Greenhouse Gases Emissions (in metric tons) from Oil Transportation and Processing under Alternative B

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
9	-	-	-	-	-
10	67,505	86.33	4.36	71,269	75,819
11	135,011	172.66	8.73	142,539	151,638
12	270,021	345.33	16.46	284,805	303,004
13	248,420	317.86	15.02	261,993	278,744
14	228,546	291.99	14.62	241,238	256,626
15	210,263	268.67	13.25	221,887	236,046
16	260,947	333.19	16.27	275,319	292,878
17	312,977	400.17	19.33	330,178	351,267
18	433,751	553.92	26.77	457,565	486,756
19	399,050	509.92	25.07	421,089	447,962
20	367,126	468.89	22.42	387,220	411,930
21	337,756	431.74	20.83	356,307	379,060
22	378,241	482.73	23.65	399,081	424,521
23	420,887	537.47	26.51	444,140	472,465
24	533,028	681.23	32.77	562,276	598,177
25	490,386	626.49	30.91	517,495	550,511
26	451,155	575.93	28.12	475,994	506,346
27	415,062	530.46	26.39	438,074	466,029
28	381,857	487.98	23.72	402,874	428,591
29	418,815	534.75	26.47	441,975	470,157
30	458,215	585.37	28.26	483,374	514,223
31	567,369	725.10	35.47	598,660	636,873
32	521,980	666.41	32.55	550,725	585,845
33	480,221	613.98	29.71	506,627	538,984
34	441,804	564.70	27.93	466,257	496,016
35	406,460	519.48	25.22	428,824	456,201
36	373,943	477.24	23.56	394,596	419,747
37	344,027	439.91	21.95	363,129	386,312
38	316,505	404.39	19.40	333,852	355,163
39	291,184	371.64	17.89	307,142	326,727
40	267,890	342.59	16.41	282,580	300,635
41	246,459	315.18	14.98	259,941	276,551
42	226,742	289.37	14.58	239,346	254,596
43	208,602	266.10	13.22	220,140	234,163
44	191,914	245.33	11.88	202,468	215,397
45	176,561	226.02	10.57	186,182	198,094
46	162,436	207.14	10.28	171,417	182,333
47	149,442	190.65	9.02	157,586	167,633
48	137,486	175.52	8.78	145,113	154,363
49	126,487	161.72	7.56	133,369	141,891

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
50	116,369	148.22	7.35	122,793	130,604
51	107,059	137.00	7.16	113,097	120,317
52	98,494	126.04	5.99	103,885	110,528
53	90,615	115.32	5.83	95,643	101,721
54	83,366	106.81	5.69	88,101	93,730
55	76,696	97.51	4.55	80,844	85,982
56	70,561	90.39	4.43	74,463	79,226
57	64,916	82.44	4.31	68,550	72,894
58	59,723	76.64	4.21	63,155	67,194
59	54,944	69.99	3.11	57,879	61,568
60	50,549	64.47	3.02	53,295	56,693
61	46,505	59.07	2.94	49,068	52,181
62	42,785	54.79	2.86	45,200	48,087
63	39,362	50.60	2.80	41,633	44,300
64	36,213	46.52	2.73	38,345	40,796
65	33,316	42.51	1.67	35,039	37,280
66	30,650	39.59	1.62	32,272	34,359
67	28,199	35.75	1.57	29,693	31,577
68	25,943	32.97	1.52	27,342	29,079
69	23,867	30.25	1.48	25,173	26,768
Total	**14,036,661**	**17,932**	**876**	**14,810,119**	**15,755,160**

Table 2-8. Annual Greenhouse Gases Emissions (in metric tons) from Oil Transportation and Processing under Alternative C

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	67,505	86.33	4.36	71,269	75,819
11	135,011	172.66	8.73	142,539	151,638
12	270,021	345.33	16.46	284,805	303,004
13	248,420	317.86	15.02	261,993	278,744
14	228,546	291.99	14.62	241,238	256,626
15	210,263	268.67	13.25	221,887	236,046
16	260,947	333.19	16.27	275,319	292,878

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
17	312,977	400.17	19.33	330,178	351,267
18	433,751	553.92	26.77	457,565	486,756
19	399,050	509.92	25.07	421,089	447,962
20	367,126	468.89	22.42	387,220	411,930
21	337,756	431.74	20.83	356,307	379,060
22	378,241	482.73	23.65	399,081	424,521
23	420,887	537.47	26.51	444,140	472,465
24	533,028	681.23	32.77	562,276	598,177
25	490,386	626.49	30.91	517,495	550,511
26	451,155	575.93	28.12	475,994	506,346
27	415,062	530.46	26.39	438,074	466,029
28	381,857	487.98	23.72	402,874	428,591
29	351,309	448.42	22.10	370,705	394,337
30	323,204	412.71	20.53	341,108	362,858
31	297,348	379.77	19.01	313,855	333,869
32	273,560	349.55	17.53	288,762	307,183
33	251,675	321.99	16.09	265,662	282,630
34	231,541	296.03	14.68	244,370	259,971
35	213,018	272.62	13.31	224,775	239,142
36	195,977	250.73	11.96	206,714	219,928
37	180,298	230.32	11.64	190,340	202,478
38	165,875	212.33	10.35	175,029	186,219
39	152,604	194.74	9.08	160,888	171,151
40	140,396	179.52	8.84	148,159	157,620
41	129,164	164.64	7.61	136,148	144,825
42	118,832	152.07	7.40	125,384	133,398
43	109,325	139.79	7.21	115,458	122,825
44	100,579	128.76	6.03	106,063	112,849
45	92,532	117.98	5.87	97,651	103,868
46	85,130	108.42	5.72	89,923	95,637
47	78,320	100.07	4.58	82,553	87,827
48	72,054	91.90	4.46	76,009	80,852
49	66,289	84.91	4.34	70,004	74,479
50	60,986	78.08	4.23	64,468	68,583
51	56,107	71.39	3.13	59,090	62,853
52	51,619	65.84	3.04	54,412	57,882
53	47,490	60.41	2.96	50,098	53,282
54	43,690	56.10	2.88	46,149	49,105
55	40,195	50.89	2.81	42,480	45,162
56	36,979	46.78	2.75	39,123	41,589
57	34,021	43.76	1.69	35,786	38,092

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
58	31,299	39.82	1.63	32,932	35,030
59	28,796	36.95	1.58	30,329	32,276
60	26,492	34.16	1.54	27,929	29,729
61	24,372	31.42	1.49	25,716	27,372
62	22,423	28.75	1.45	23,676	25,191
63	20,629	26.13	1.42	21,794	23,171
Total	**10,496,116**	**13,411**	**656**	**11,074,887**	**11,781,633**

Table 2-9. Annual Greenhouse Gases Emissions (in metric tons) from Oil Transportation and Processing under Alternative D

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	67,505	86.33	4.36	71,269	75,819
11	135,011	172.66	8.73	142,539	151,638
12	270,021	345.33	16.46	284,805	303,004
13	248,420	317.86	15.02	261,993	278,744
14	228,546	291.99	14.62	241,238	256,626
15	210,263	268.67	13.25	221,887	236,046
16	193,441	246.86	11.91	204,049	217,059
17	177,966	227.51	11.60	187,912	199,902
18	163,729	209.59	10.31	172,789	183,835
19	150,630	192.06	9.04	158,823	168,945
20	138,580	176.90	8.80	146,254	155,577
21	127,494	163.07	7.58	134,422	143,015
22	117,295	149.54	7.37	123,763	131,644
23	107,911	138.30	7.18	113,993	121,281
24	99,278	127.31	6.01	104,711	111,421
25	91,336	116.57	5.85	96,406	102,549
26	84,029	107.04	5.70	88,775	94,416
27	77,306	98.72	4.56	81,494	86,696
28	71,122	90.58	4.44	75,033	79,807
29	65,432	83.62	4.32	69,104	73,511
30	60,197	76.81	4.22	63,637	67,685

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
31	55,381	71.14	3.12	58,353	62,102
32	50,951	64.61	3.03	53,704	57,109
33	46,876	60.20	2.95	49,474	52,647
34	43,125	54.91	2.87	45,545	48,439
35	39,675	50.71	2.80	41,951	44,623
36	36,502	46.62	2.74	38,638	41,095
37	33,581	42.61	1.68	35,309	37,554
38	30,895	39.68	1.62	32,520	34,612
39	28,423	35.82	1.57	29,921	31,809
40	26,149	33.04	1.53	27,551	29,292
41	24,057	30.31	1.49	25,366	26,964
42	22,133	28.65	1.45	23,382	24,891
43	20,362	26.04	1.41	21,523	22,895
44	18,733	23.47	1.38	19,809	21,046
45	17,234	21.96	1.35	18,257	19,414
46	15,856	20.48	1.32	16,827	17,906
47	14,587	19.04	1.29	15,508	16,511
48	13,421	17.64	1.27	14,293	15,223
49	12,346	16.27	1.25	13,172	14,029
50	11,359	14.93	0.23	11,867	12,653
51	10,451	13.61	0.21	10,914	11,631
Total	**3,457,609**	**4,419**	**218**	**3,648,780**	**3,881,663**

Table 2-10. Annual Greenhouse Gases Emissions (in metric tons) from Oil Transportation and Processing under Alternative D2

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	67,505	86	4	71,269	75,819
11	135,011	173	9	142,539	151,638
12	270,021	345	16	284,805	303,004
13	248,420	318	15	261,993	278,744
14	202,966	259	13	214,266	227,923

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
15	157,513	201	10	166,296	176,912
16	144,911	185	9	152,864	162,618
17	133,319	170	9	140,761	149,724
18	122,653	156	7	129,355	137,597
19	112,841	144	7	119,120	126,708
20	103,814	133	6	109,438	116,441
21	95,509	122	6	100,764	107,194
22	87,868	112	6	92,793	98,715
23	80,838	103	5	85,171	90,596
24	74,372	95	5	78,423	83,414
25	68,422	88	4	72,230	76,850
26	62,948	81	4	66,521	70,776
27	57,912	74	3	60,983	64,884
28	53,279	68	3	56,158	59,764
29	49,017	63	3	51,709	55,026
30	45,095	58	3	47,606	50,641
31	41,488	53	3	43,852	46,663
32	38,169	49	3	40,391	42,984
33	35,115	45	2	36,927	39,306
34	32,306	41	2	33,984	36,154
35	29,722	38	2	31,299	33,316
36	27,344	34	2	28,794	30,610
37	25,157	32	2	26,513	28,183
38	23,144	30	1	24,438	26,019
39	21,292	27	1	22,498	23,940
40	19,589	25	1	20,709	22,014
41	18,022	23	1	19,087	20,311
42	16,580	21	1	17,562	18,655
43	15,253	19	1	16,185	17,200
44	14,033	18	1	14,915	15,856
45	12,911	16	1	13,746	14,614
46	11,878	15	1	12,667	13,463
47	10,928	14	0	11,399	12,125
48	10,054	12	0	10,481	11,138
Total	**2,777,217**	**3,549**	**174**	**2,930,513**	**3,117,539**

Annual GHG emissions from downstream combustion of oil produced within program area under Alternatives B, C, D, and D2 are shown in Table 2-11, Table 2-12, Table 2-13, and Table 2-14, respectively, and these emissions are also zero until production starts in year 10.

Table 2-11. Annual Greenhouse Gases Emissions (in metric tons) from Downstream Combustion of Produced Oil under Alternative B

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,612,134	154	31	3,625,186	3,633,302
11	7,224,267	308	62	7,250,371	7,266,603
12	14,448,534	616	124	14,500,743	14,533,206
13	13,292,652	566	114	13,340,641	13,370,469
14	12,229,240	521	105	12,273,431	12,300,888
15	11,250,901	479	97	11,291,656	11,316,900
16	13,962,962	595	120	14,013,453	14,044,810
17	16,747,032	713	144	16,807,591	16,845,167
18	23,209,476	989	200	23,293,548	23,345,669
19	21,352,720	910	184	21,430,070	21,478,027
20	19,644,502	837	169	19,715,582	19,759,692
21	18,072,942	770	156	18,138,476	18,179,055
22	20,239,240	862	174	20,312,430	20,357,857
23	22,521,206	959	194	22,602,746	22,653,286
24	28,521,718	1,215	245	28,624,810	28,688,841
25	26,239,984	1,118	226	26,334,998	26,393,917
26	24,140,782	1,028	208	24,228,200	24,282,376
27	22,209,520	946	191	22,289,854	22,339,708
28	20,432,756	870	176	20,506,730	20,552,579
29	22,410,268	955	193	22,491,416	22,541,745
30	24,518,552	1,045	211	24,607,296	24,662,368
31	30,359,280	1,293	261	30,469,064	30,537,206
32	27,930,536	1,190	240	28,031,518	28,094,231
33	25,696,096	1,095	221	25,789,060	25,846,767
34	23,640,406	1,007	203	23,725,834	23,778,903
35	21,749,174	927	187	21,827,850	21,876,703
36	20,009,240	852	172	20,081,586	20,126,486
37	18,408,502	784	158	18,474,999	18,516,316
38	16,935,822	721	146	16,997,166	17,035,163
39	15,580,957	664	134	15,637,326	15,672,319
40	14,334,478	611	123	14,386,265	14,418,465

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
41	13,187,721	562	113	13,235,318	13,264,935
42	12,132,702	517	104	12,176,501	12,203,747
43	11,162,088	476	96	11,202,481	11,227,566
44	10,269,120	437	88	10,306,167	10,329,197
45	9,447,589	402	81	9,481,682	9,502,867
46	8,691,783	370	75	8,723,284	8,742,783
47	7,996,440	341	69	8,025,439	8,043,410
48	7,356,724	313	63	7,383,250	7,399,746
49	6,768,186	288	58	6,792,602	6,807,780
50	6,226,732	265	54	6,249,371	6,263,337
51	5,728,594	244	49	5,749,242	5,762,101
52	5,270,306	225	45	5,289,296	5,301,154
53	4,848,681	207	42	4,866,316	4,877,225
54	4,460,787	190	38	4,476,823	4,486,836
55	4,103,924	175	35	4,118,694	4,127,917
56	3,775,610	161	32	3,789,144	3,797,629
57	3,473,561	148	30	3,486,161	3,493,961
58	3,195,676	136	27	3,207,100	3,214,267
59	2,940,022	125	25	2,950,572	2,957,160
60	2,704,821	115	23	2,714,527	2,720,588
61	2,488,434	106	21	2,497,326	2,502,912
62	2,289,360	98	20	2,297,740	2,302,905
63	2,106,211	90	18	2,113,807	2,118,550
64	1,937,714	83	17	1,944,828	1,949,203
65	1,782,697	76	15	1,789,057	1,793,062
66	1,640,081	70	14	1,645,989	1,649,678
67	1,508,875	64	13	1,514,331	1,517,704
68	1,388,165	59	12	1,393,199	1,396,309
69	1,277,112	54	11	1,281,724	1,284,570
Total	**751,085,595**	**31,997**	**6,457**	**753,801,867**	**755,488,109**

Table 2-12. Annual Greenhouse Gases Emissions (in metric tons) from Downstream Combustion of Produced Oil under Alternative C

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
8	-	-	-	-	-
9	-	-	-	-	-
10	3,612,134	154	31	3,625,186	3,633,302
11	7,224,267	308	62	7,250,371	7,266,603
12	14,448,534	616	124	14,500,743	14,533,206
13	13,292,652	566	114	13,340,641	13,370,469
14	12,229,240	521	105	12,273,431	12,300,888
15	11,250,901	479	97	11,291,656	11,316,900
16	13,962,962	595	120	14,013,453	14,044,810
17	16,747,032	713	144	16,807,591	16,845,167
18	23,209,476	989	200	23,293,548	23,345,669
19	21,352,720	910	184	21,430,070	21,478,027
20	19,644,502	837	169	19,715,582	19,759,692
21	18,072,942	770	156	18,138,476	18,179,055
22	20,239,240	862	174	20,312,430	20,357,857
23	22,521,206	959	194	22,602,746	22,653,286
24	28,521,718	1,215	245	28,624,810	28,688,841
25	26,239,984	1,118	226	26,334,998	26,393,917
26	24,140,782	1,028	208	24,228,200	24,282,376
27	22,209,520	946	191	22,289,854	22,339,708
28	20,432,756	870	176	20,506,730	20,552,579
29	18,798,136	801	162	18,866,232	18,908,445
30	17,294,286	737	149	17,356,926	17,395,766
31	15,910,743	678	137	15,968,348	16,004,079
32	14,637,882	624	126	14,690,875	14,723,760
33	13,466,854	574	116	13,515,627	13,545,877
34	12,389,505	528	107	12,434,450	12,462,276
35	11,398,345	486	98	11,439,582	11,465,194
36	10,486,477	447	90	10,524,368	10,547,925
37	9,647,559	411	83	9,682,466	9,704,126
38	8,875,753	378	76	8,907,765	8,927,686
39	8,165,694	348	70	8,195,174	8,213,514
40	7,512,438	320	65	7,539,719	7,556,583
41	6,911,442	294	59	6,936,310	6,951,804
42	6,358,528	271	55	6,381,619	6,395,901
43	5,849,845	249	50	5,870,915	5,884,038
44	5,381,858	229	46	5,401,240	5,413,309
45	4,951,309	211	43	4,969,336	4,980,456
46	4,555,204	194	39	4,571,632	4,581,856
47	4,190,788	179	36	4,205,950	4,215,384
48	3,855,525	164	33	3,869,421	3,878,064

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
49	3,547,084	151	31	3,560,047	3,568,005
50	3,263,316	139	28	3,275,102	3,282,428
51	3,002,251	128	26	3,013,163	3,019,909
52	2,762,070	118	24	2,772,138	2,778,357
53	2,541,105	108	22	2,550,329	2,556,021
54	2,337,816	100	20	2,346,256	2,351,526
55	2,150,792	92	19	2,158,721	2,163,569
56	1,978,728	84	17	1,985,872	1,990,299
57	1,820,430	78	16	1,827,122	1,831,233
58	1,674,796	71	14	1,680,734	1,684,476
59	1,540,812	66	13	1,546,328	1,549,806
60	1,417,547	60	12	1,422,611	1,425,773
61	1,304,143	56	11	1,308,815	1,311,766
62	1,199,812	51	10	1,204,062	1,206,750
63	1,103,826	47	9	1,107,684	1,110,161
Total	**561,635,267**	**23,928**	**4,832**	**563,667,457**	**564,928,463**

Table 2-13. Annual Greenhouse Gases Emissions (in metric tons) from Downstream Combustion of Produced Oil under Alternative D

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,612,134	154	31	3,625,186	3,633,302
11	7,224,267	308	62	7,250,371	7,266,603
12	14,448,534	616	124	14,500,743	14,533,206
13	13,292,652	566	114	13,340,641	13,370,469
14	12,229,240	521	105	12,273,431	12,300,888
15	11,250,901	479	97	11,291,656	11,316,900
16	10,350,830	441	89	10,388,269	10,411,510
17	9,522,763	406	82	9,557,248	9,578,644
18	8,760,941	373	75	8,792,531	8,812,189
19	8,060,066	343	69	8,089,124	8,107,201
20	7,415,260	316	64	7,442,149	7,458,802
21	6,822,040	291	59	6,846,819	6,862,155
22	6,276,276	267	54	6,298,975	6,313,046

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
23	5,774,174	246	50	5,795,155	5,808,119
24	5,312,242	226	46	5,331,535	5,343,445
25	4,887,261	208	42	4,904,925	4,915,887
26	4,496,280	192	39	4,512,649	4,522,767
27	4,136,578	176	36	4,151,651	4,160,926
28	3,805,652	162	33	3,819,489	3,828,026
29	3,501,200	149	30	3,513,830	3,521,683
30	3,221,103	137	28	3,232,830	3,240,050
31	2,963,416	126	25	2,973,996	2,980,636
32	2,726,342	116	23	2,736,078	2,742,191
33	2,508,234	107	22	2,517,429	2,523,068
34	2,307,576	98	20	2,315,956	2,321,121
35	2,122,970	90	18	2,130,566	2,135,309
36	1,953,132	83	17	1,960,246	1,964,621
37	1,796,882	77	15	1,803,272	1,807,330
38	1,653,131	70	14	1,659,039	1,662,728
39	1,520,880	65	13	1,526,366	1,529,792
40	1,399,210	60	12	1,404,274	1,407,436
41	1,287,274	55	11	1,291,916	1,294,815
42	1,184,292	50	10	1,188,512	1,191,147
43	1,089,548	46	9	1,093,376	1,095,800
44	1,002,384	43	9	1,006,122	1,008,389
45	922,193	39	8	925,539	927,595
46	848,418	36	7	851,402	853,299
47	780,544	33	7	783,438	785,178
48	718,101	31	6	720,663	722,297
49	660,653	28	6	663,125	664,601
50	607,800	26	5	609,940	611,310
51	559,176	24	5	561,256	562,521
Total	**185,012,550**	**7,880**	**1,591**	**185,681,717**	**186,096,993**

Table 2-14. Annual Greenhouse Gases Emissions (in metric tons) from Downstream Combustion of Produced Oil under Alternative D2

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,612,134	154	31	3,625,186	3,633,302
11	7,224,267	308	62	7,250,371	7,266,603
12	14,448,534	616	124	14,500,743	14,533,206
13	13,292,652	566	114	13,340,641	13,370,469
14	10,860,481	463	93	10,899,667	10,924,068
15	8,428,313	359	73	8,458,940	8,477,860
16	7,754,048	330	67	7,782,173	7,799,564
17	7,133,725	304	61	7,159,437	7,175,458
18	6,563,026	280	56	6,586,658	6,601,414
19	6,037,984	257	52	6,059,839	6,073,383
20	5,554,945	237	48	5,575,112	5,587,602
21	5,110,550	218	44	5,129,058	5,140,547
22	4,701,706	200	40	4,718,586	4,729,126
23	4,325,569	184	37	4,341,153	4,350,850
24	3,979,524	170	34	3,993,872	4,002,831
25	3,661,162	156	32	3,674,547	3,682,768
26	3,368,269	143	29	3,380,447	3,387,984
27	3,098,807	132	27	3,110,112	3,117,068
28	2,850,903	121	25	2,861,334	2,867,711
29	2,622,830	112	23	2,632,447	2,638,349
30	2,413,004	103	21	2,421,806	2,427,235
31	2,219,964	95	19	2,227,982	2,232,989
32	2,042,366	87	18	2,049,873	2,054,458
33	1,878,978	80	16	1,885,730	1,889,946
34	1,728,659	74	15	1,734,959	1,738,859
35	1,590,366	68	14	1,596,214	1,599,798
36	1,463,137	62	13	1,468,534	1,471,801
37	1,346,086	57	12	1,351,061	1,354,065
38	1,238,399	53	11	1,242,981	1,245,775
39	1,139,327	49	10	1,143,517	1,146,100
40	1,048,181	45	9	1,051,979	1,054,351

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
41	964,326	41	8	967,732	969,893
42	887,180	38	8	890,496	892,499
43	816,206	35	7	819,160	821,005
44	750,909	32	6	753,501	755,187
45	690,837	29	6	693,339	694,868
46	635,570	27	5	637,740	639,163
47	584,724	25	5	586,834	588,152
48	537,946	23	5	539,996	541,209
Total	**148,605,594**	**6,333**	**1,280**	**149,143,757**	**149,477,507**

2.2.3 GHG Emissions from Displaced Energy Sources

The oil produced in the program area and brought to market under the action alternatives would displace other sources of energy, such as oil, natural gas, other fossil fuels, and renewables. The BLM Energy Substitution Model (EnergySub) is used to estimate the quantity and type of energy sources that would be displaced by oil produced in the Coastal Plain under each action alternative, or the energy source that would fulfill energy demand in the absence of program area oil. The substitution rates from the EnergySub model are available for the first year of production (2032) through the year 2053, and thus results are presented for this period. Details on the methodology and results of the EnergySub modeling are provide in the BLM Energy Substitution Model appendix of the SEIS.

The energy substitution rates estimated by EnergySub for each action alternative are used as input to GLEEM to estimate GHG emissions that would result from displaced energy sources. GLEEM does not include development and production emissions, and thus these emissions are not included in the GHG emissions for displaced energy sources presented below.

The net GHG emissions for each alternative are then calculated by subtracting the GHG emissions from the displaced energy sources from the gross oil and gas emissions from the program area under each action alternative. The net emissions are reported in Section 3.2.1 of the SEIS.

The estimated GHG emissions from substitute energy sources under Alternative B, Alternative C, Alternative D, and Alternative D2 are presented in Table 2-15, Table 2-16, Table 2-17, and

Table 2-18, respectively.

Table 2-15. Annual Greenhouse Gases Emissions (in metric tons) from Displaced Energy Sources under Alternative B

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,033,686	236	28	3,048,363	3,060,800
11	6,067,374	472	56	6,096,728	6,121,602
12	12,134,747	945	111	12,193,211	12,243,013
13	11,163,971	869	103	11,217,986	11,263,783
14	10,270,853	800	95	10,320,628	10,362,788
15	9,449,185	735	87	9,494,839	9,533,574
16	11,726,935	913	108	11,783,626	11,831,742
17	14,065,164	1,095	130	14,133,285	14,190,992
18	19,492,714	1,517	180	19,587,061	19,667,007
19	17,933,299	1,396	165	18,019,945	18,093,514
20	16,498,636	1,284	152	16,578,395	16,646,062
21	15,178,742	1,182	140	15,252,186	15,314,477
22	16,998,132	1,323	156	17,080,145	17,149,868
23	18,914,666	1,472	175	19,006,307	19,083,881
24	23,954,254	1,865	220	24,069,891	24,168,177
25	22,037,914	1,715	203	22,144,440	22,234,821
26	20,274,882	1,578	187	20,372,957	20,456,118
27	18,652,892	1,452	171	18,742,845	18,819,365
28	17,160,659	1,336	158	17,243,606	17,314,013
29	18,821,493	1,465	174	18,912,652	18,989,858
30	20,592,158	1,603	190	20,691,797	20,776,276
31	25,497,550	1,985	235	25,620,858	25,725,468
Total	**349,919,906**	**27,238**	**3,224**	**351,611,750**	**353,047,193**

Table 2-16 Annual Greenhouse Gases Emissions (in metric tons) from Displaced Energy Source for Produced Oil under Alternative C

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,050,121	238	28	3,064,857	3,077,400
11	6,100,242	476	57	6,129,988	6,155,073
12	12,200,482	952	113	12,259,701	12,309,871
13	11,224,444	876	104	11,278,941	11,325,106
14	10,326,487	806	96	10,376,714	10,419,190
15	9,500,369	741	88	9,546,475	9,585,526
16	11,790,459	920	109	11,847,632	11,896,116
7	14,141,354	1,103	131	14,209,986	14,268,115
18	19,598,307	1,529	181	19,693,284	19,773,863
19	18,030,439	1,407	167	18,117,959	18,192,108
20	16,588,004	1,294	154	16,668,607	16,736,801
21	15,260,964	1,191	141	15,334,949	15,397,715
22	17,090,206	1,333	158	17,173,063	17,243,313
23	19,017,117	1,484	176	19,109,388	19,187,595
24	24,084,011	1,879	222	24,200,611	24,299,635
25	22,157,293	1,729	205	22,264,782	22,355,901
26	20,384,706	1,591	189	20,483,715	20,567,561
27	18,753,929	1,464	173	18,844,785	18,921,938
28	17,253,616	1,346	159	17,337,134	17,408,068
29	15,873,327	1,239	147	15,950,380	16,015,676
30	14,603,459	1,140	135	14,674,286	14,734,364
31	13,435,184	1,049	124	13,500,296	13,555,579
Total	**330,464,520**	**25,787**	**3,057**	**332,067,534**	**333,426,509**

Table 2-17 Annual Greenhouse Gases Emissions (in metric tons) from Displaced Energy Source for Produced Oil under Alternative D

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,056,342	239	28	3,071,108	3,083,704
11	6,112,687	478	57	6,142,492	6,167,683
12	12,225,372	956	113	12,284,710	12,335,091
13	11,247,342	879	104	11,301,928	11,348,252
14	10,347,555	809	96	10,397,871	10,440,506
15	9,519,751	744	88	9,565,946	9,605,155
16	8,758,171	685	81	8,800,697	8,836,797
17	8,057,516	630	74	8,096,492	8,129,693
18	7,412,915	580	69	7,449,036	7,479,602
19	6,819,882	534	63	6,852,994	6,881,136
20	6,274,292	491	58	6,304,758	6,330,634
21	5,772,349	451	53	5,800,258	5,824,026
22	5,310,559	415	49	5,336,303	5,358,174
23	4,885,715	382	45	4,909,384	4,929,515
24	4,494,859	351	41	4,516,512	4,535,010
25	4,135,270	323	38	4,155,269	4,172,292
26	3,804,448	297	35	3,822,854	3,838,506
27	3,500,092	273	33	3,517,236	3,531,624
28	3,220,084	251	29	3,235,481	3,248,709
29	2,962,477	231	27	2,976,732	2,988,906
30	2,725,479	213	25	2,738,651	2,749,877
31	2,507,440	196	23	2,519,560	2,529,889
Total	**133,150,597**	**10,408**	**1,229**	**133,796,272**	**134,344,774**

Table 2-18 Annual Greenhouse Gases Emissions (in metric tons) from Displaced Energy Source for Produced Oil under Alternative D2

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	3,057,070	239	28	3,071,836	3,084,432
11	6,114,142	478	57	6,143,947	6,169,138
12	12,228,284	956	113	12,287,622	12,338,003
13	11,250,022	879	104	11,304,608	11,350,932
14	9,191,594	718	85	9,236,195	9,274,034
15	7,133,167	558	66	7,167,813	7,197,220
16	6,562,513	513	61	6,594,453	6,621,489
17	6,037,512	472	56	6,066,866	6,091,740
18	5,554,510	434	51	5,581,366	5,604,238
19	5,110,149	399	47	5,134,870	5,155,898
20	4,701,337	368	44	4,724,315	4,743,709
21	4,325,230	338	40	4,346,222	4,364,035
22	3,979,212	311	37	3,998,581	4,014,971
23	3,660,876	286	34	3,678,681	3,693,753
24	3,368,005	264	32	3,384,608	3,398,521
25	3,098,564	242	28	3,113,420	3,126,173
26	2,850,678	223	26	2,864,421	2,876,174
27	2,622,626	205	24	2,635,287	2,646,091
28	2,412,815	188	22	2,424,423	2,434,331
29	2,219,790	174	21	2,230,708	2,239,878
30	2,042,208	159	19	2,052,133	2,060,513
31	1,878,829	147	17	1,887,851	1,895,598
Total	**109,399,133**	**8,551**	**1,012**	**109,930,229**	**110,380,867**

2.2.4 Downstream Combustion GHG Emissions from the Change in Foreign Oil Consumption

As oil is a global commodity with prices determined by global supply and demand, oil production in the program area under the action alternatives would increase the global oil supply and place downward pressure on global oil prices. Reductions in global oil prices would increase demand relative to the No Action Alternative resulting in additional GHG emissions. EnergySub is used to estimate the change in domestic and foreign oil

consumption resulting from oil production in the program area. The EnergySub model results are available for the first year of production (2032) through the year 2053, and thus results are presented for this period. Emissions from the change in foreign oil consumption are estimated by applying EPA (2023d) emission factors for stationary combustion of petroleum products to the estimated change in foreign oil consumption. The highest EPA emission factors are used (11.91 kilograms of CO_2 per gallon, 0.47 grams of CH_4 per gallon, and 0.09 grams of N_2O per gallon) and it is assumed that all foreign oil is combusted due to the lack of information on the type and amount of petroleum products consumed in foreign markets. In reality, increased foreign oil consumption would include a wide variety of petroleum products with varying emission intensities including products that are not combusted (e.g., plastics). Thus, this approach likely results in a conservatively high estimate of these foreign downstream combustion emissions.

The estimated downstream combustion GHG emissions from the change in foreign oil consumption under Alternative B, Alternative C, Alternative D, and Alternative D2 are presented in Table 2-19, Table 2-20, Table 2-21, and Table 2-22, respectively.

Table 2-19. Annual Greenhouse Gases Emissions (in metric tons) from Change in Foreign Oil Consumption under Alternative B.

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	1,062,050	41.91	8.03	1,065,489.84	1,067,698.57
11	2,125,704	83.89	16.06	2,132,589.49	2,137,010.27
12	4,251,055	167.76	32.12	4,264,823.72	4,273,664.56
13	3,912,972	154.42	29.57	3,925,646.44	3,933,784.17
14	3,600,412	142.08	27.21	3,612,073.56	3,619,561.27
15	3,312,744	130.73	25.03	3,323,473.67	3,330,363.12
16	4,111,855	162.26	31.07	4,125,172.73	4,133,724.07
17	4,928,047	194.47	37.24	4,944,008.34	4,954,257.10
18	6,829,302	269.50	51.61	6,851,421.50	6,865,624.27
19	6,275,942	247.67	47.43	6,296,269.14	6,309,321.10
20	5,769,598	227.68	43.60	5,788,285.36	5,800,284.29
21	5,308,522	209.49	40.11	5,325,715.66	5,336,755.69
22	5,943,481	234.55	44.91	5,962,731.51	5,975,092.05
23	6,609,782	260.84	49.95	6,631,190.96	6,644,937.20
24	8,365,612	330.13	63.22	8,392,708.25	8,410,106.06
25	7,686,424	303.33	58.08	7,711,320.45	7,727,305.76
26	7,070,553	279.02	53.43	7,093,453.82	7,108,158.31

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
27	6,504,467	256.68	49.15	6,525,534.99	6,539,062.21
28	5,980,093	235.99	45.19	5,999,462.60	6,011,899.28
29	6,557,194	258.76	49.55	6,578,432.66	6,592,069.53
30	7,173,796	283.10	54.21	7,197,032.04	7,211,951.25
31	8,881,725	350.50	67.12	8,910,493.01	8,928,964.16
Total	**122,261,330**	**4,824.75**	**923.89**	**122,657,330**	**122,911,594**

Table 2-20. Annual Greenhouse Gases Emissions (in metric tons) from Change in Foreign Oil Consumption under Alternative C.

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	1,062,050	41.91	8.03	1,065,489.84	1,067,698.57
11	2,125,704	83.89	16.06	2,132,589.49	2,137,010.27
12	4,251,055	167.76	32.12	4,264,823.72	4,273,664.56
13	3,912,972	154.42	29.57	3,925,646.44	3,933,784.17
14	3,600,412	142.08	27.21	3,612,073.56	3,619,561.27
15	3,312,744	130.73	25.03	3,323,473.67	3,330,363.12
16	4,111,855	162.26	31.07	4,125,172.73	4,133,724.07
17	4,928,047	194.47	37.24	4,944,008.34	4,954,257.10
18	6,829,302	269.50	51.61	6,851,421.50	6,865,624.27
19	6,275,942	247.67	47.43	6,296,269.14	6,309,321.10
20	5,769,598	227.68	43.60	5,788,285.36	5,800,284.29
21	5,308,522	209.49	40.11	5,325,715.66	5,336,755.69
22	5,943,481	234.55	44.91	5,962,731.51	5,975,092.05
23	6,609,782	260.84	49.95	6,631,190.96	6,644,937.20
24	8,365,612	330.13	63.22	8,392,708.25	8,410,106.06
25	7,686,424	303.33	58.08	7,711,320.45	7,727,305.76
26	7,070,553	279.02	53.43	7,093,453.82	7,108,158.31
27	6,504,467	256.68	49.15	6,525,534.99	6,539,062.21
28	5,980,093	235.99	45.19	5,999,462.60	6,011,899.28
29	5,500,765	217.07	41.57	5,518,581.58	5,530,021.42
30	5,060,846	199.71	38.24	5,077,237.85	5,087,762.80

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
31	4,656,113	183.74	35.18	4,671,194.19	4,680,877.42
Total	**114,866,338**	**4,532.93**	**868.01**	**115,238,386**	**115,477,271**

Table 2-21. Annual Greenhouse Gases Emissions (in metric tons) from Change in Foreign Oil Consumption under Alternative D

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	1,062,050	41.91	8.03	1,065,489.84	1,067,698.57
11	2,125,704	83.89	16.06	2,132,589.49	2,137,010.27
12	4,251,055	167.76	32.12	4,264,823.72	4,273,664.56
13	3,912,972	154.42	29.57	3,925,646.44	3,933,784.17
14	3,600,412	142.08	27.21	3,612,073.56	3,619,561.27
15	3,312,744	130.73	25.03	3,323,473.67	3,330,363.12
16	3,048,263	120.29	23.03	3,058,136.64	3,064,476.05
17	2,802,416	110.59	21.18	2,811,493.23	2,817,321.36
18	2,578,275	101.75	19.48	2,586,625.66	2,591,987.65
19	2,369,342	93.50	17.90	2,377,016.38	2,381,943.86
20	2,178,146	85.96	16.46	2,185,200.79	2,189,730.64
21	2,004,069	79.09	15.14	2,010,560.14	2,014,727.97
22	1,843,315	72.74	13.93	1,849,285.14	1,853,118.65
23	1,694,934	66.89	12.81	1,700,423.99	1,703,948.91
24	1,558,481	61.50	11.78	1,563,528.63	1,566,769.77
25	1,431,850	56.50	10.82	1,436,487.29	1,439,465.08
26	1,317,109	51.98	9.95	1,321,375.52	1,324,114.68
27	1,211,550	47.81	9.16	1,215,473.89	1,217,993.52
28	1,113,933	43.96	8.42	1,117,540.74	1,119,857.37
29	1,025,082	40.45	7.75	1,028,402.41	1,030,534.25
30	942,871	37.21	7.12	945,924.85	947,885.72
31	867,746	34.24	6.56	870,556.29	872,360.92
Total	**46,252,319**	**1,825.24**	**349.51**	**46,402,128**	**46,498,318**

Table 2-22. Annual Greenhouse Gases Emissions (in metric tons) from Change in Foreign Oil Consumption under Alternative D2

Year	CO_2	CH_4	N_2O	CO_2e 100-year	CO_2e 20-year
1	-	-	-	-	-
2	-	-	-	-	-
3	-	-	-	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	-	-	-
9	-	-	-	-	-
10	1,062,049.91	41.91	8.03	1,065,489.84	1,067,698.57
11	2,125,704.42	83.89	16.06	2,132,589.49	2,137,010.27
12	4,251,054.73	167.76	32.12	4,264,823.72	4,273,664.56
13	3,912,972.48	154.42	29.57	3,925,646.44	3,933,784.17
14	3,197,468.88	126.18	24.16	3,207,825.35	3,214,475.07
15	2,481,733.85	97.94	18.75	2,489,772.08	2,494,933.30
16	2,283,589.84	90.12	17.26	2,290,986.30	2,295,735.44
17	2,099,407.06	82.85	15.86	2,106,206.96	2,110,573.05
18	1,931,490.12	76.22	14.60	1,937,746.14	1,941,763.02
19	1,774,966.47	70.04	13.41	1,780,715.51	1,784,406.88
20	1,631,690.37	64.39	12.33	1,636,975.34	1,640,368.74
21	1,501,266.69	59.24	11.34	1,506,129.23	1,509,251.39
22	1,380,896.33	54.49	10.43	1,385,368.99	1,388,240.82
23	1,269,670.65	50.10	9.59	1,273,783.06	1,276,423.57
24	1,167,424.83	46.07	8.82	1,171,206.07	1,173,633.94
25	1,072,632.63	42.33	8.11	1,076,106.85	1,078,337.58
26	986,650.76	38.94	7.46	989,846.48	991,898.40
27	907,582.81	35.82	6.86	910,522.43	912,409.92
28	834,448.16	32.93	6.31	837,150.90	838,886.29
29	767,915.51	30.30	5.80	770,402.75	771,999.77
30	706,334.59	27.87	5.34	708,622.37	710,091.33
31	650,878.70	25.69	4.92	652,986.87	654,340.49
Total	**37,997,830**	**1,499.49**	**287.14**	**38,120,903**	**38,199,927**

3.0 References

Air Sciences, Inc. and Pinyon Environmental. 2022. Kaktovik, Alaska Ambient Air Monitoring Station: Annual Data Summary Report for October 15, 2021 – September 30, 2022. Prepared for the Bureau of Land Management (BLM). https://catalog.northslopescience.org/dataset/3019.

Alaska Department of Environmental Conservation (ADEC). 2018. Ambient Concentrations Measured at Various Industrial Monitoring Sites. https://dec.alaska.gov/air/air-permit/dispersion-modeling.

Alyeska Pipeline Service Company. 2023. Historic Throughput. Accessed May 22, 2023: https://www.alyeska-pipe.com/historic-throughput/

ADEC. 2022. Chapter 50. Air Quality Control (18 AAC 50).

ADEC. 2023. Air Permits, Approvals & Public Notices. Accessed April 11, 2023. https://dec.alaska.gov/Applications/Air/airtoolsweb/AirPermitsApprovalsAndPublicNotices

Bureau of Land Management (BLM). 2022. Kaktovik, Alaska Ambient Air Monitoring Station: Annual Data Summary Report for October 15, 2021– September 30, 2022.

BLM. 2023. Willow Master Development Plan: Final Supplemental Environmental Impact Statement. Volume 1: Executive Summary, Chapters 1 through 5, Glossary, and References. January 2023. https://eplanning.blm.gov/public_projects/109410/200258032/20073121/250079303/Willow%20FSEIS_Vol%201_Ch%201-Ch%205.pdf.

BOEM. 2018. Final Environmental Impact Statement Volume 1. Executive Summary and Chapters 1 through 6. August 2018. https://www.boem.gov/sites/default/files/about-boem/BOEM-Regions/Alaska-Region/Leasing-and-Plans/Plans/Vol-1-Liberty-FEIS.pdf

ConocoPhillips. 2019. ConocoPhillips Alaska, Inc. Kuparuk River Unit, Colville River Unit, and Greater Mooses Tooth Unit: Applications to Facilitate Transition of Drilling Operations to the Minor General Permit 2 (MG2). October 17, 2019. https://dec.alaska.gov/Applications/Air/airtoolsweb/AirPermitsApprovalsAndPublicNotices/

USACE. 2018. Final Environmental Impact Statement Nanushuk Project. November 2018. https://cdxapps.epa.gov/cdx-enepa-II/public/action/eis/details?eisId=260614

Energy Information Administration (EIA). 2023. April 2023 Monthly Energy Review. https://www.eia.gov/totalenergy/data/monthly/pdf/mer.pdf

Environmental Protection Agency (EPA). 2021a. Table 2. Acute Dose-Response Values for Screening Risk Assessments. https://www.epa.gov/sites/default/files/2014-05/documents/table2.pdf.

EPA. 2021b. Table 1. Prioritized Chouronic Dose-Response Values. https://www.epa.gov/system/files/documents/2021-09/chouronicfinaloutput_9_29_2021-12-46-18-pm_0.pdf.

EPA. 2022a. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2020. U.S. Environmental Protection Agency, EPA 430-R-22-003. https://www.epa.gov/ghgemissions/draft-inventory-us-greenhouse-gas-emissions-and-sinks-1990-2020.

EPA. 2022b. 2011-2021 Greenhouse Gas Reporting Program Industrial Profile: Petroleum Refineries Sector. https://www.epa.gov/system/files/documents/2022-11/refineries_2021_sector_profile.pdf.

EPA. 2023a. National Ambient Air Quality Standards Table. https://www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA. 2023b. Clean Air Status and Trends Network (CASTNET). Annual Total Deposition Data. https://www.epa.gov/castnet.

EPA. 2023c. Facility Level Information on Greenhouse Gases Tool (FLIGHT). Greenhouse Gas Emissions from Large Facilities. https://ghgdata.epa.gov/.

EPA. 2023d. Emission Factors for Greenhouse Gas Inventories. https://www.epa.gov/system/files/documents/2023-03/ghg_emission_factors_hub.pdf

EPA. 2023e. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021. U.S. Environmental Protection Agency, EPA 430-R-23-002. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2021

Federal Land Manager Environmental Database (FED). 2023. Visibility Trends and Composition Following the Regional Haze Rule Metrics. http://views.cira.colostate.edu/fed/Sites/?appkey=SBA_AqrvVisibility.

Fields Simms, P., B. Do, B. Brashers, T. Stoeckenius, and R. Morris. 2018. Arctic Air Quality Impact Assessment Modeling Study: Final Project Report. Prepared by Eastern Research Group, Inc., Sacramento, CA for U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, AK. OCS Study BOEM 2018-020.

Federal Land Managers' Air Quality Related Values Work Group (FLAG). 2010. Federal Land Managers' Air Quality Related Values Work Group (FLAG): Phase I Report—Revised (2010). Natural Resource Report NPS/NRPC/NRR-2010/232. http://npshistory.com/publications/air-quality/flag-2010.pdf.

Hirsch, Brian. 2021. Technical Analysis Report for the Terms and Conditions of Minor Permit AQ1503MSS01. Prepared for ConocoPhillips Alaska, Inc. January 15, 2021. https://dec.alaska.gov/Applications/Air/airtoolsweb/AirPermitsApprovalsAndPublicNotices/

IPCC. 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

National Atmospheric Deposition Program (NADP). 2023. National Trends Network (NTN). Deposition Data. https://nadp.slh.wisc.edu/networks/national-trends-network/.

Pardo, L.H., M.E. Fenn, C.L. Goodale, L.H., C.T. Driscoll, …, R.L. Dennis. 2011. Effects of Nitrogen Deposition and Empirical Nitrogen Critical Loads for Ecoregions of the United States. Ecological Applications 21:3049–3082. http://dx.doi.org/10.1890/10-2341.1

SLR. 2021. Nuiqsut Ambient Air and Meteorological Monitoring Program: 2020 Annual Report. Anchorage, AK. Prepared for ConocoPhillips Alaska, Inc.

SLR. 2022a. Nuiqsut Ambient Air and Meteorological Monitoring Program: 2021 Annual Report. Anchorage, AK. Prepared for ConocoPhillips Alaska, Inc.

SLR. 2022b. Volatile Organic Compounds (VOCs) Near the Village of Nuiqsut, Alaska. Anchorage, AK. Prepared for ConocoPhillips Alaska, Inc.

SLR. 2022c. GLEEM Response to RFI 241. Anchorage, AK.

SLR. 2023. Nuiqsut Ambient Air and Meteorological Monitoring Program: 2022 Annual Report. Anchorage, AK. Prepared for ConocoPhillips Alaska, Inc.

Stoeckenius, T., J. Jung, B. Koo, T. Shah, and R. Morris, 2017. Arctic Air Quality Modeling Study – Final Photochemical Modeling Report. BOEM 2016-076. Prepared by Ramboll Environ, Novato, CA for U.S. Department of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, AK. OCS Study BOEM 2016-076.

Sullivan, T. J. 2016. Air quality related values (AQRVs) for Arctic Network (ARCN) parks: Effects from ozone; visibility reducing particles; and atmospheric deposition of acids, nutrients and toxics. Natural Resource Report NPS/ARCN/NRR—2016/1155. National Park Service, Fort Collins, Colorado.

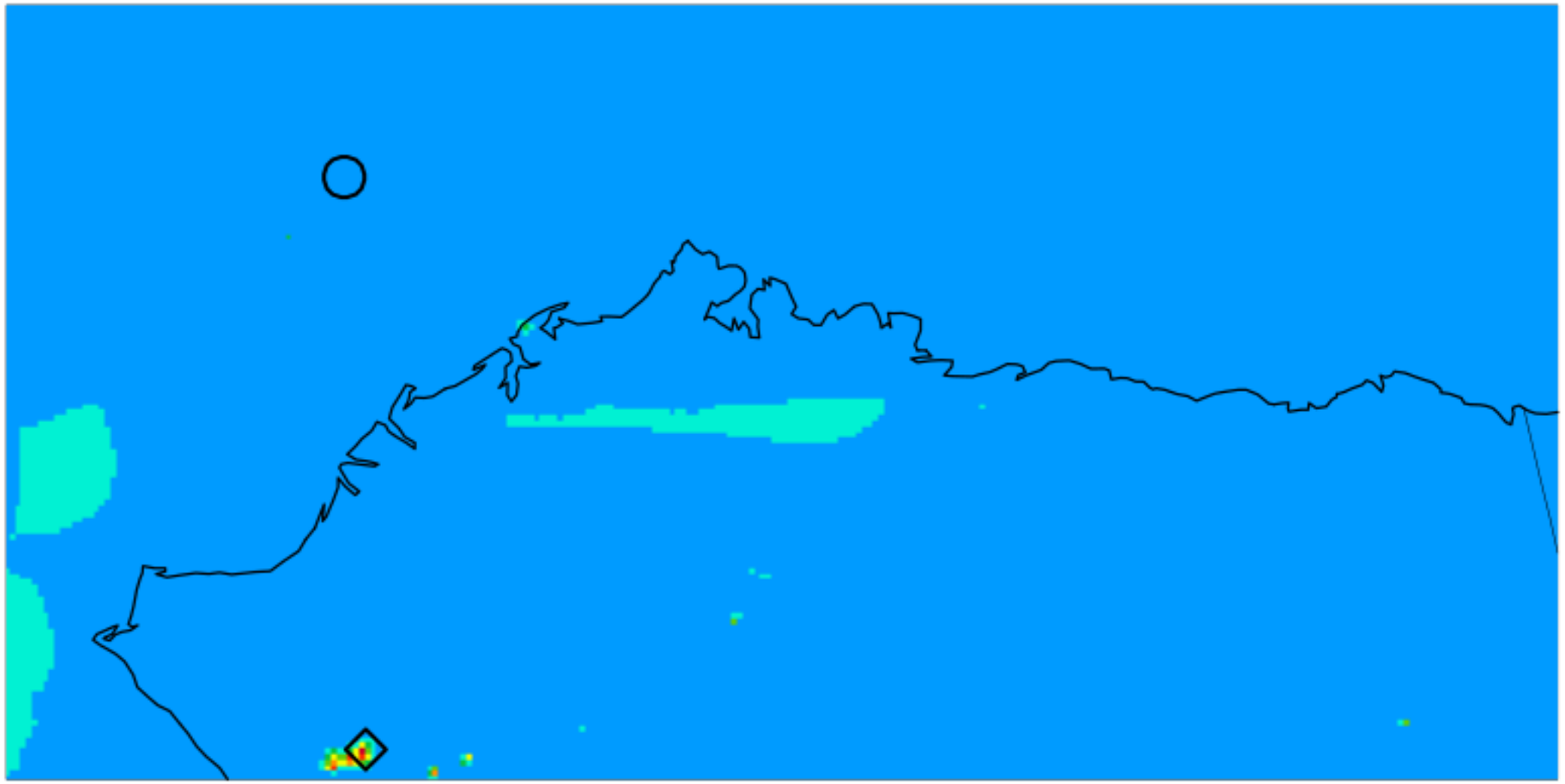
U.S. Department of Energy. 2023. Alaska LNG Project Final Supplemental Environmental Impact Statement. January 2023. https://www.energy.gov/sites/default/files/2023-01/final-seis-0512-s1-alaska-lng-volume-1-2023-01.pdf

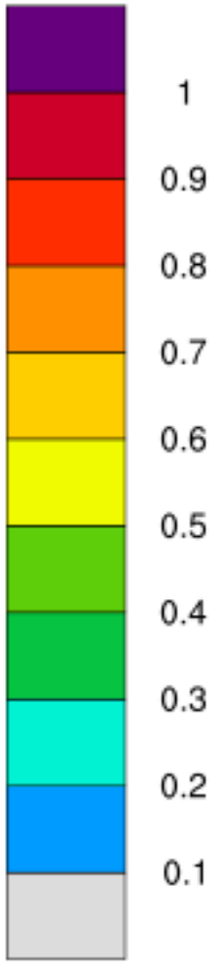
Wolvovsky, E. 2022. The Greenhouse Gas Life Cycle Energy Emissions Model (GLEEM) 2022 Version. July 2022. https://www.boem.gov/sites/default/files/documents/environment/GLEEM_2022_Technical_Paper.pdf.

APPENDIX A

Spatial plots of Modeled Cumulative and Indirect Impacts for Regional Modeling Scenarios

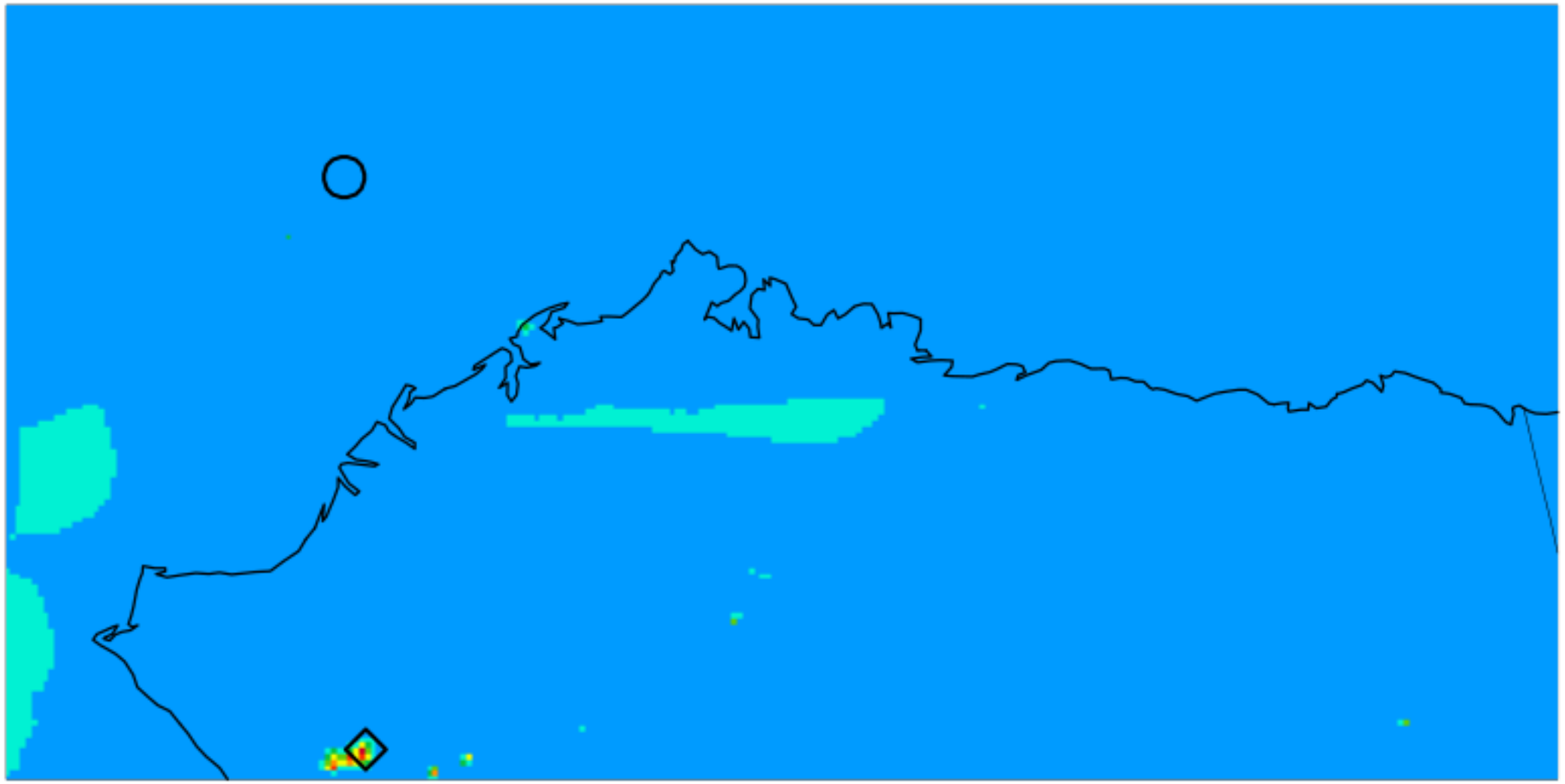
2nd highest 8-hr daily max CO
High Development Scenario-Cumulative

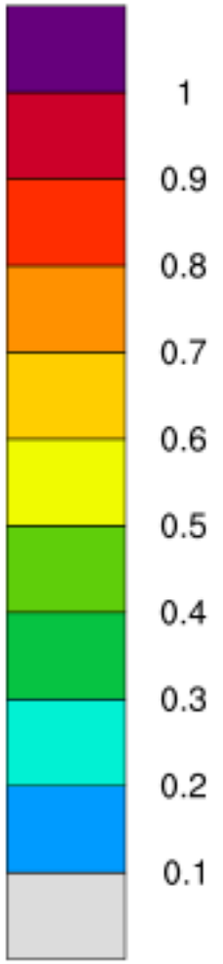




◇ max(64,6) = 0.9 ppm
○ min(61,108) = 0.1 ppm

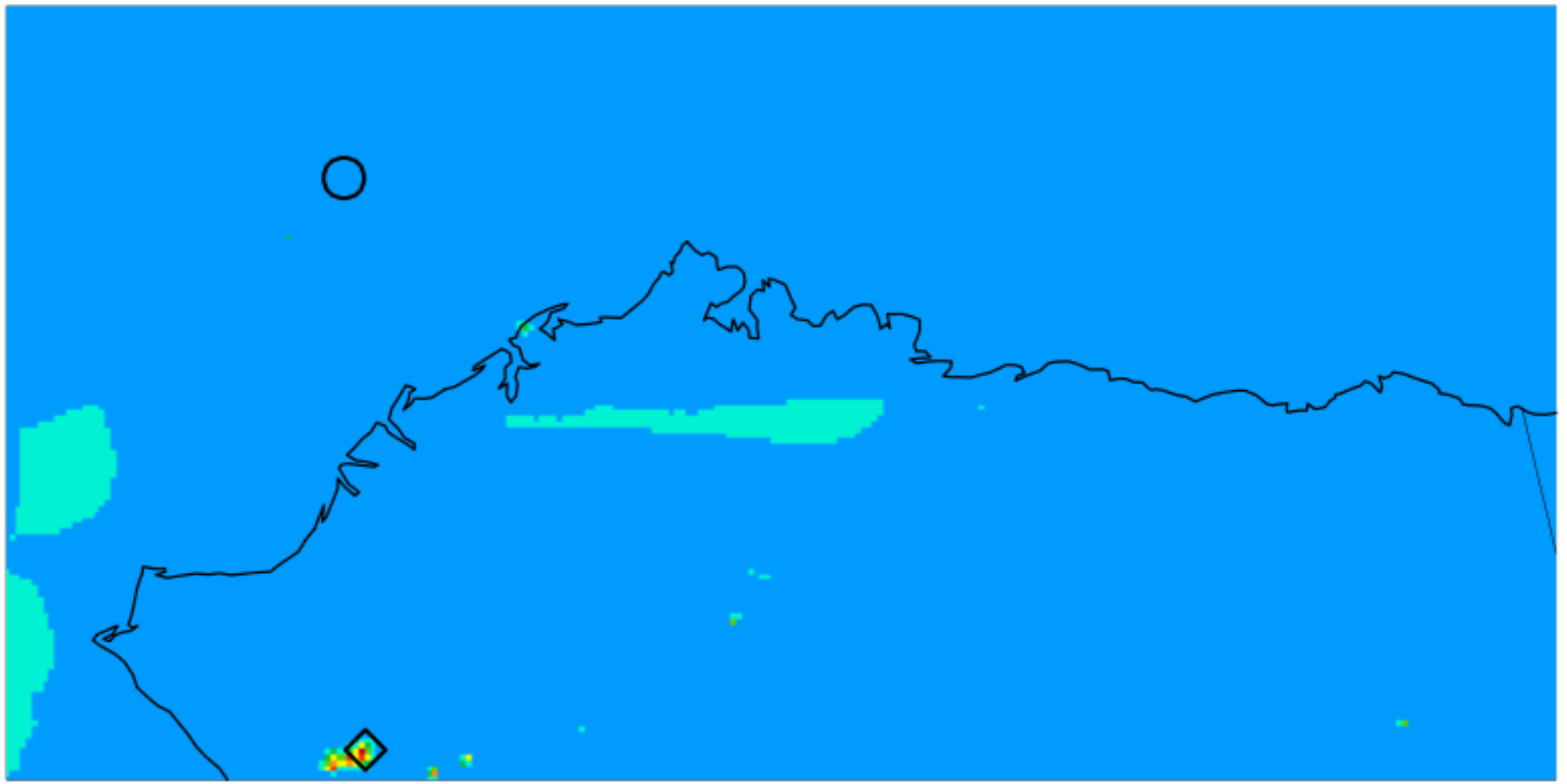
2nd highest 8-hr daily max CO
Low Development Scenario-Cumulative

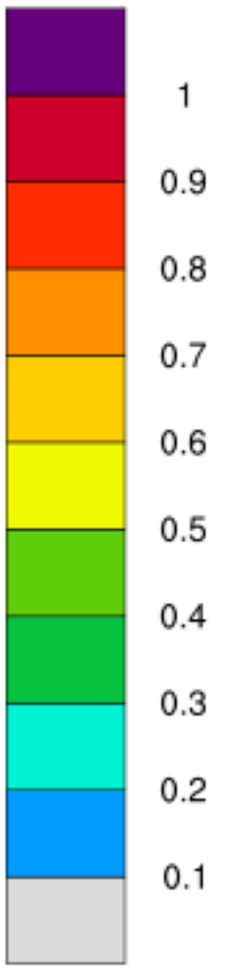




◇ max(64,6) = 0.9 ppm
○ min(61,108) = 0.1 ppm

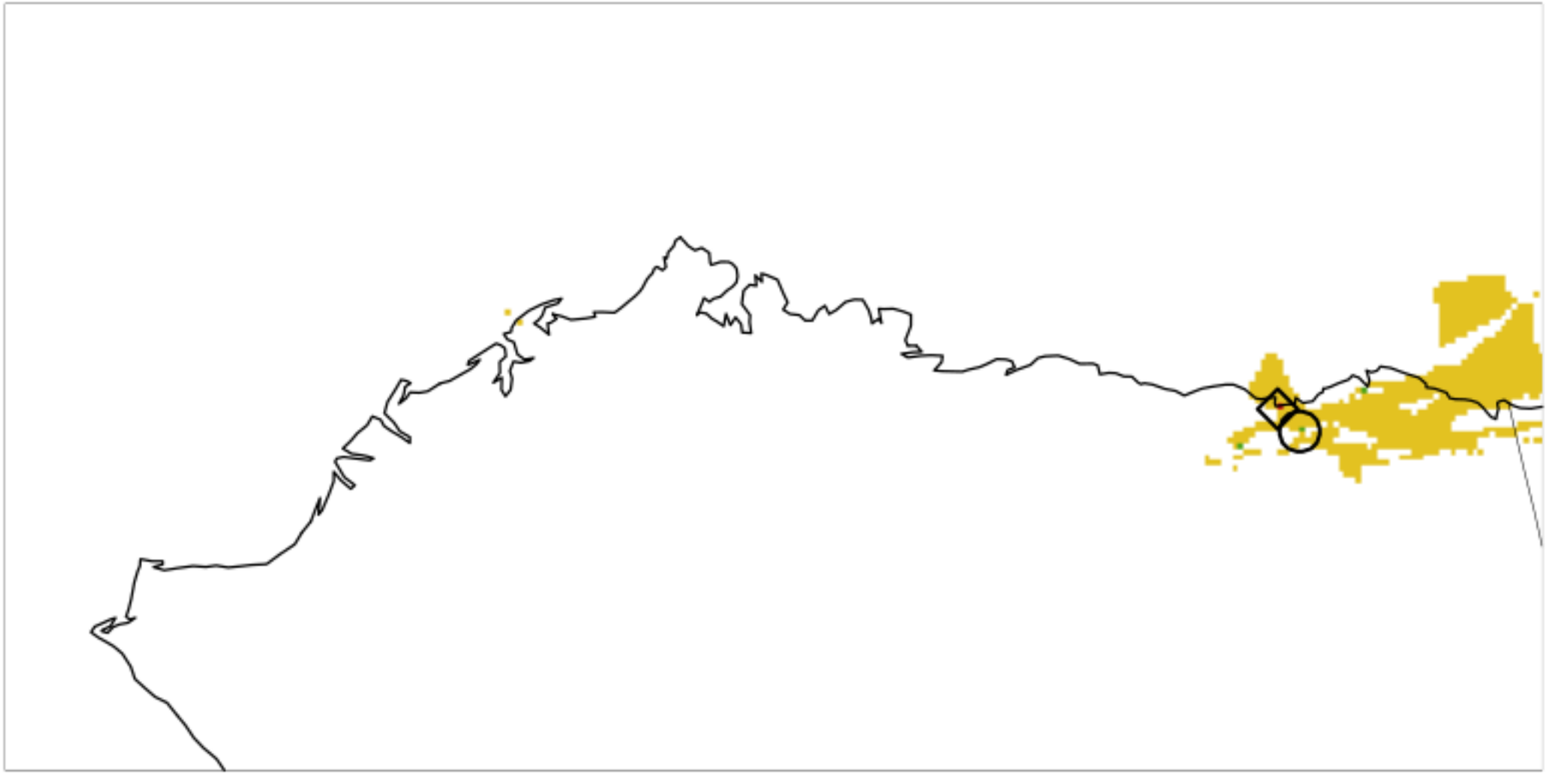
2nd highest 8-hr daily max CO
No Action Alternative-Cumulative





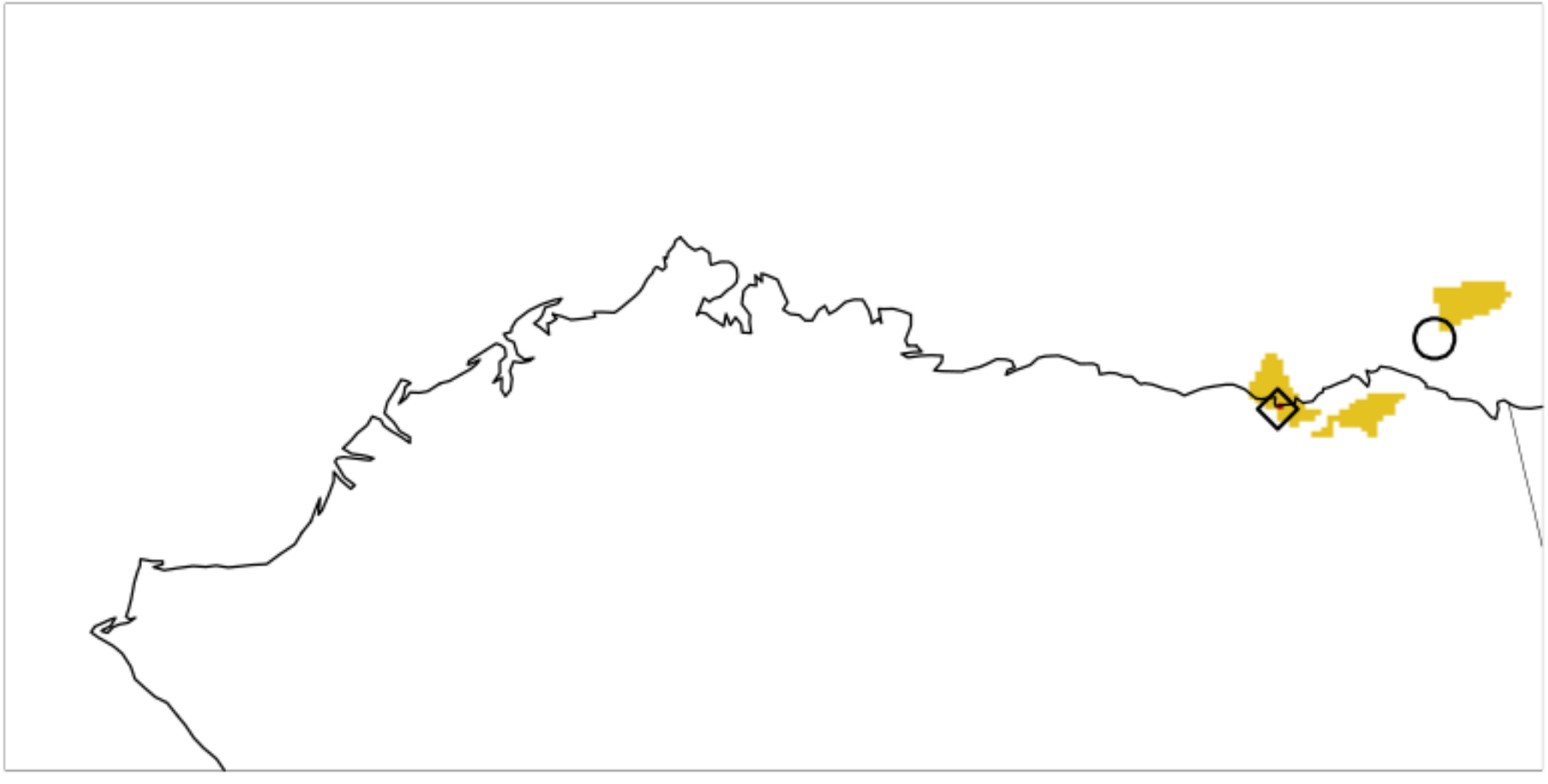
◇ max(64,6) = 0.9 ppm
○ min(61,108) = 0.1 ppm

2nd highest 8-hr daily max CO
High Development Scenario-Indirect Impact



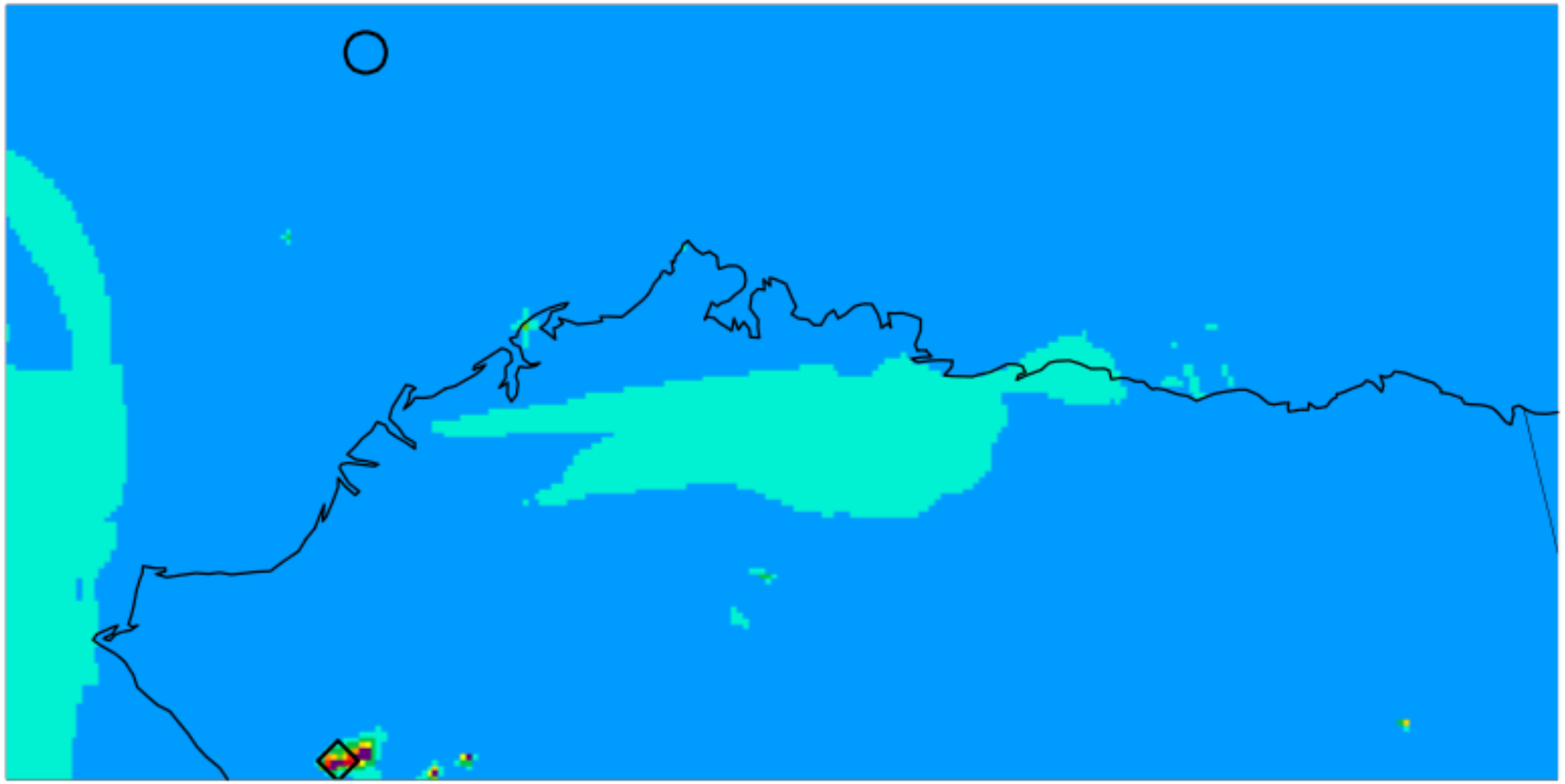
◇max(229,66) = 0.0061 ppm
○min(233,62) = -0.0002 ppm

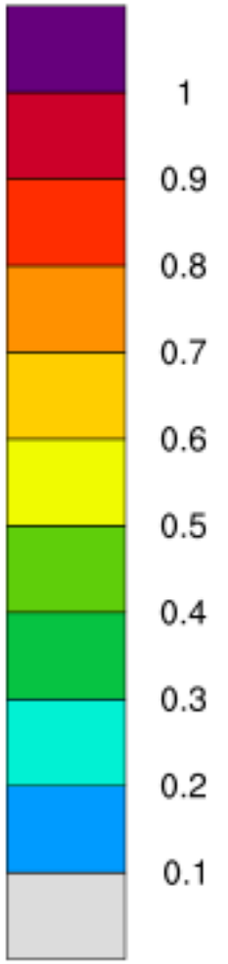
2nd highest 8-hr daily max CO
Low Development Scenario-Indirect Impact



◇max(229,66) = 0.0060 ppm
○min(257,79) = -0.0001 ppm

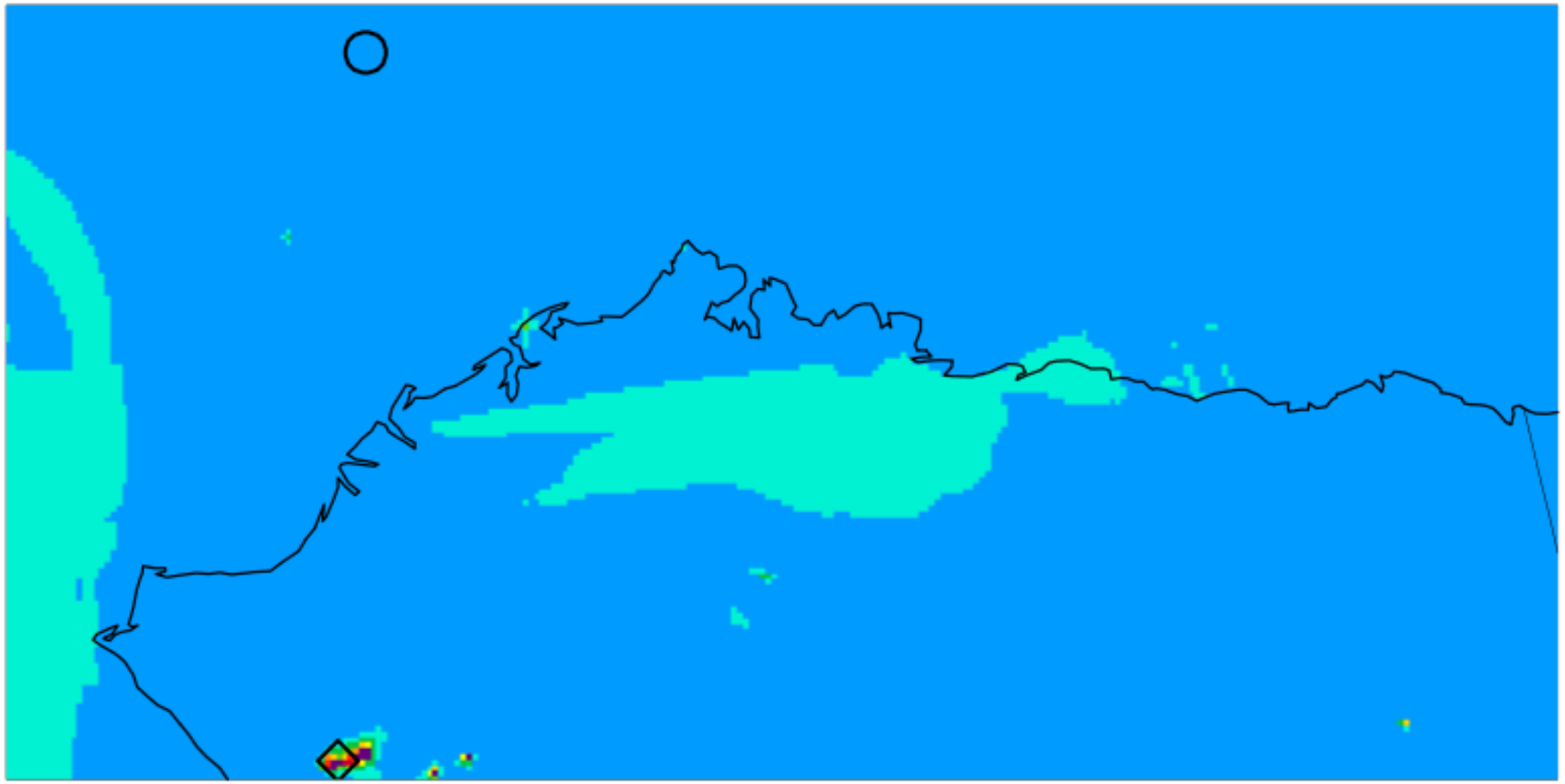
2nd highest 1-hr daily max CO
High Development Scenario-Cumulative

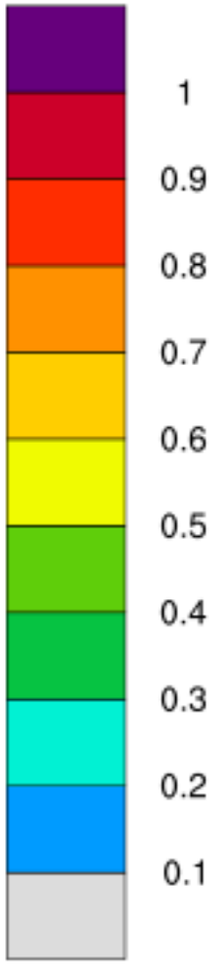




◇ max(59,4) = 3.1 ppm
○ min(65,130) = 0.1 ppm

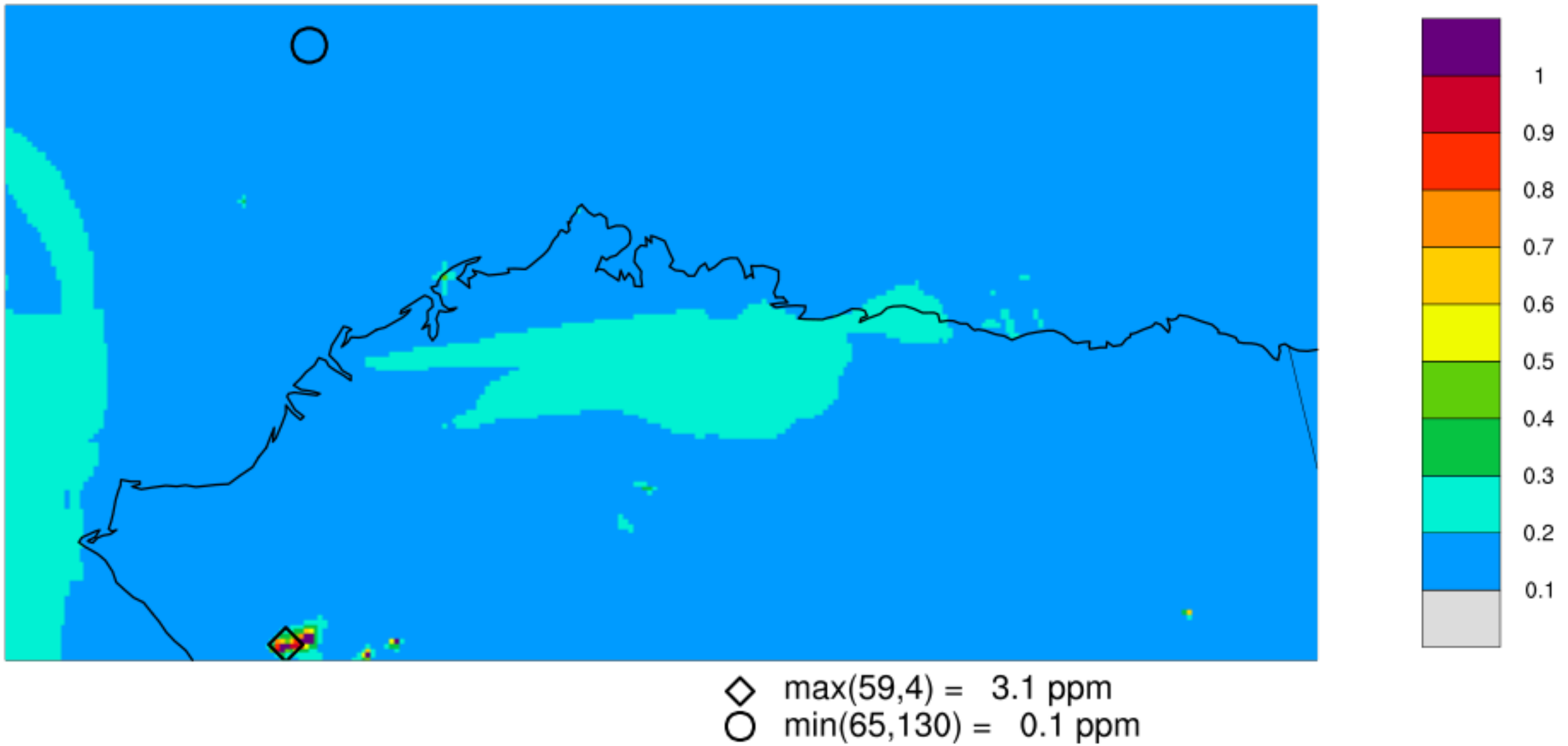
2nd highest 1-hr daily max CO
Low Development Scenario-Cumulative



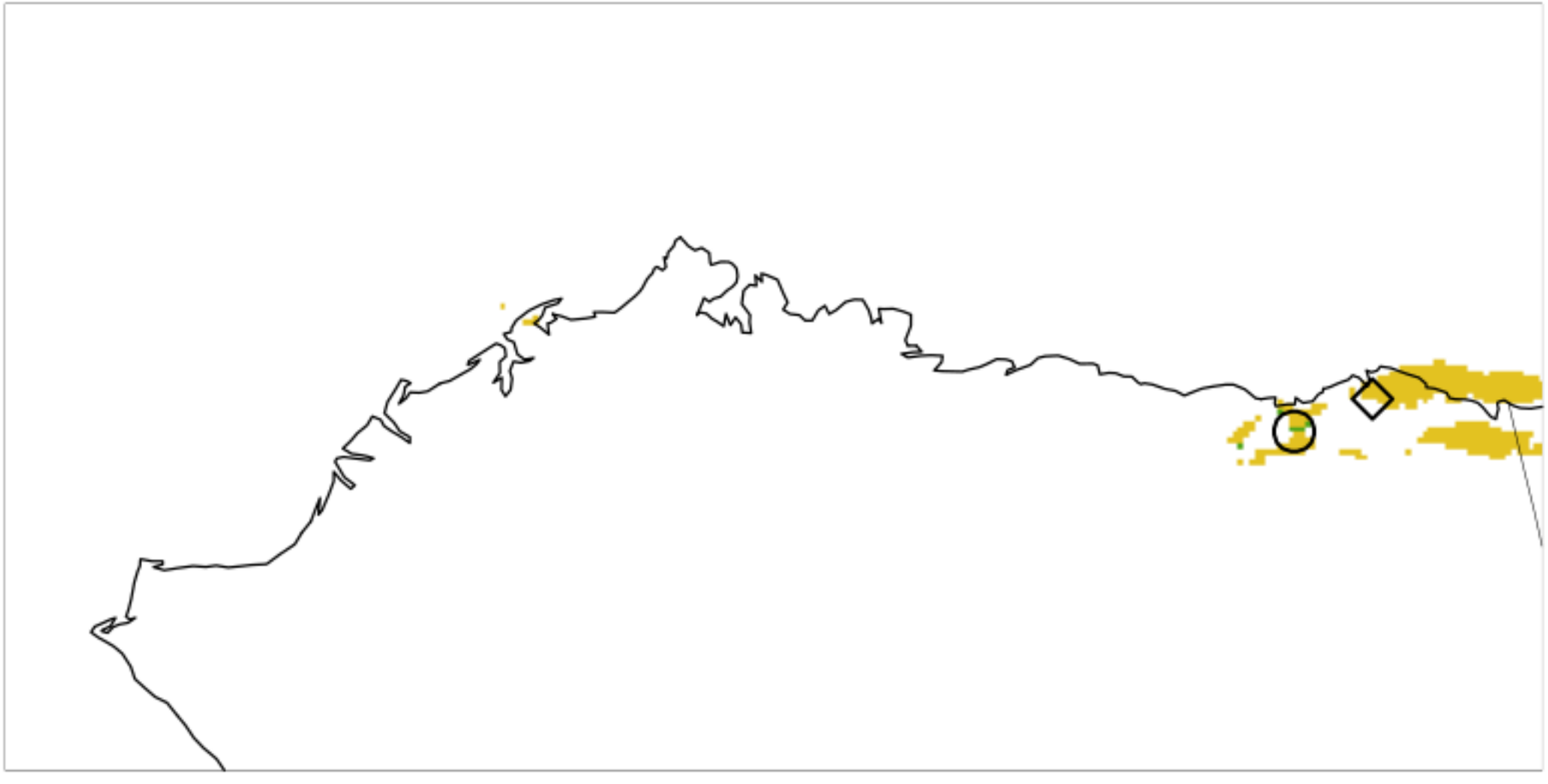


◇ max(59,4) = 3.1 ppm
○ min(65,130) = 0.1 ppm

2nd highest 1-hr daily max CO
No Action Alternative-Cumulative

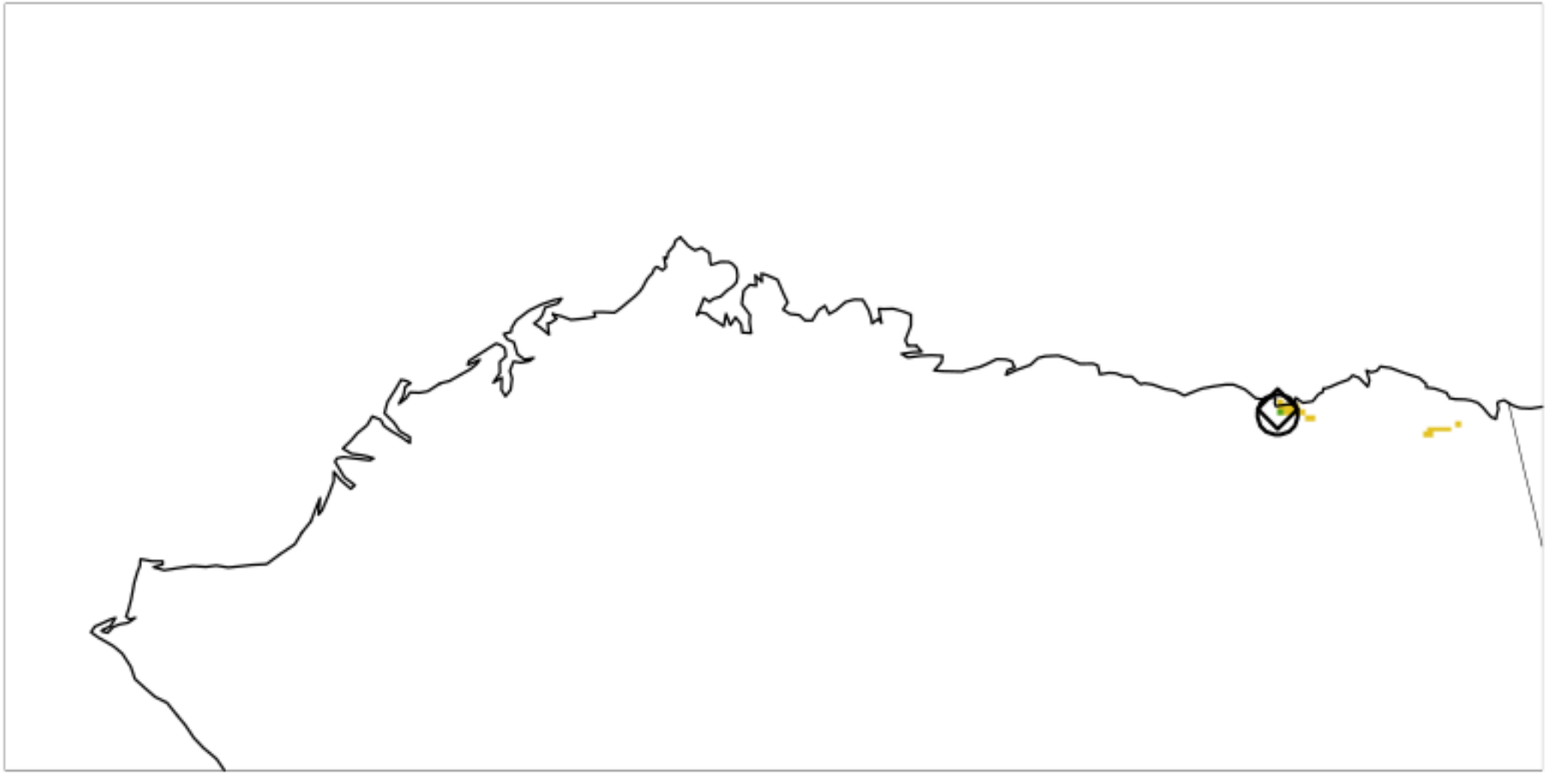


2nd highest 1-hr daily max CO
High Development Scenario-Indirect Impact



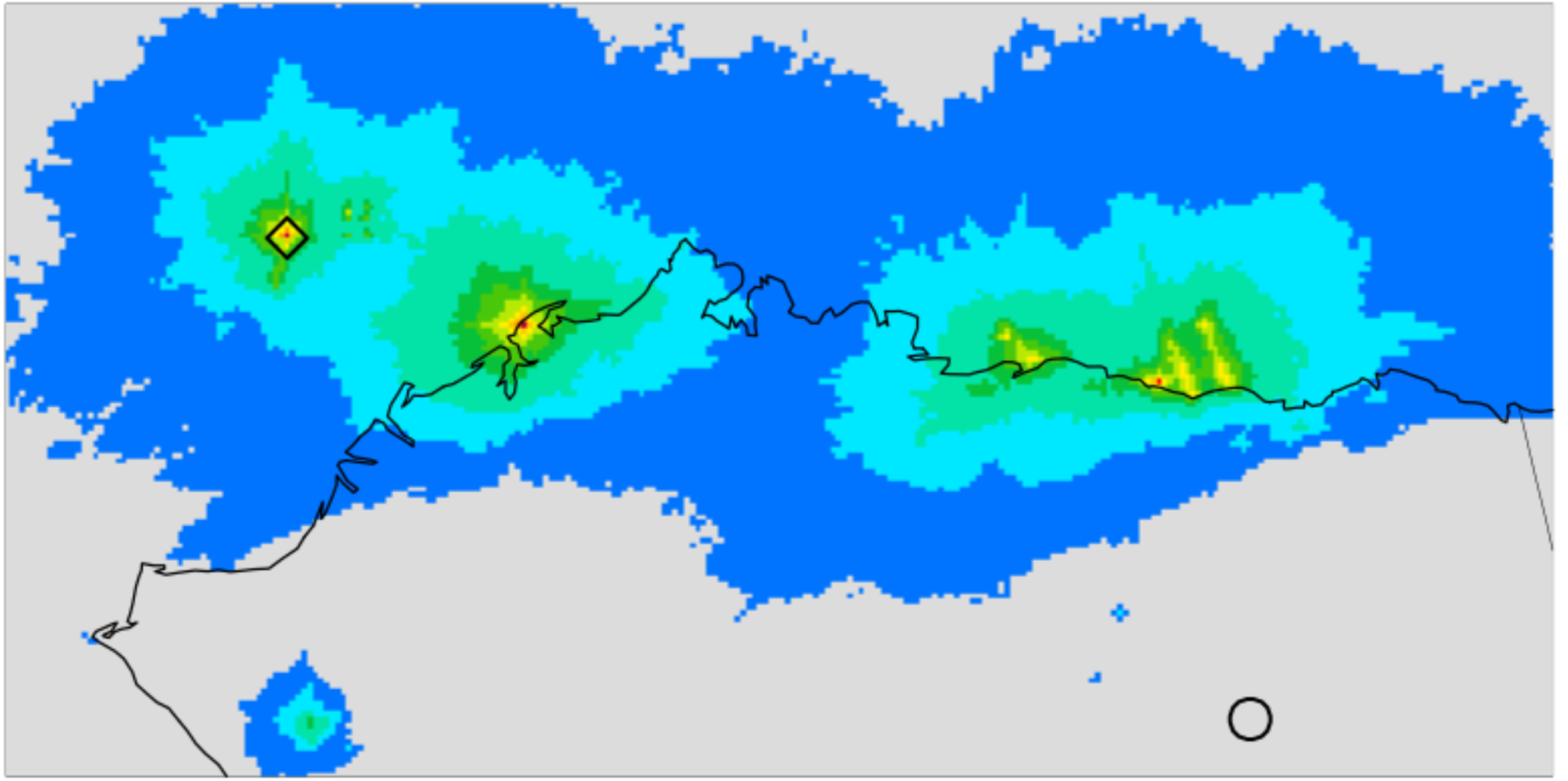
◇max(246,68) = 0.0050 ppm
○min(232,62) = -0.0005 ppm

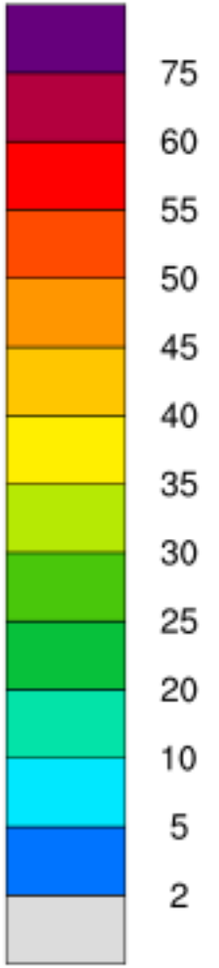
2nd highest 1-hr daily max CO
Low Development Scenario-Indirect Impact



◇max(229,66) = 0.0031 ppm
○min(229,65) = -0.0002 ppm

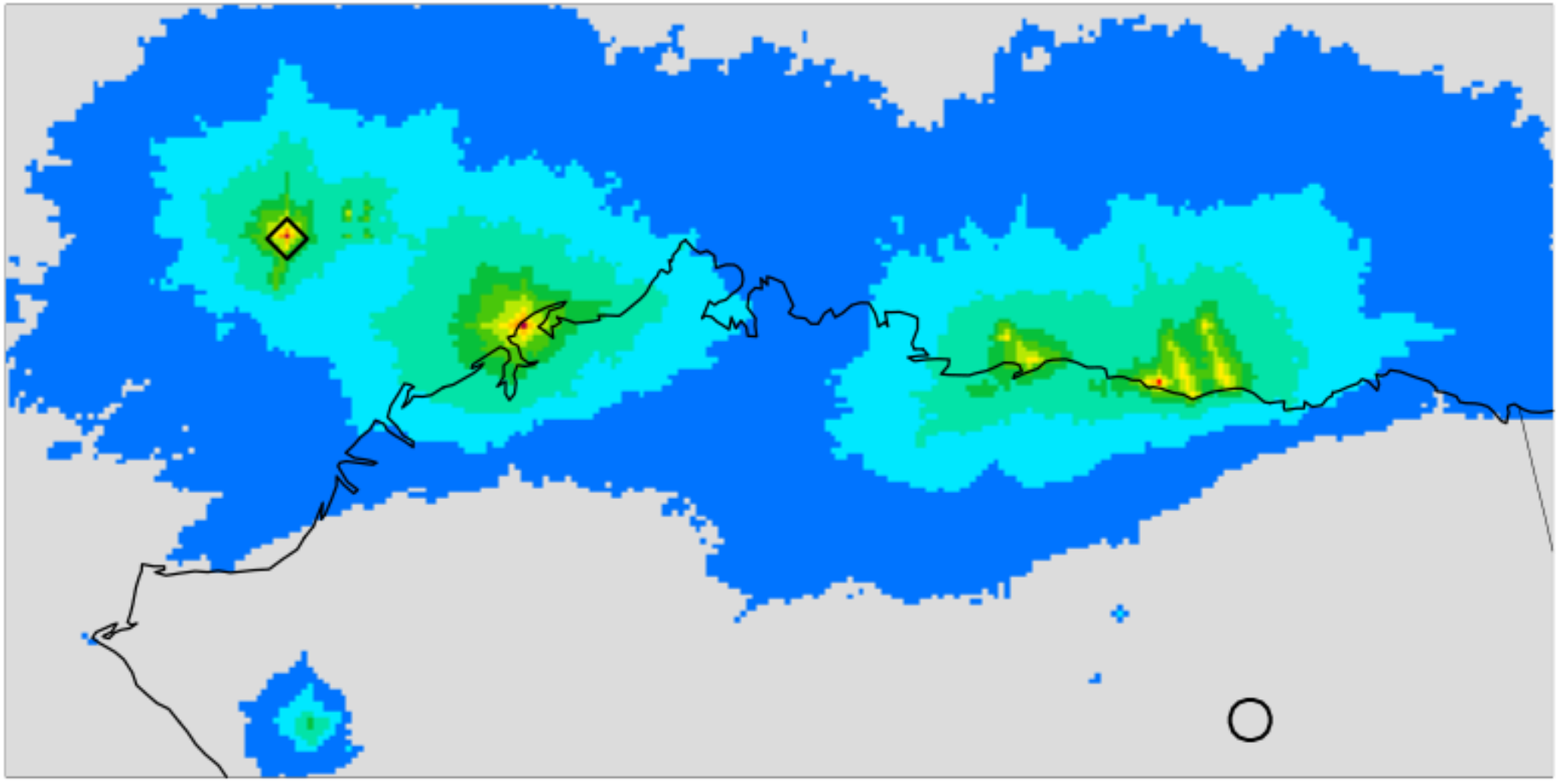
98th percentile daily max NO_2
High Development Scenario-Cumulative

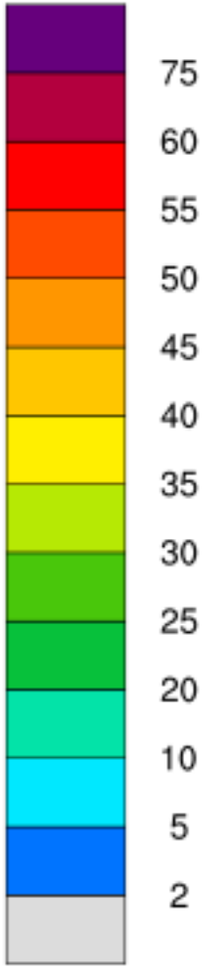




◇ max(51,97) = 72.4 ppb
○ min(223,11) = 0.1 ppb

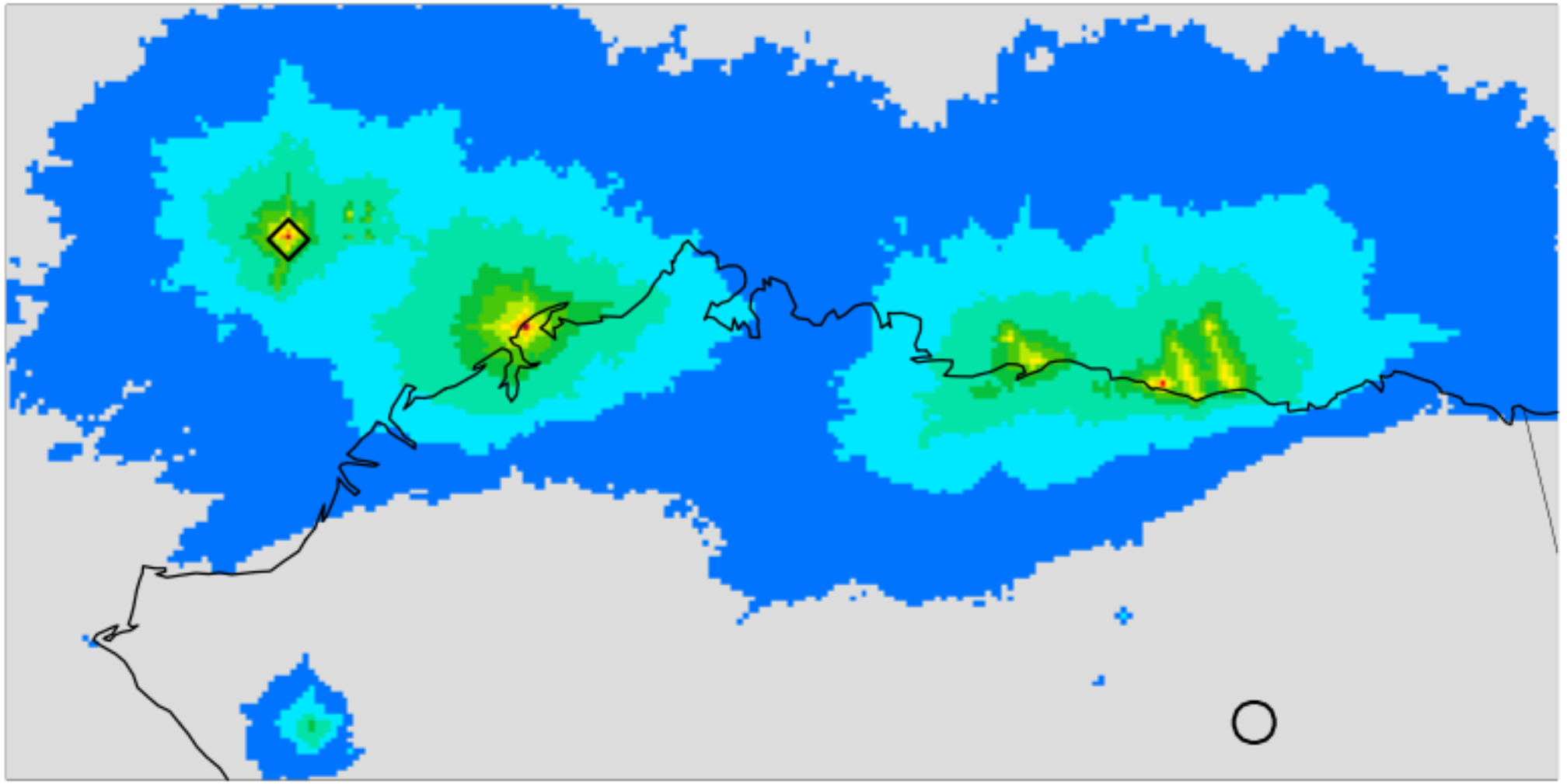
98th percentile daily max NO_2
Low Development Scenario-Cumulative

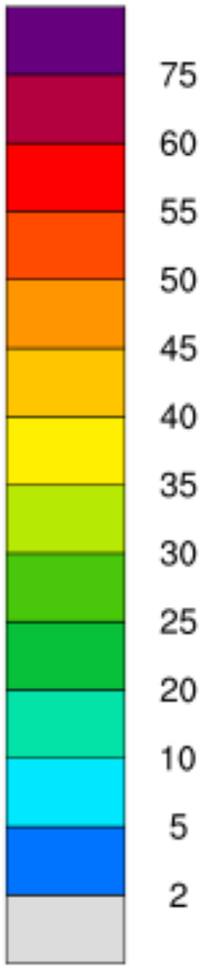




◇ max(51,97) = 72.4 ppb
○ min(223,11) = 0.1 ppb

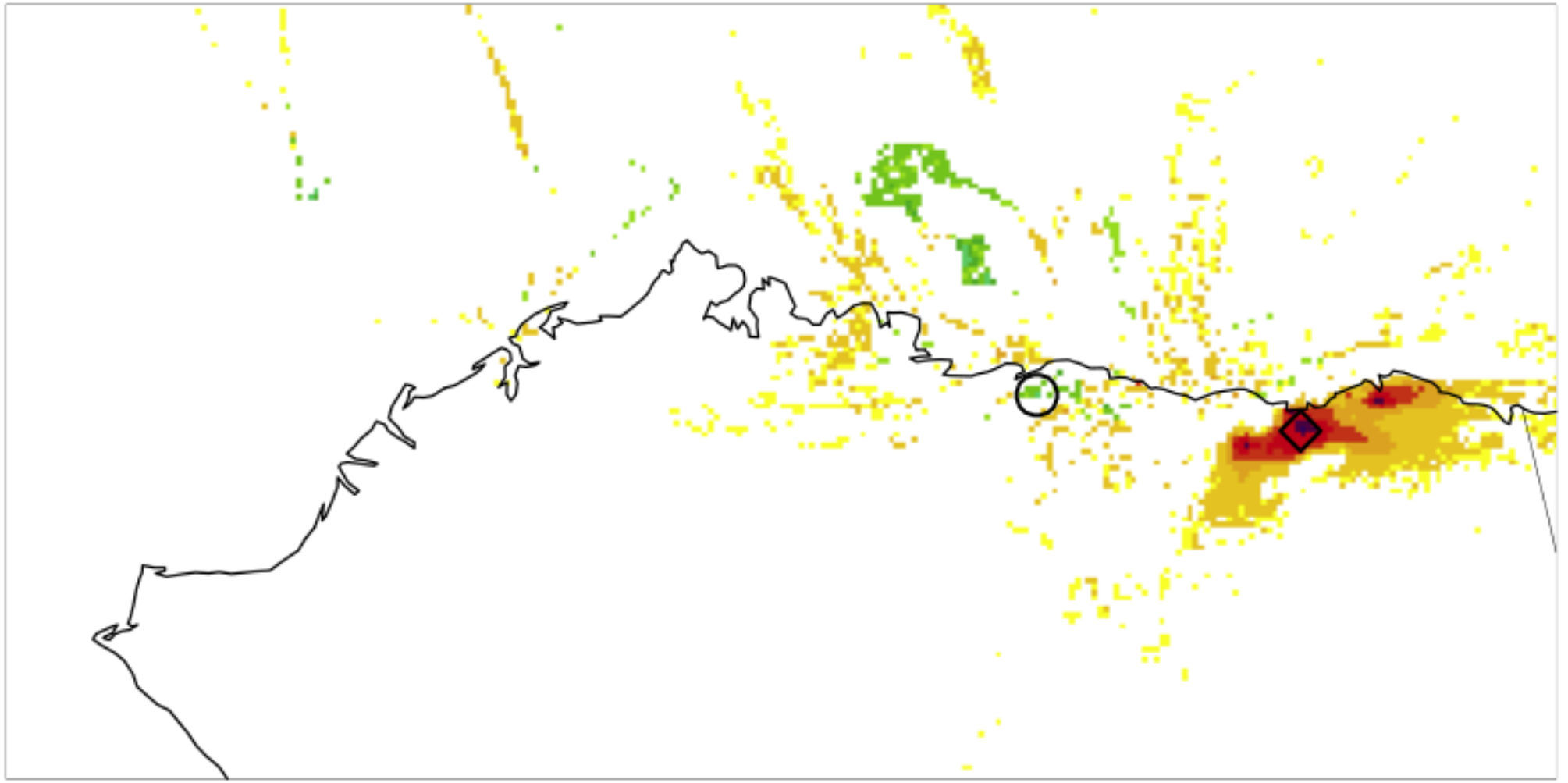
98th percentile daily max NO_2
No Action Alternative-Cumulative

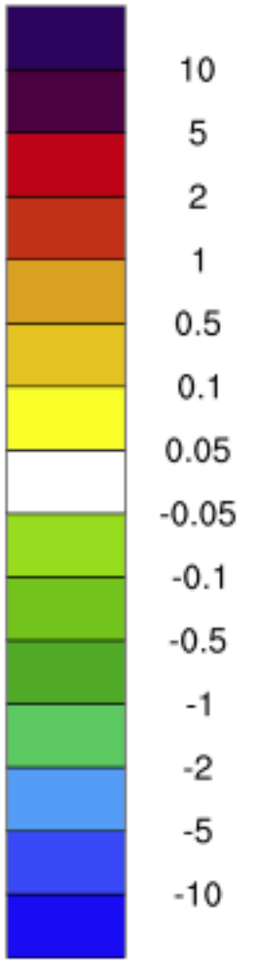




◇ max(51,97) = 72.4 ppb
○ min(223,11) = 0.1 ppb

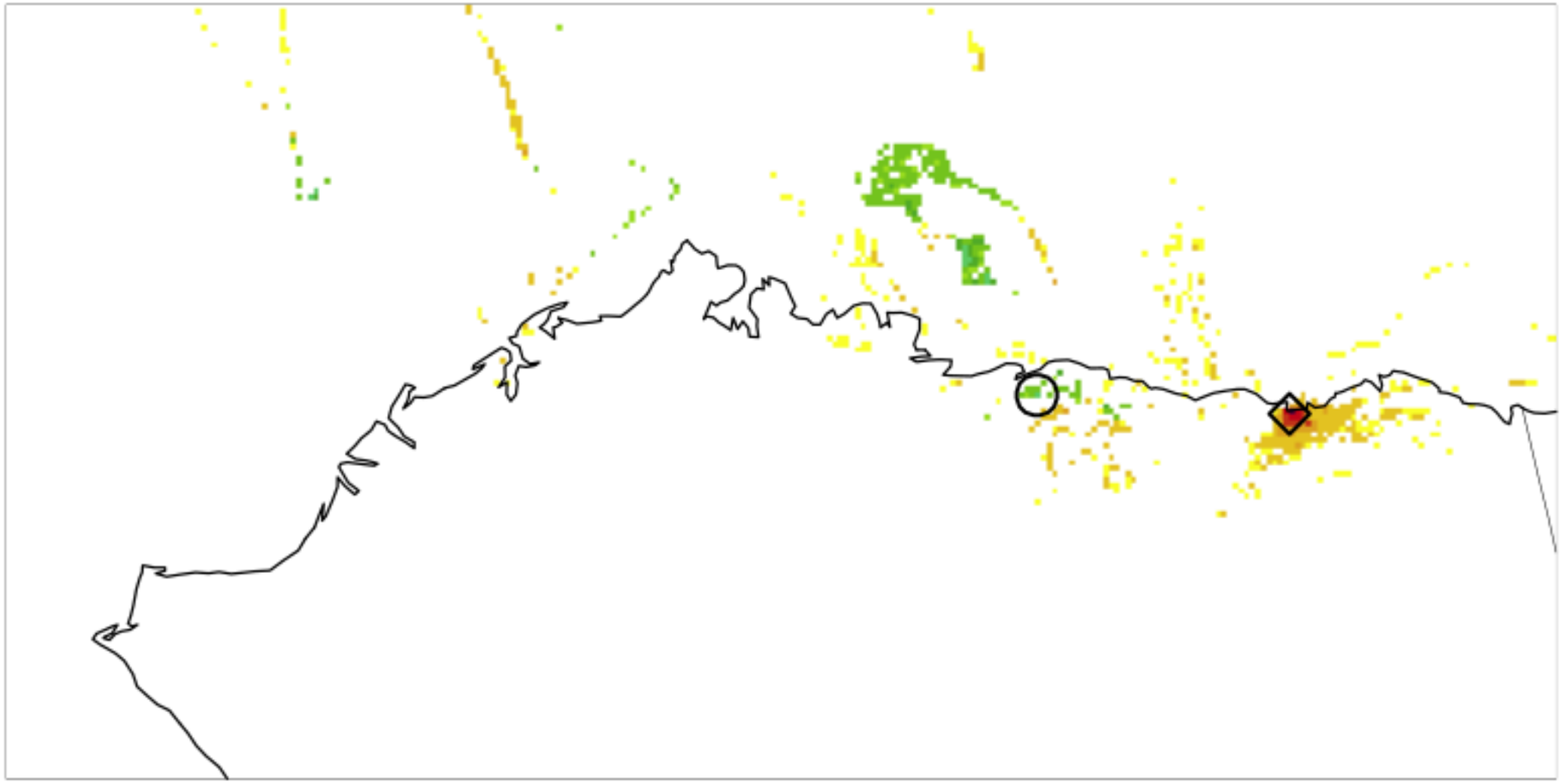
98th percentile daily max NO_2
High Development Scenario-Indirect Impact

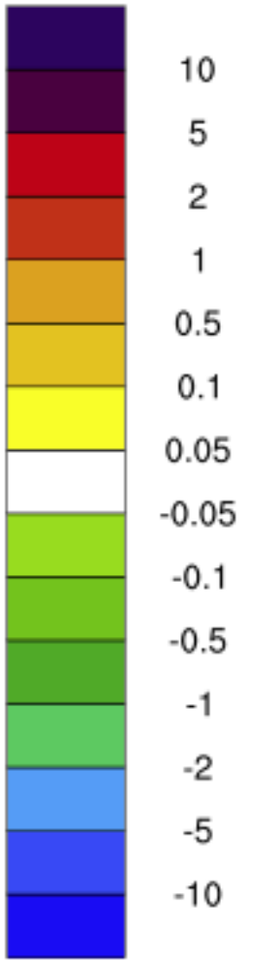




◇ max(231,63) = 12.846 ppb
○ min(184,69) = -1.940 ppb

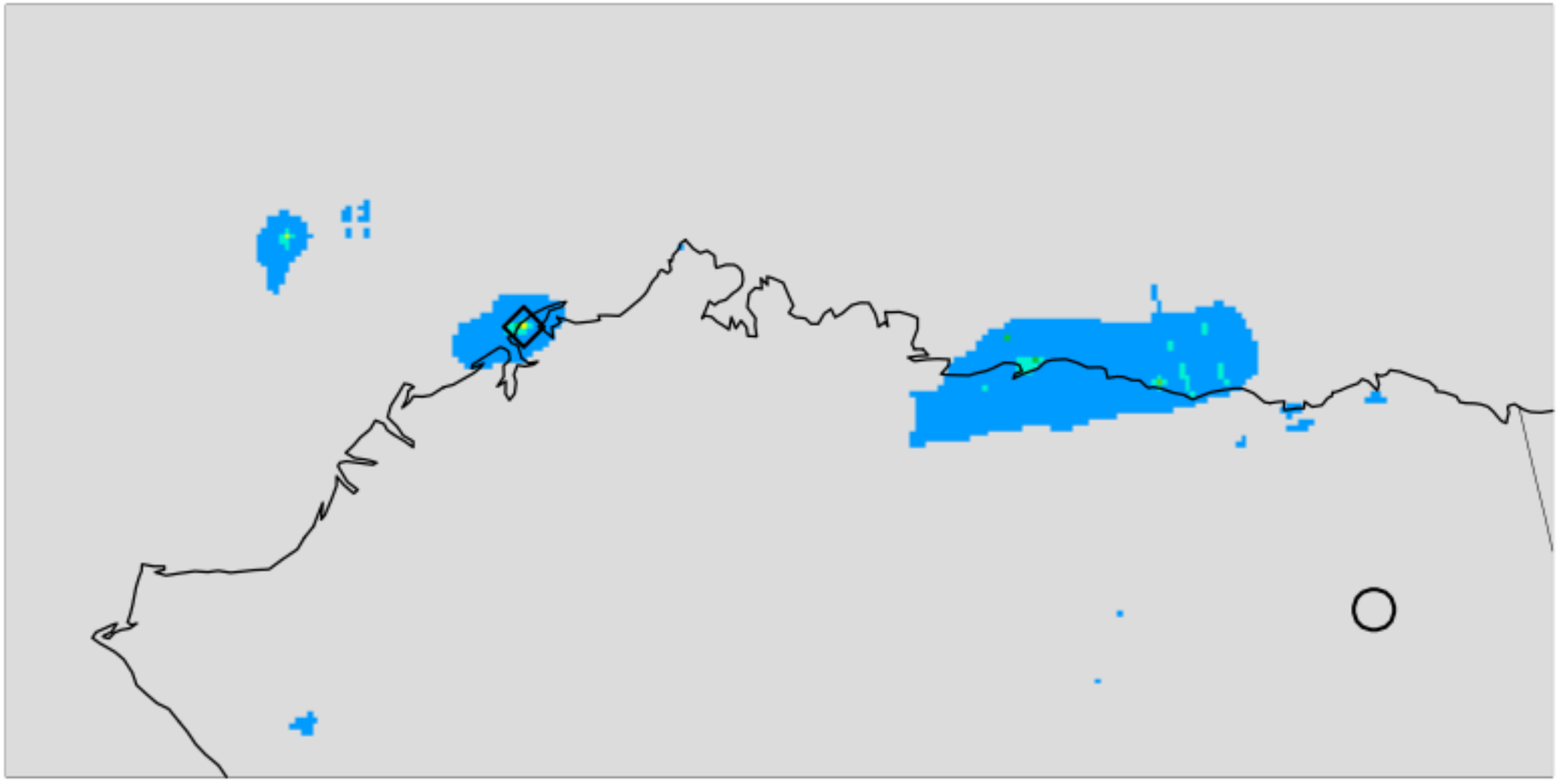
98th percentile daily max NO_2
Low Development Scenario-Indirect Impact

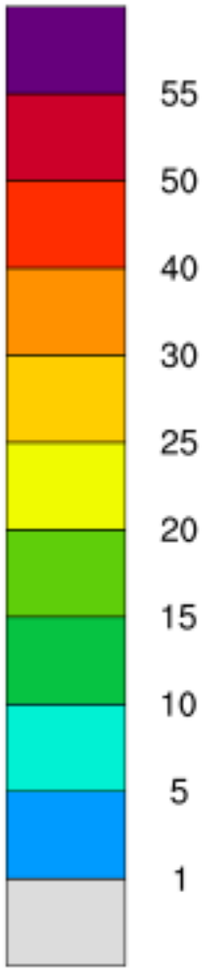




◇ max(229,66) = 6.780 ppb
○ min(184,69) = -1.940 ppb

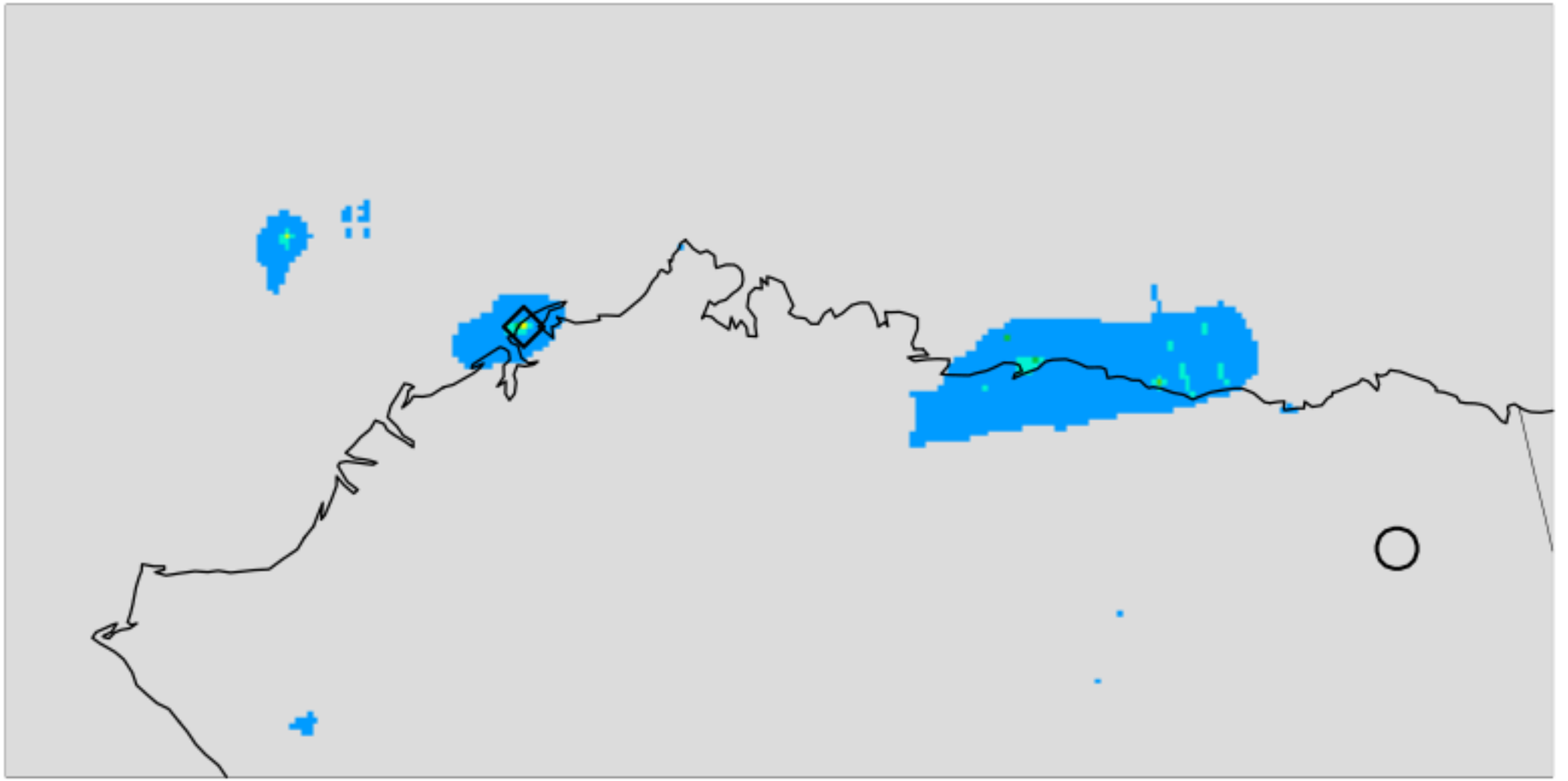
Annual Average NO_2
High Development Scenario-Cumulative

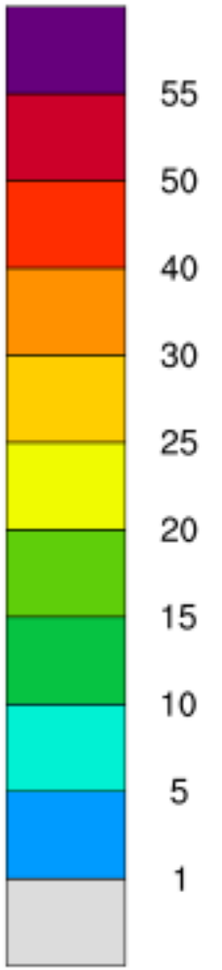




◇ max(93,81) = 22.0 ppb
○ min(245,31) = 0.0 ppb

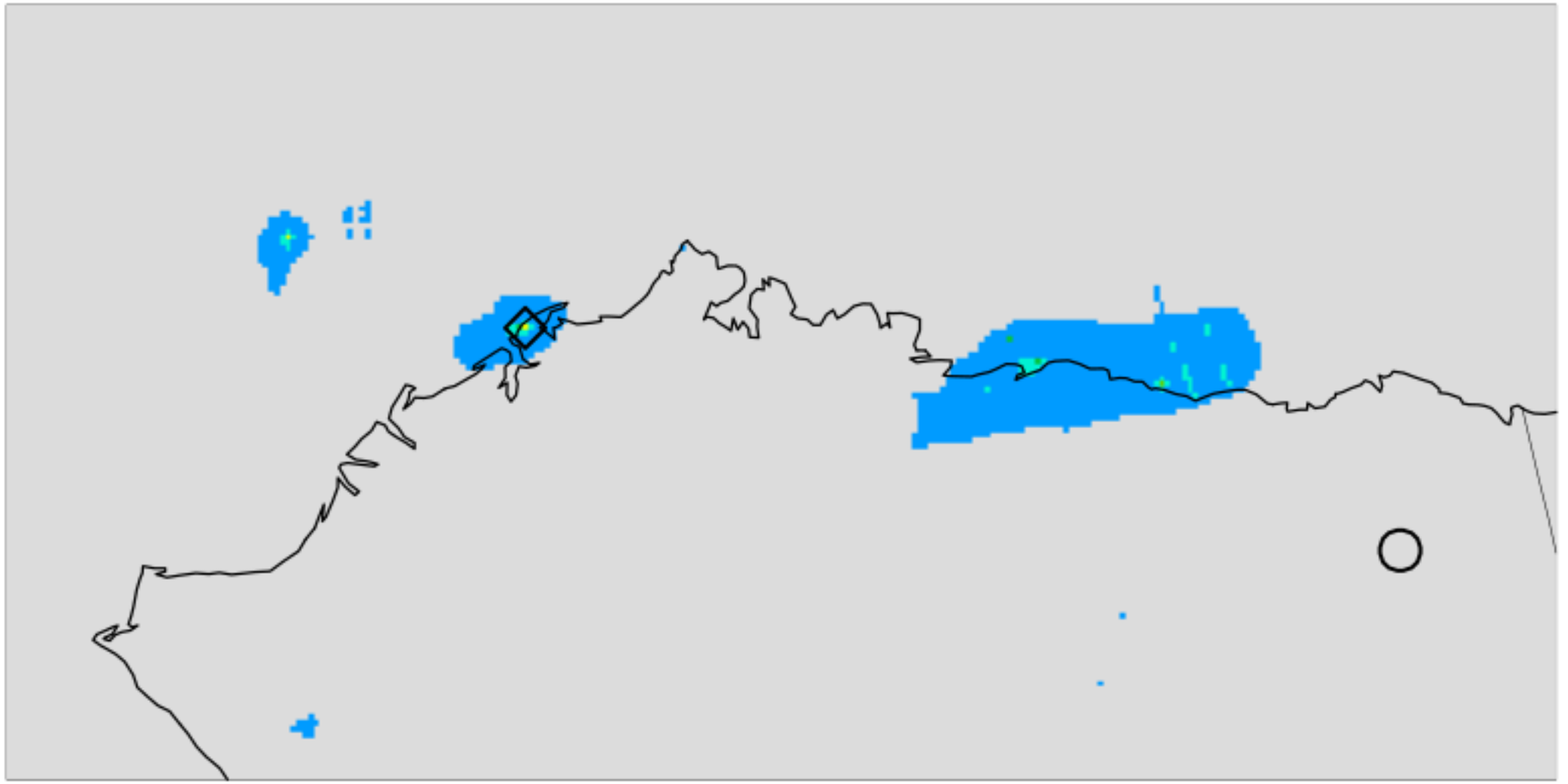
Annual Average NO_2
Low Development Scenario-Cumulative

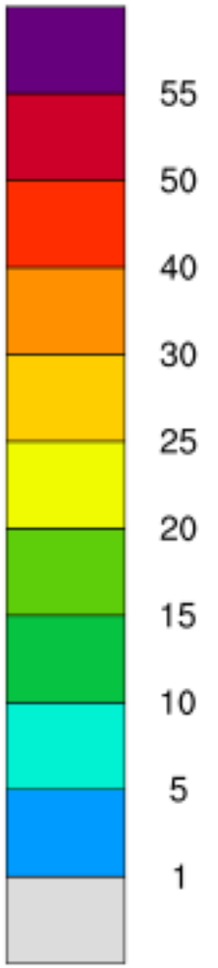




◇ max(93,81) = 22.0 ppb
○ min(249,42) = 0.0 ppb

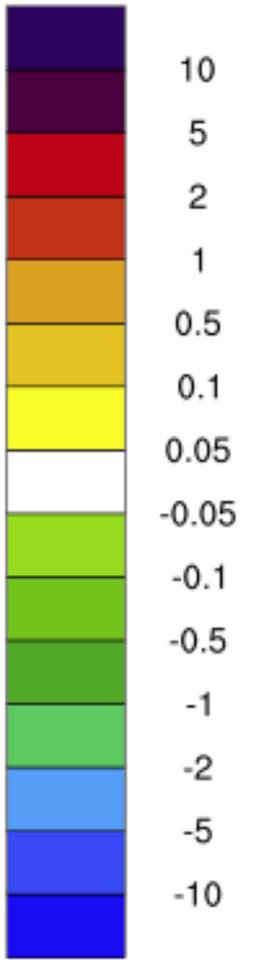
Annual Average NO_2
No Action Alternative-Cumulative





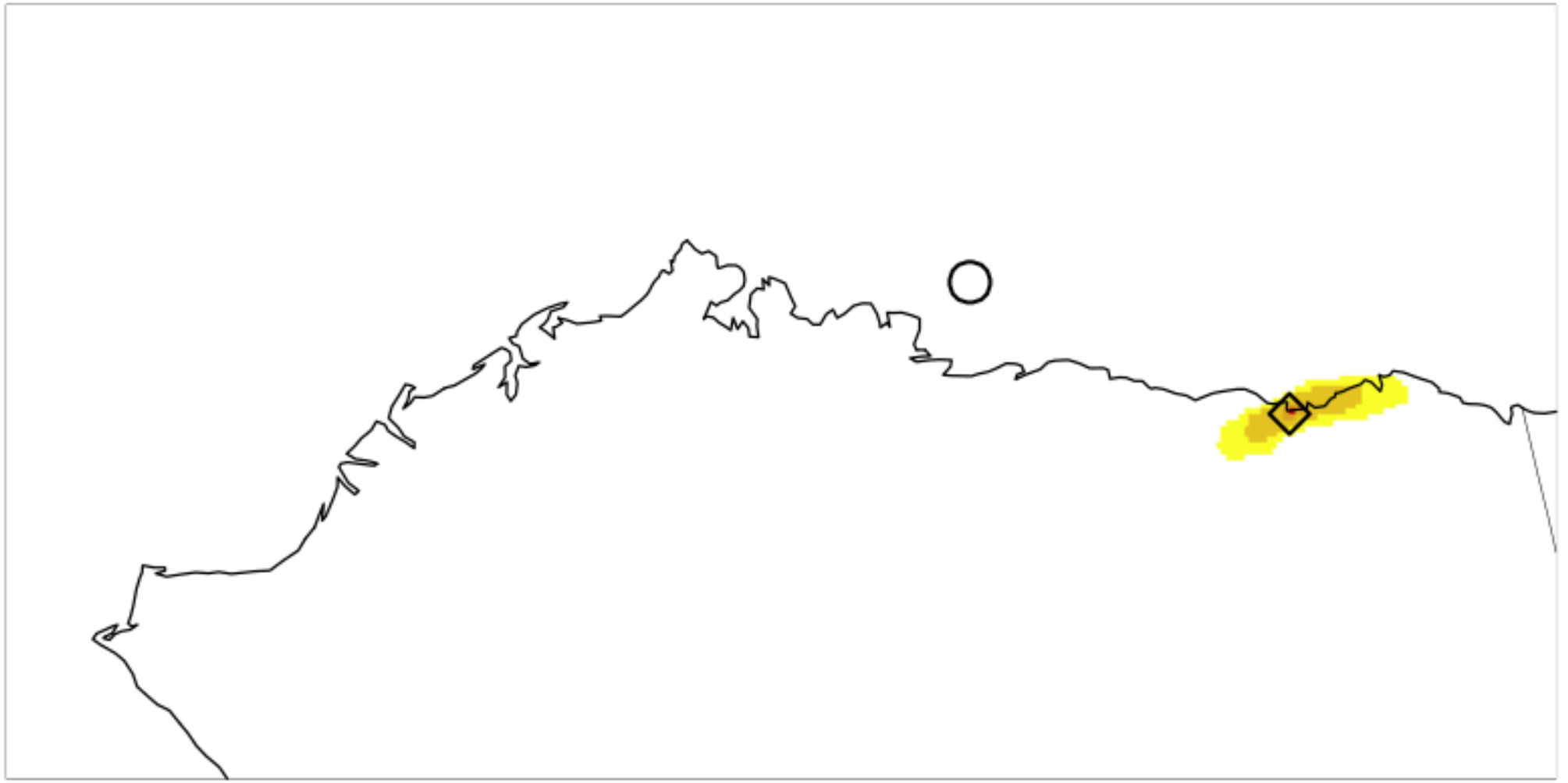
◇ max(93,81) = 22.0 ppb
○ min(249,42) = 0.0 ppb

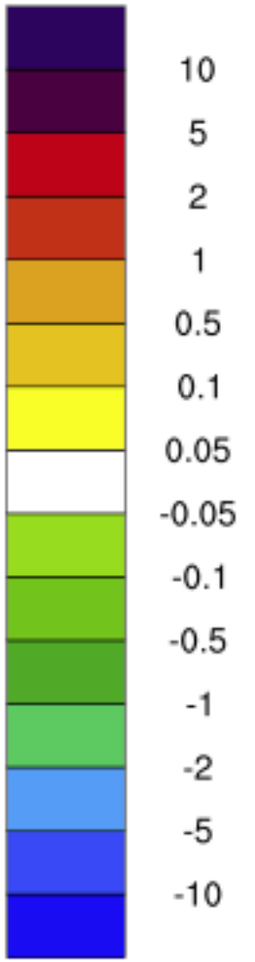
Annual average NO_2
High Development Scenario-Indirect Impact



◇ max(231,63) = 3.373 ppb
○ min(51,98) = -0.002 ppb

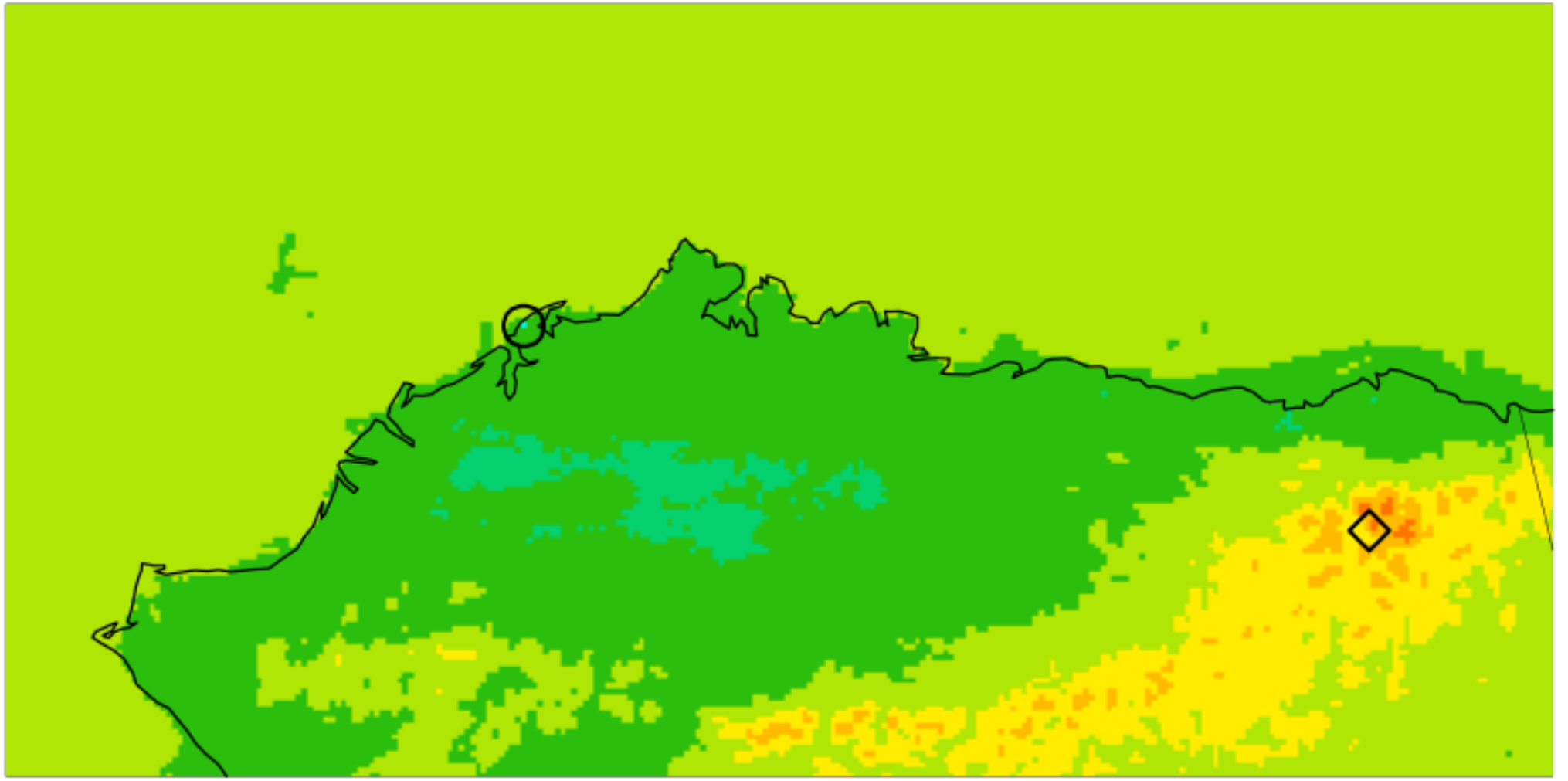
Annual average NO_2
Low Development Scenario-Indirect Impact

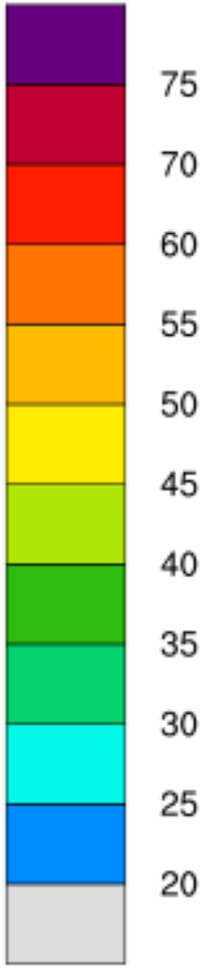




◇ max(229,66) = 2.469 ppb
○ min(172,89) = -0.004 ppb

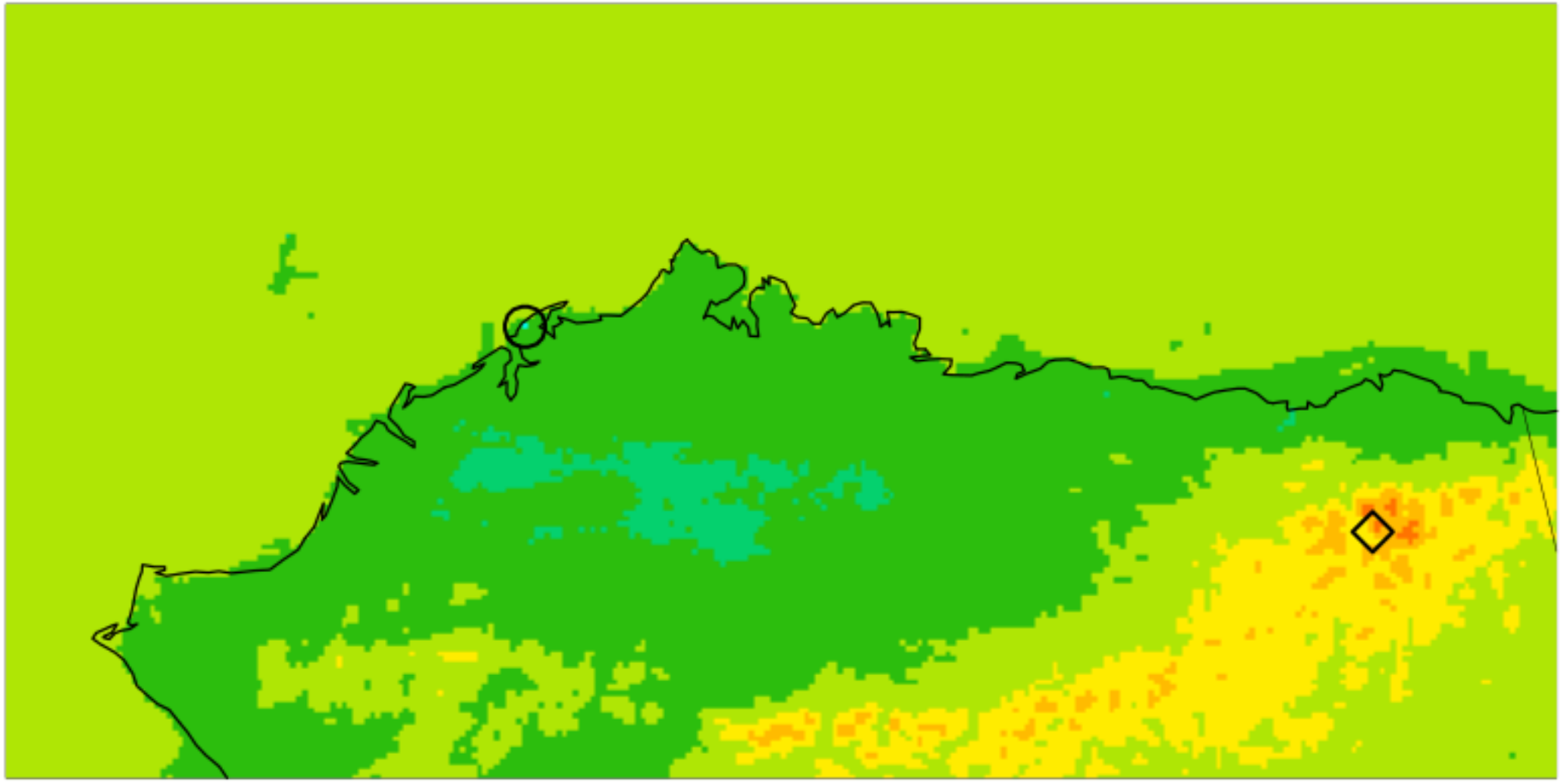
4th High Daily Max 8 Hour Avg Ozone
High Development Scenario-Cumulative

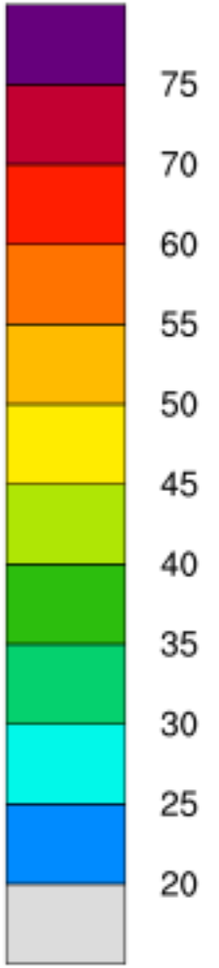




◇ max(244,45) = 56.3 ppb
○ min(93,81) = 27.1 ppb

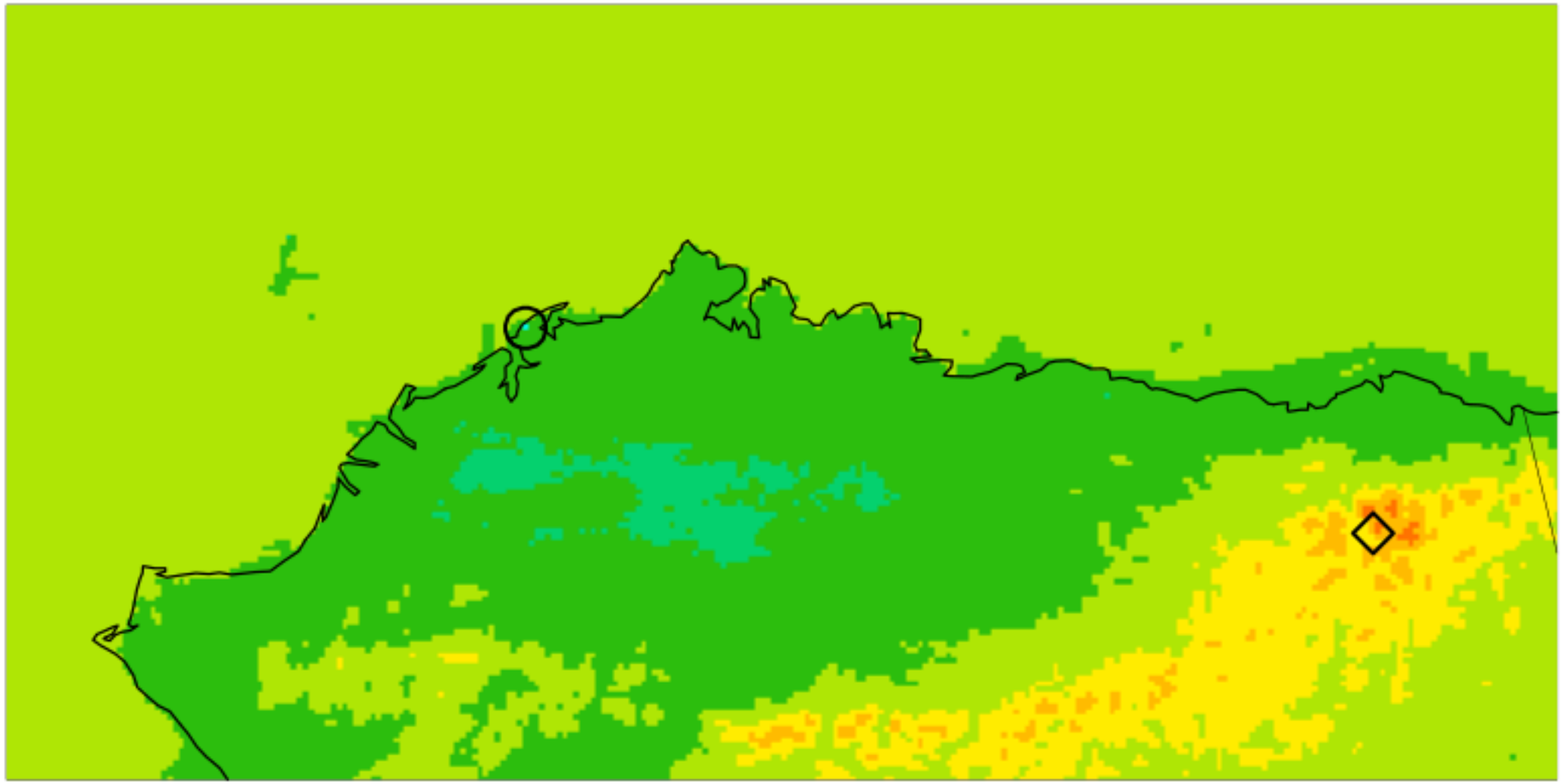
4th High Daily Max 8 Hour Avg Ozone
Low Development Scenario-Cumulative

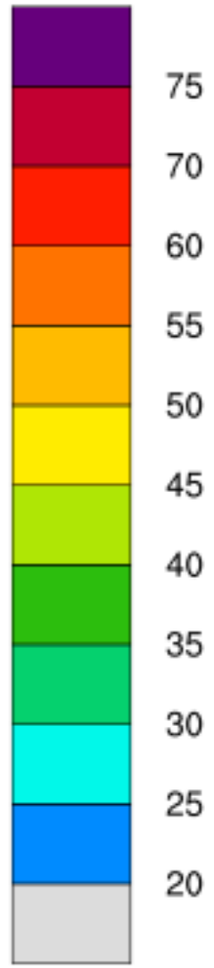




◇ max(244,45) = 56.3 ppb
○ min(93,81) = 27.1 ppb

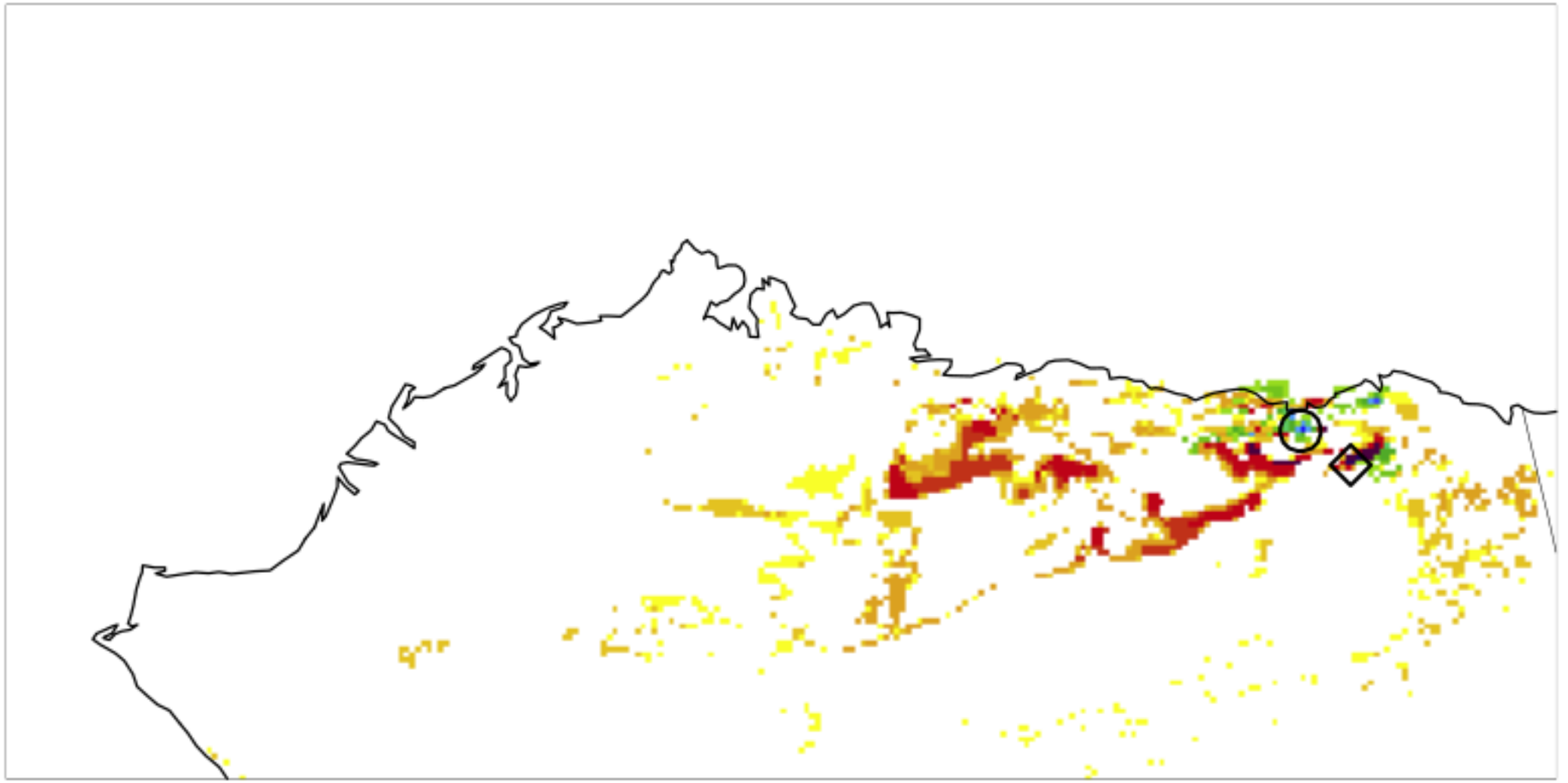
4th High Daily Max 8 Hour Avg Ozone
No Action Alternative-Cumulative

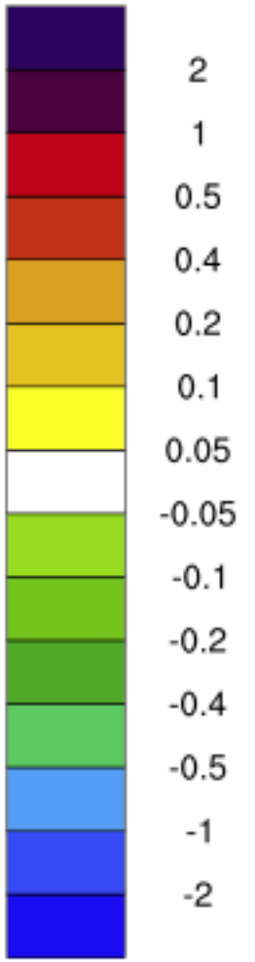




◇ max(244,45) = 56.3 ppb
○ min(93,81) = 27.1 ppb

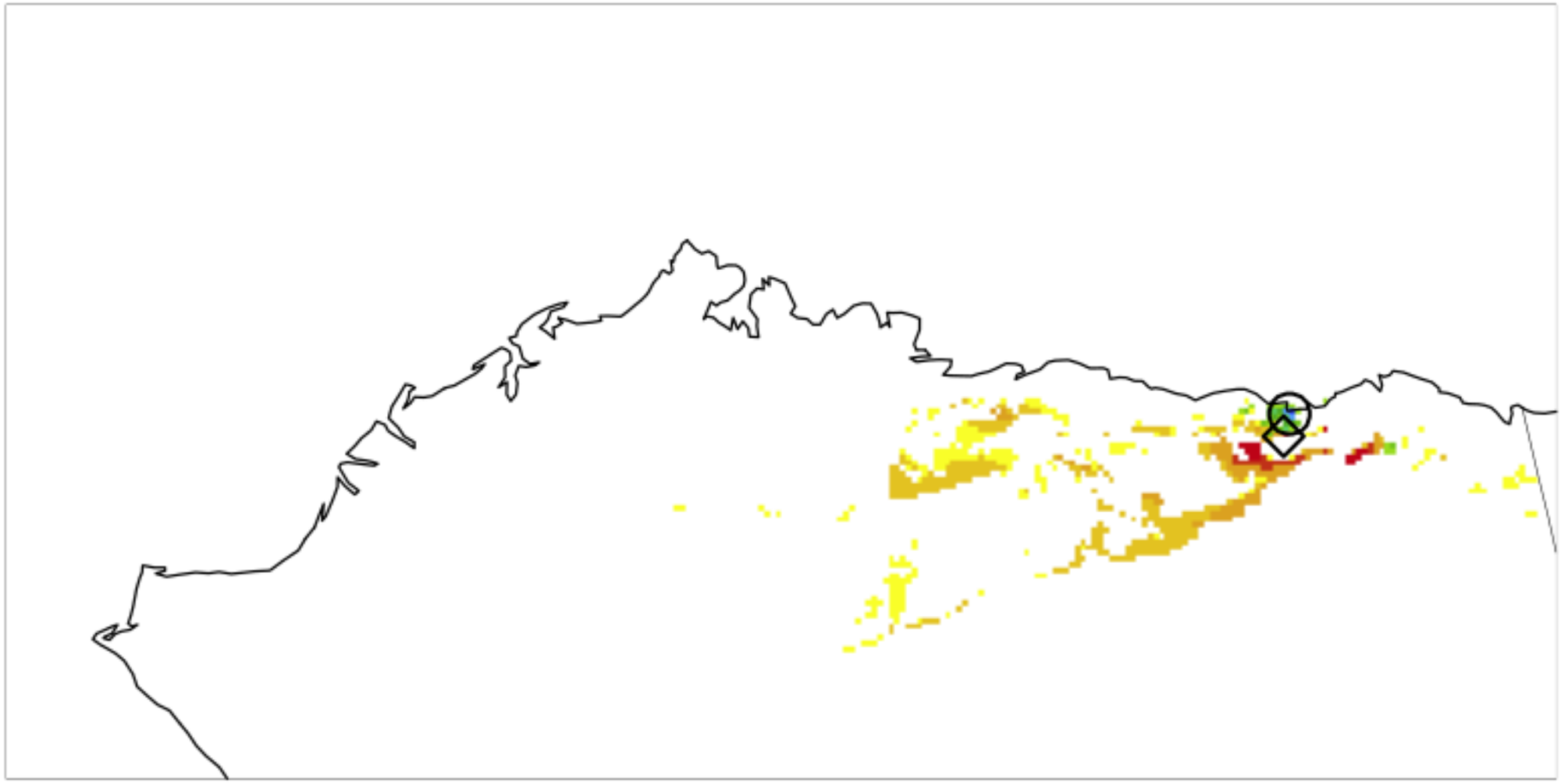
4th High Daily Max 8 Hour Avg Ozone
High Development Scenario-Indirect Impact

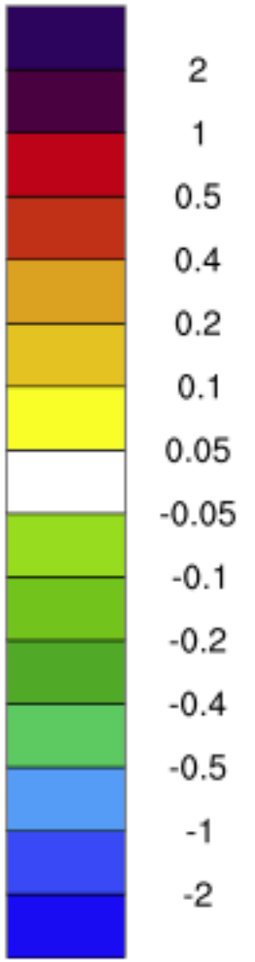




◇ max(240,57) = 2.216 ppb
○ min(231,63) = -3.701 ppb

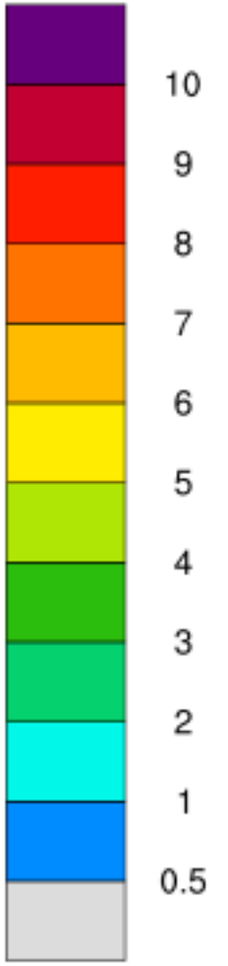
4th High Daily Max 8 Hour Avg Ozone
Low Development Scenario-Indirect Impact





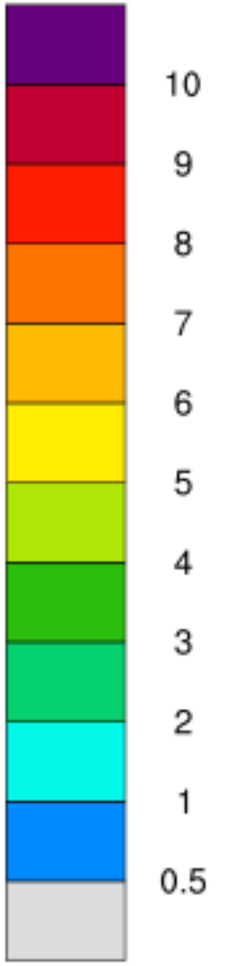
◇ max(228,62) = 0.826 ppb
○ min(229,66) = -1.591 ppb

Annual average $PM_{2.5}$ concentration
High Development Scenario-Cumulative



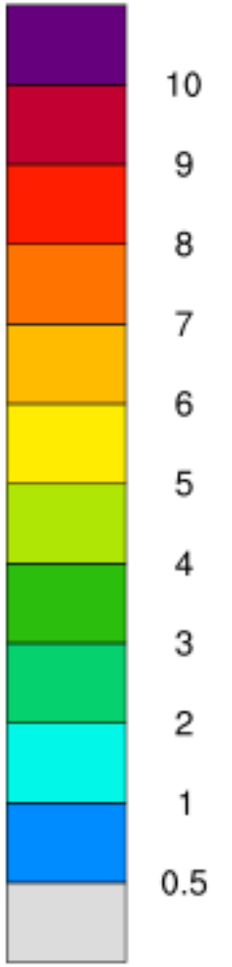
◇ max(93,81) = 10.1 μg/m^3
○ min(213,28) = 1.1 μg/m^3

Annual average $PM_{2.5}$ concentration
Low Development Scenario-Cumulative



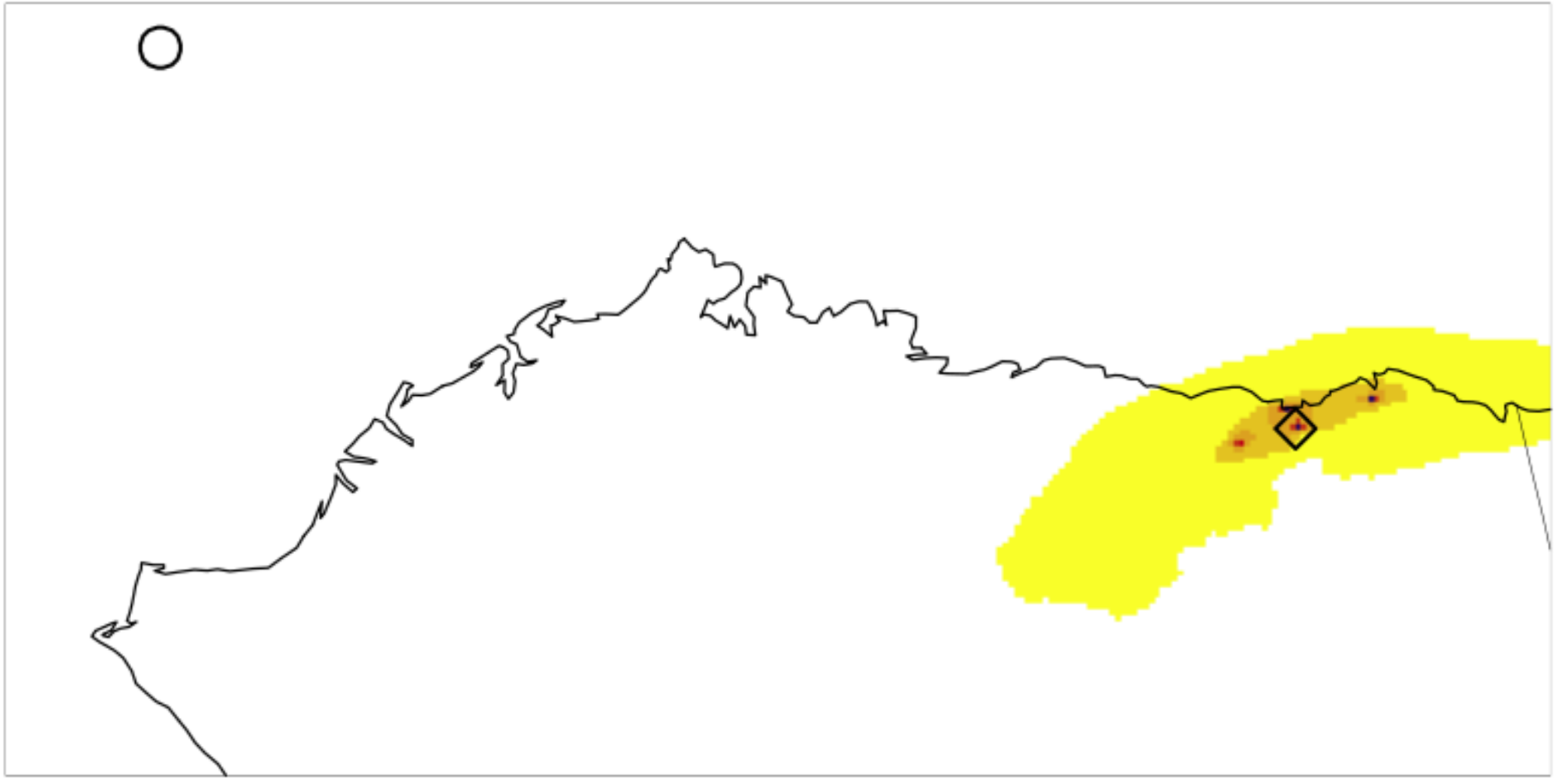
◇ max(93,81) = 10.1 μg/m^3
○ min(213,28) = 1.1 μg/m^3

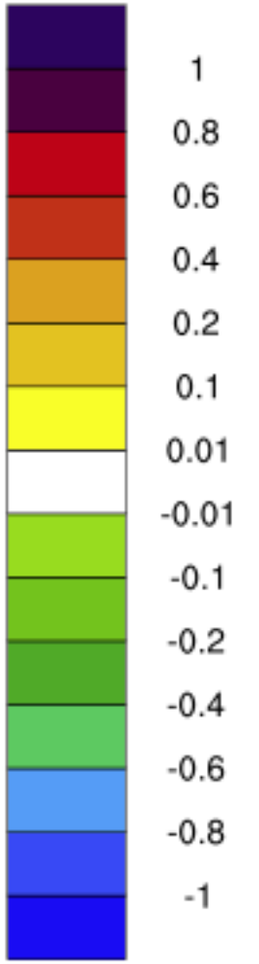
Annual average $PM_{2.5}$ concentration
No Action Alternative-Cumulative



◇ max(93,81) = 10.1 μg/m^3
○ min(213,28) = 1.1 μg/m^3

Annual average $PM_{2.5}$ concentration
High Development Scenario-Indirect Impact

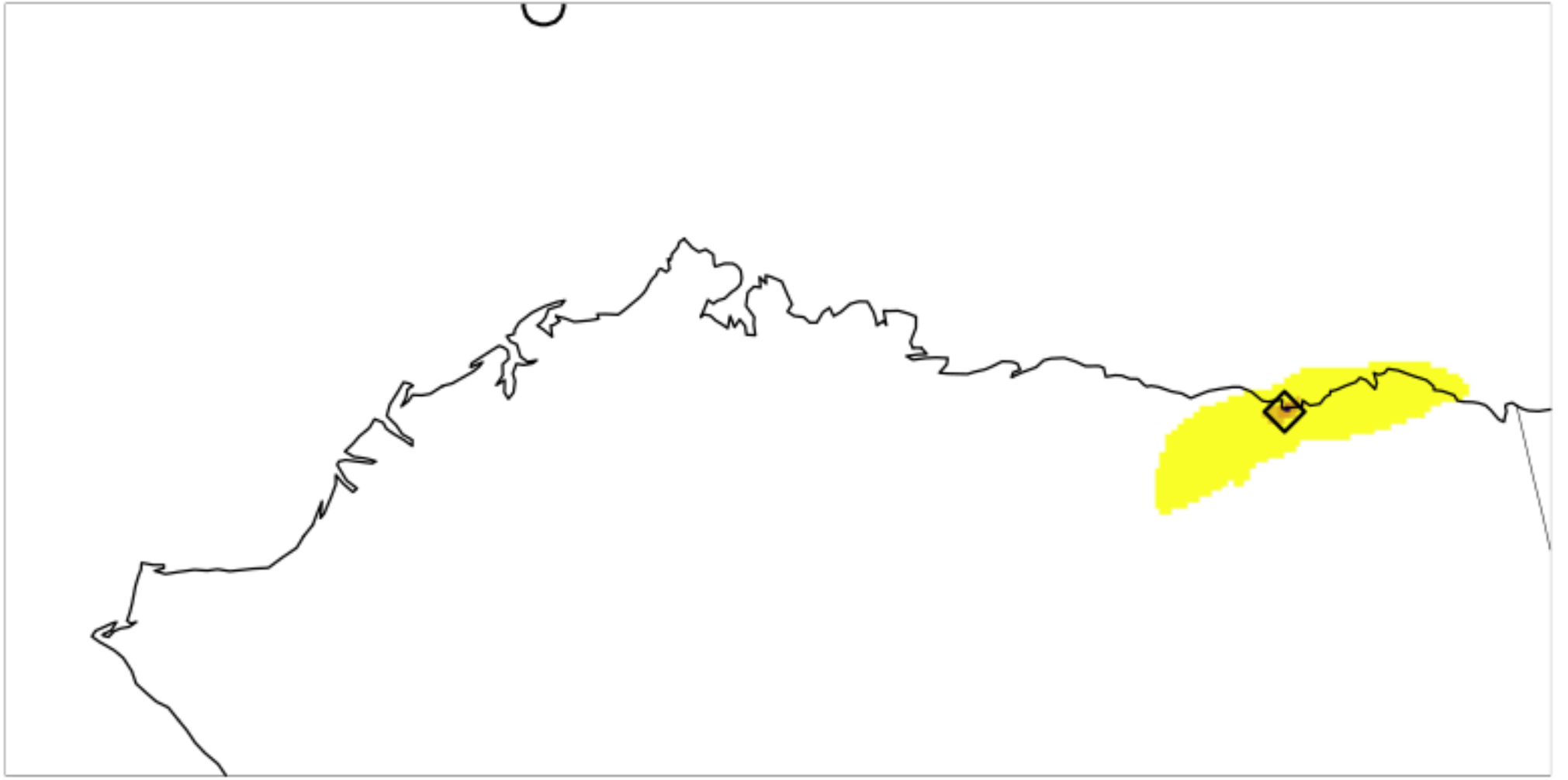


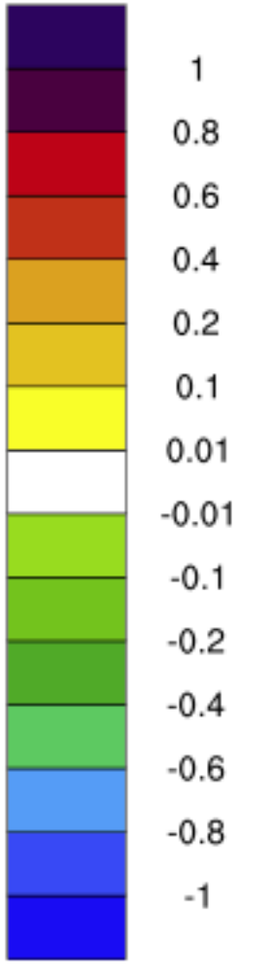


◇max(231,63) = 1.4990 $\mu g/m^3$

○min(29,131) = -0.0002 $\mu g/m^3$

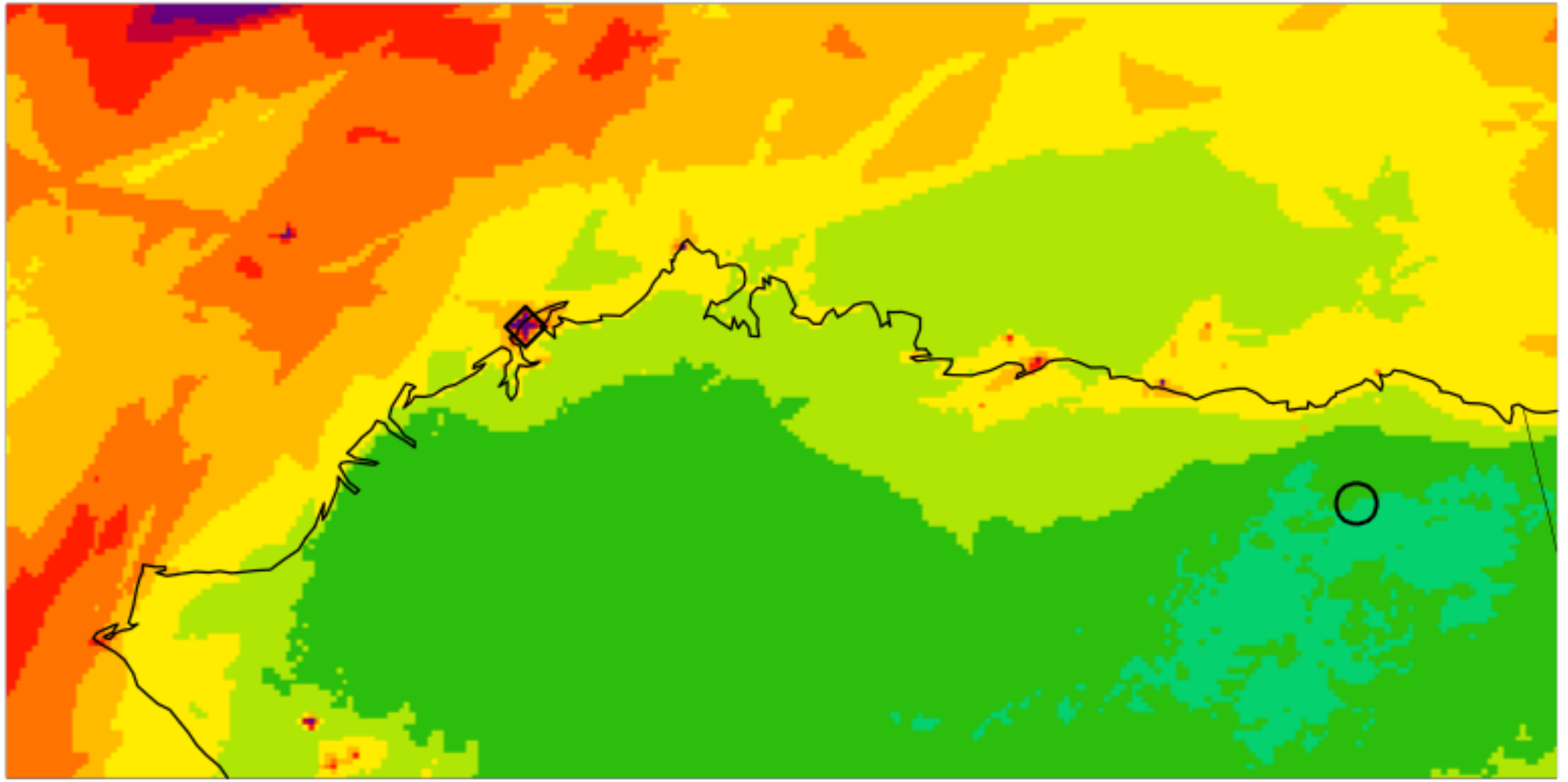
Annual average $PM_{2.5}$ concentration
Low Development Scenario-Indirect Impact

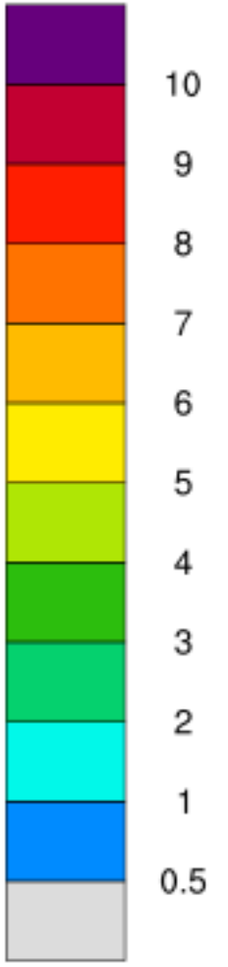




◇max(229,66) = 1.1240 μg/m^3
○min(97,138) = -0.0004 μg/m^3

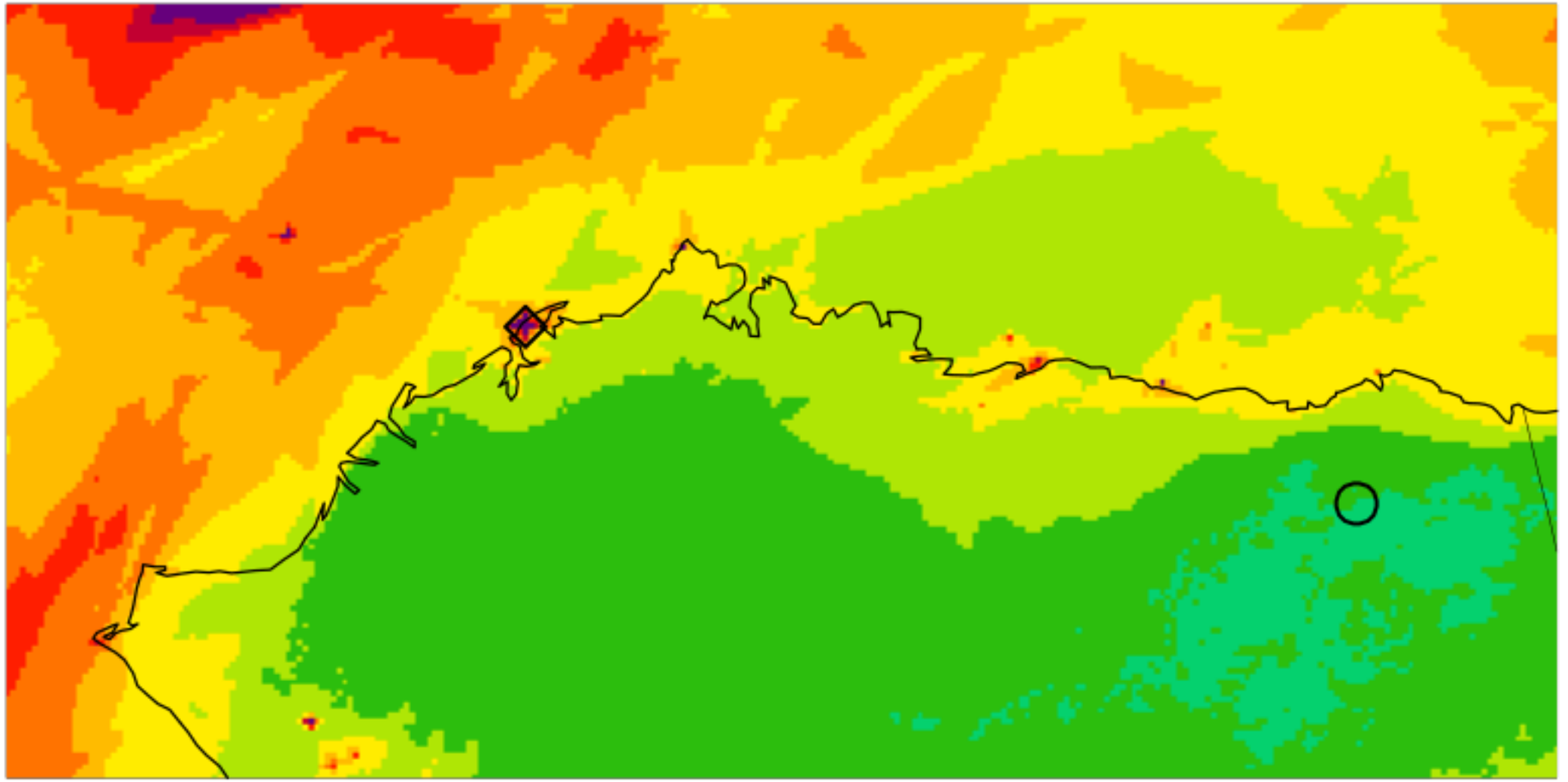
8th highest daily average $PM_{2.5}$ concentration
High Development Scenario-Cumulative

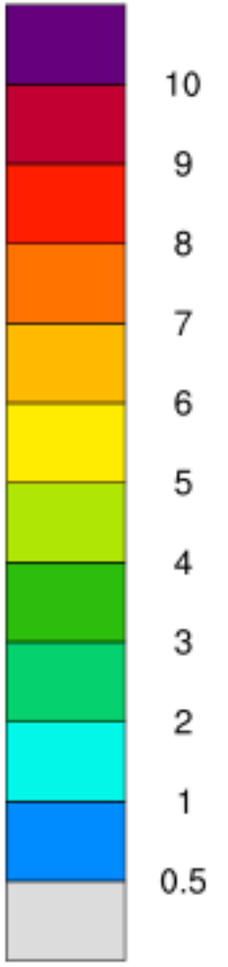




◇ max(93,81) = 31.4 μg/m^3
○ min(241,50) = 2.6 μg/m^3

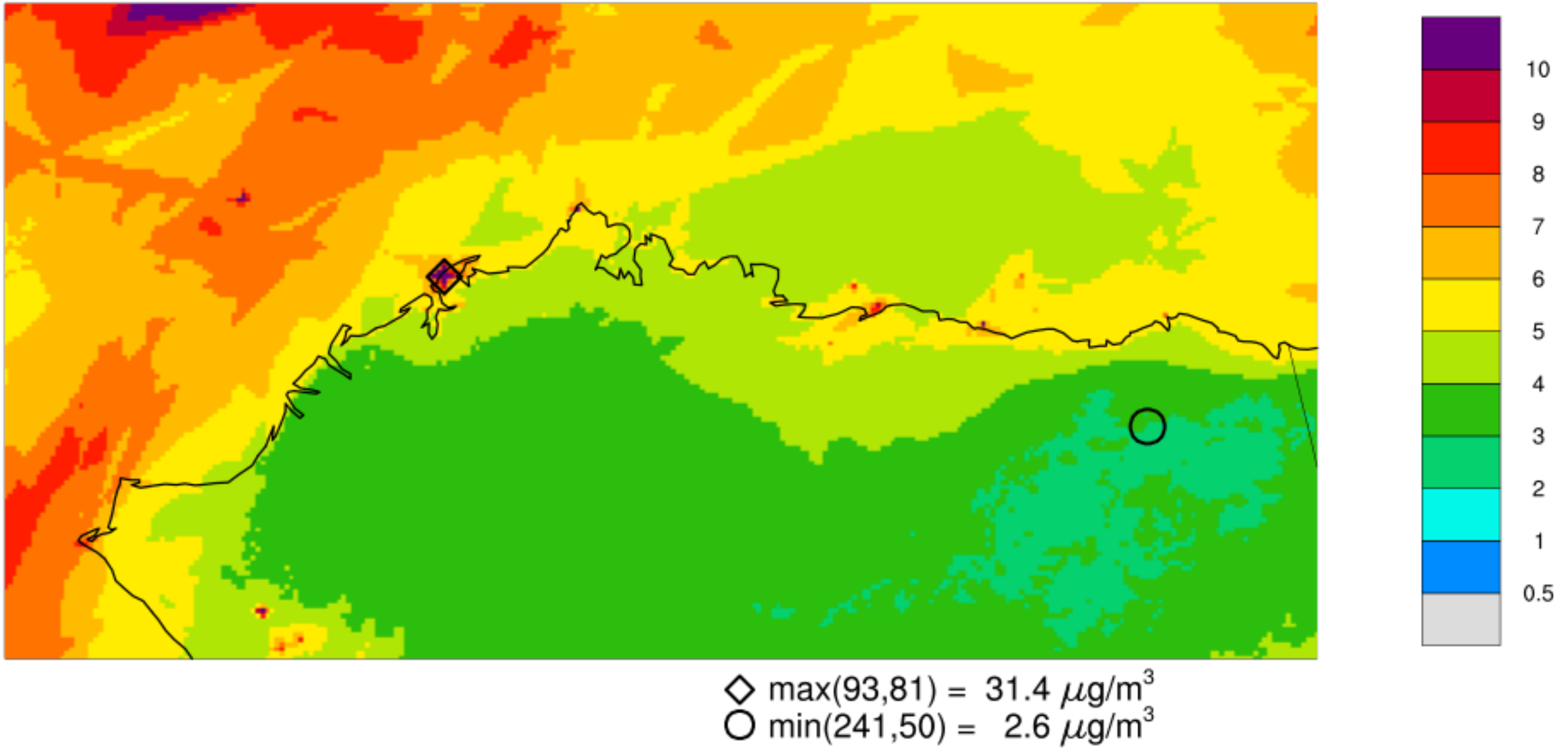
8th highest daily average $PM_{2.5}$ concentration
Low Development Scenario-Cumulative



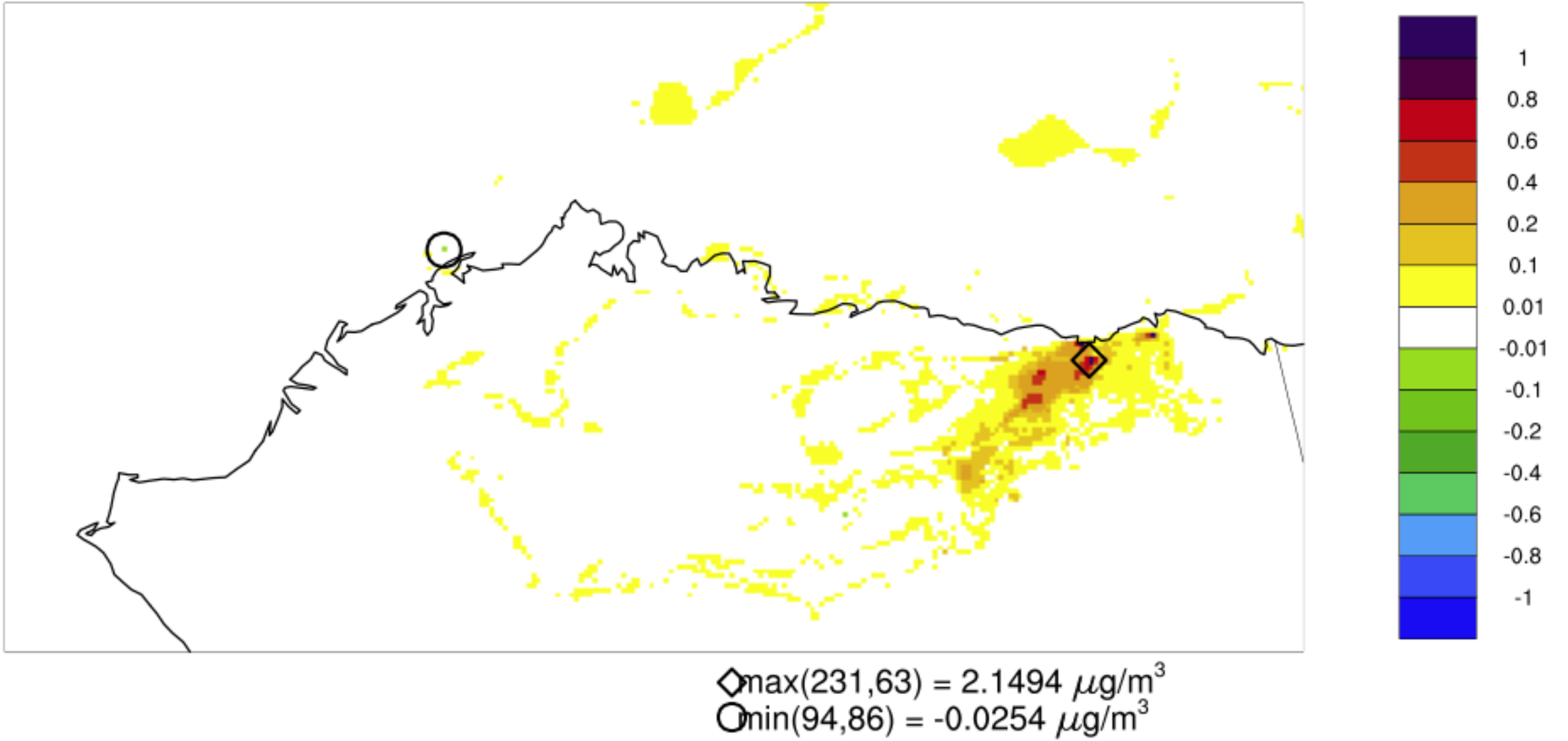


◇ max(93,81) = 31.4 μg/m^3
○ min(241,50) = 2.6 μg/m^3

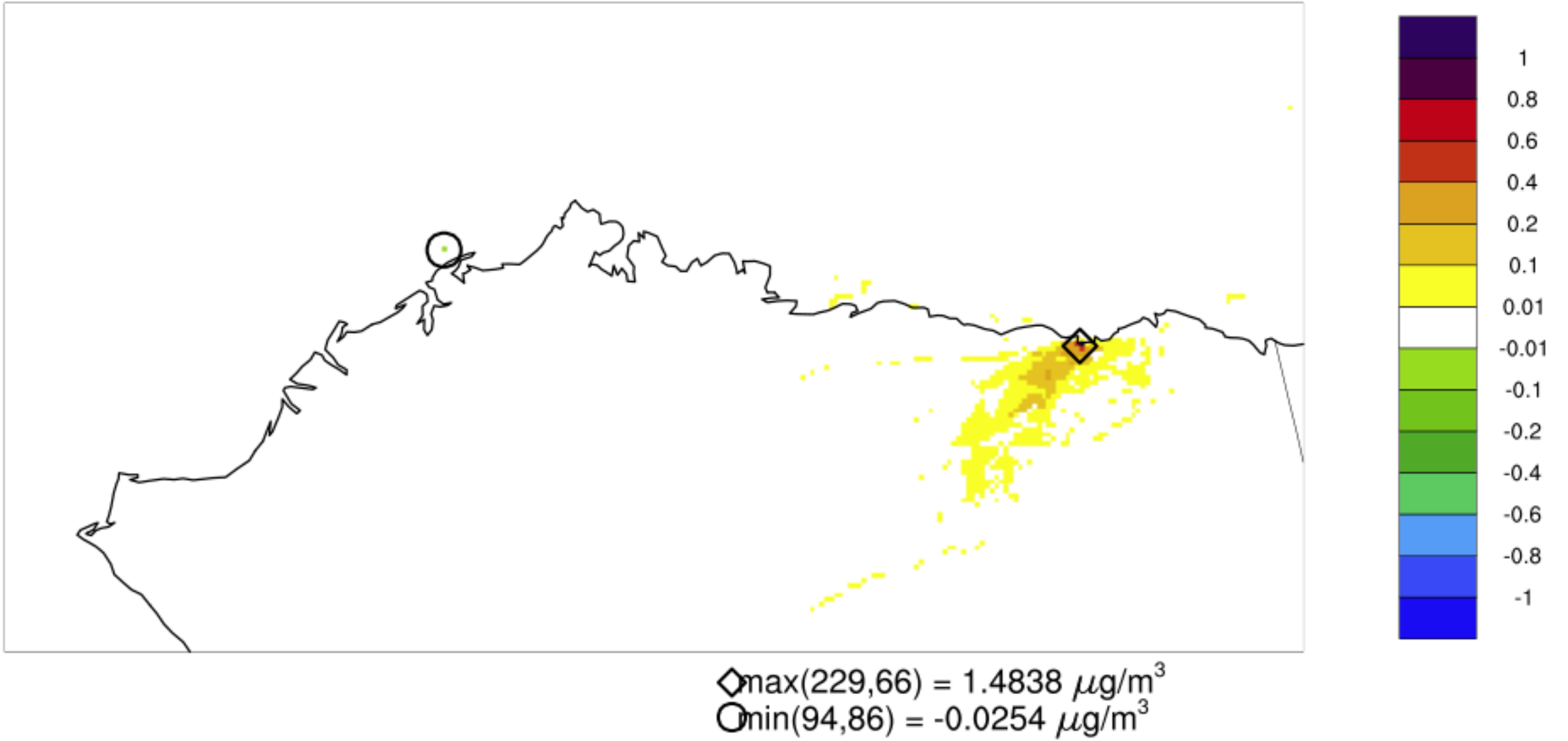
8th highest daily average $PM_{2.5}$ concentration
No Action Alternative-Cumulative



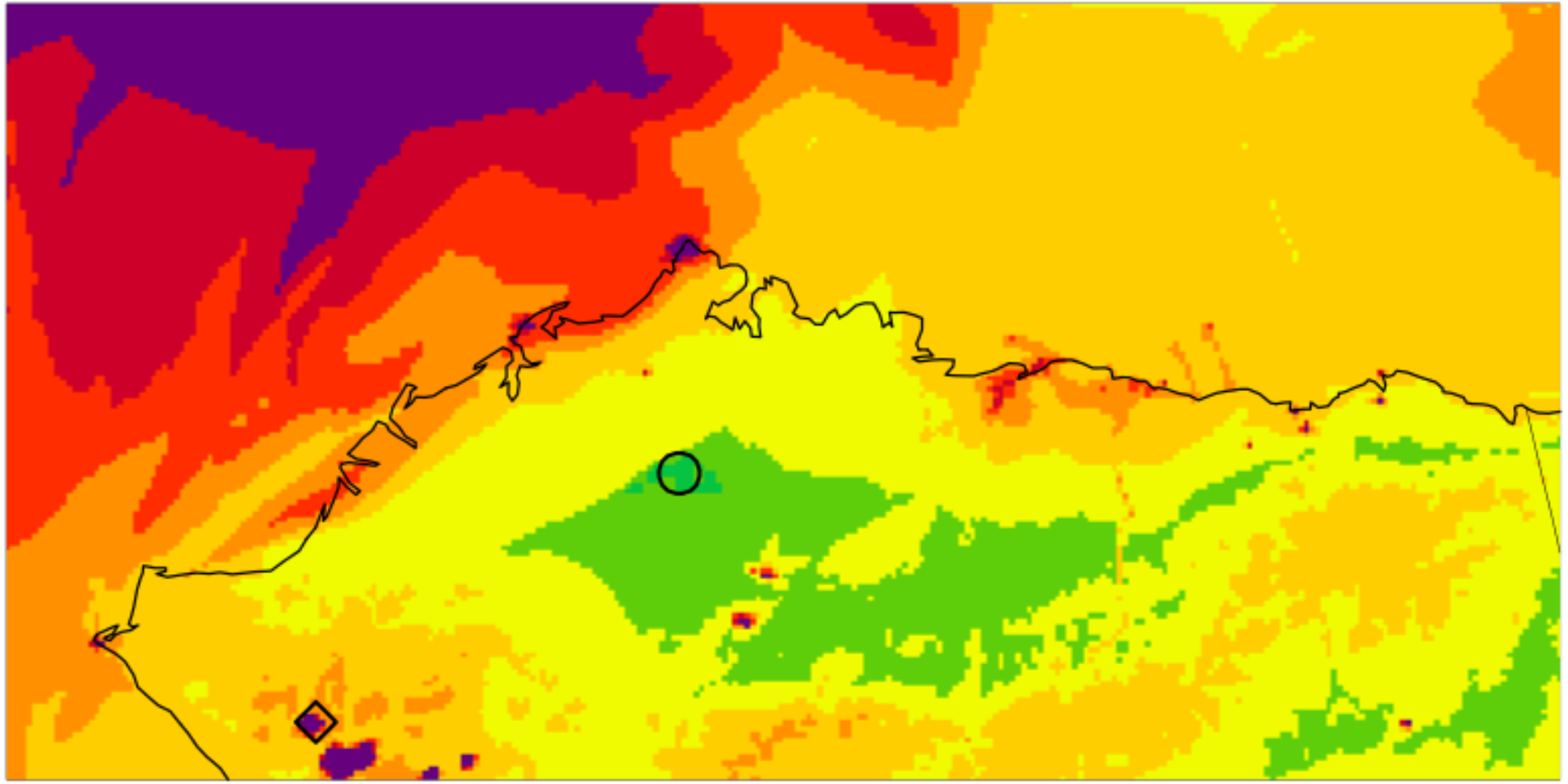
8th highest daily average $PM_{2.5}$ concentration
High Development Scenario-Indirect Impact

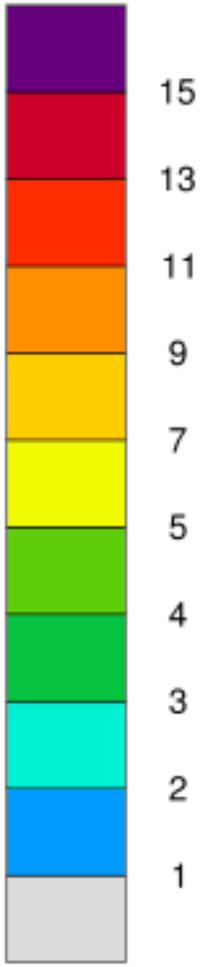


8th highest daily average $PM_{2.5}$ concentration
Low Development Scenario-Indirect Impact



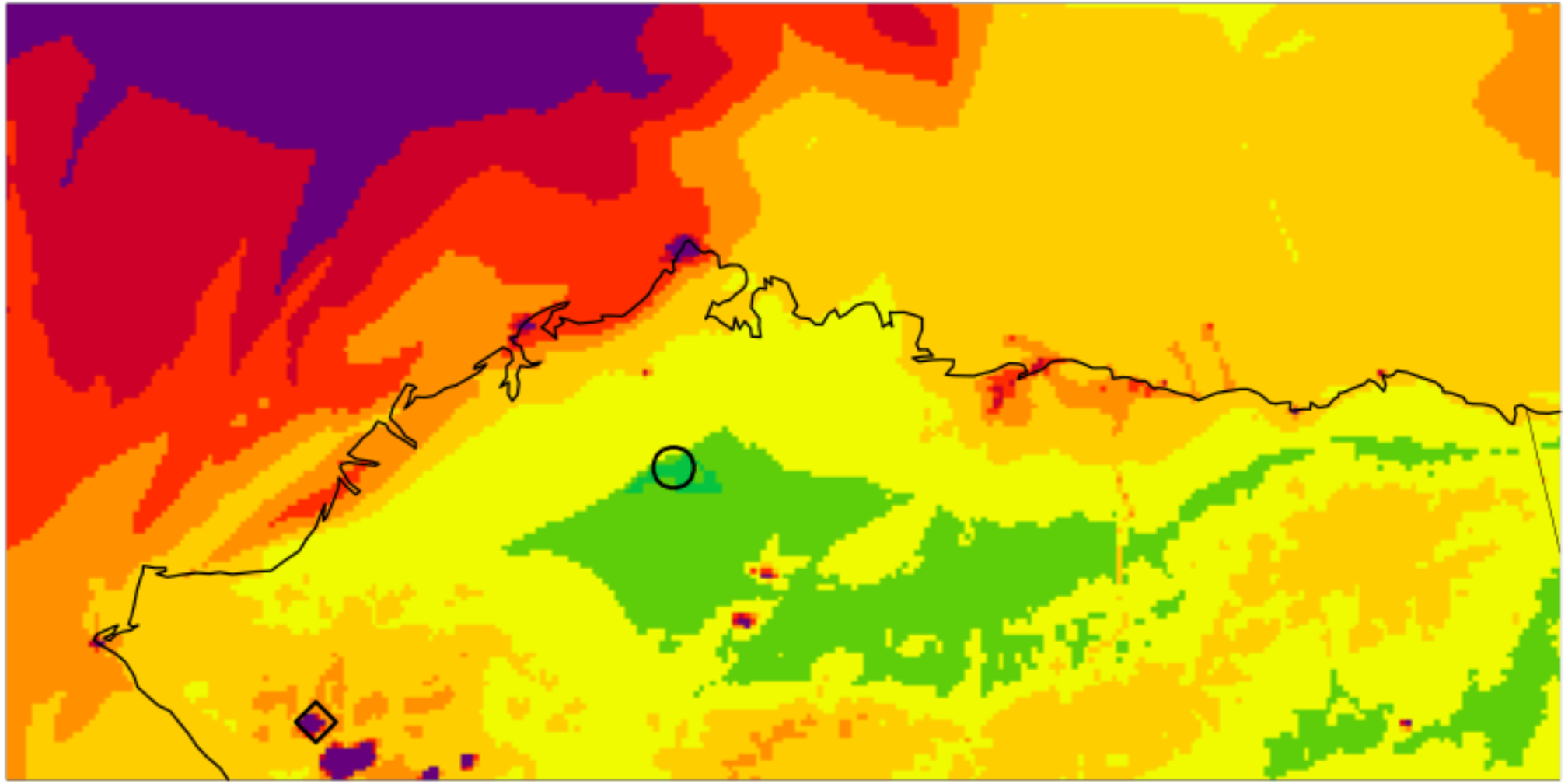
2nd highest daily average PM_{10} concentration
High Development Scenario-Cumulative

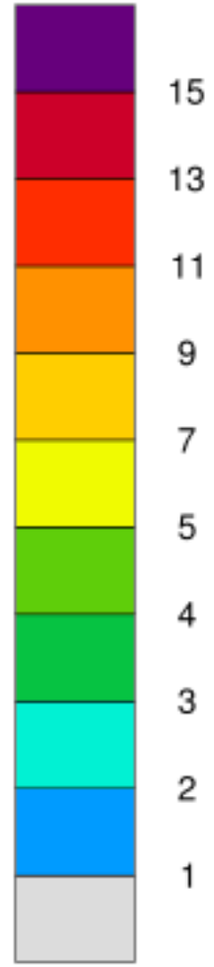




◇ max(55,11) = 121.3 μg/m^3
○ min(120,55) = 3.9 μg/m^3

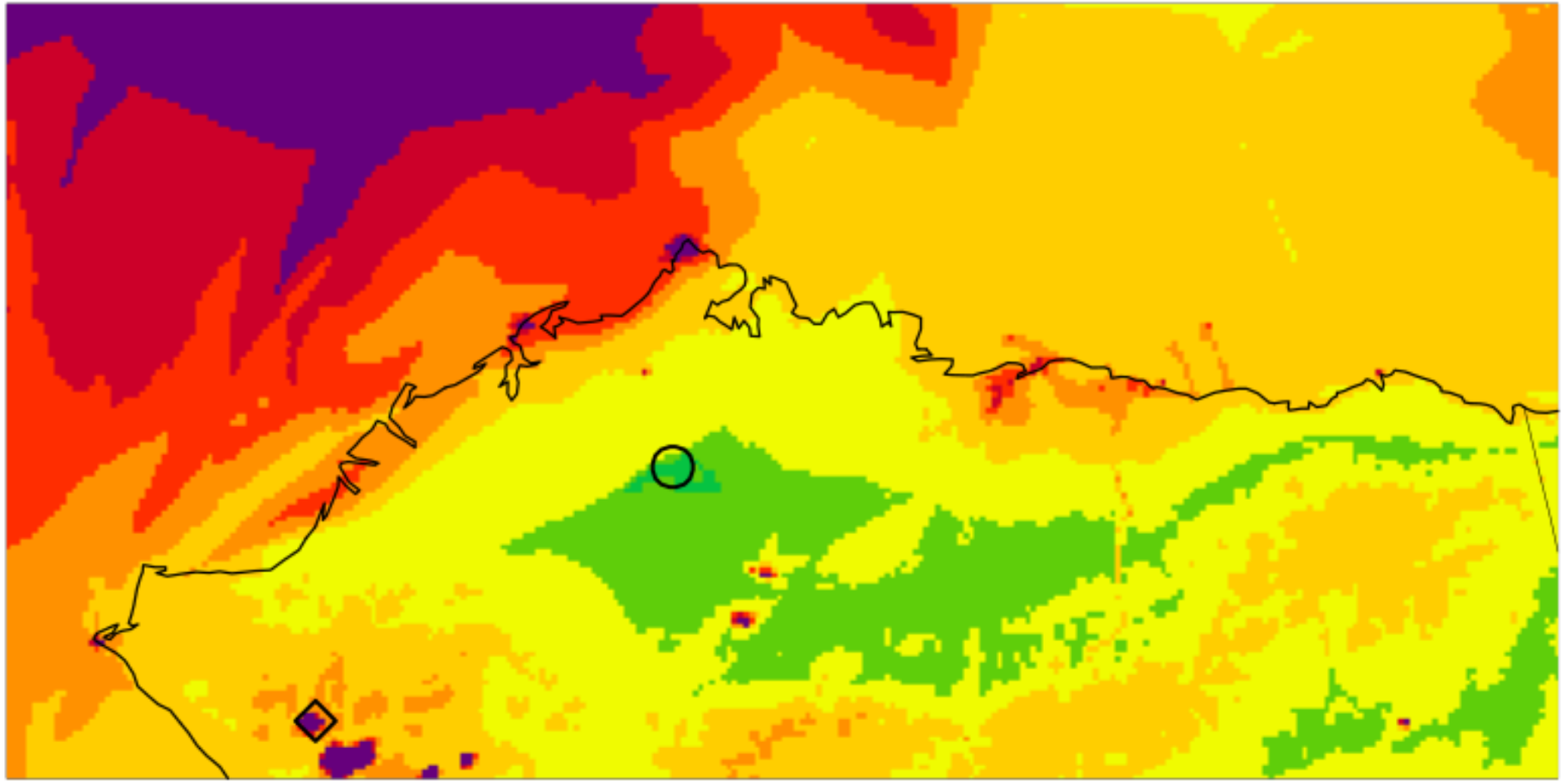
2nd highest daily average PM_{10} concentration
Low Development Scenario-Cumulative

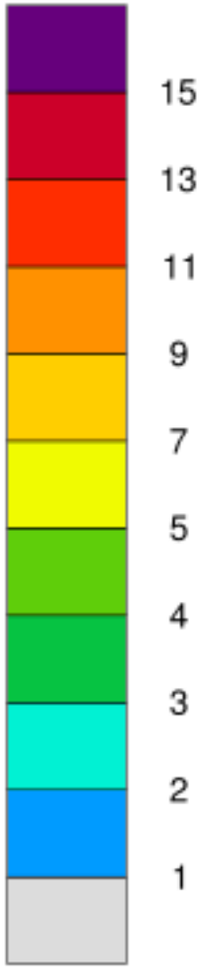




◇ max(55,11) = 121.3 μg/m^3
○ min(119,56) = 3.9 μg/m^3

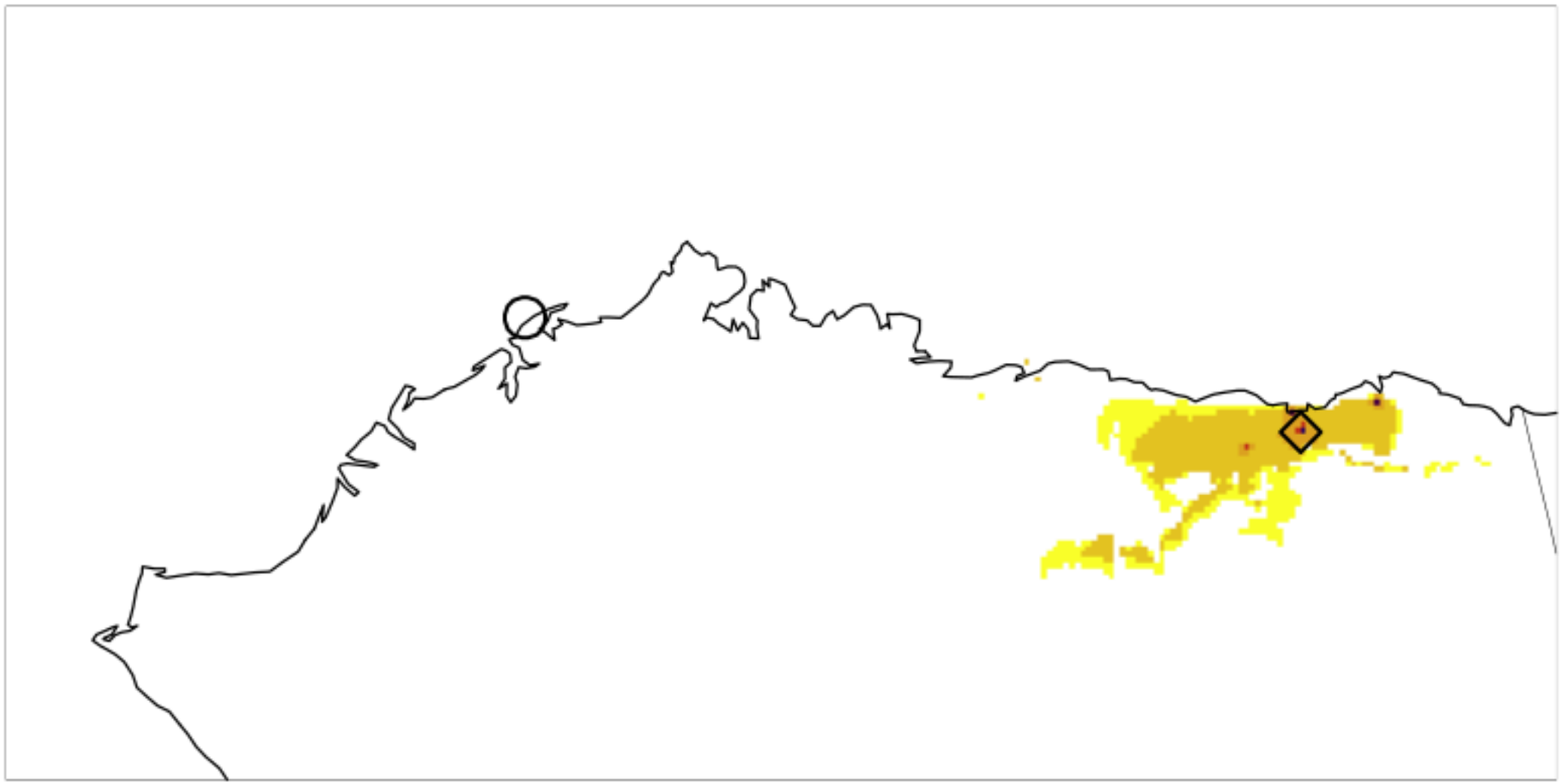
2nd highest daily average PM_{10} concentration
No Action Alternative-Cumulative

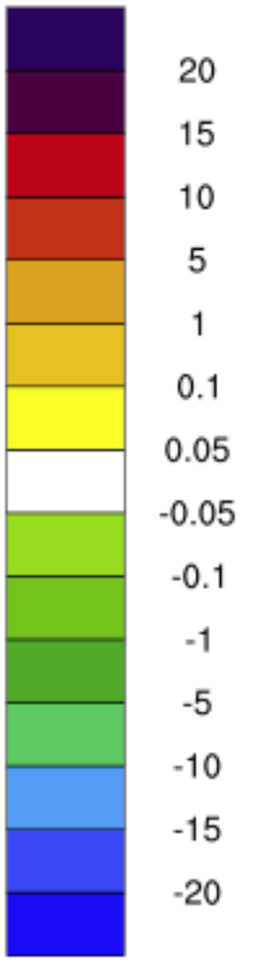




◇ max(55,11) = 121.3 μg/m^3
○ min(119,56) = 3.9 μg/m^3

2nd highest daily average PM_{10} concentration
High Development Scenario-Indirect Impact





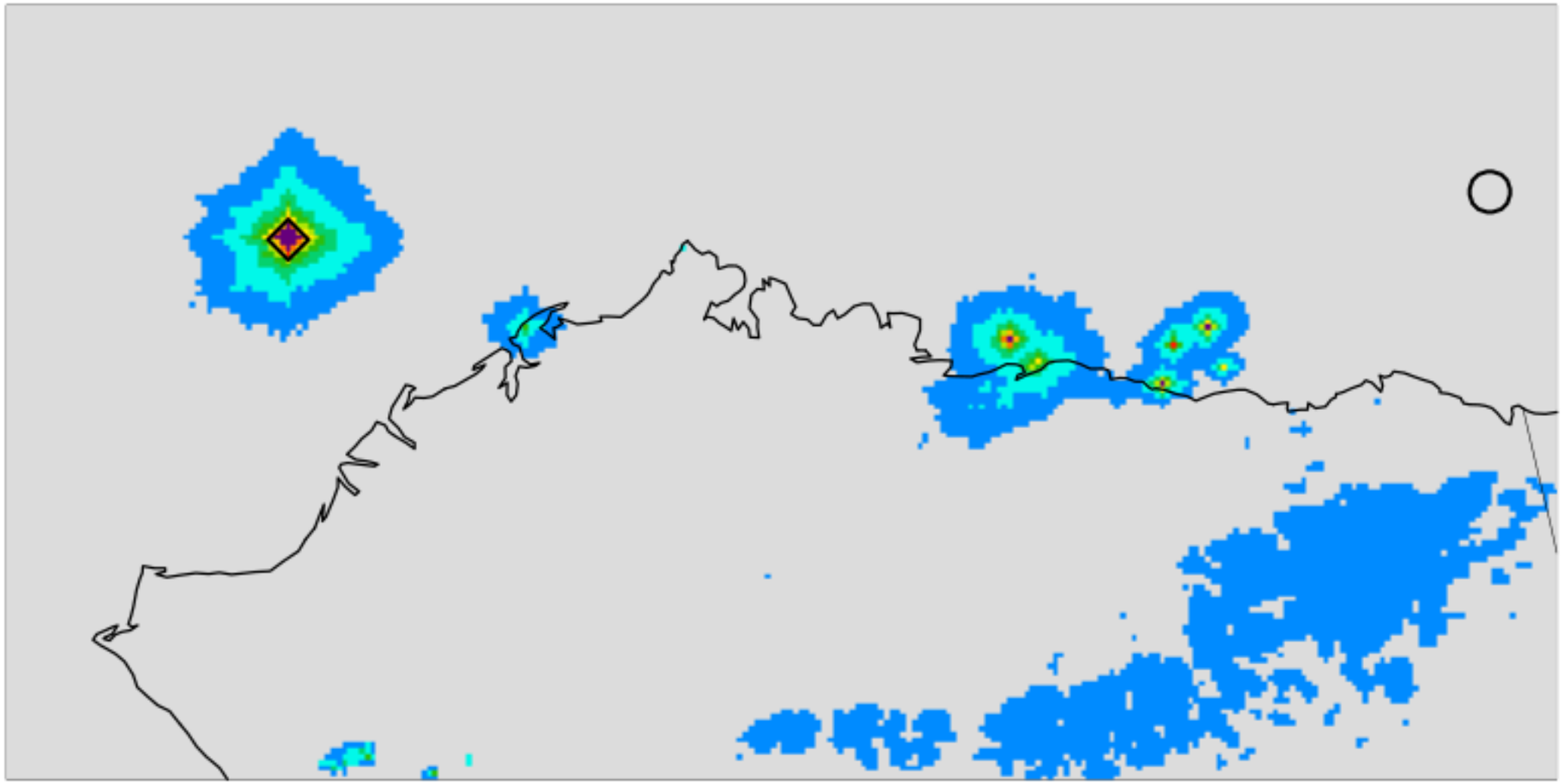
◇max(231,63) = 23.3588 μg/m^3
○min(93,83) = -0.0295 μg/m^3

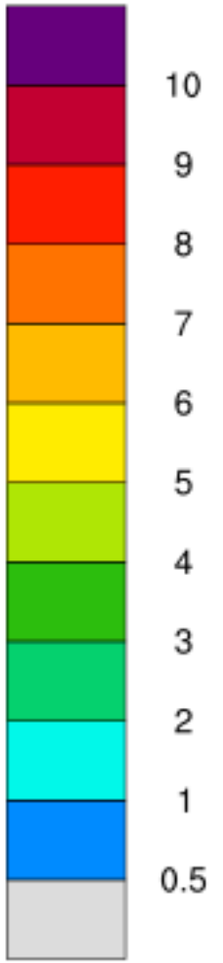
2nd highest daily average PM_{10} concentration
Low Development Scenario-Indirect Impact

20
15
10
5
1
0.1
0.05
-0.05
-0.1
-1
-5
-10
-15
-20

max(229,66) = 16.3591 μg/m^3
min(93,83) = -0.0295 μg/m^3

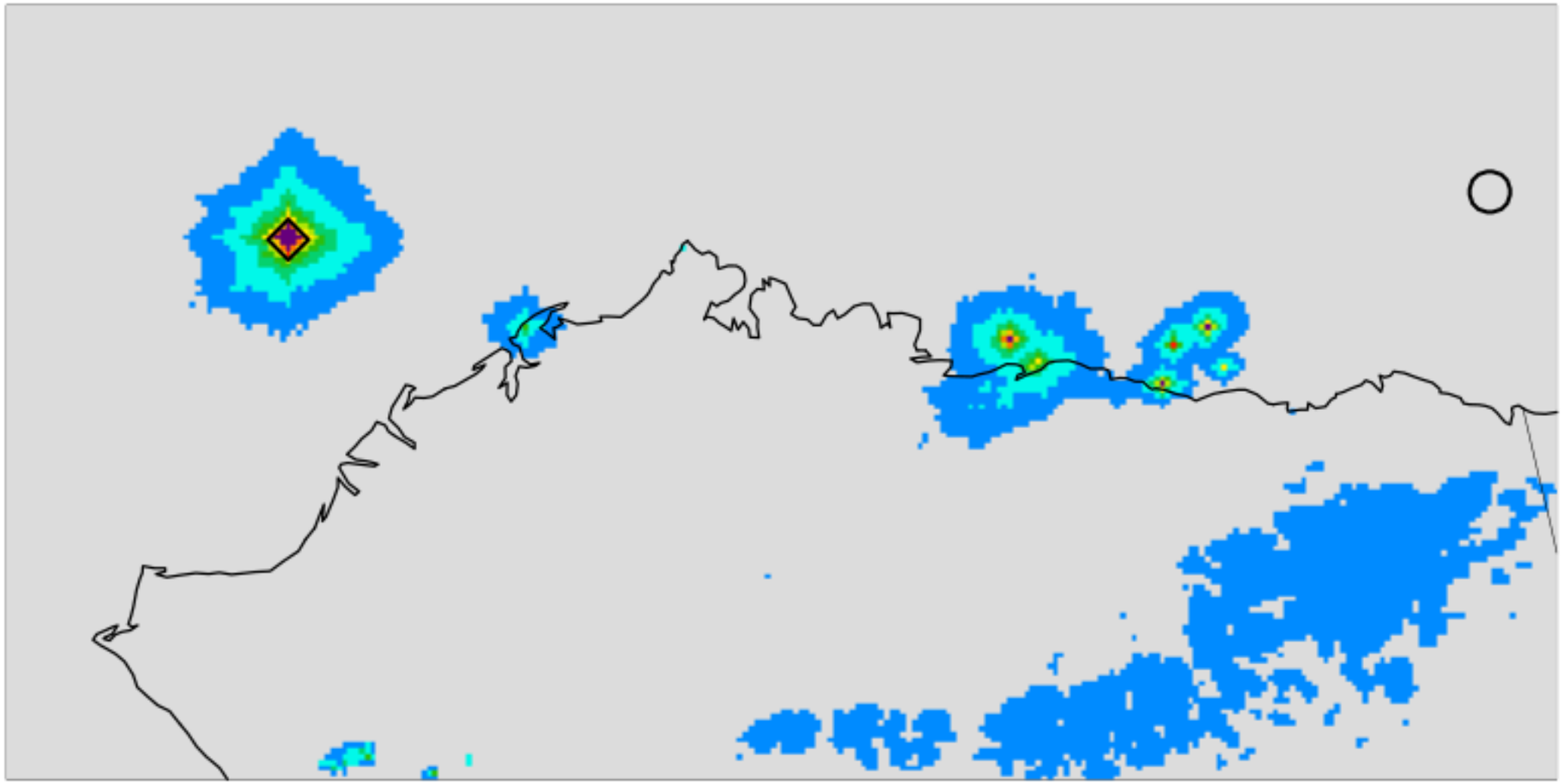
The 4th highest 1 hour daily max SO_2 concentration
High Development Scenario-Cumulative

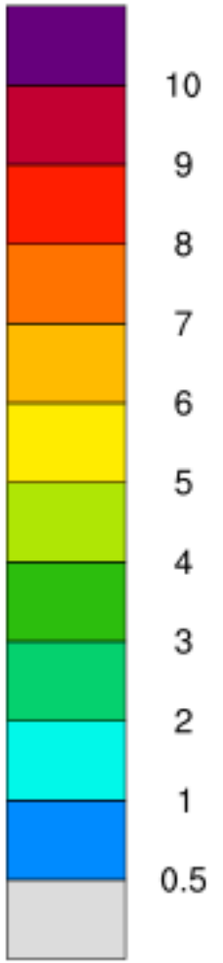




◇ max(51,97) = 58.1 ppb
○ min(264,106) = 0.1 ppb

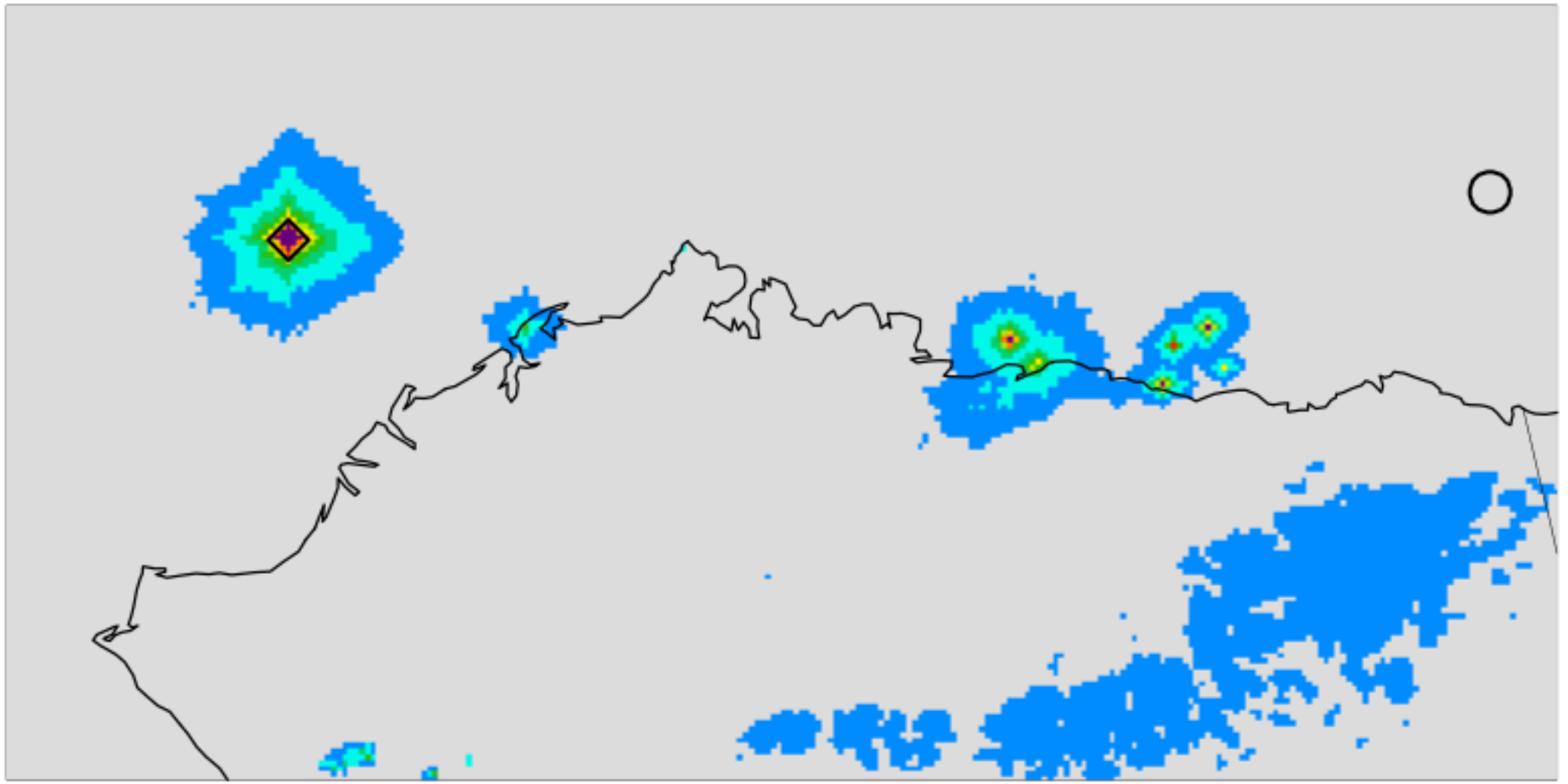
The 4th highest 1 hour daily max SO_2 concentration
Low Development Scenario-Cumulative

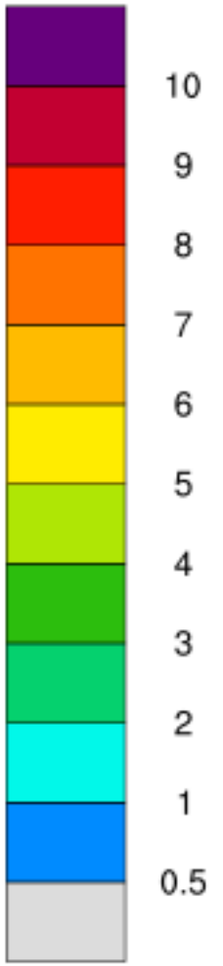




◇ max(51,97) = 58.1 ppb
○ min(264,106) = 0.1 ppb

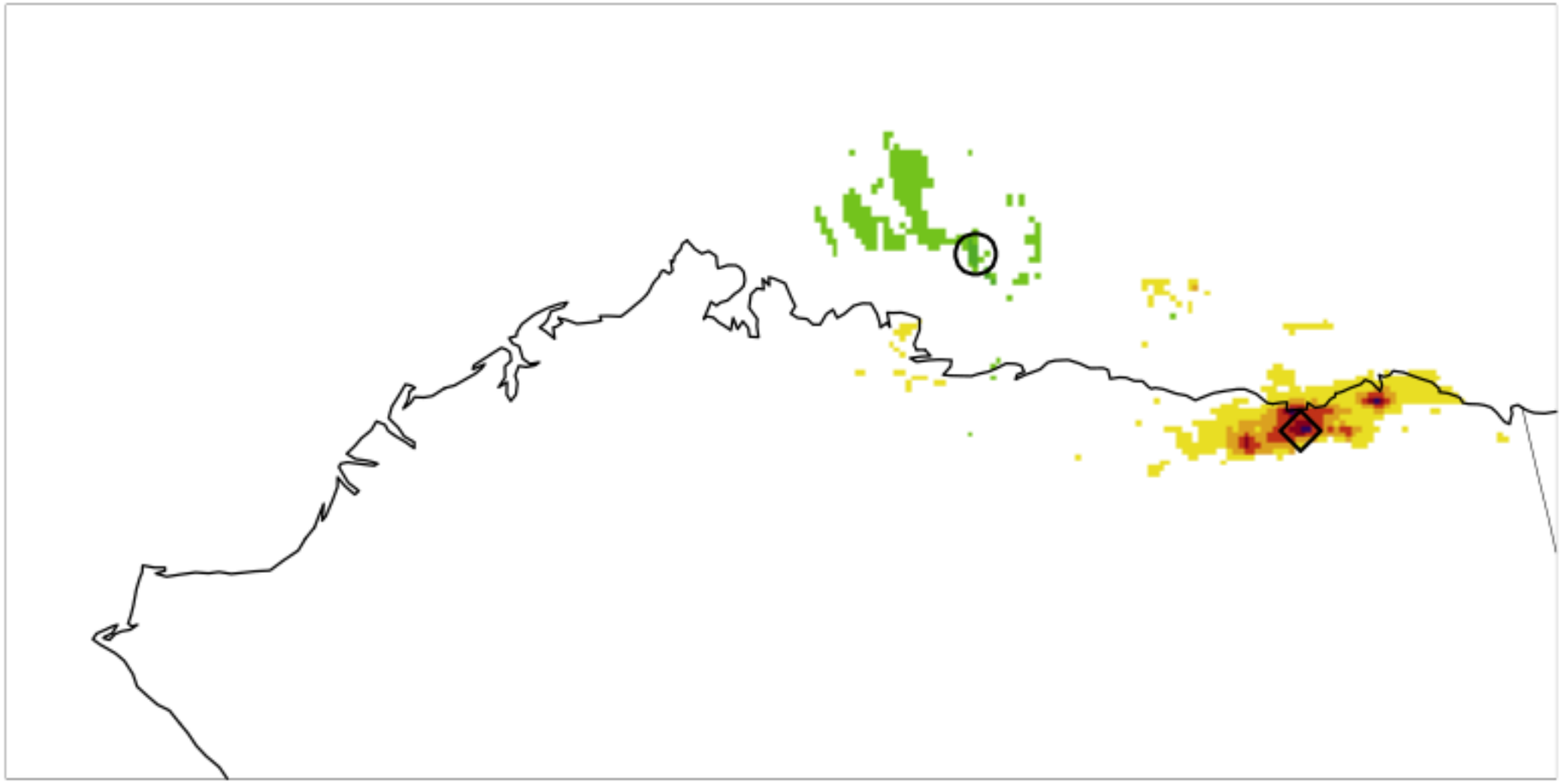
The 4th highest 1 hour daily max SO_2 concentration
No Action Alternative-Cumulative

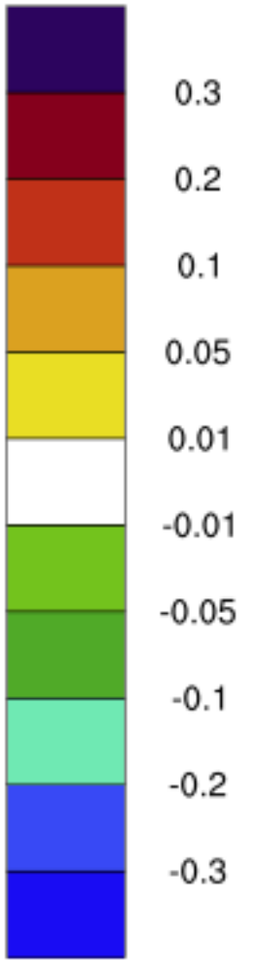




◇ max(51,97) = 58.1 ppb
○ min(264,106) = 0.1 ppb

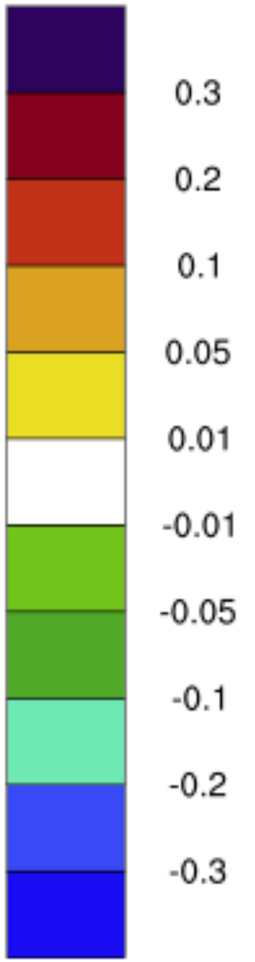
The 4th highest 1 hour daily max SO_2 concentration
High Development Scenario-Indirect Impact





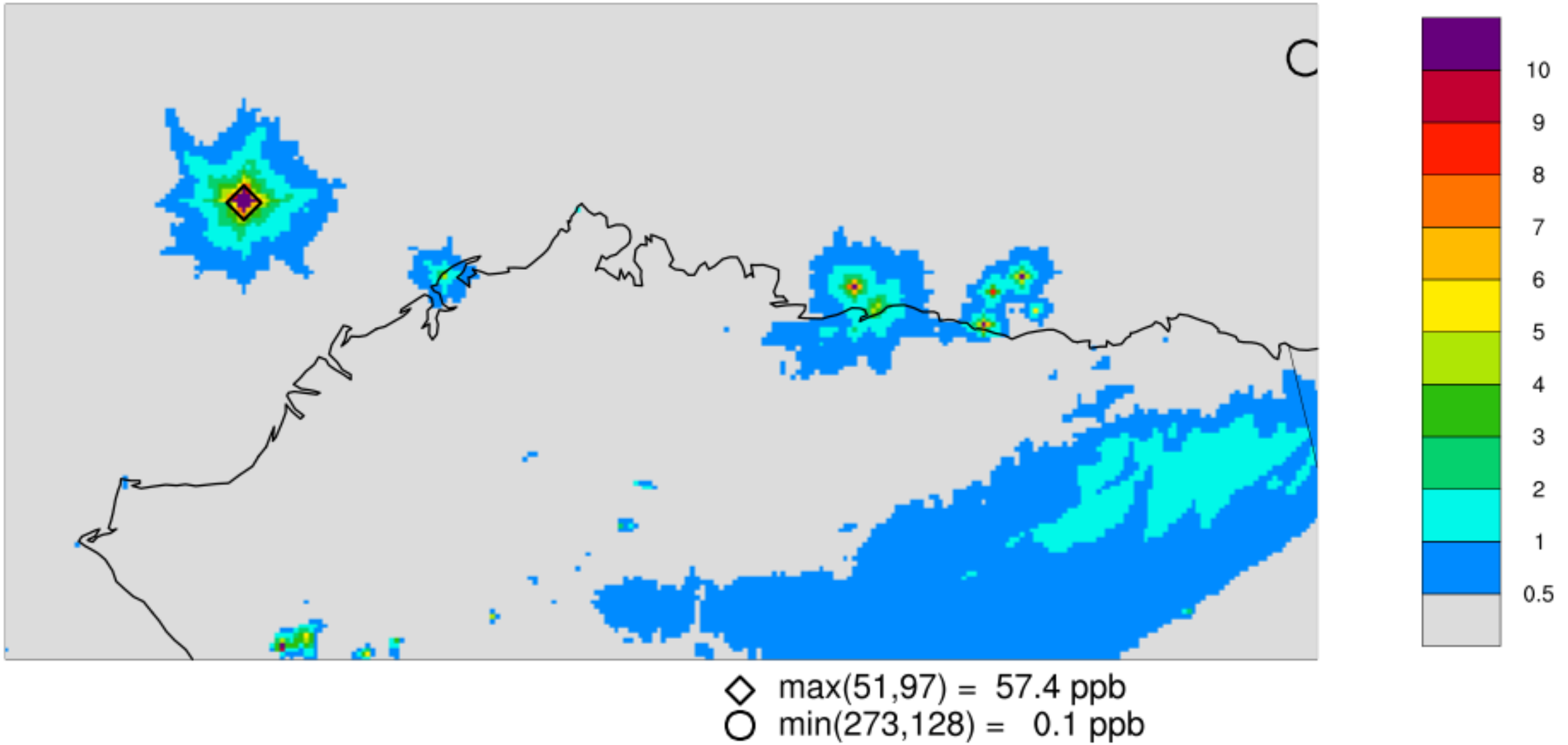
◇ max(231,63) = 0.566 ppb
○ min(173,94) = -0.093 ppb

The 4th highest 1 hour daily max SO_2 concentration
Low Development Scenario-Indirect Impact

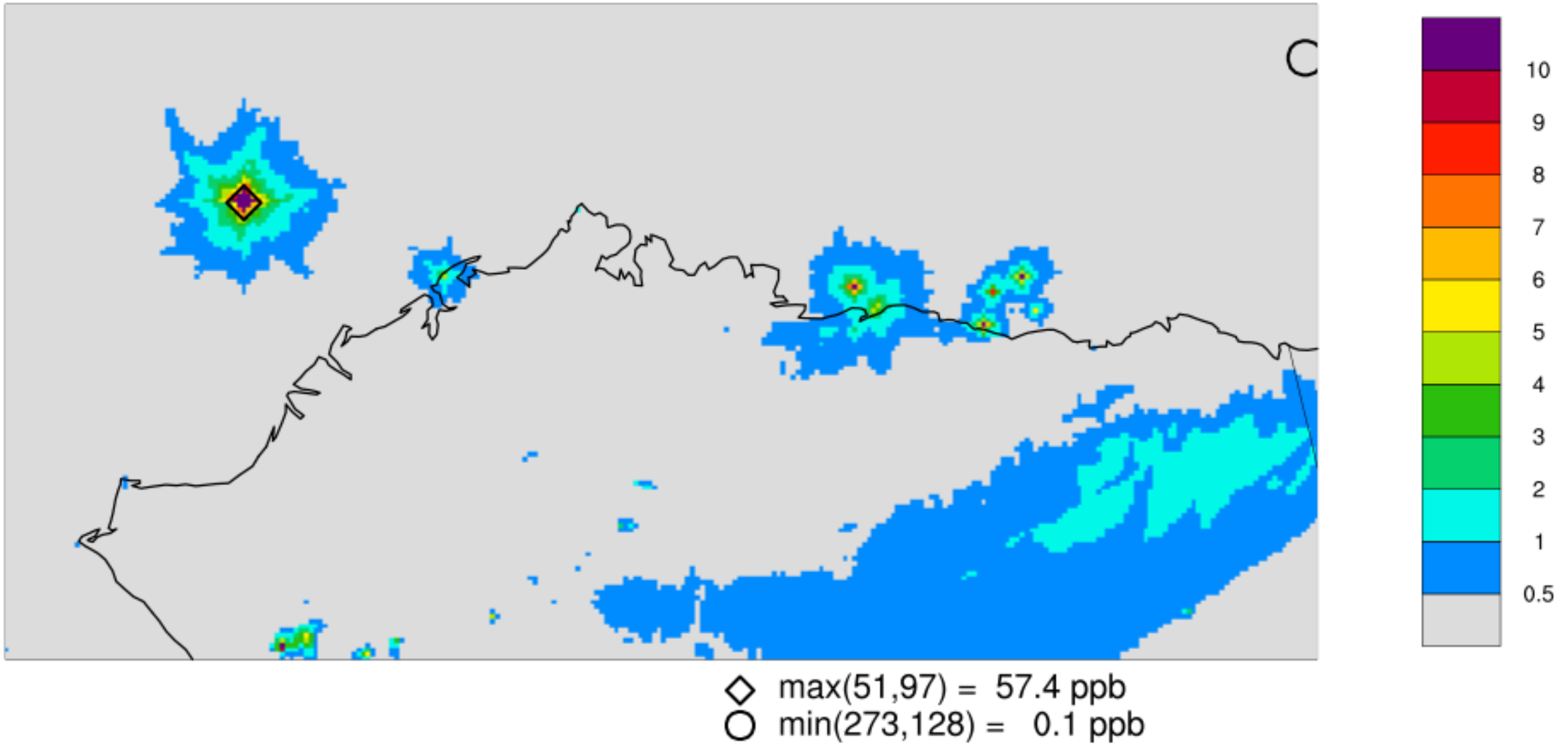


◇ max(229,66) = 0.460 ppb
○ min(173,94) = -0.093 ppb

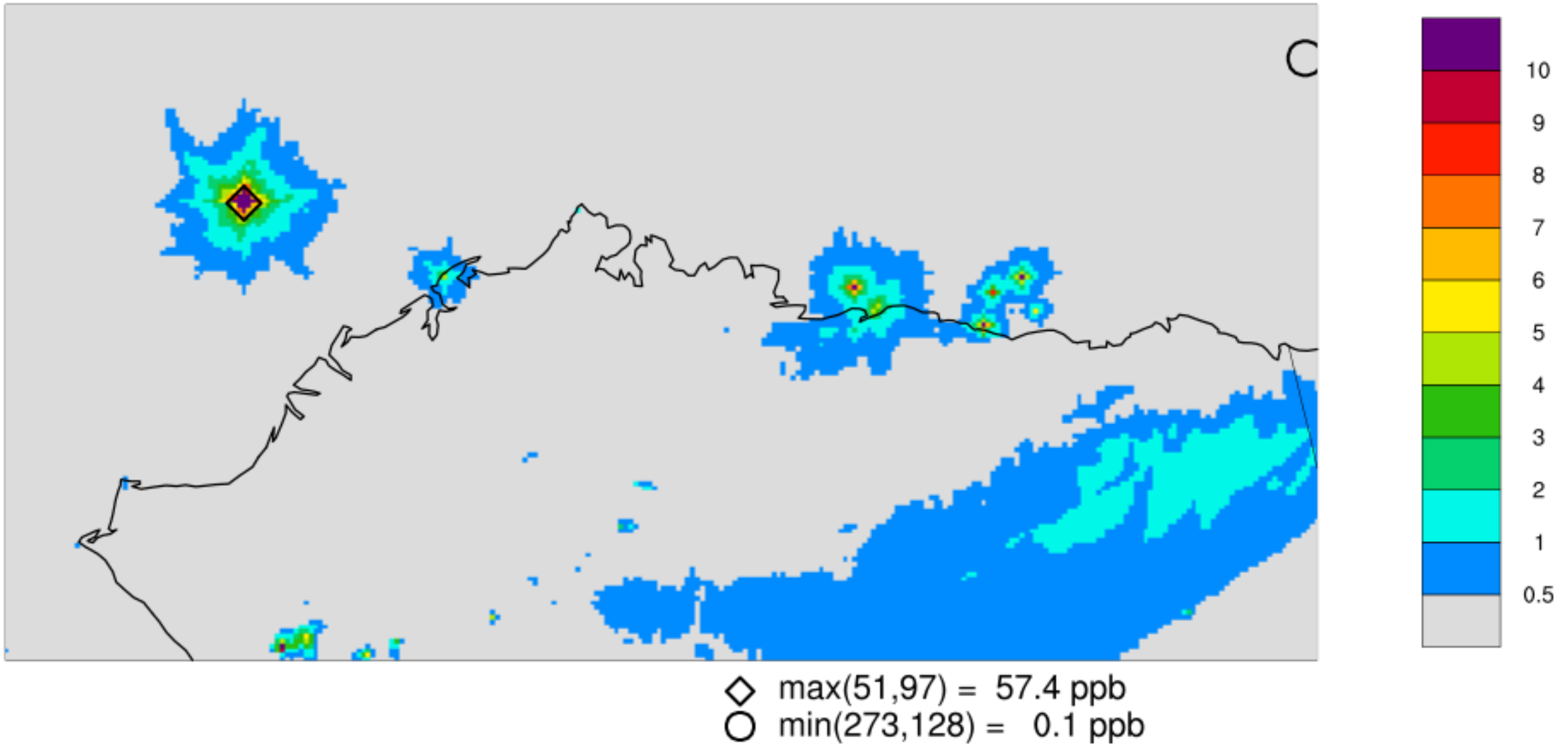
The 2nd highest 3hr average SO_2 concentration
High Development Scenario-Cumulative



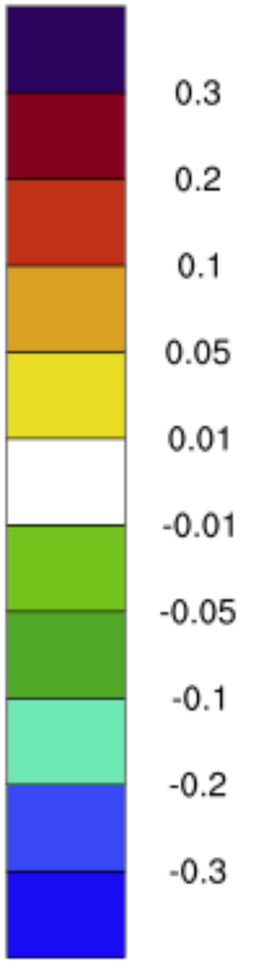
The 2nd highest 3hr average SO_2 concentration
Low Development Scenario-Cumulative



The 2nd highest 3hr average SO_2 concentration
No Action Alternative-Cumulative

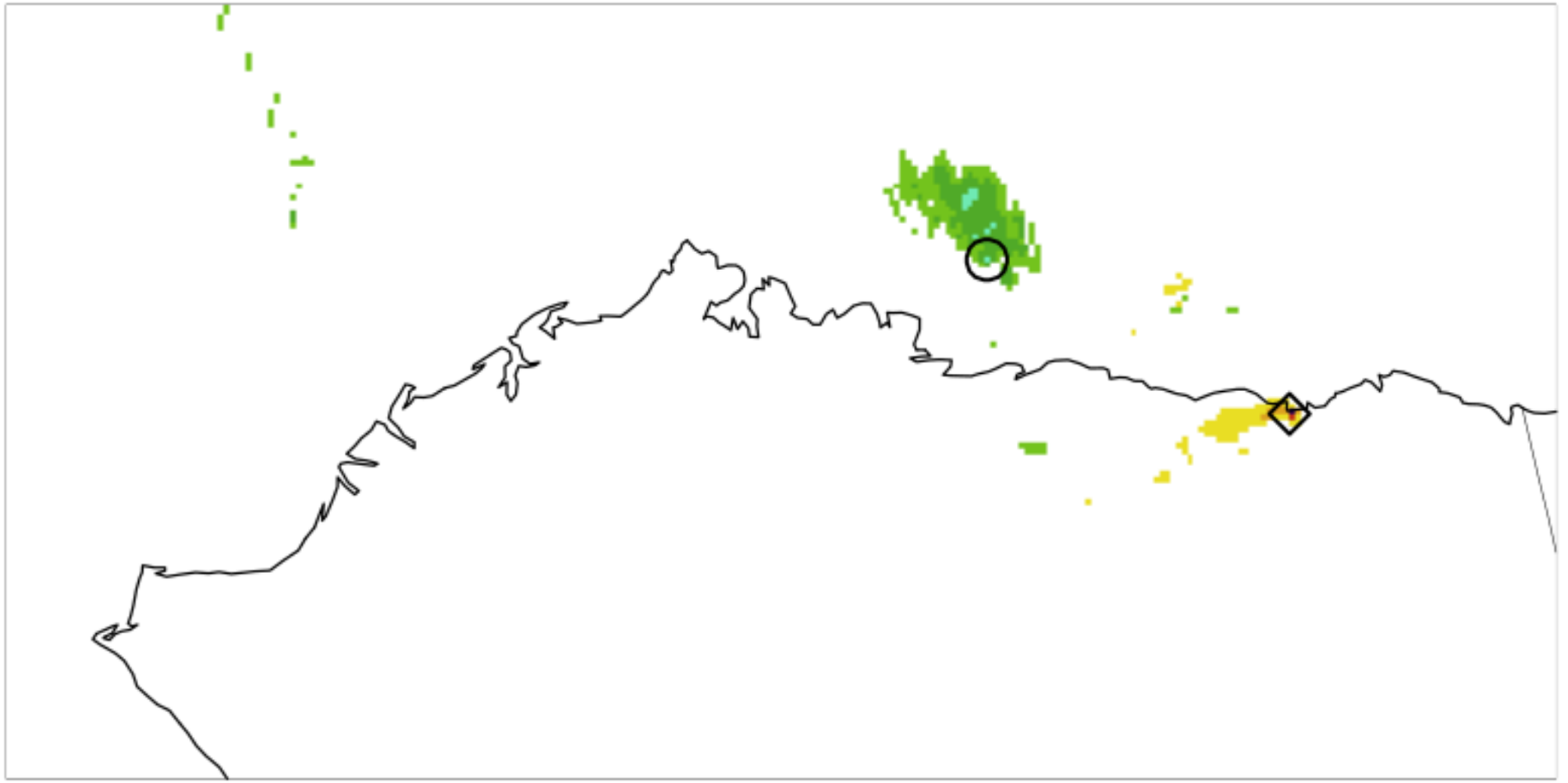


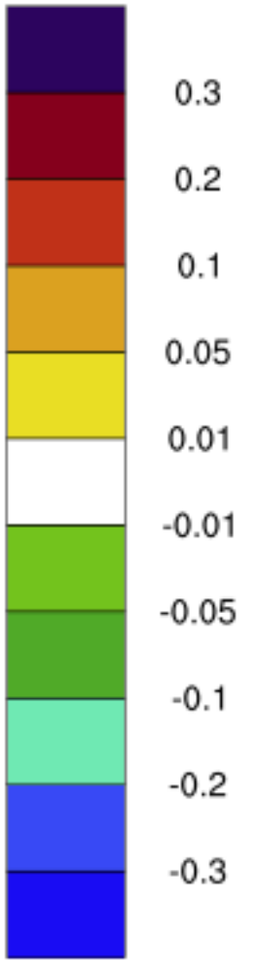
The 2nd highest 3hr average SO_2 concentration
High Development Scenario-Indirect Impact



◇ max(229,66) = 0.406 ppb
○ min(175,93) = -0.123 ppb

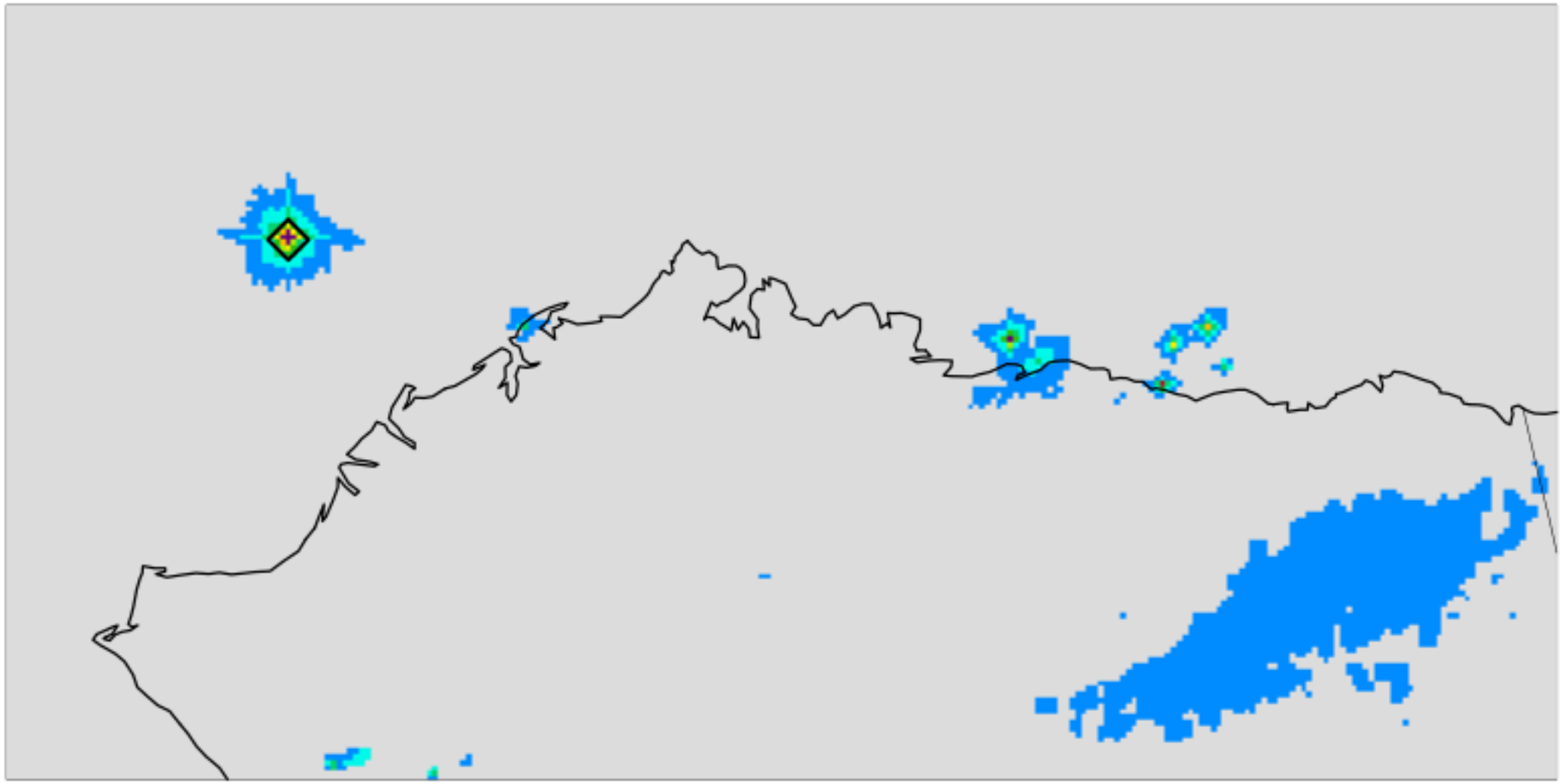
The 2nd highest 3hr average SO_2 concentration
Low Development Scenario-Indirect Impact

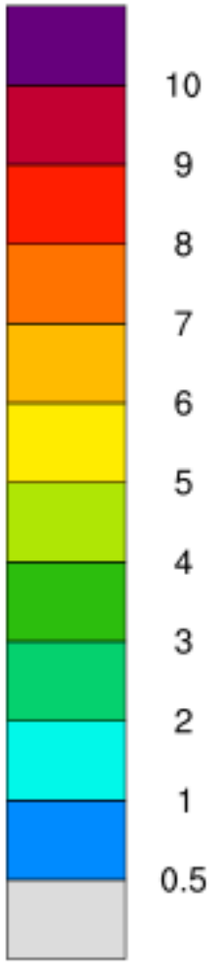




◇ max(229,66) = 0.375 ppb
○ min(175,93) = -0.123 ppb

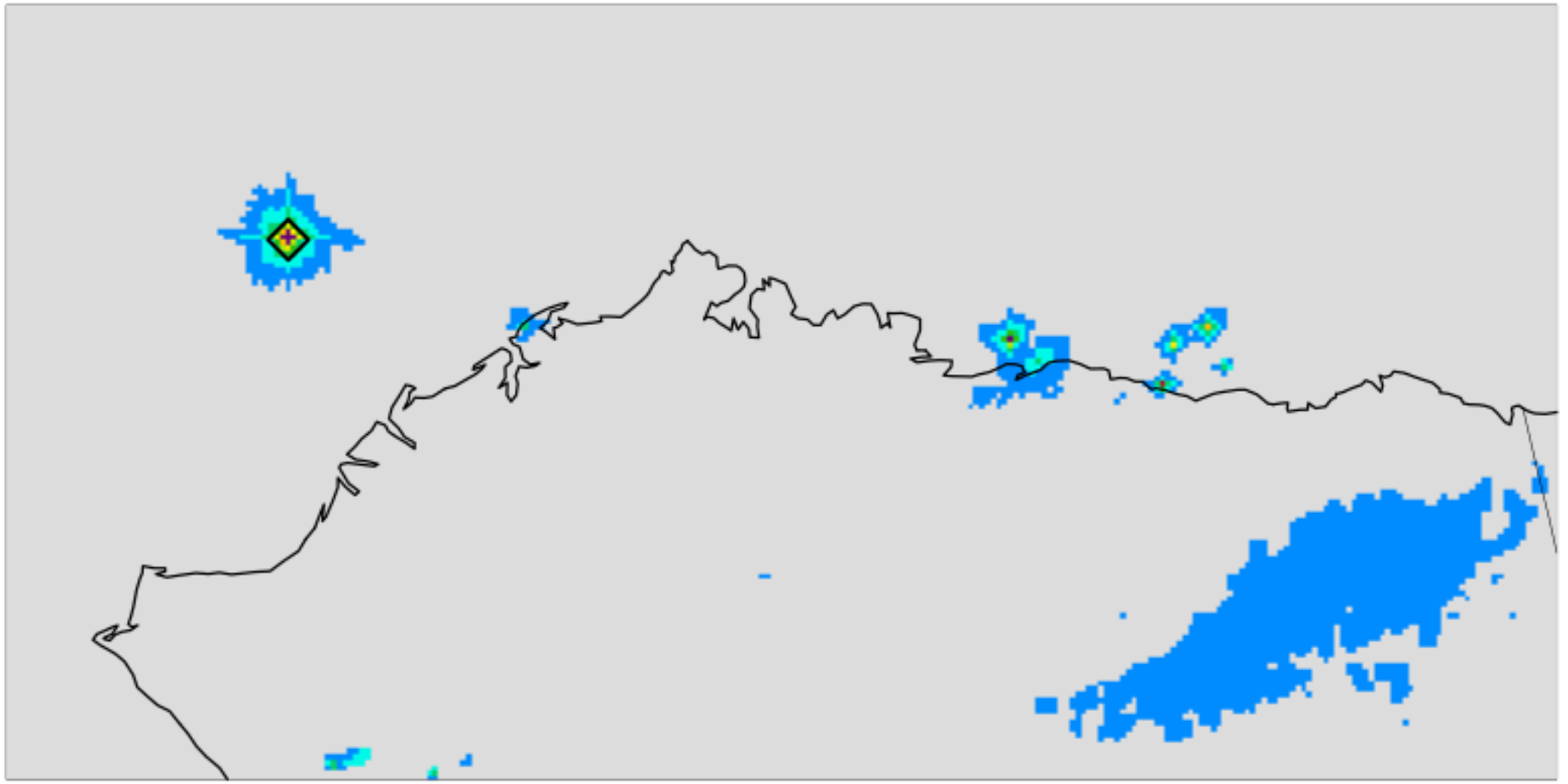
The 2nd highest daily average SO_2 concentration
High Development Scenario-Cumulative

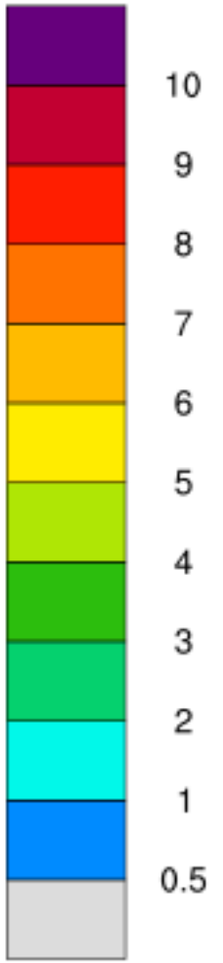




◇ max(51,97) = 34.6 ppb
○ min(276,119) = 0.1 ppb

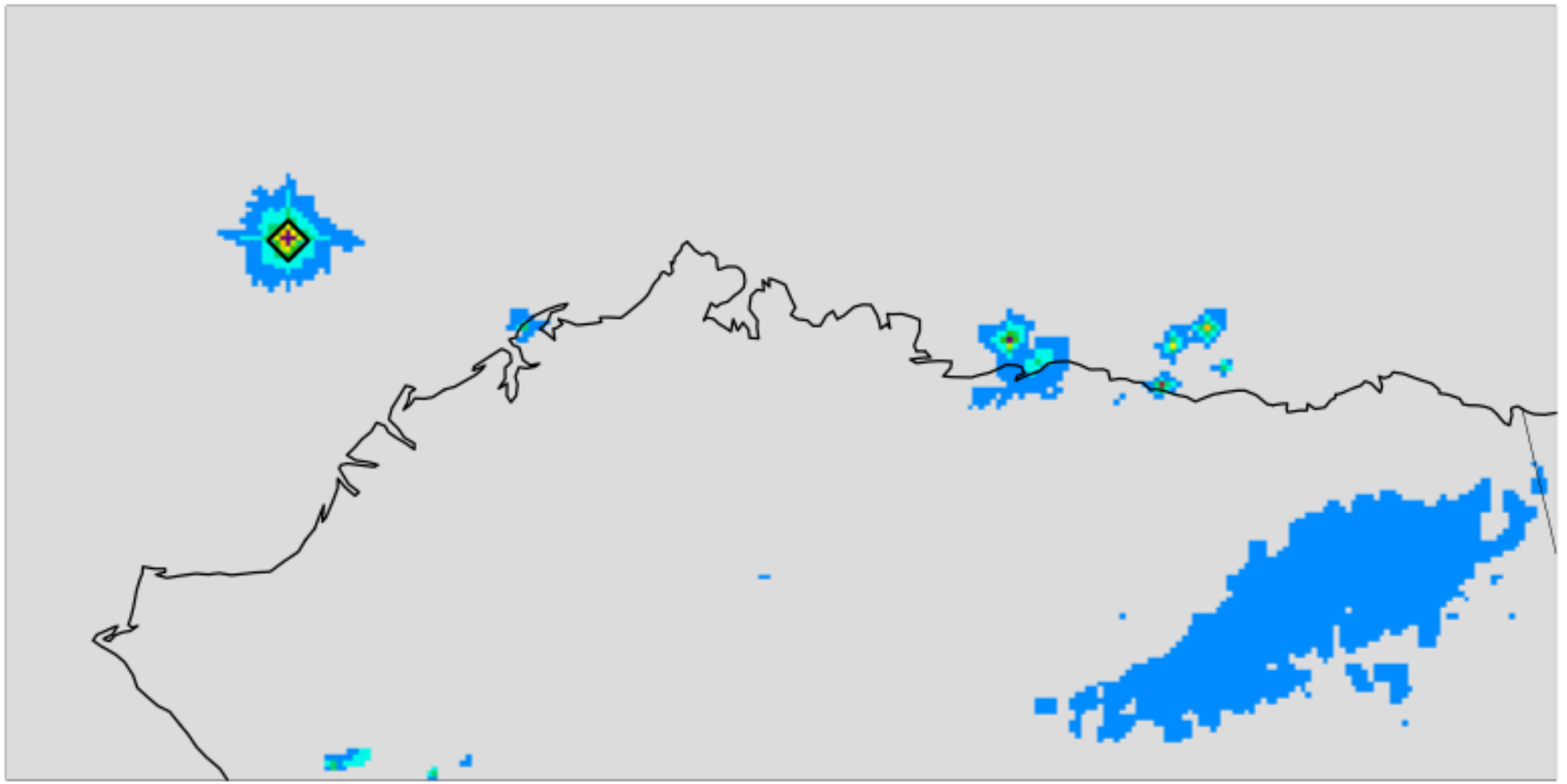
The 2nd highest daily average SO_2 concentration
Low Development Scenario-Cumulative

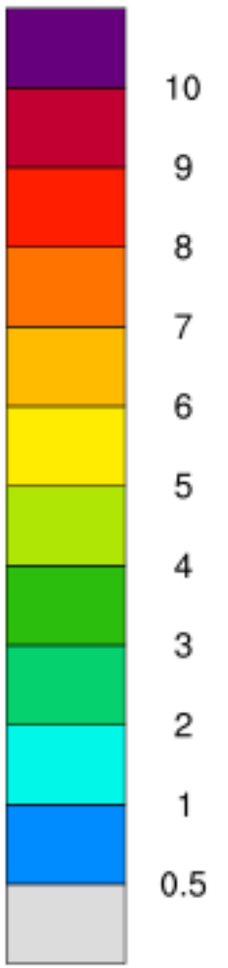




◇ max(51,97) = 34.6 ppb
○ min(276,119) = 0.1 ppb

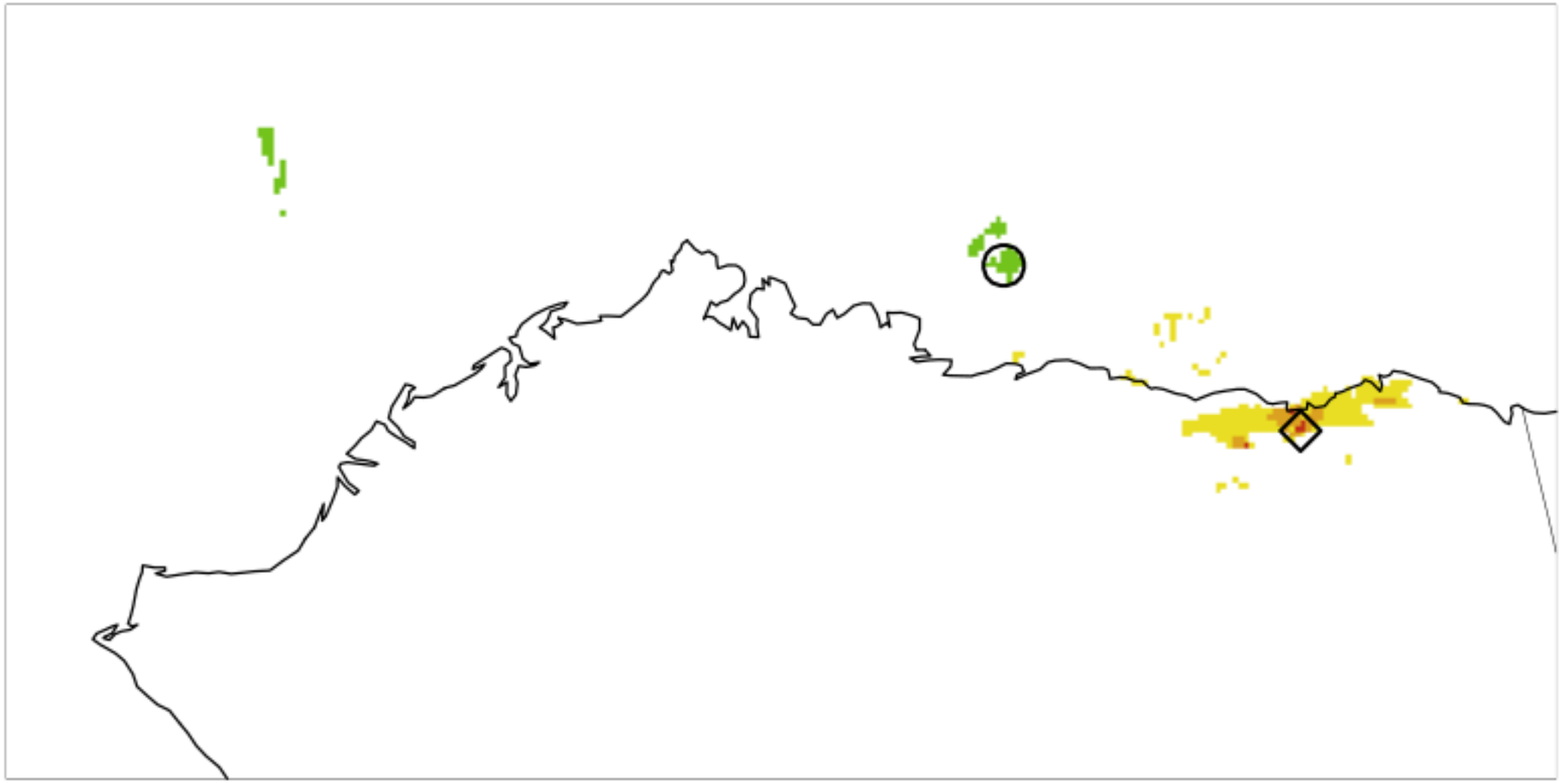
The 2nd highest daily average SO_2 concentration
No Action Alternative-Cumulative

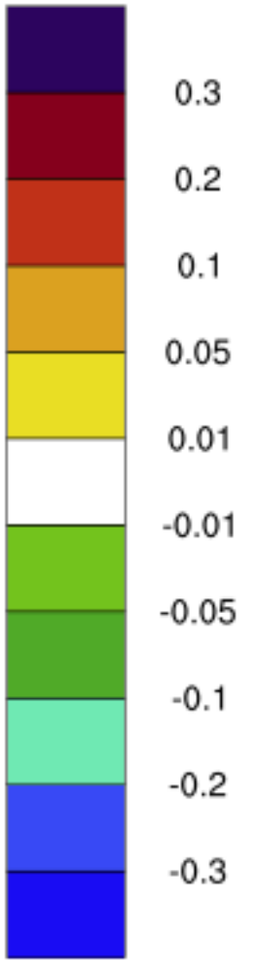




◇ max(51,97) = 34.6 ppb
○ min(276,119) = 0.1 ppb

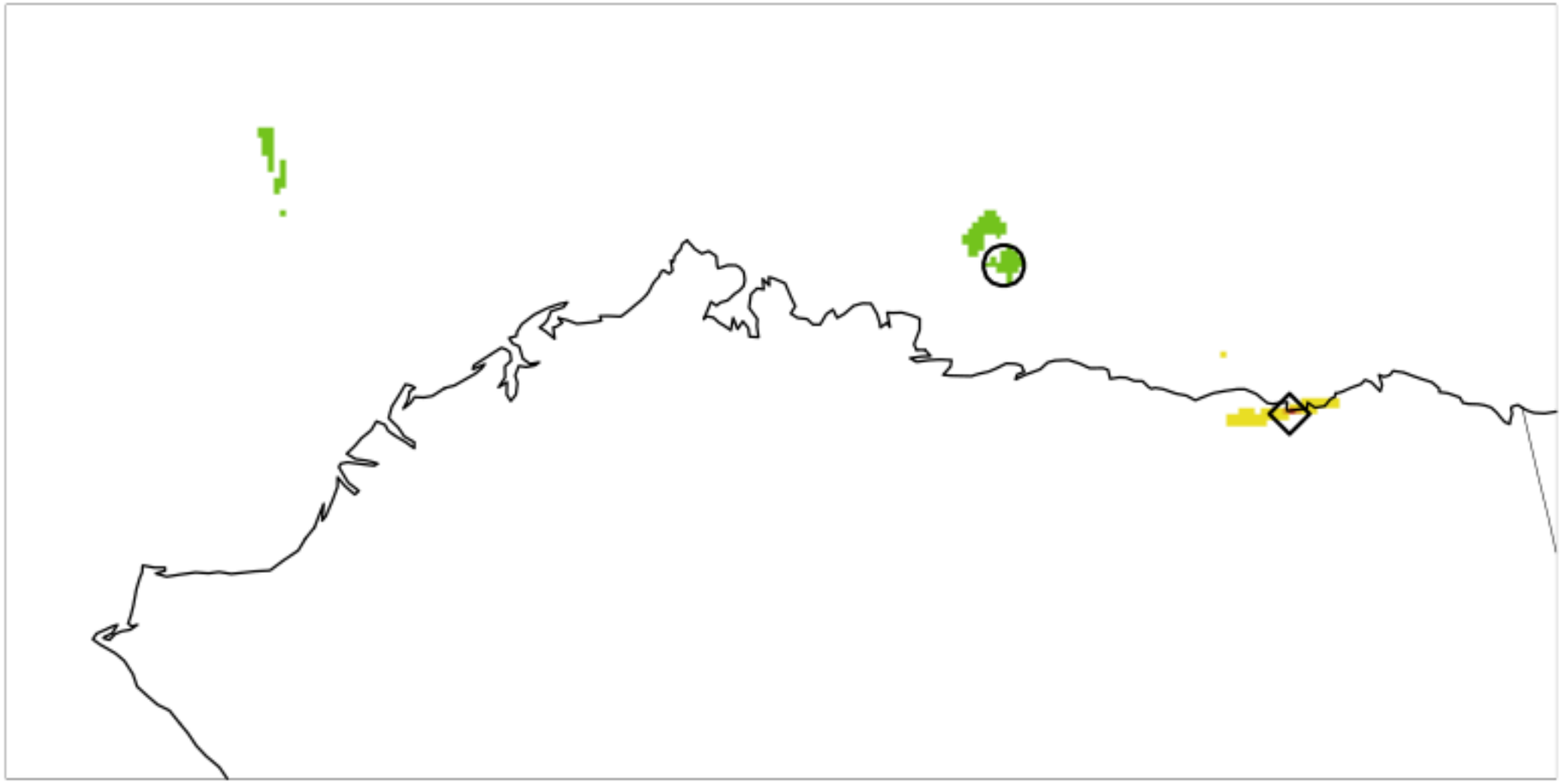
The 2nd highest daily average SO_2 concentration
High Development Scenario-Indirect Impact

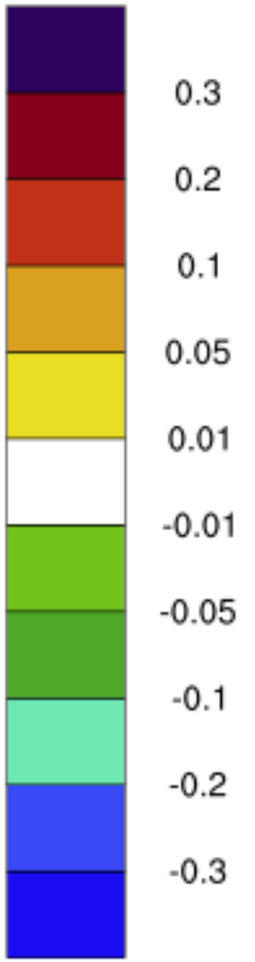




◇ max(231,63) = 0.179 ppb
○ min(178,92) = -0.028 ppb

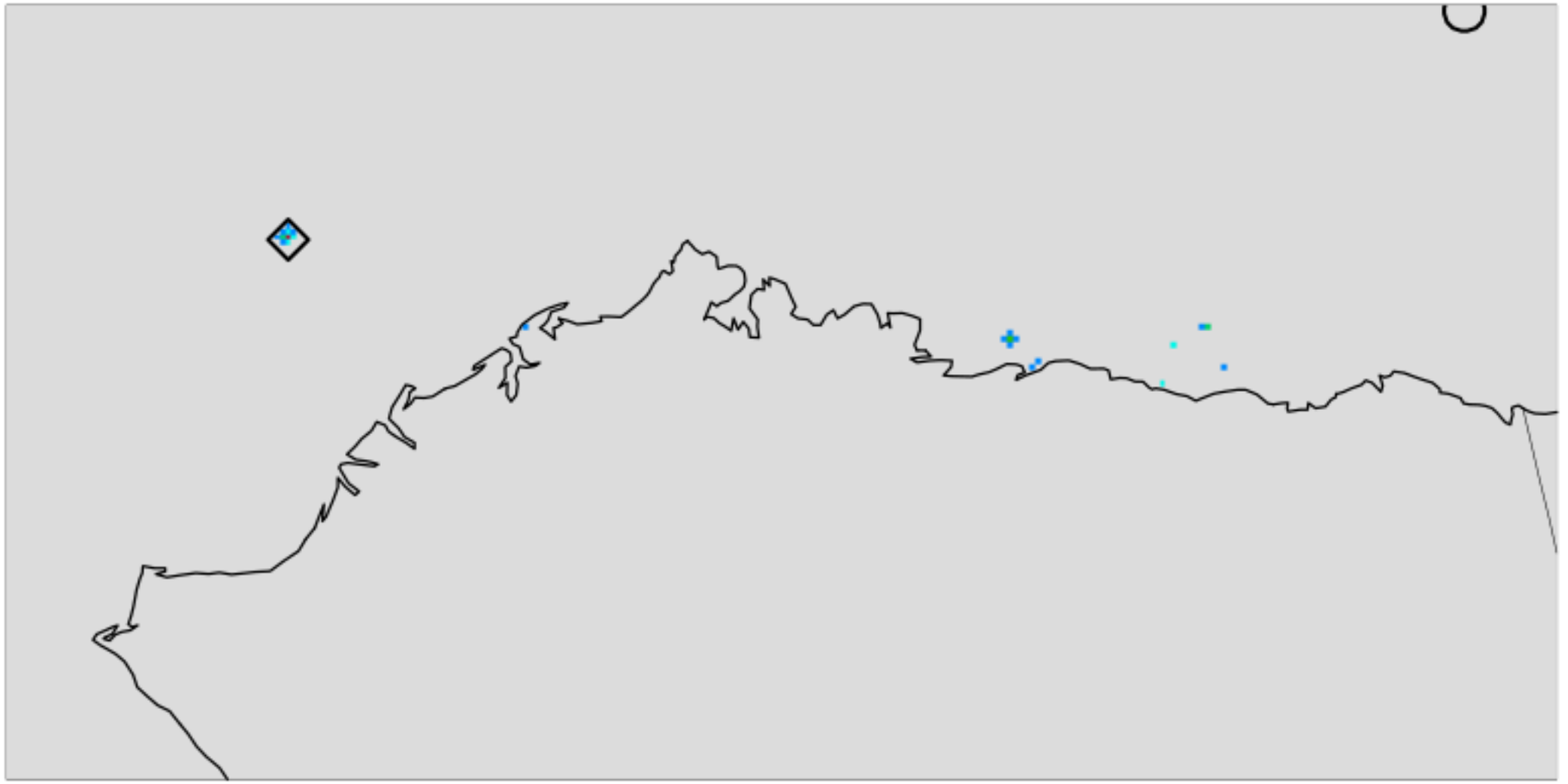
The 2nd highest daily average SO_2 concentration
Low Development Scenario-Indirect Impact

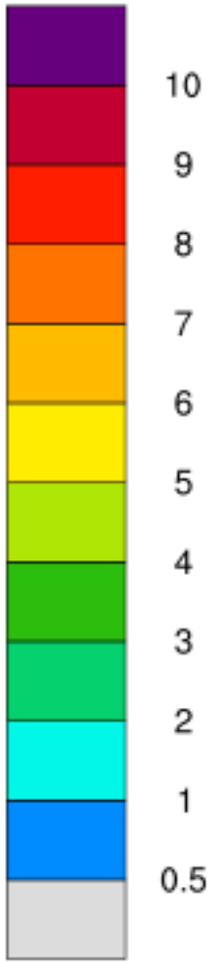




◇ max(229,66) = 0.116 ppb
○ min(178,92) = -0.028 ppb

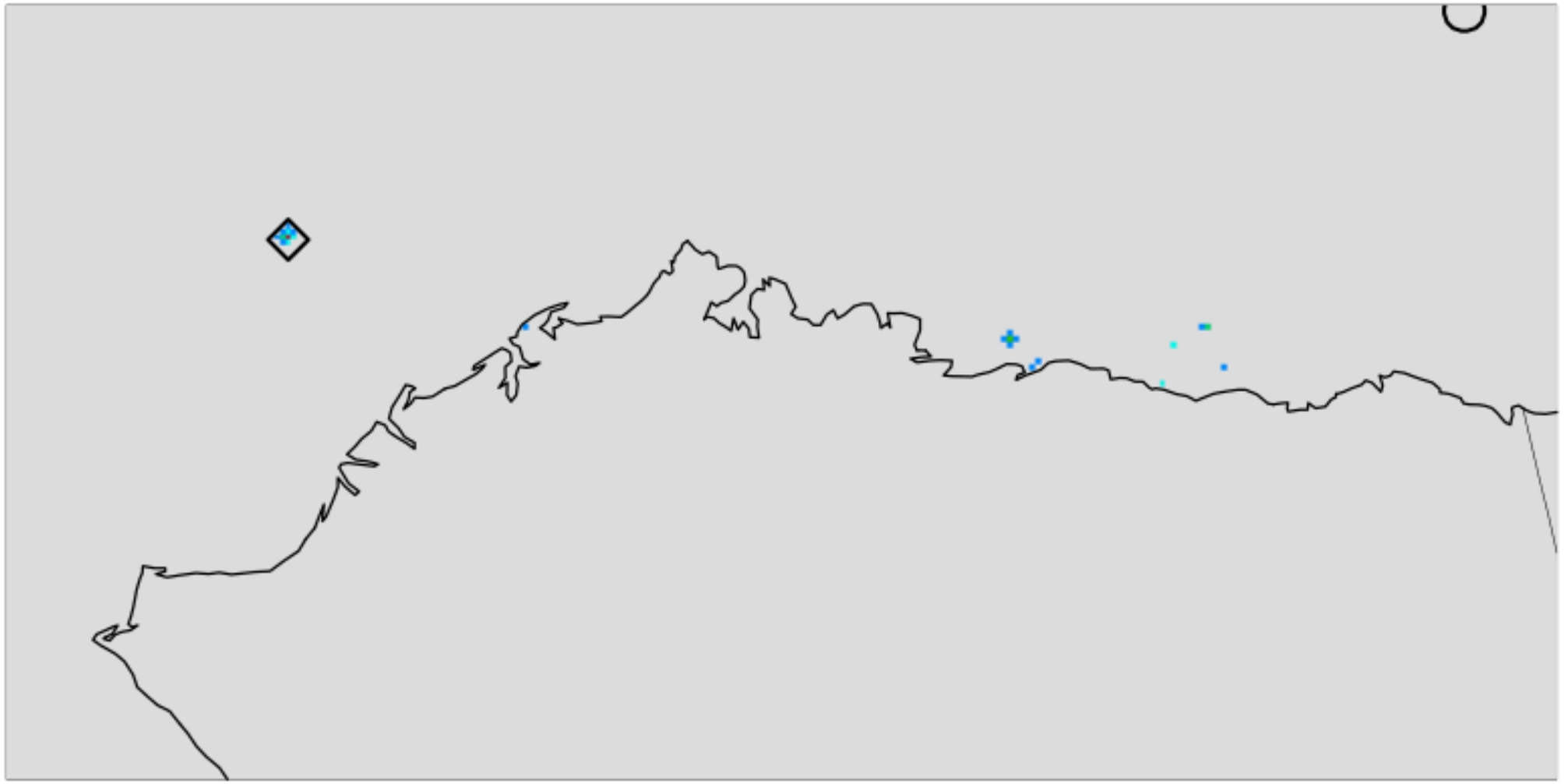
Annual average SO_2 concentration
High Development Scenario-Cumulative

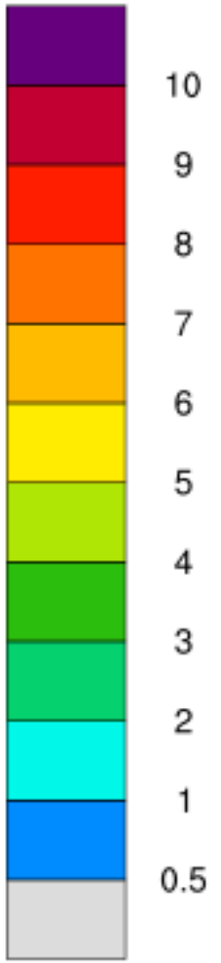




◇ max(51,97) = 9.1 ppb
○ min(259,138) = 0.0 ppb

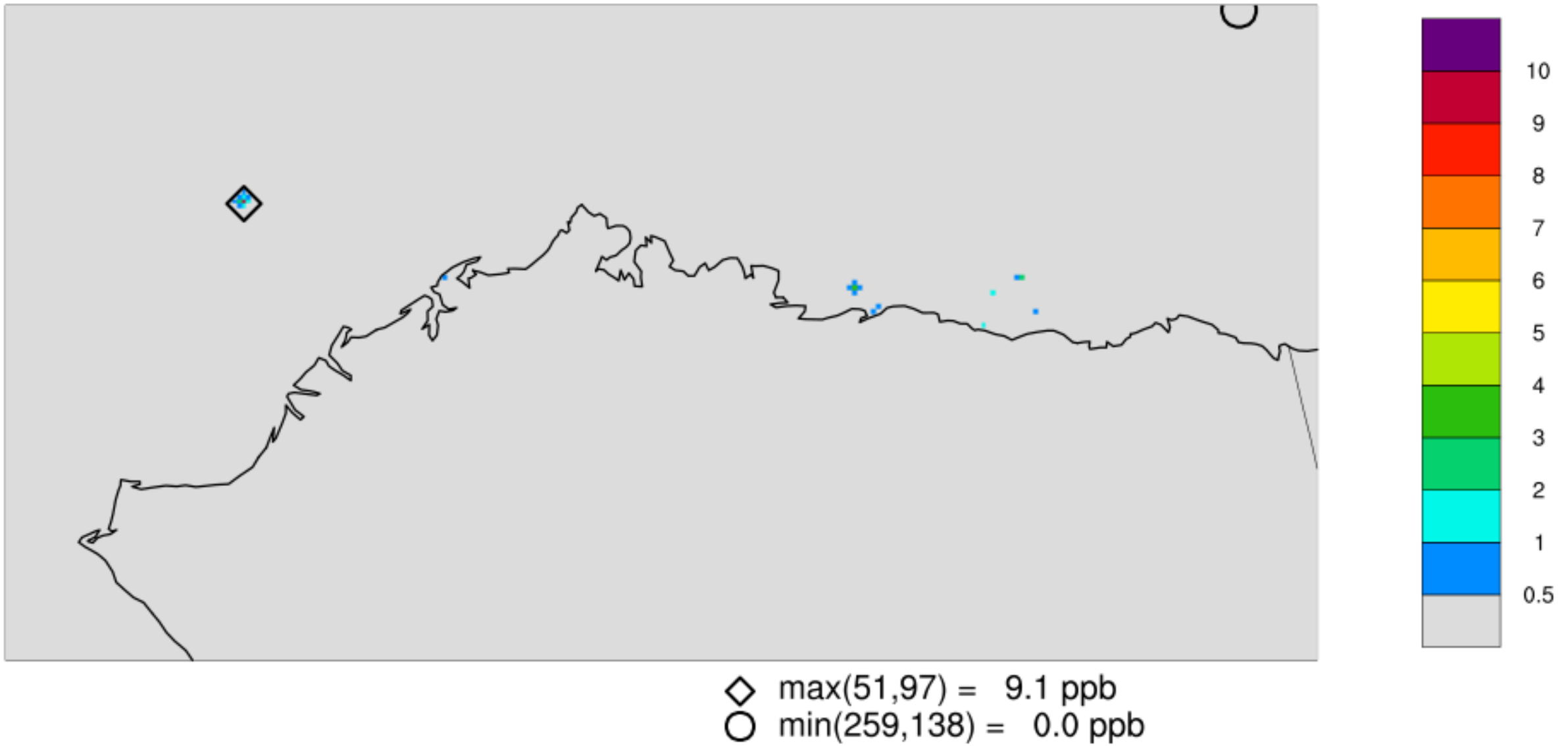
Annual average SO_2 concentration
Low Development Scenario-Cumulative



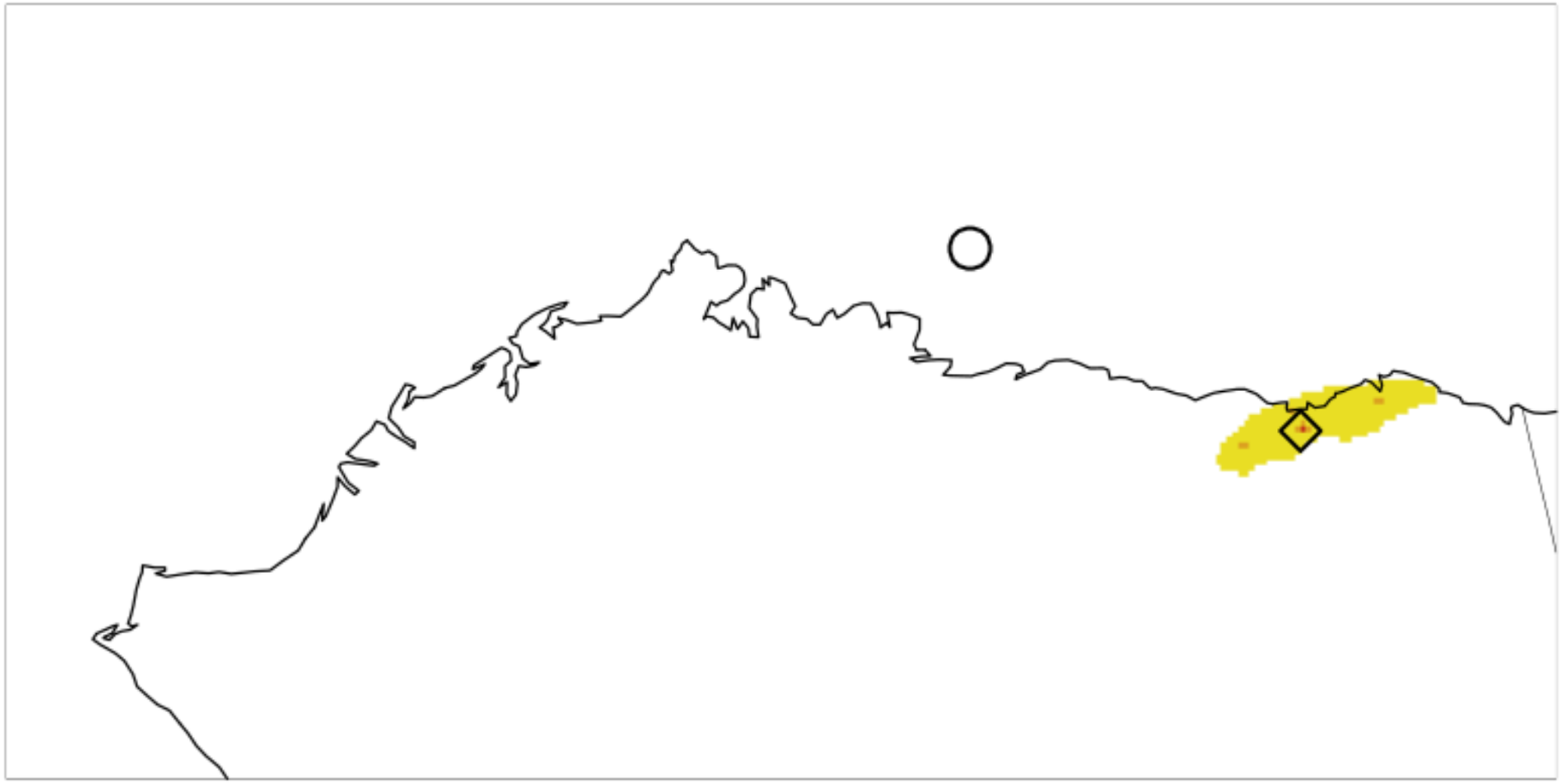


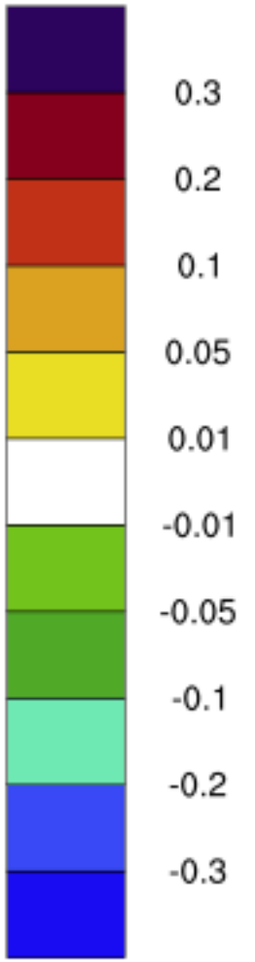
◇ max(51,97) = 9.1 ppb
○ min(259,138) = 0.0 ppb

Annual average SO_2 concentration
No Action Alternative-Cumulative



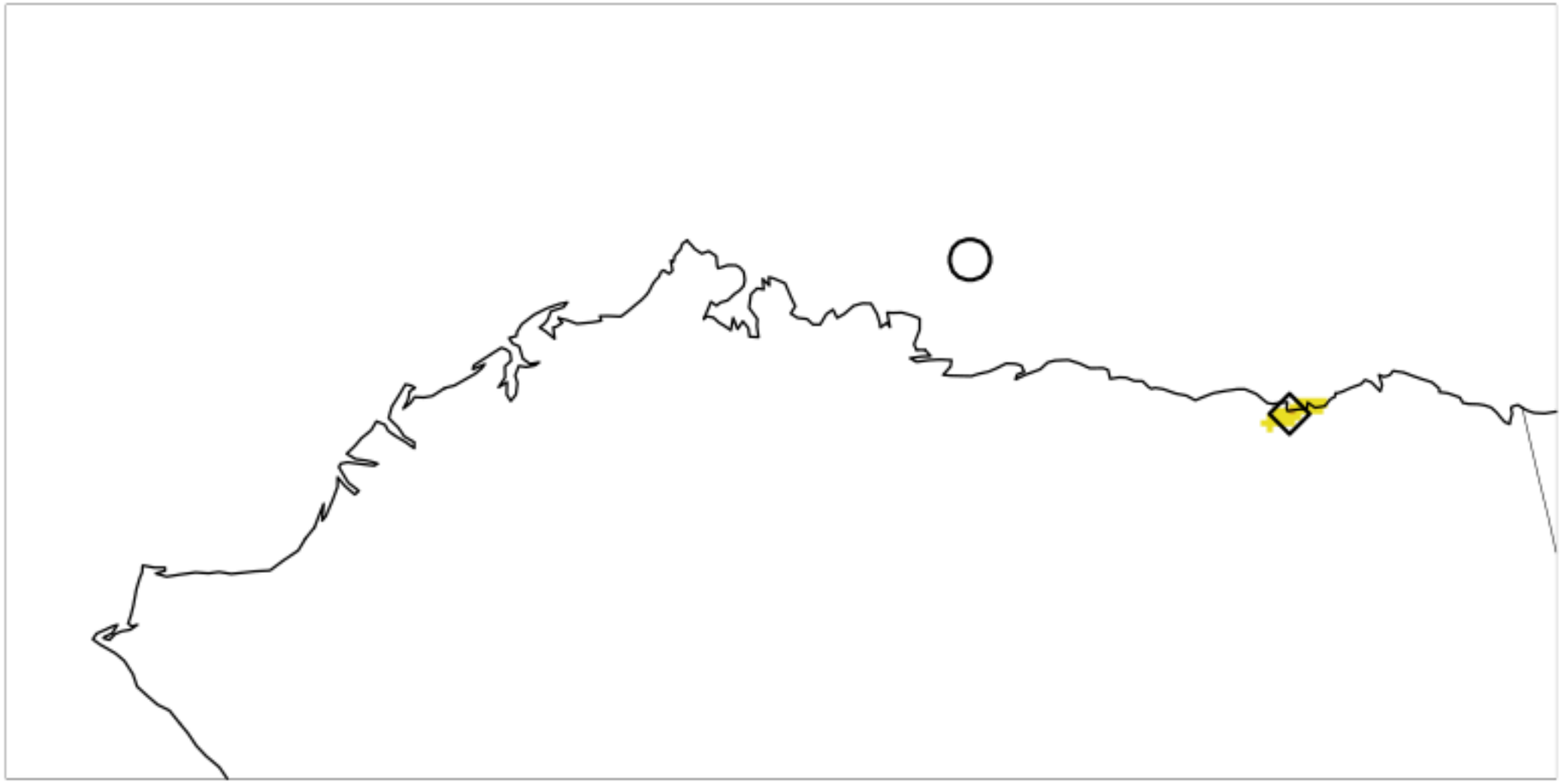
Annual average SO_2 concentration
High Development Scenario-Indirect Impact

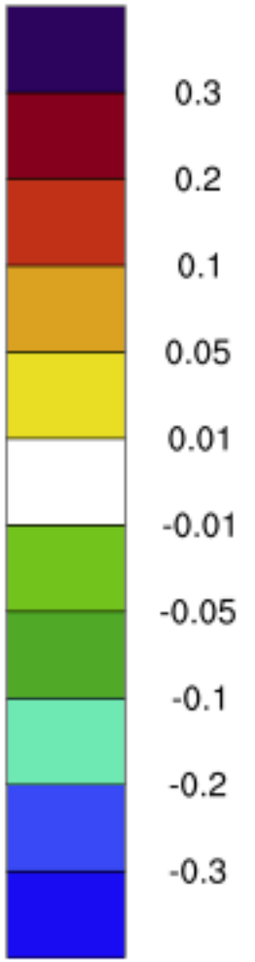




◇ max(231,63) = 0.126 ppb
○ min(172,95) = -0.000 ppb

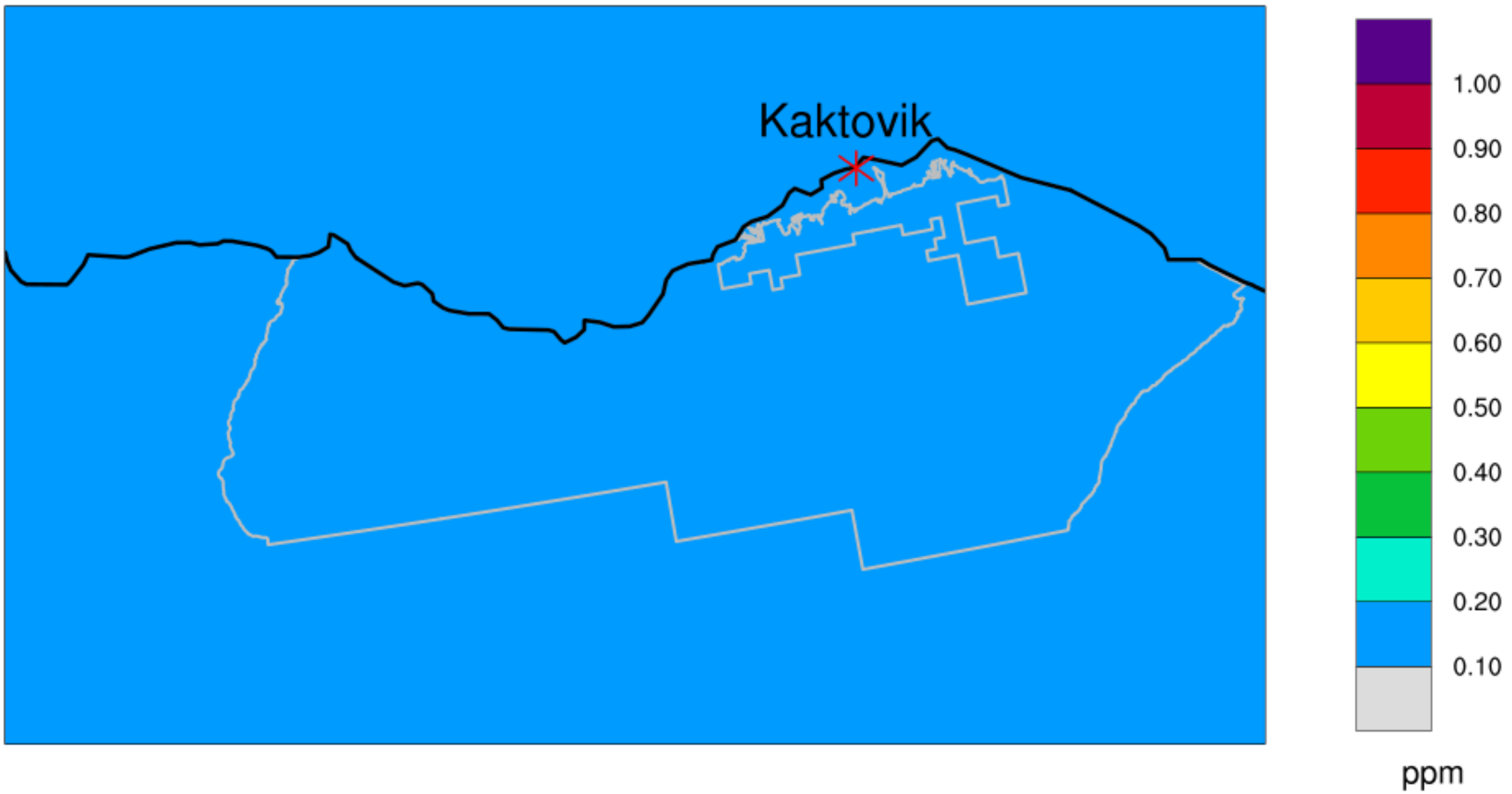
Annual average SO_2 concentration
Low Development Scenario-Indirect Impact



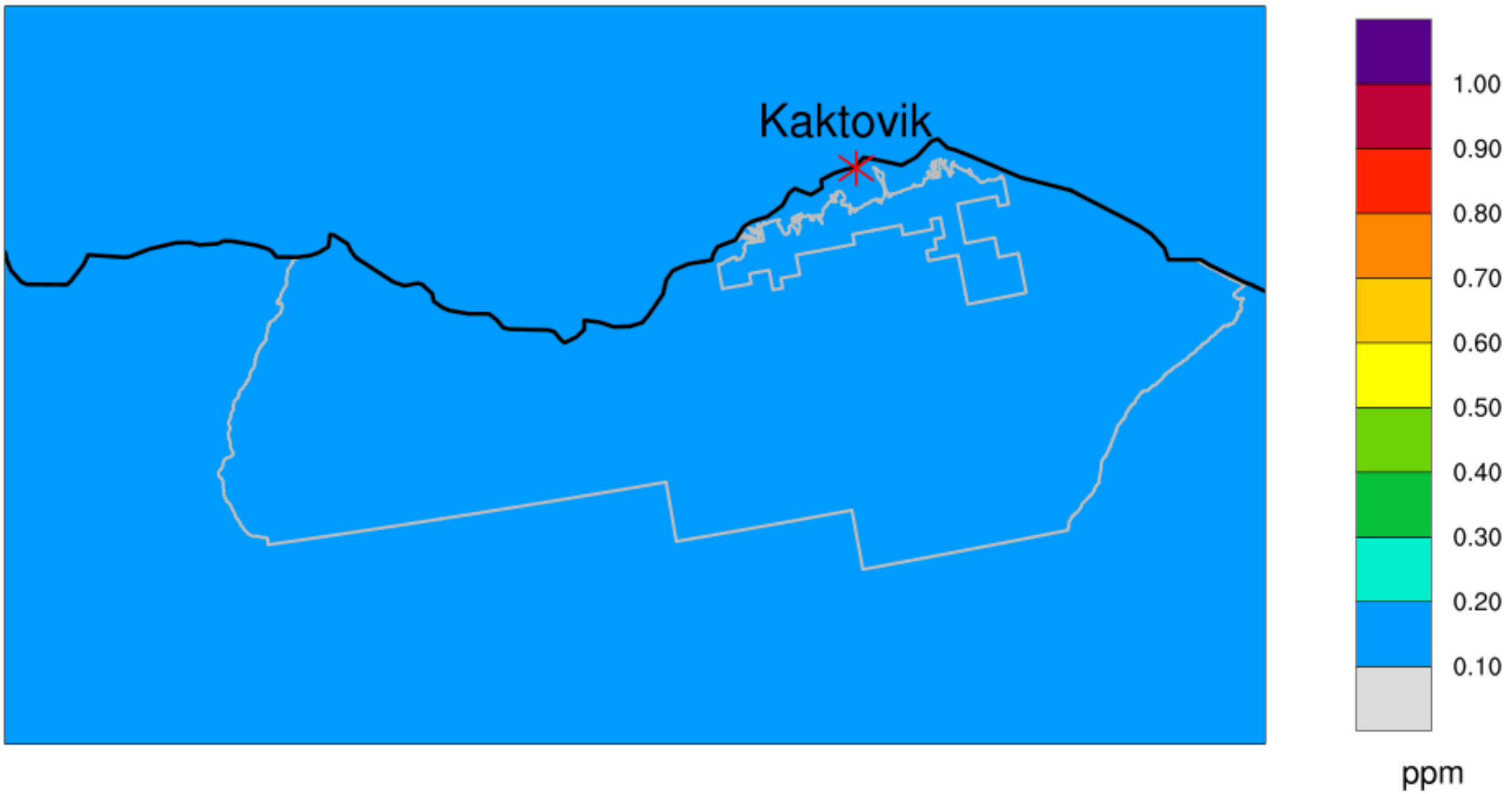


◇ max(229,66) = 0.079 ppb
○ min(172,93) = -0.000 ppb

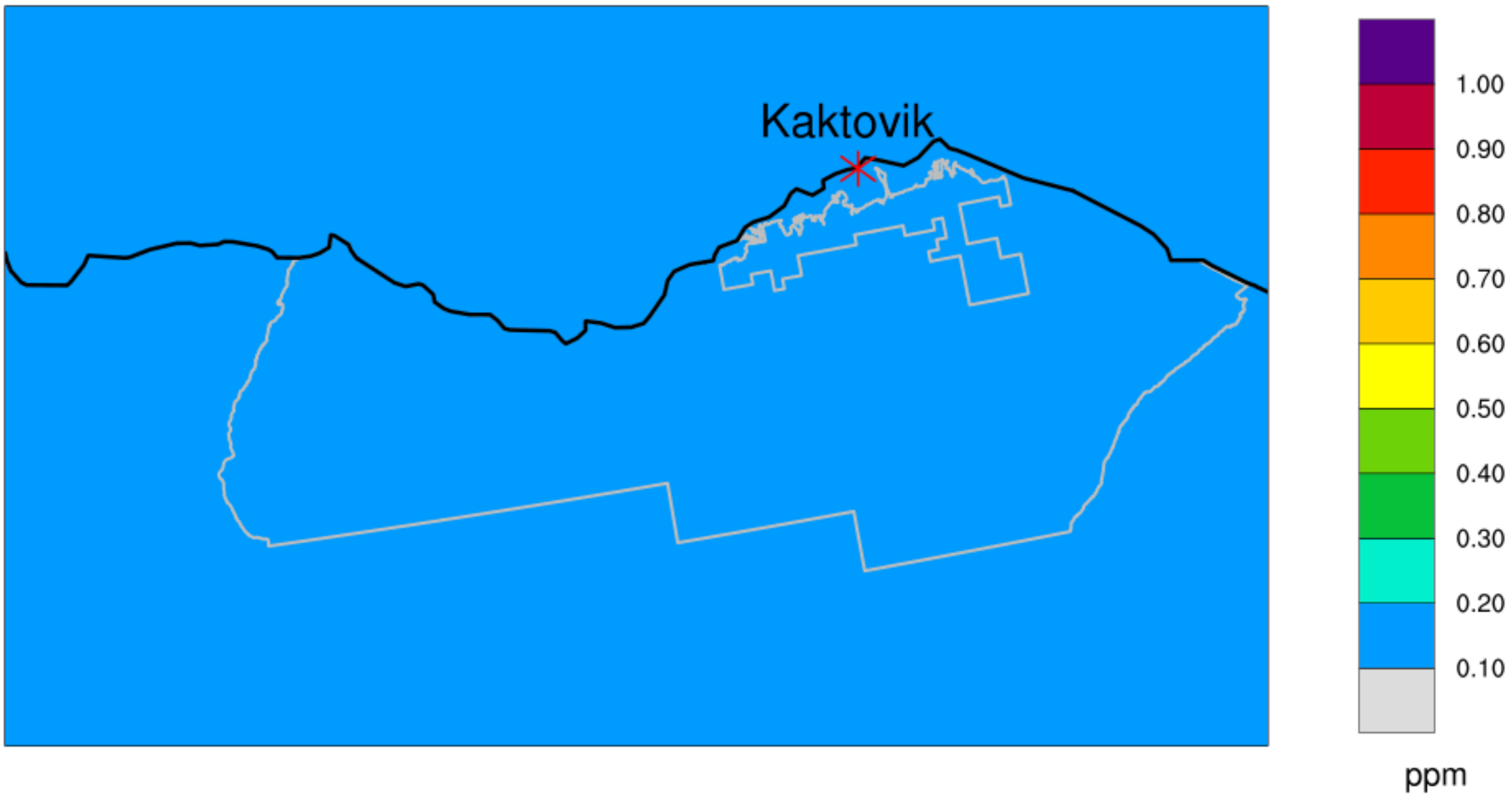
2nd highest 8-hr daily max CO
High Development Scenario-Cumulative



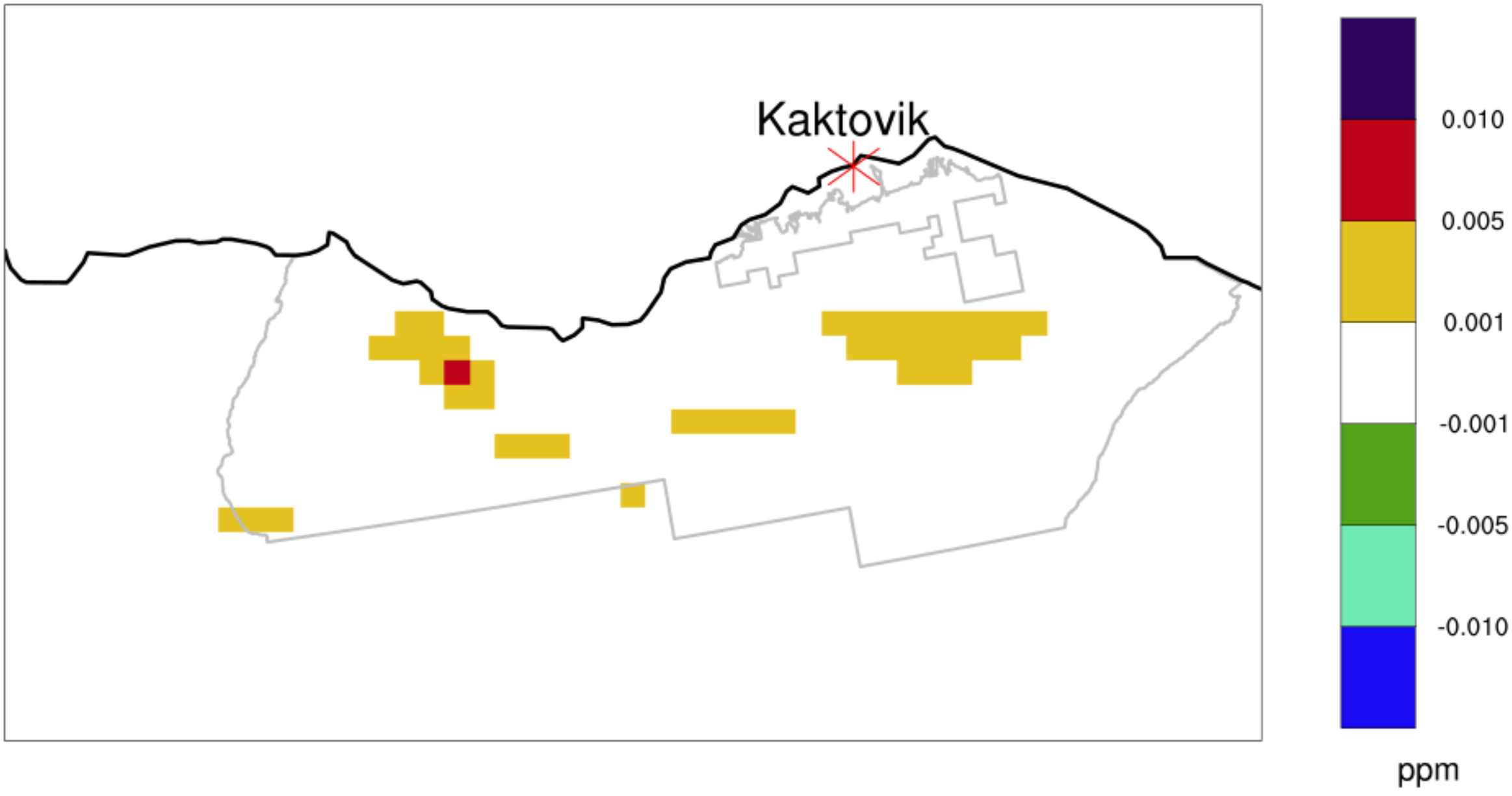
2nd highest 8-hr daily max CO
Low Development Scenario-Cumulative



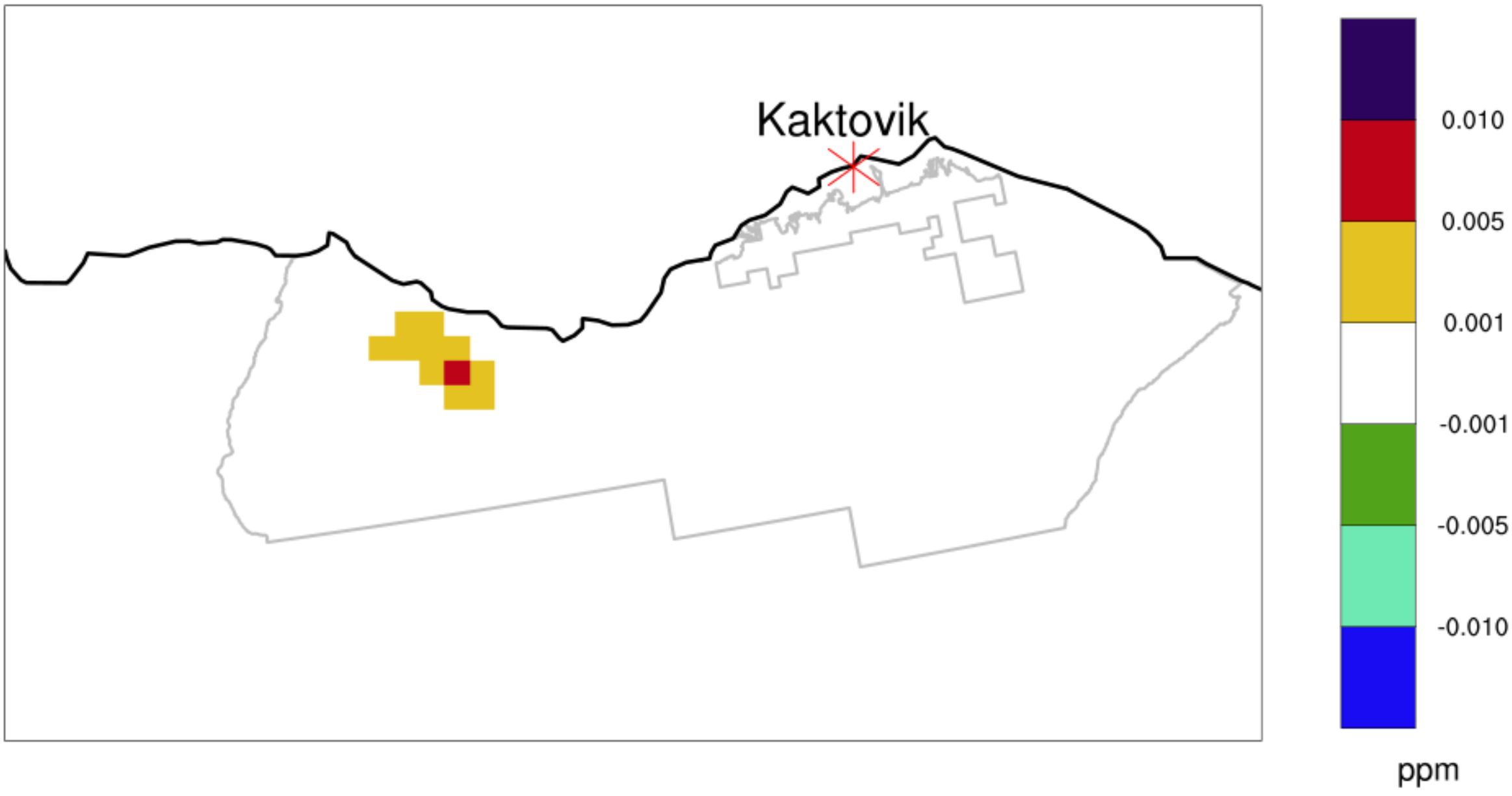
2nd highest 8-hr daily max CO
No Action Alternative-Cumulative



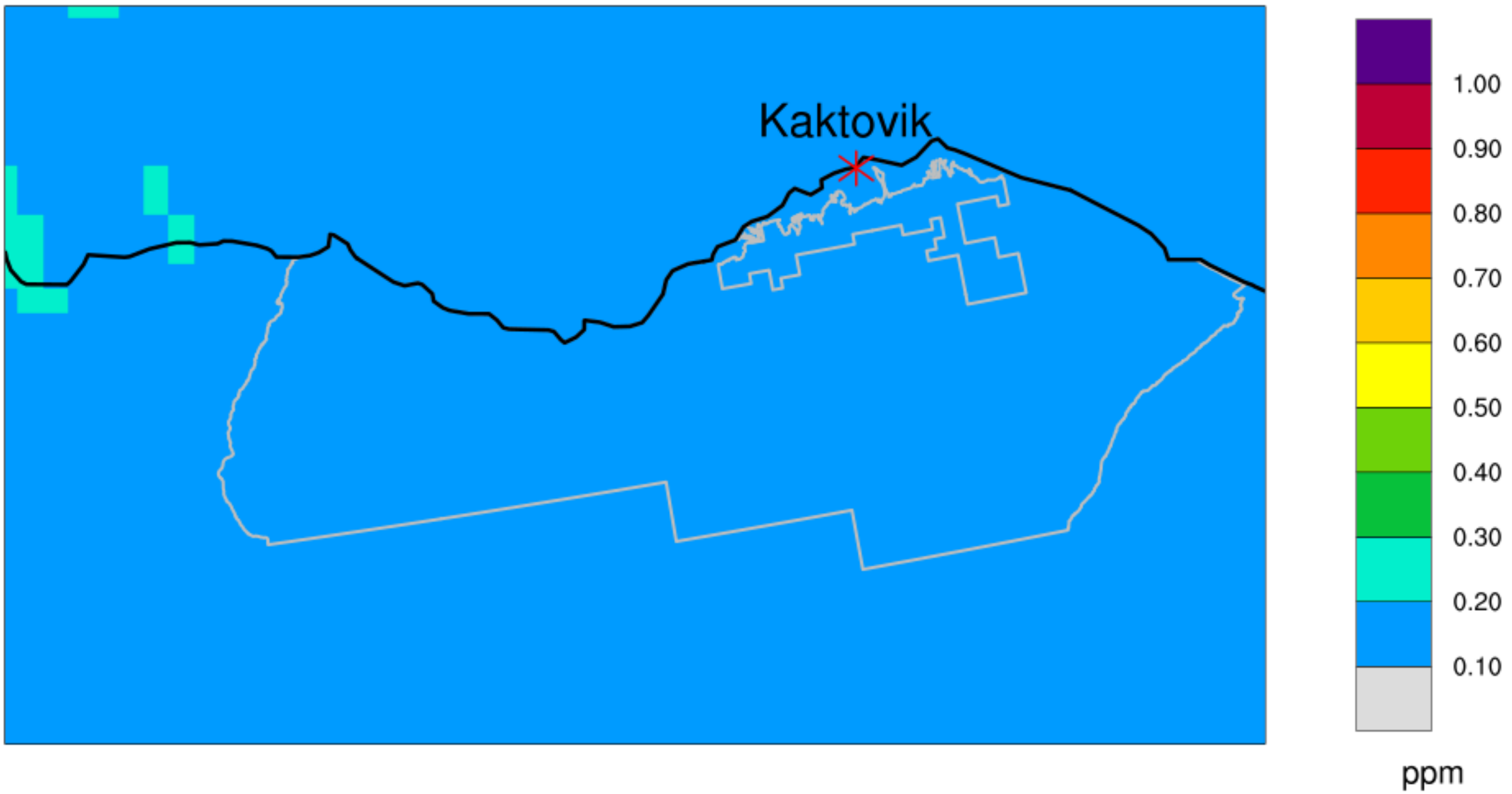
2nd highest 8-hr daily max CO
High Development Scenario-Indirect Impact



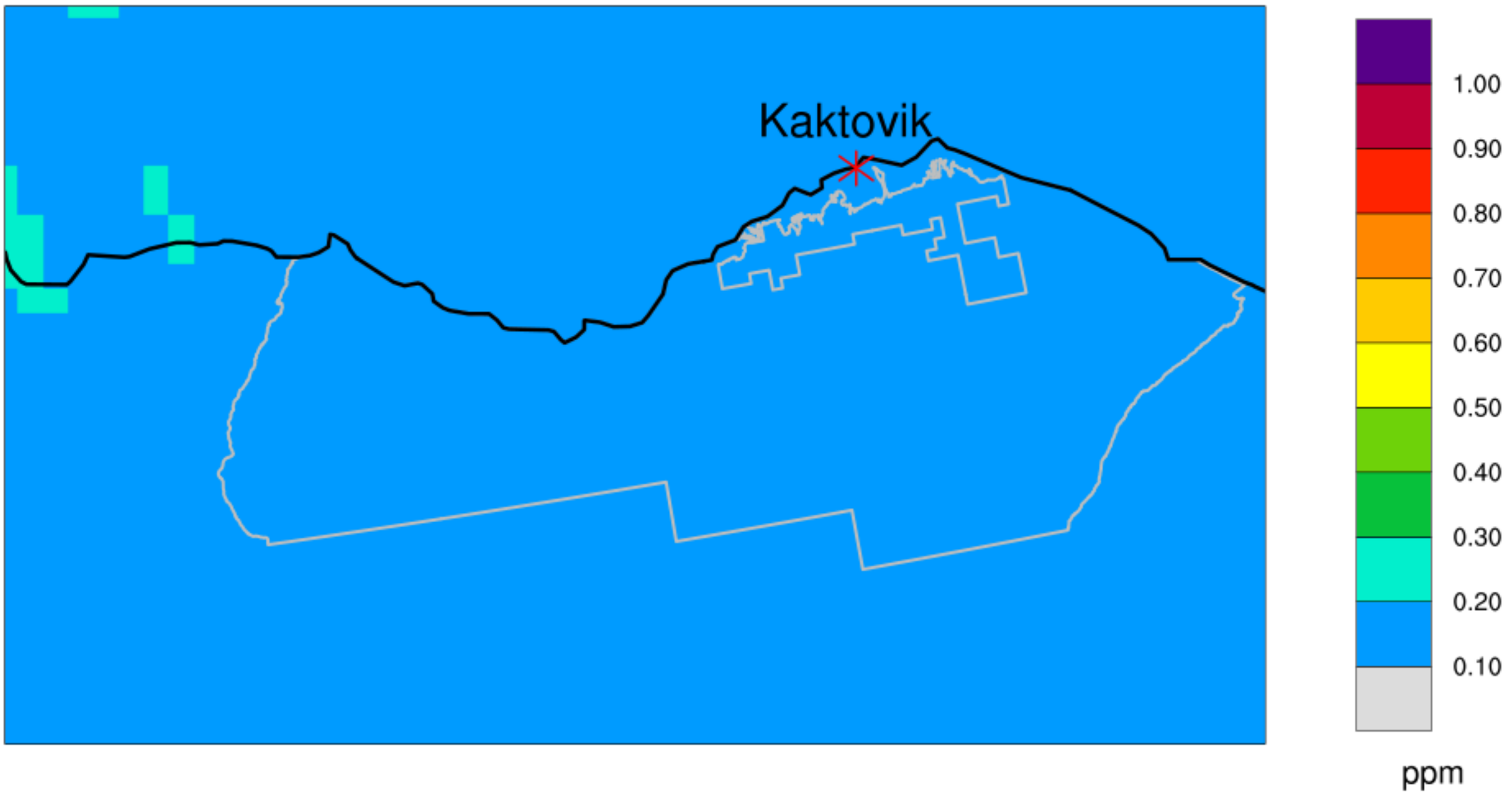
2nd highest 8-hr daily max CO
Low Development Scenario-Indirect Impact



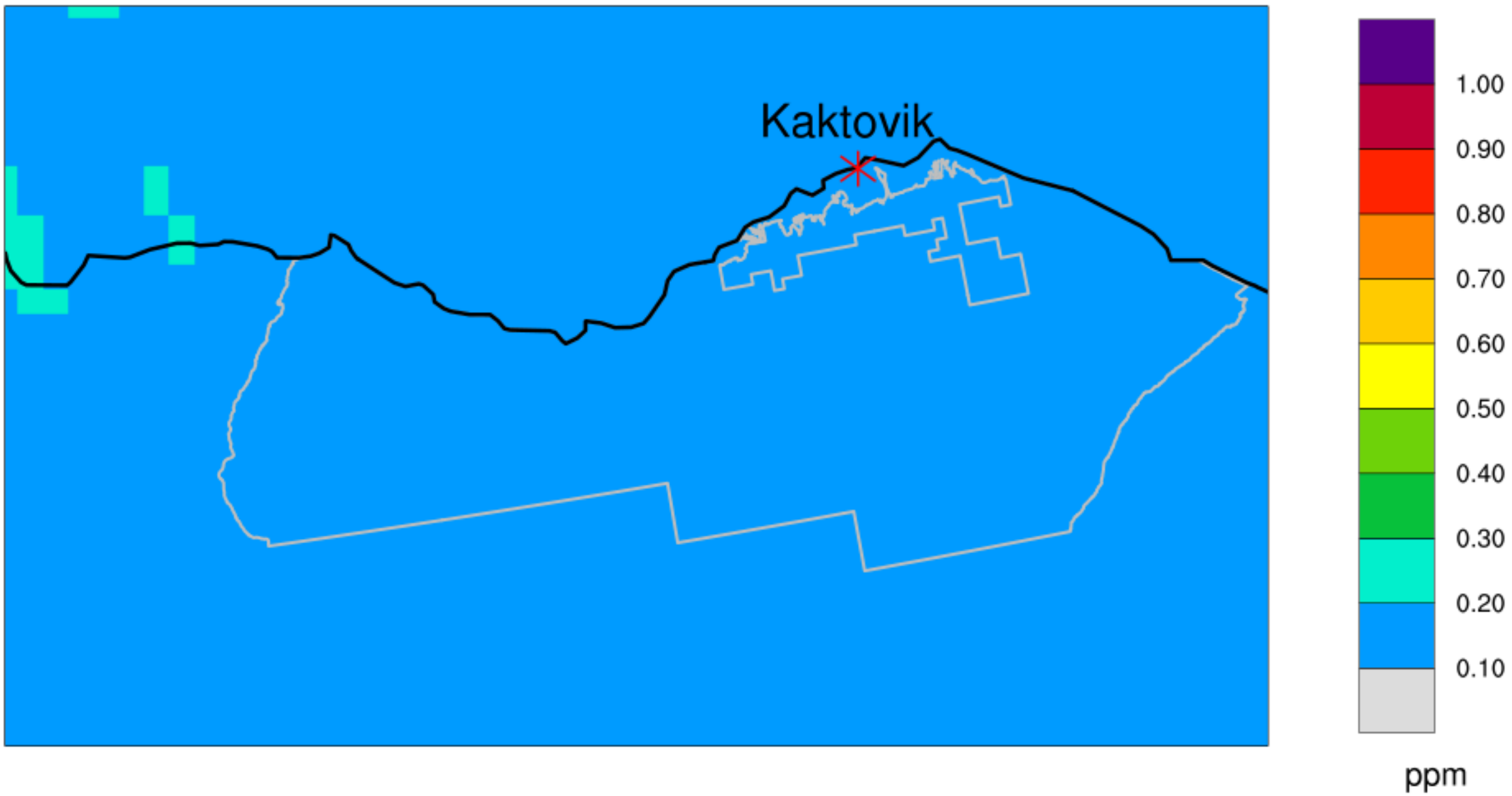
2nd highest 1-hr daily max CO
High Development Scenario-Cumulative



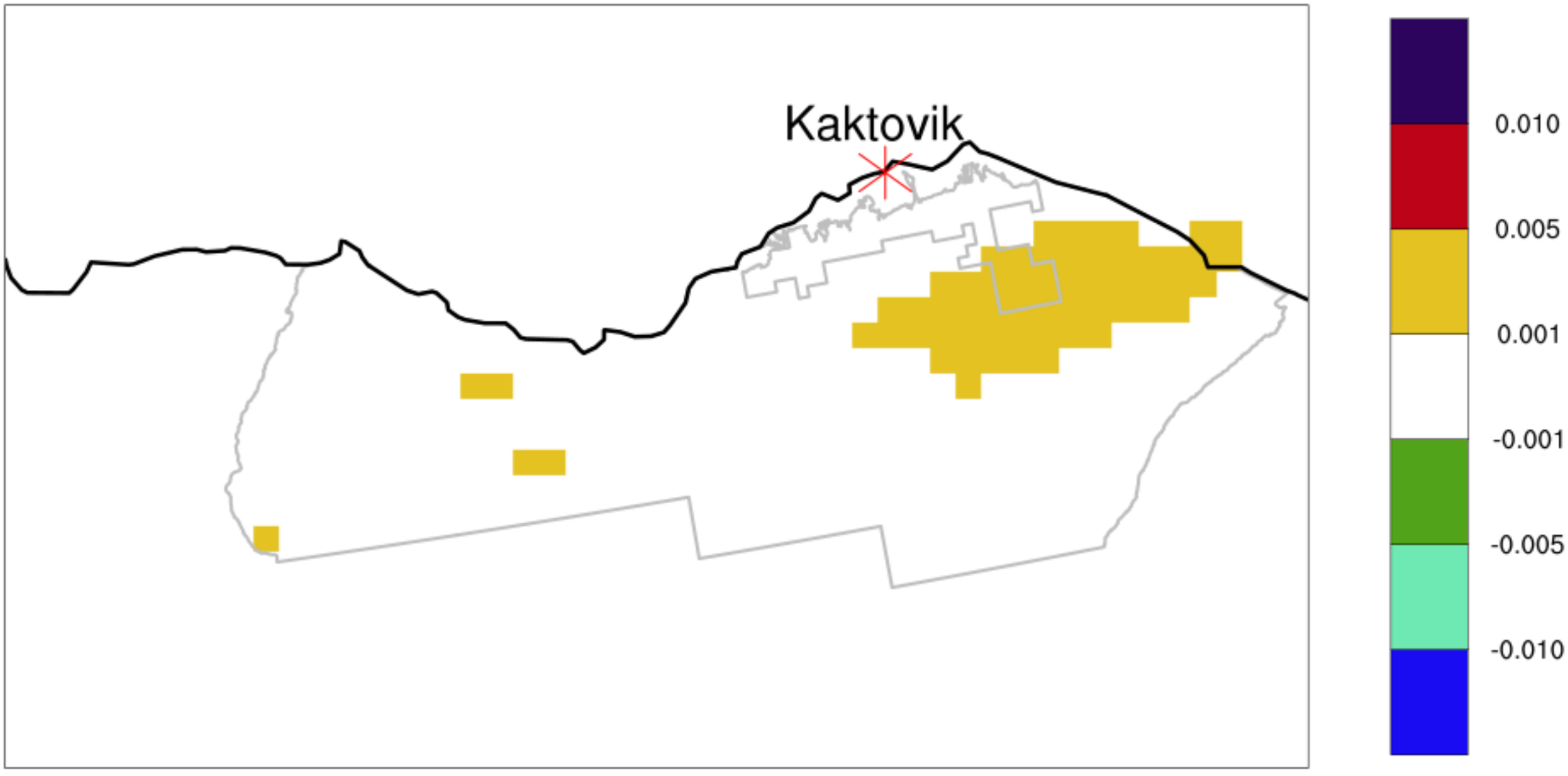
2nd highest 1-hr daily max CO
Low Development Scenario-Cumulative



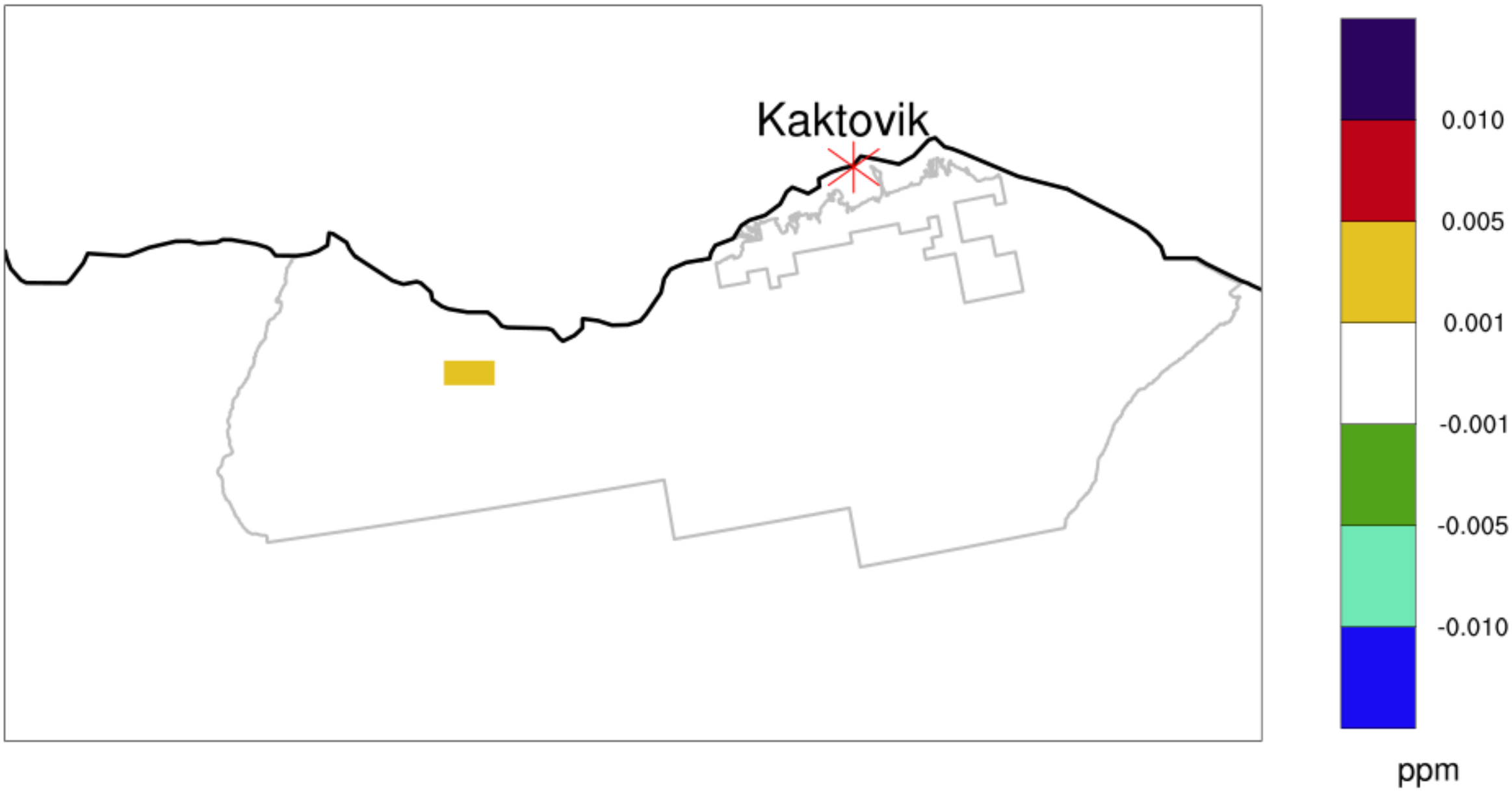
2nd highest 1-hr daily max CO
No Action Alternative-Cumulative



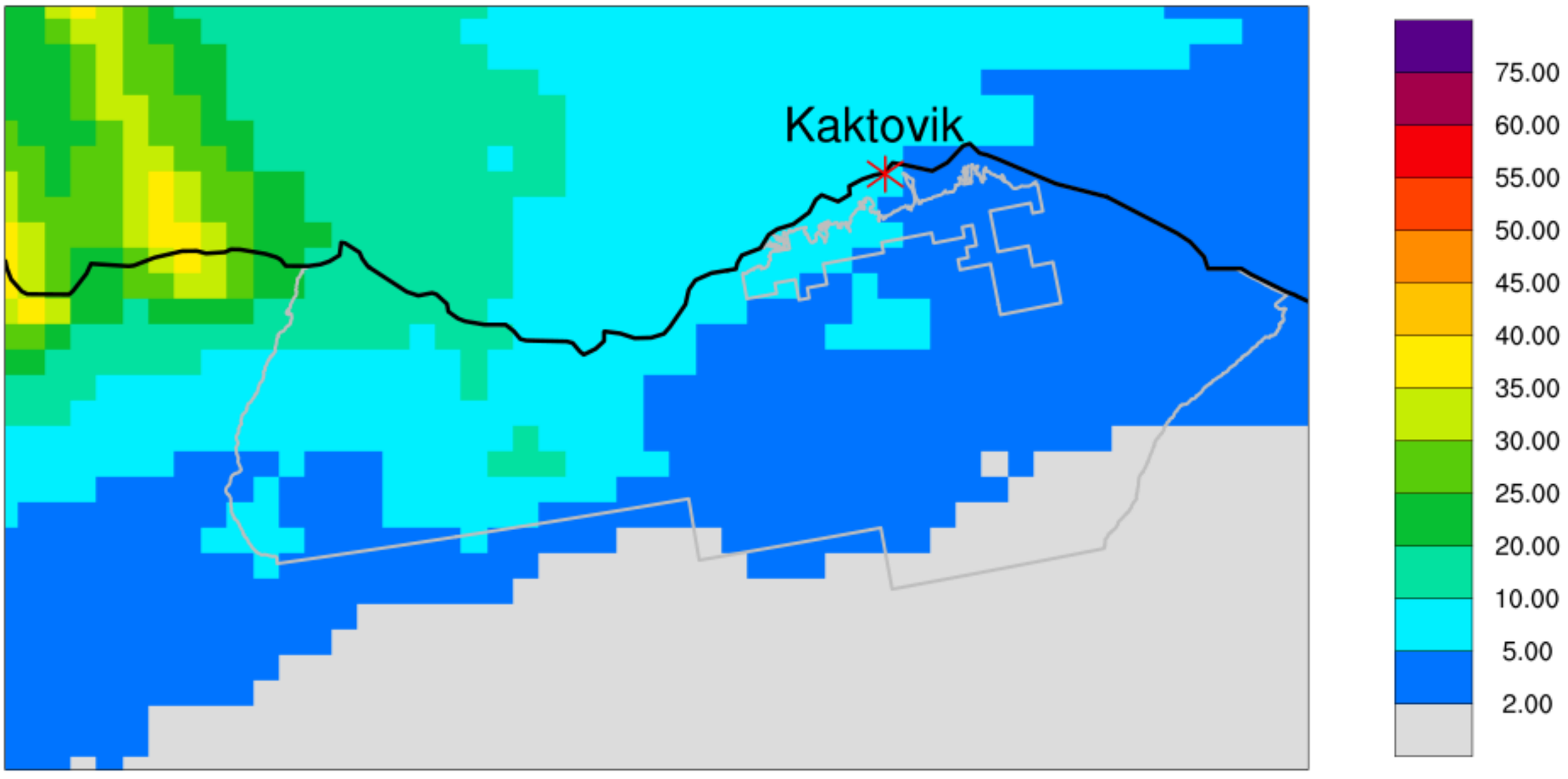
2nd highest 1-hr daily max CO
High Development Scenario-Indirect Impact



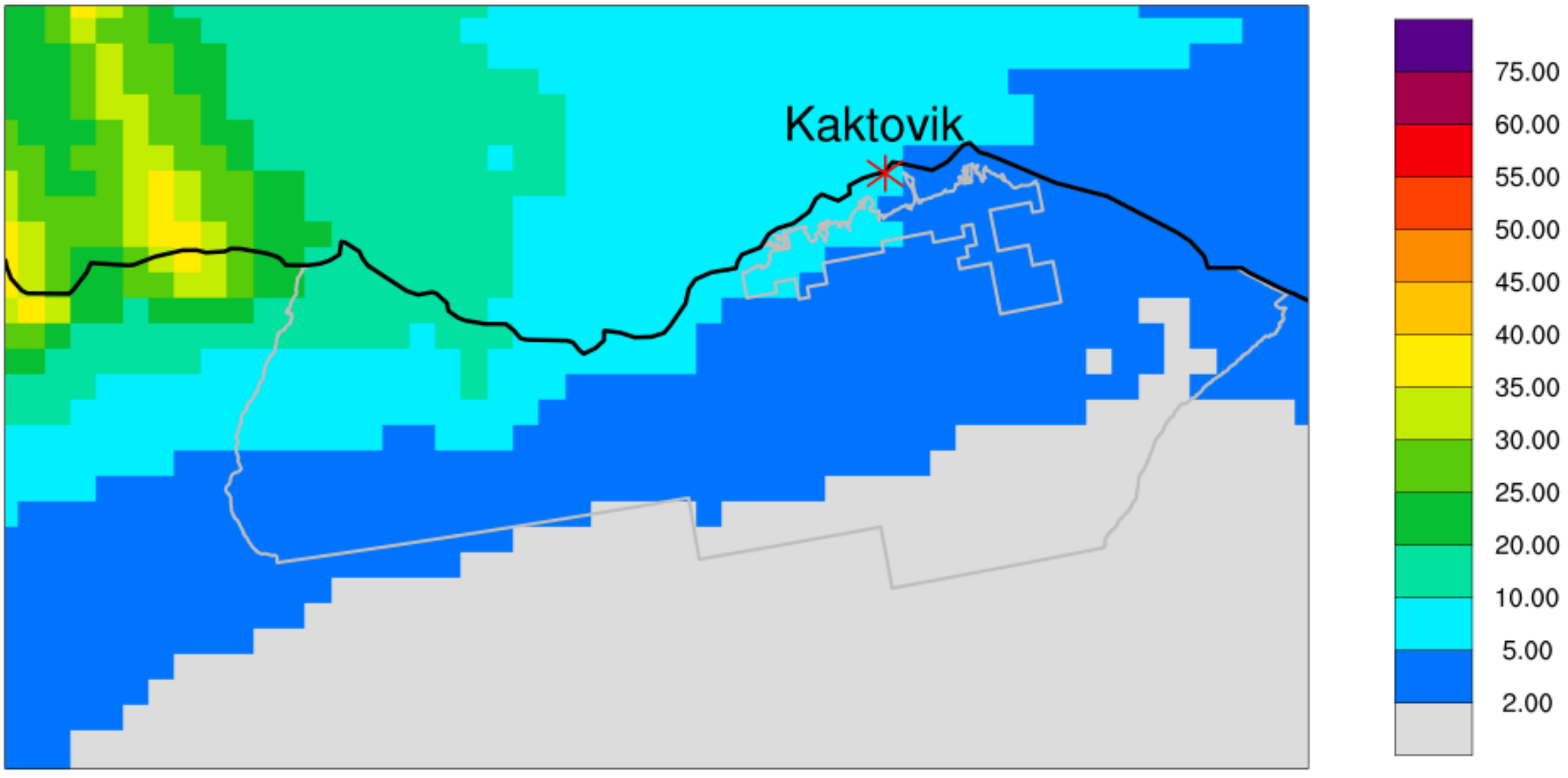
2nd highest 1-hr daily max CO
Low Development Scenario-Indirect Impact



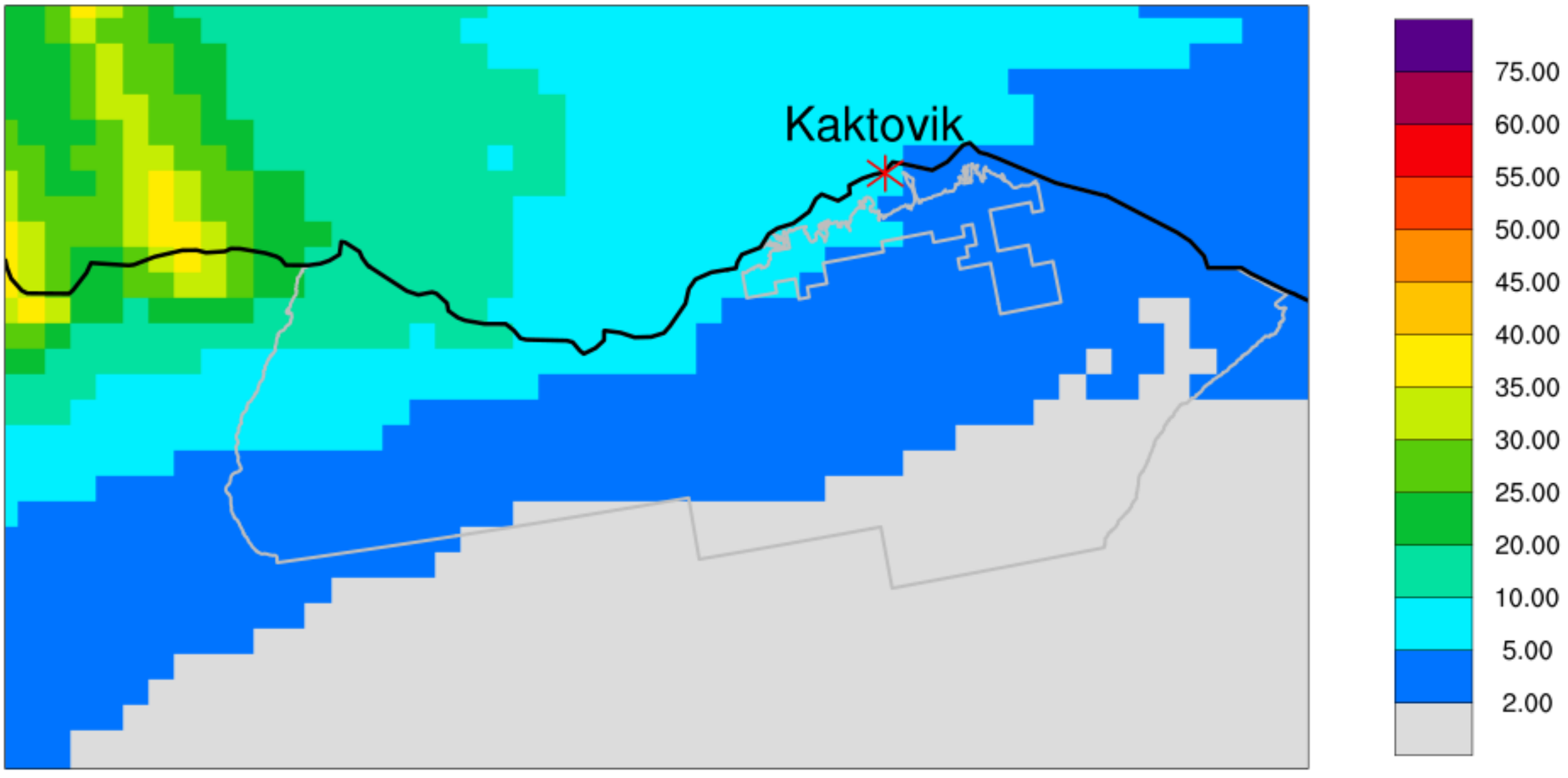
98th percentile daily max NO_2
High Development Scenario-Cumulative



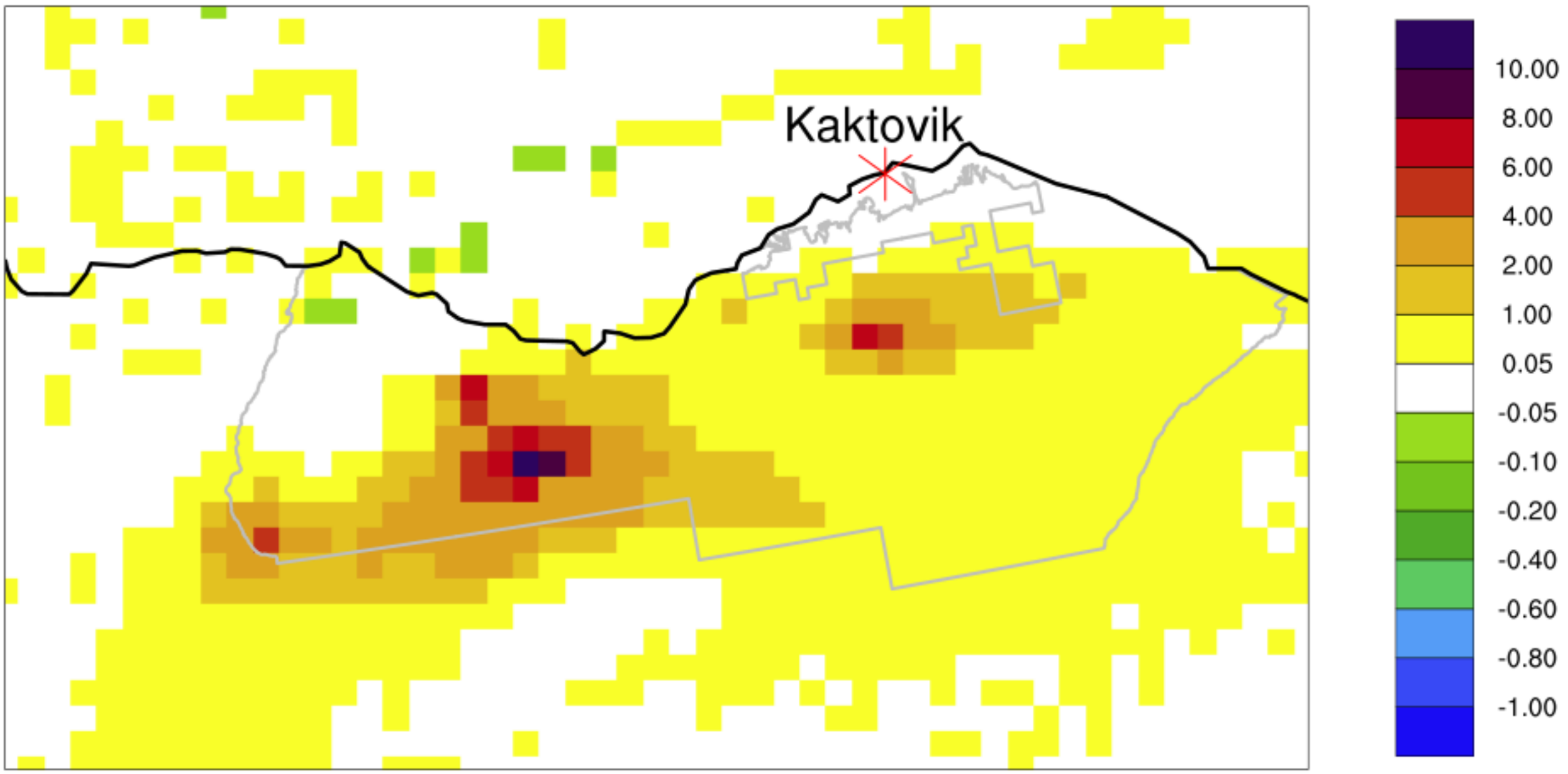
98th percentile daily max NO_2
Low Development Scenario-Cumulative



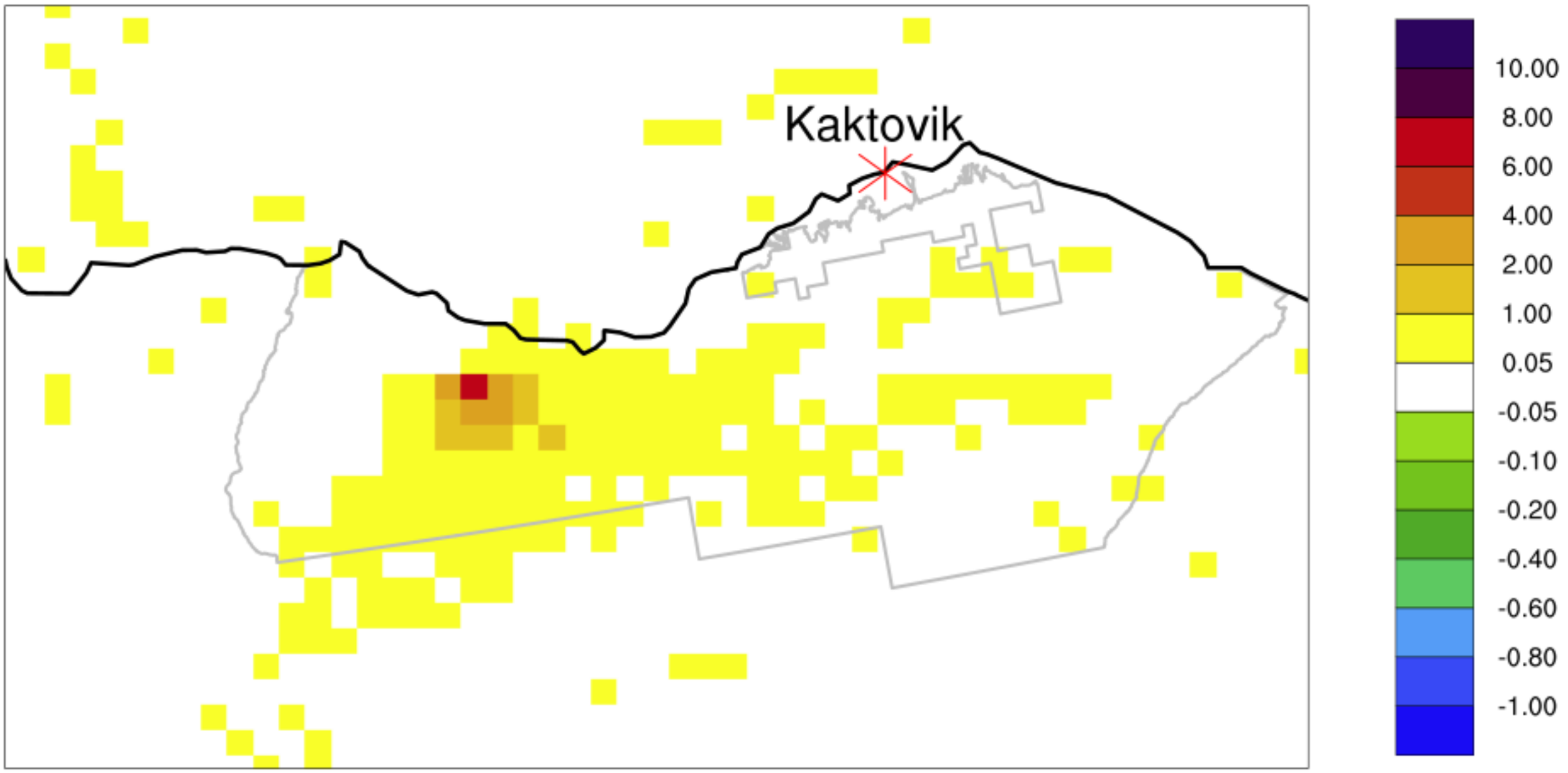
98th percentile daily max NO_2
No Action Alternative-Cumulative



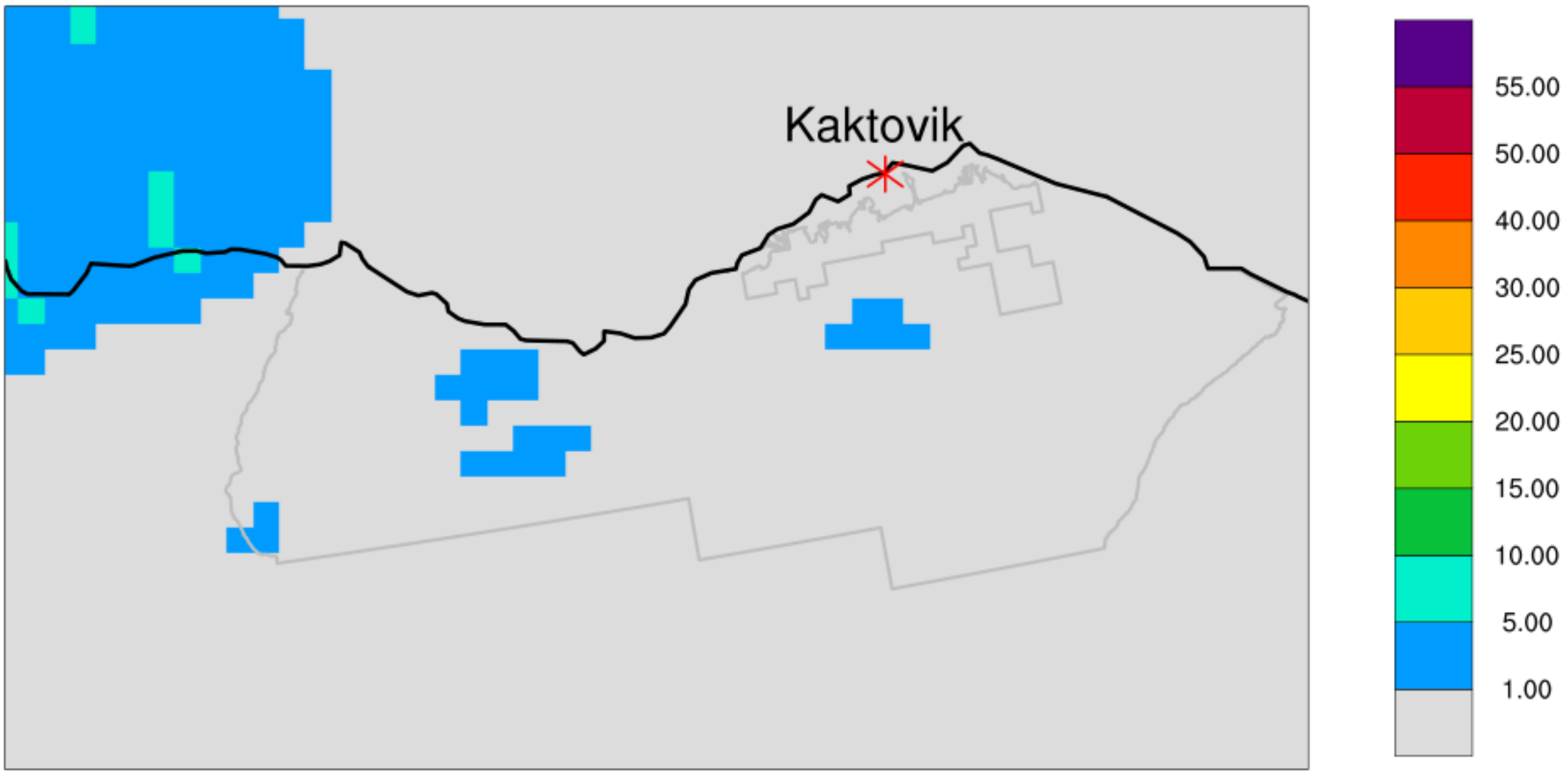
98th percentile daily max NO_2
High Development Scenario-Indirect Impact



98th percentile daily max NO_2
Low Development Scenario-Indirect Impact



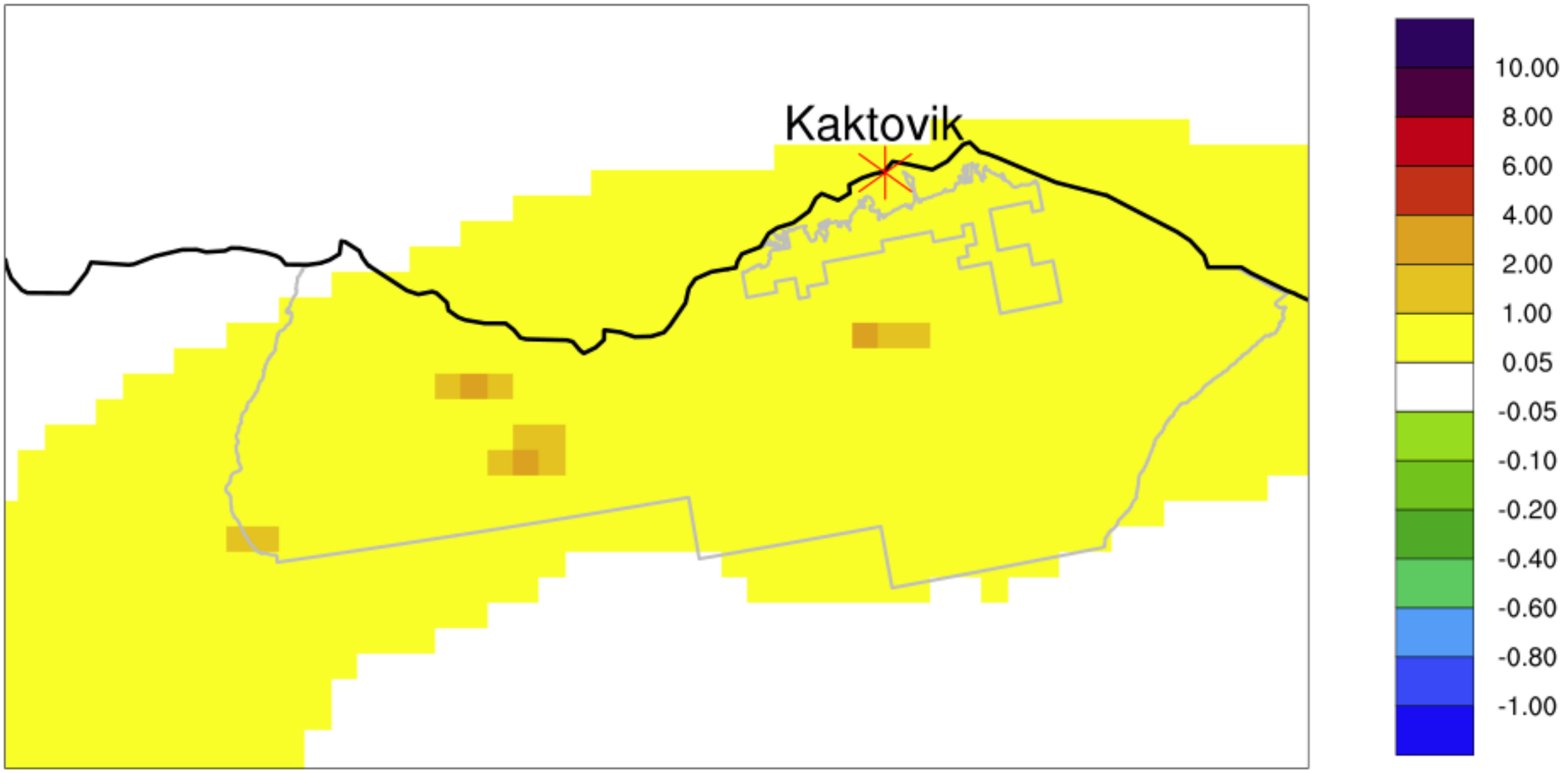
Annual Average NO_2
High Development Scenario-Cumulative



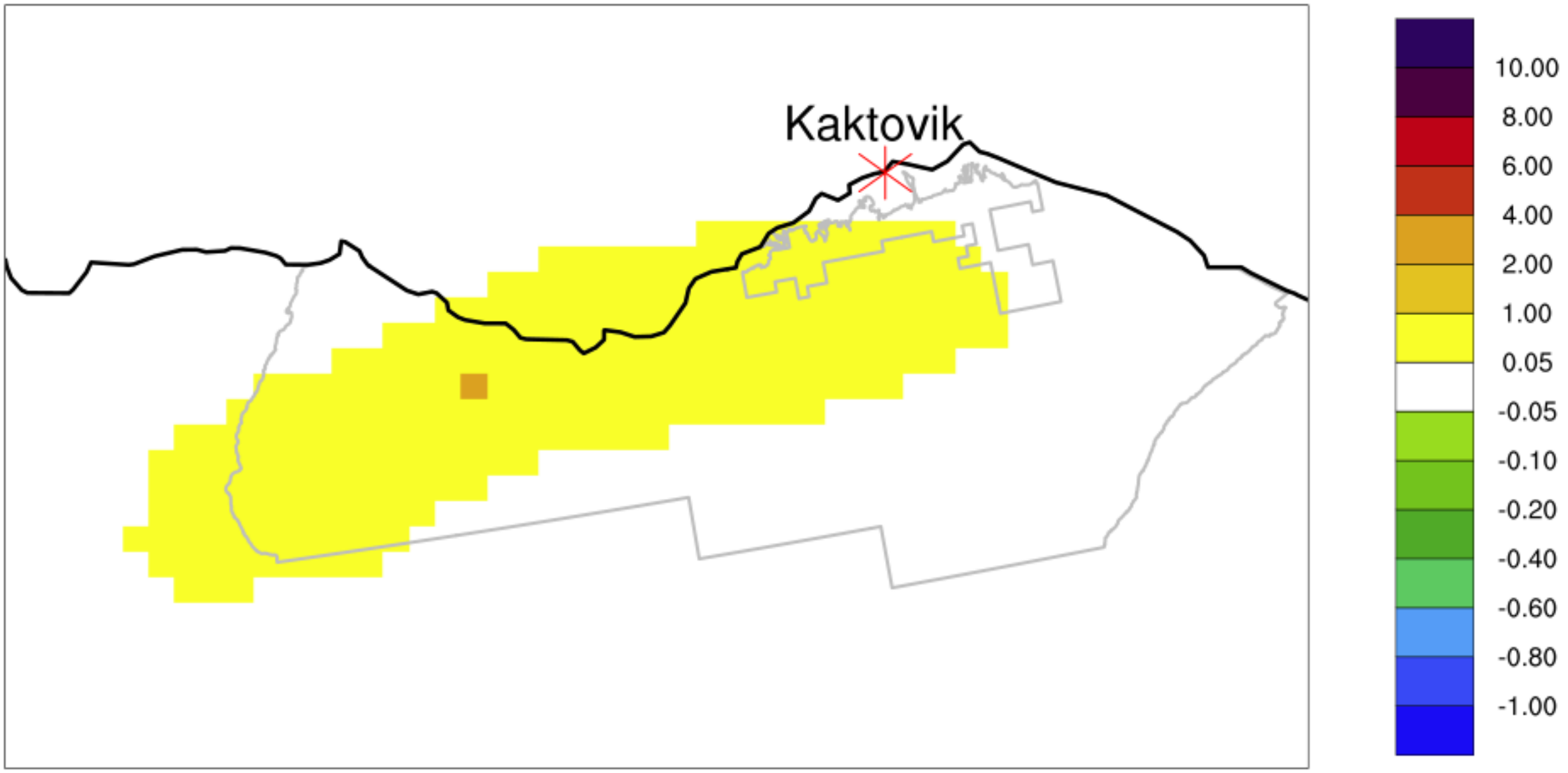
Annual Average NO_2
Low Development Scenario-Cumulative

Annual Average NO_2
No Action Alternative-Cumulative

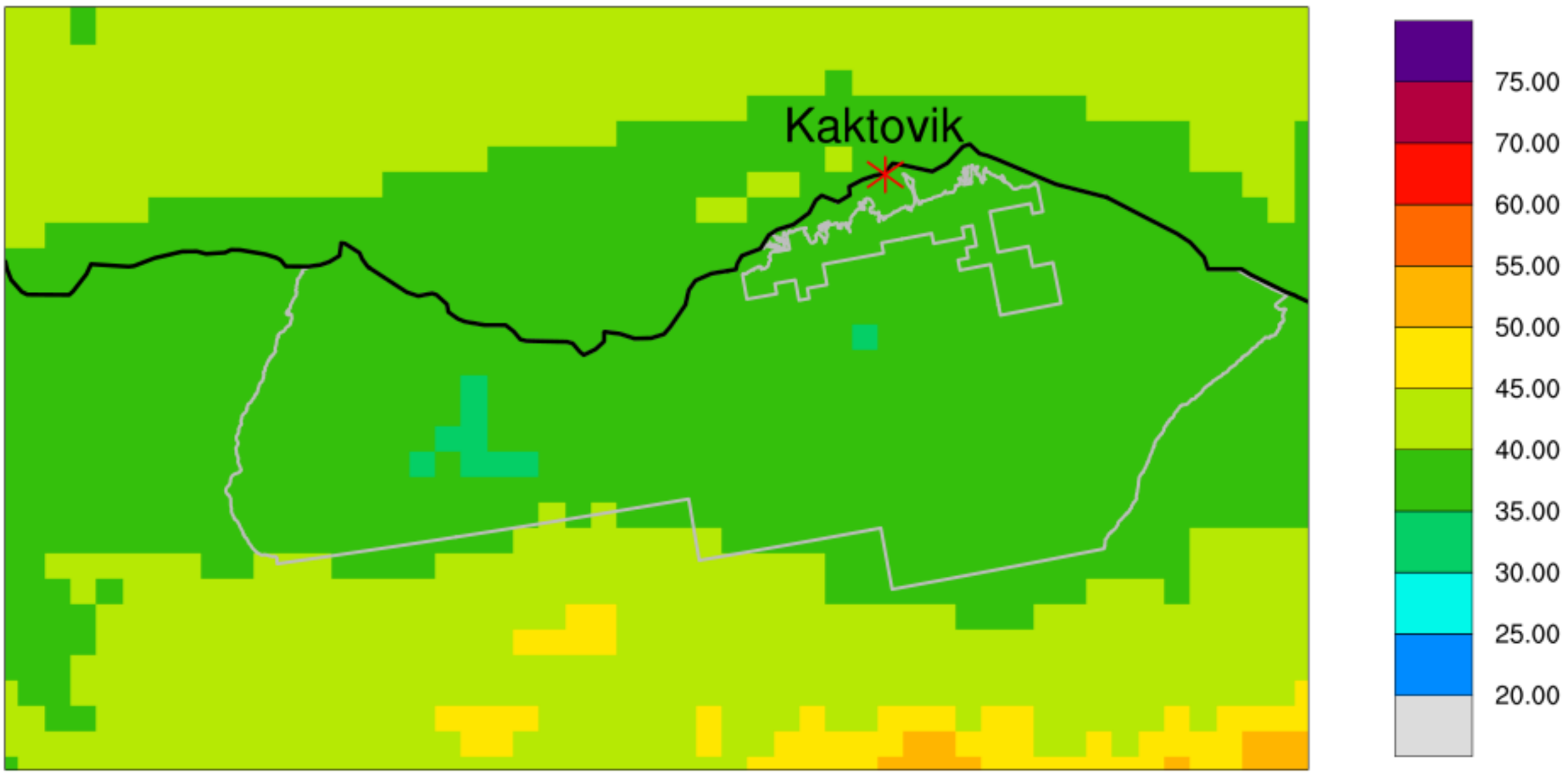
Annual average NO_2
High Development Scenario-Indirect Impact



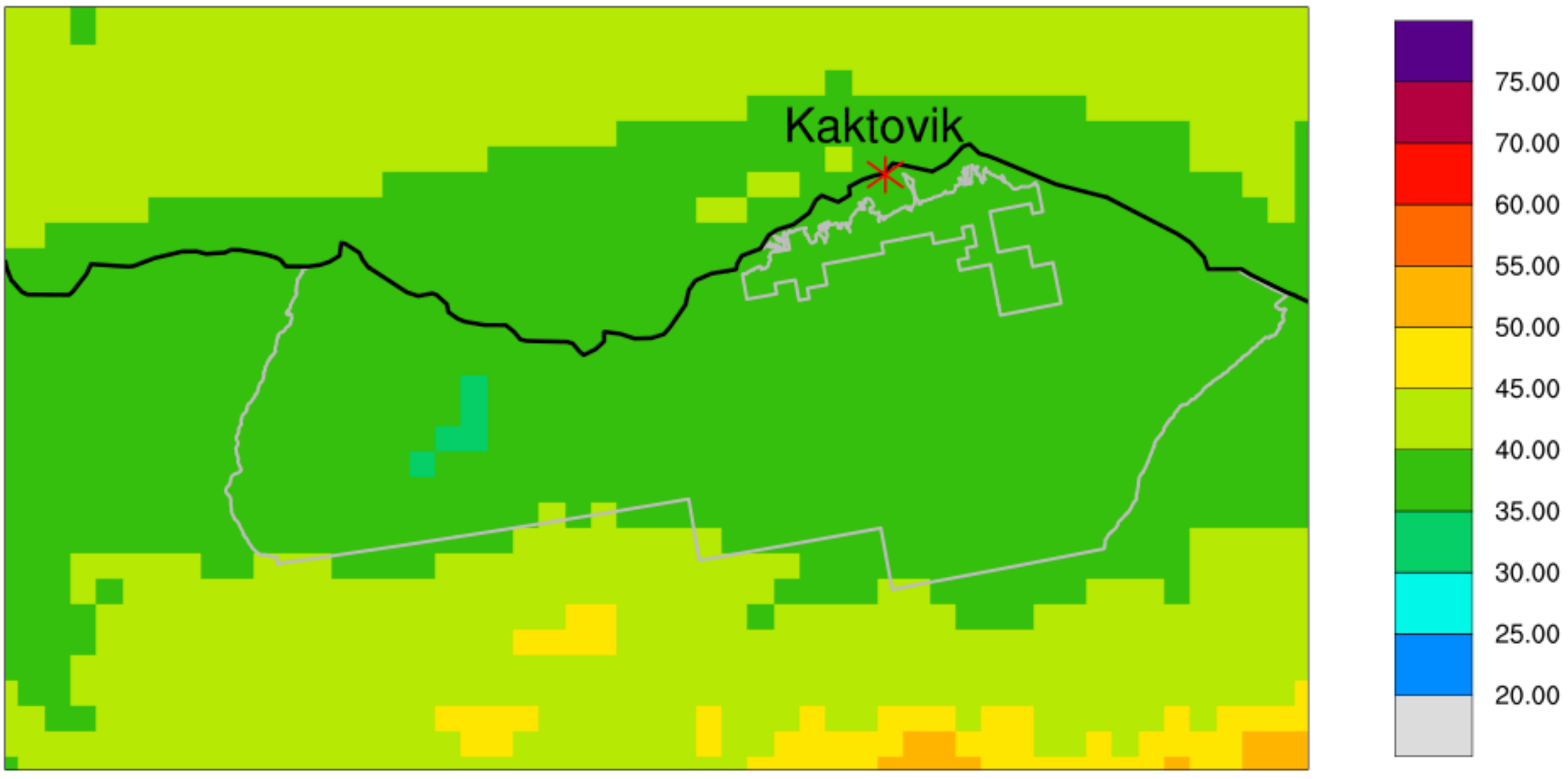
Annual average NO_2
Low Development Scenario-Indirect Impact



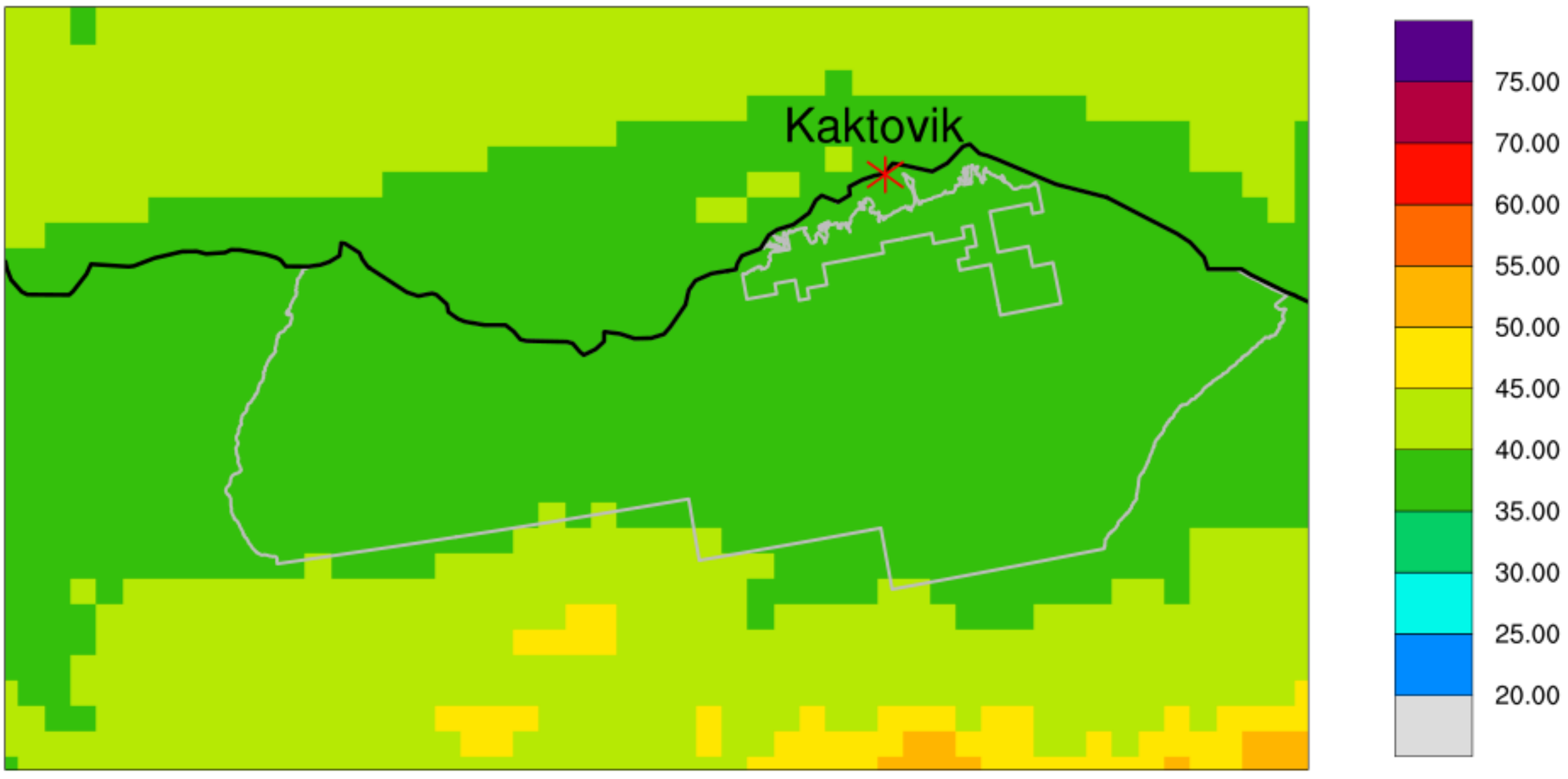
4th High Daily Max 8 Hour Avg Ozone
High Development Scenario-Cumulative



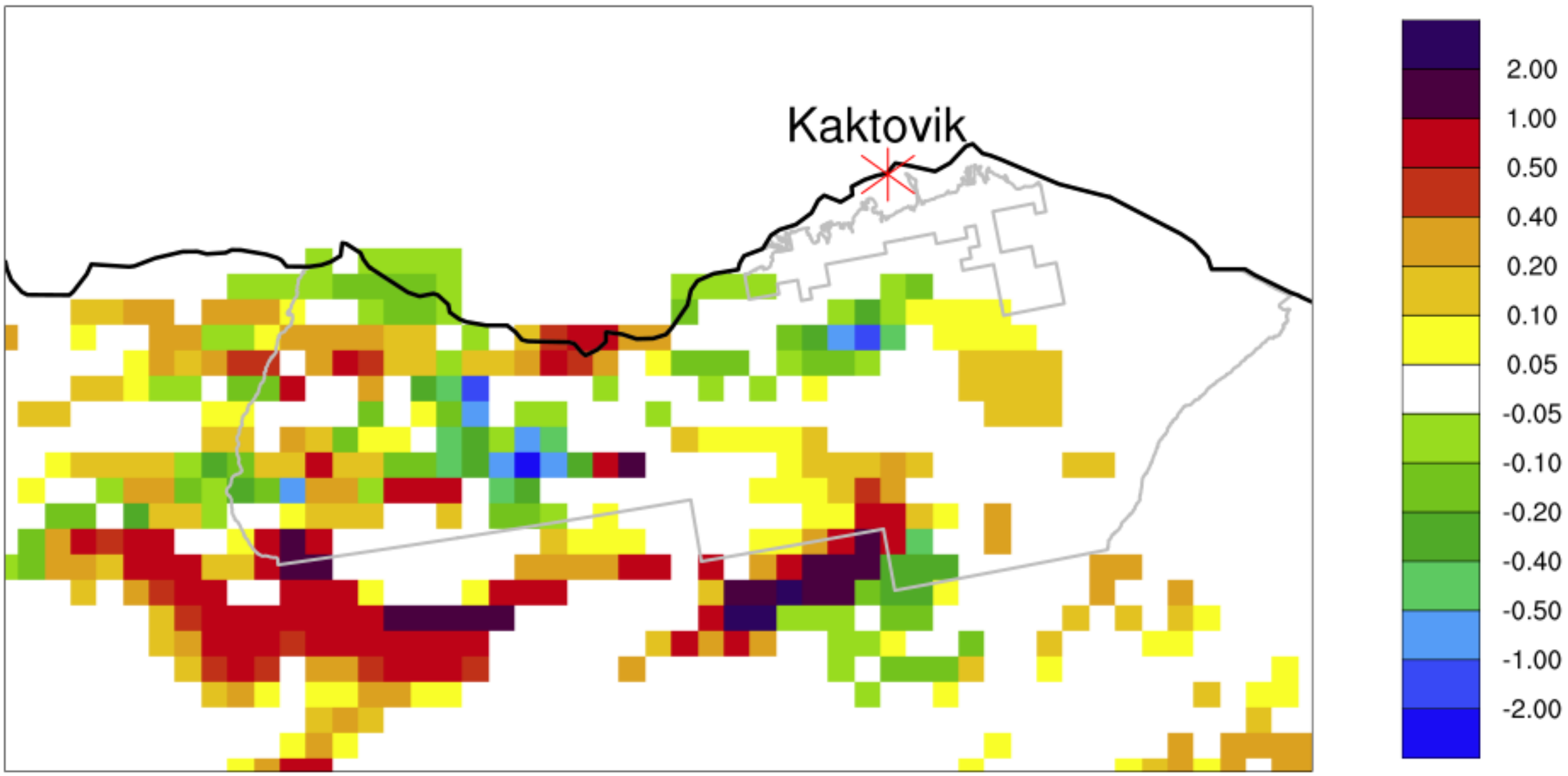
4th High Daily Max 8 Hour Avg Ozone
Low Development Scenario-Cumulative



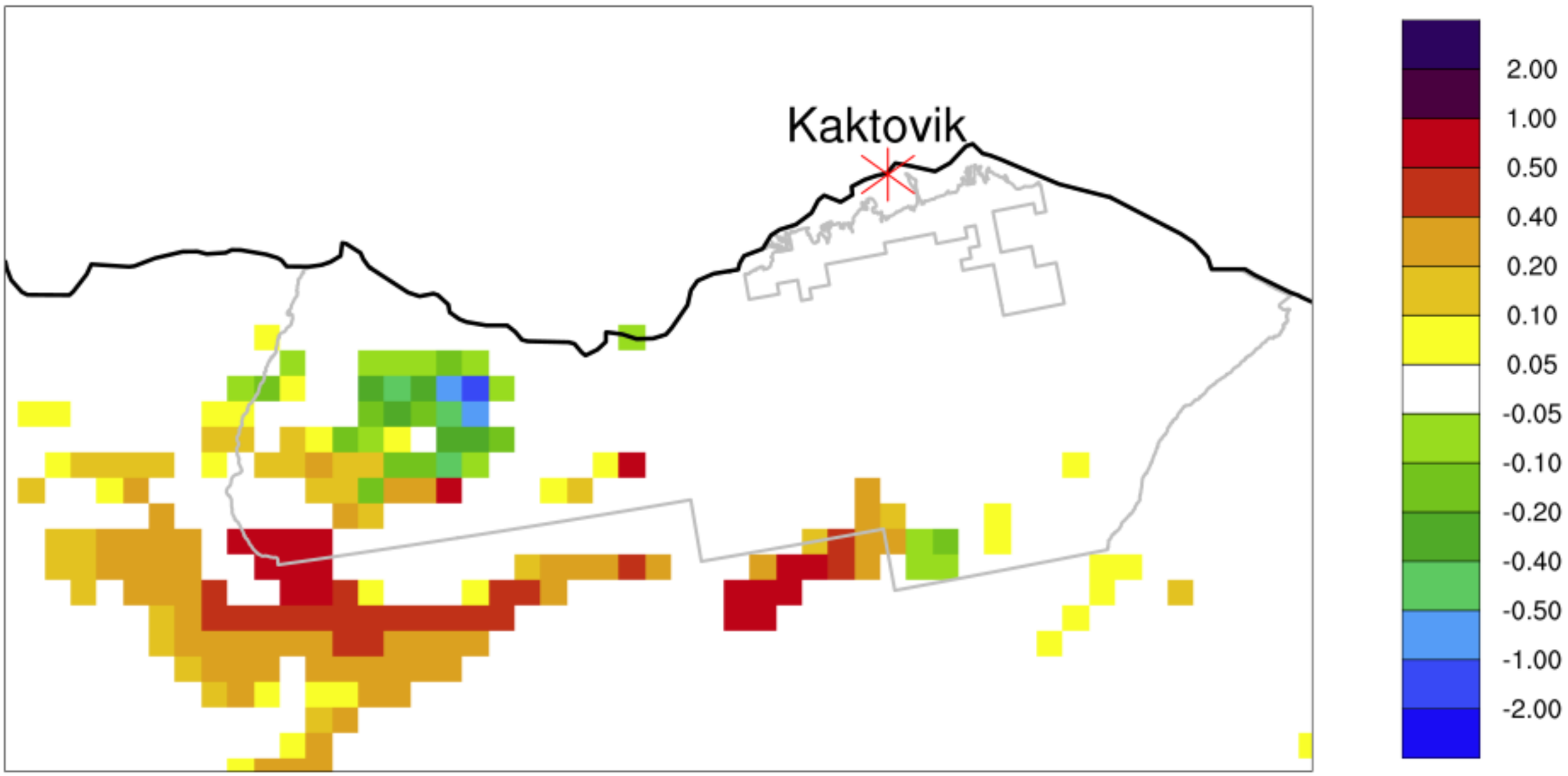
4th High Daily Max 8 Hour Avg Ozone
No Action Alternative-Cumulative



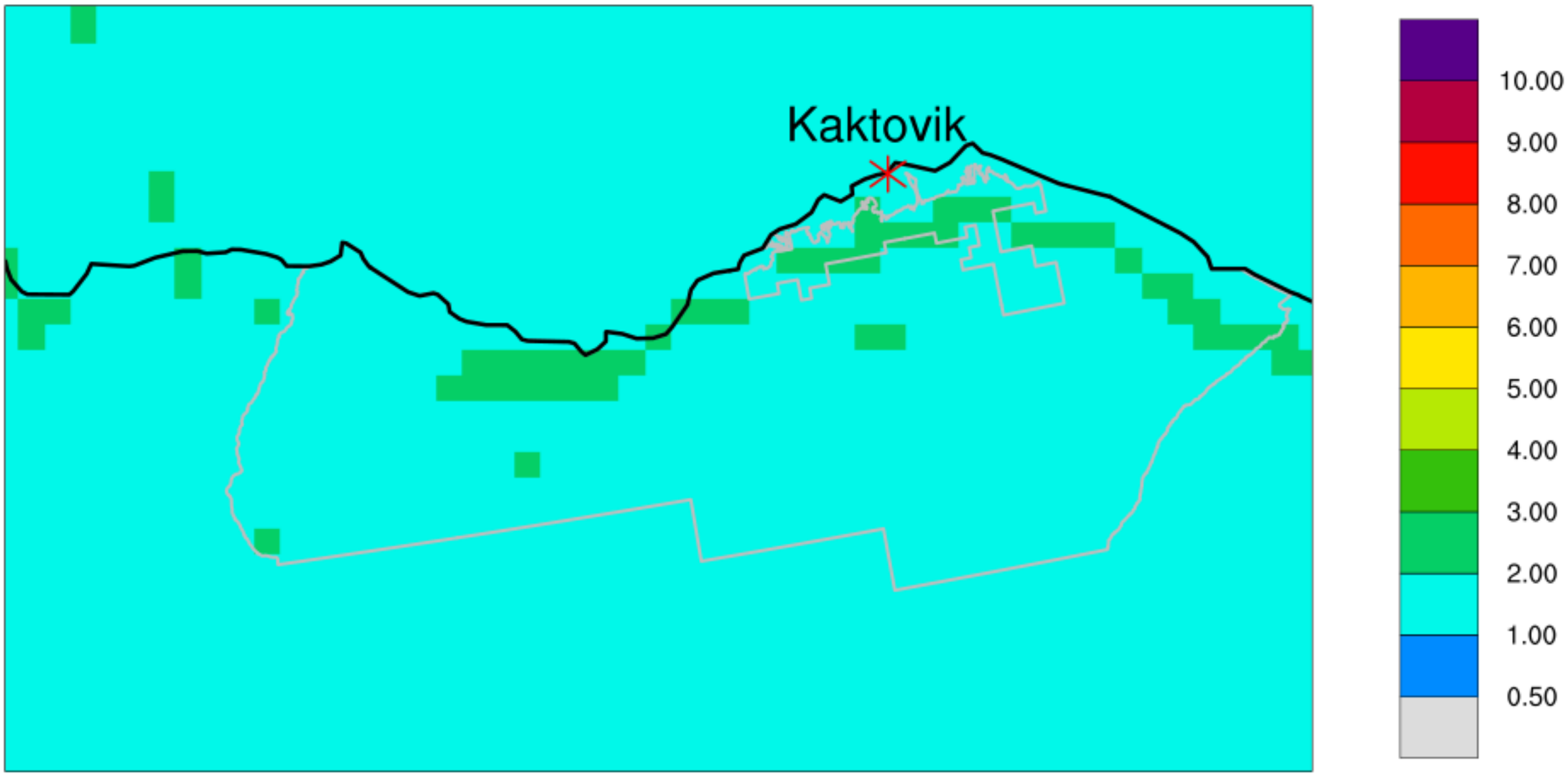
4th High Daily Max 8 Hour Avg Ozone
High Development Scenario-Indirect Impact



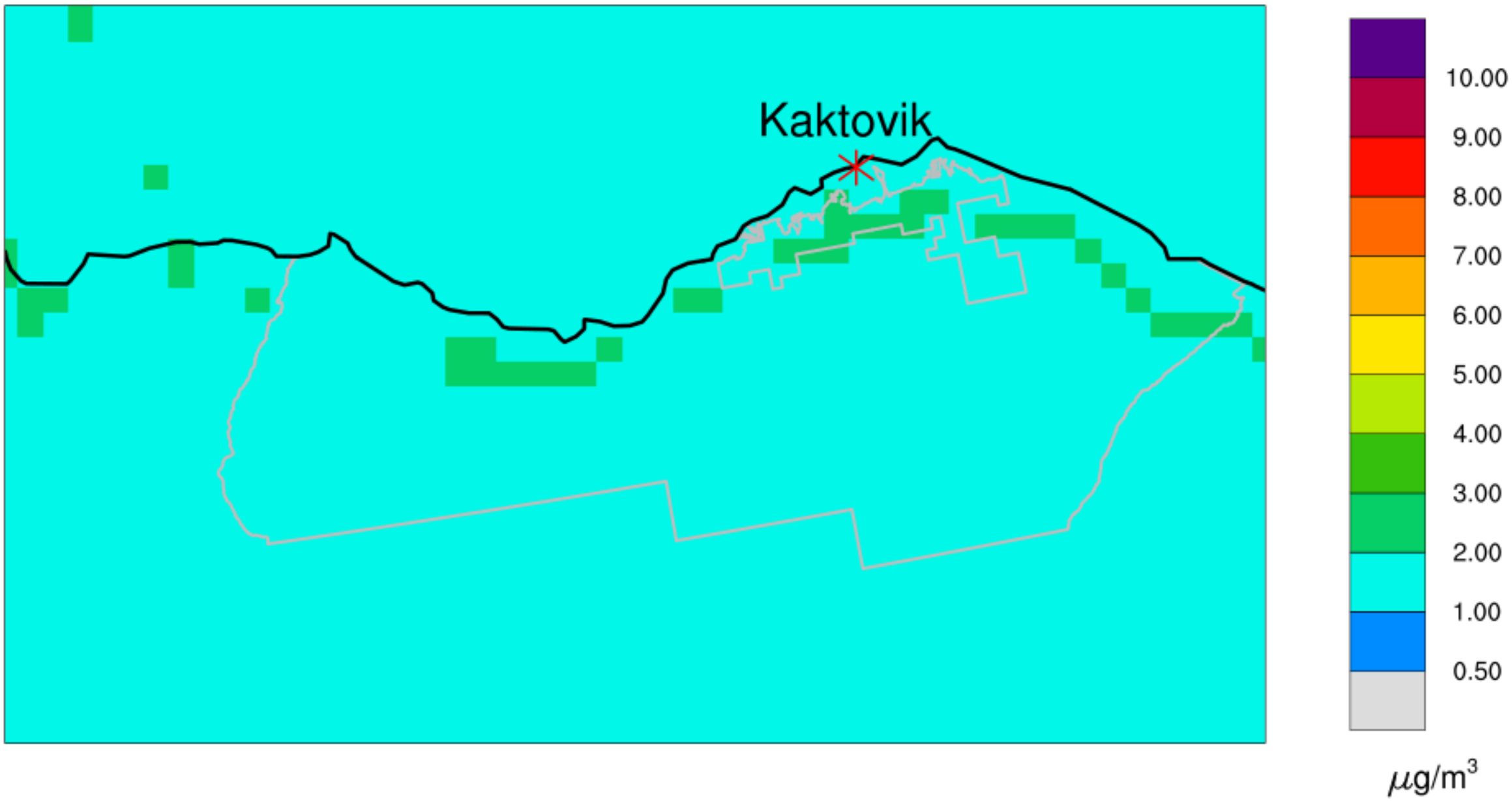
4th High Daily Max 8 Hour Avg Ozone
Low Development Scenario-Indirect Impact



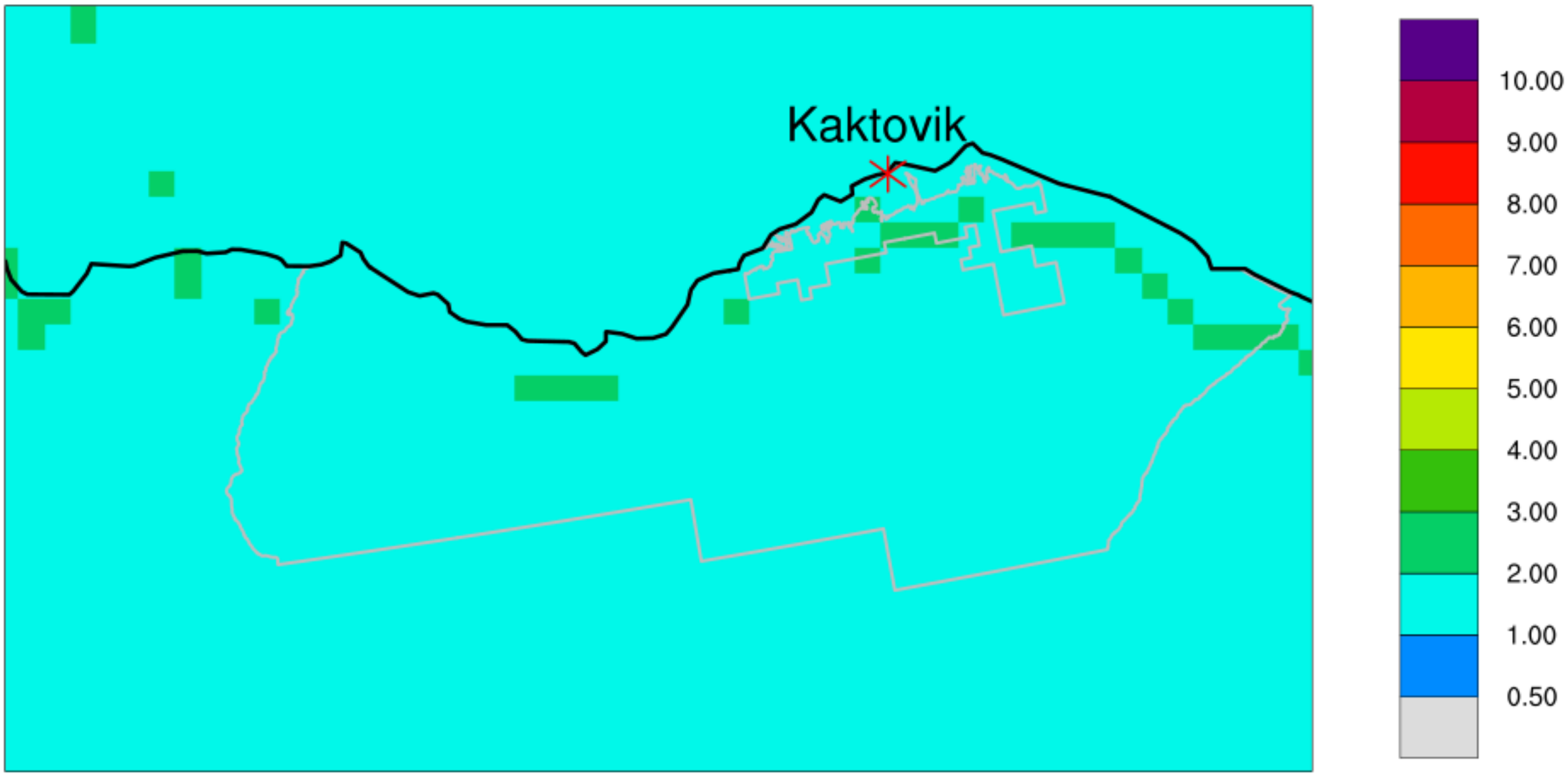
Annual average $PM_{2.5}$ concentration
High Development Scenario-Cumulative



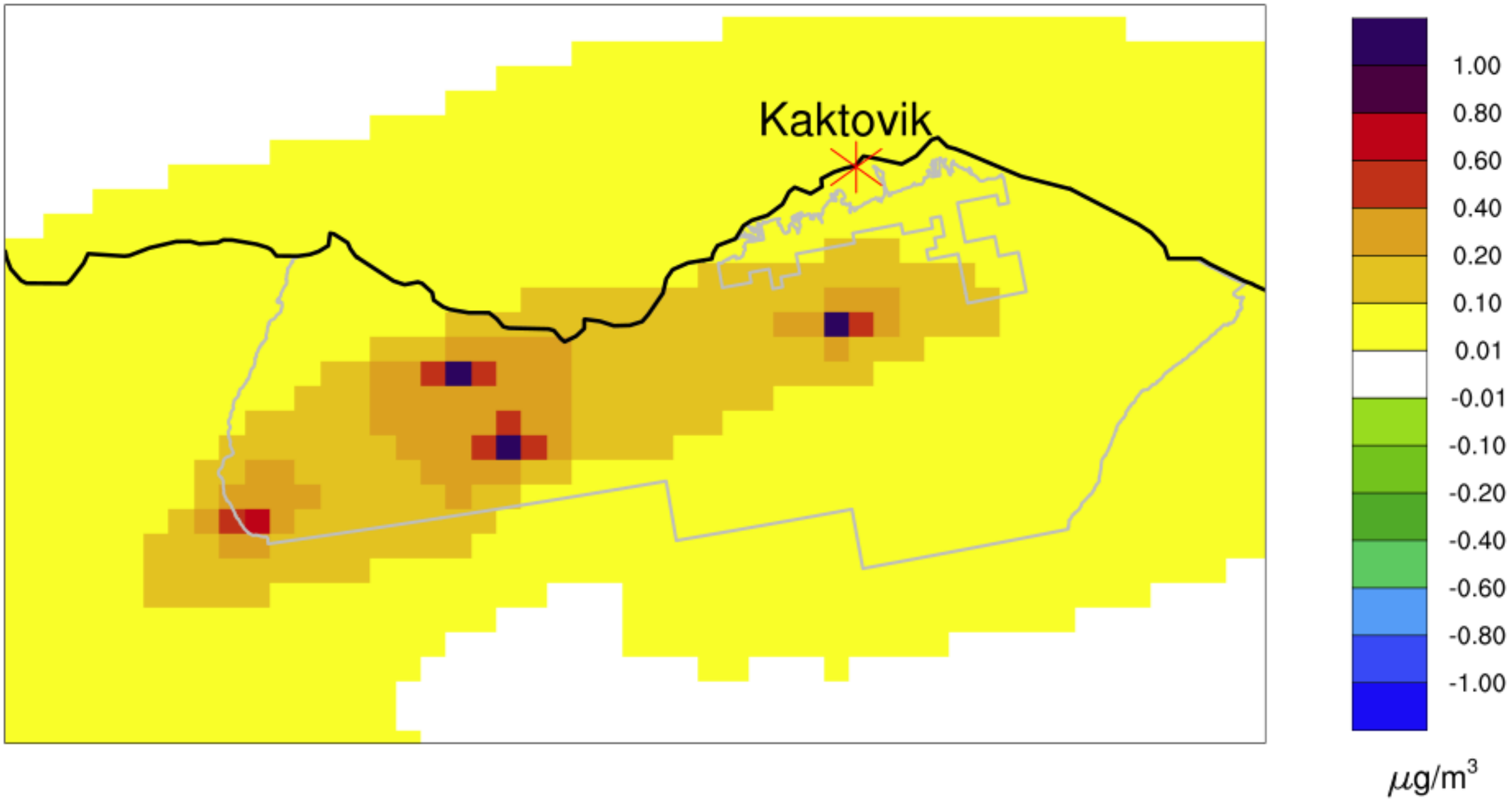
Annual average $PM_{2.5}$ concentration
Low Development Scenario-Cumulative



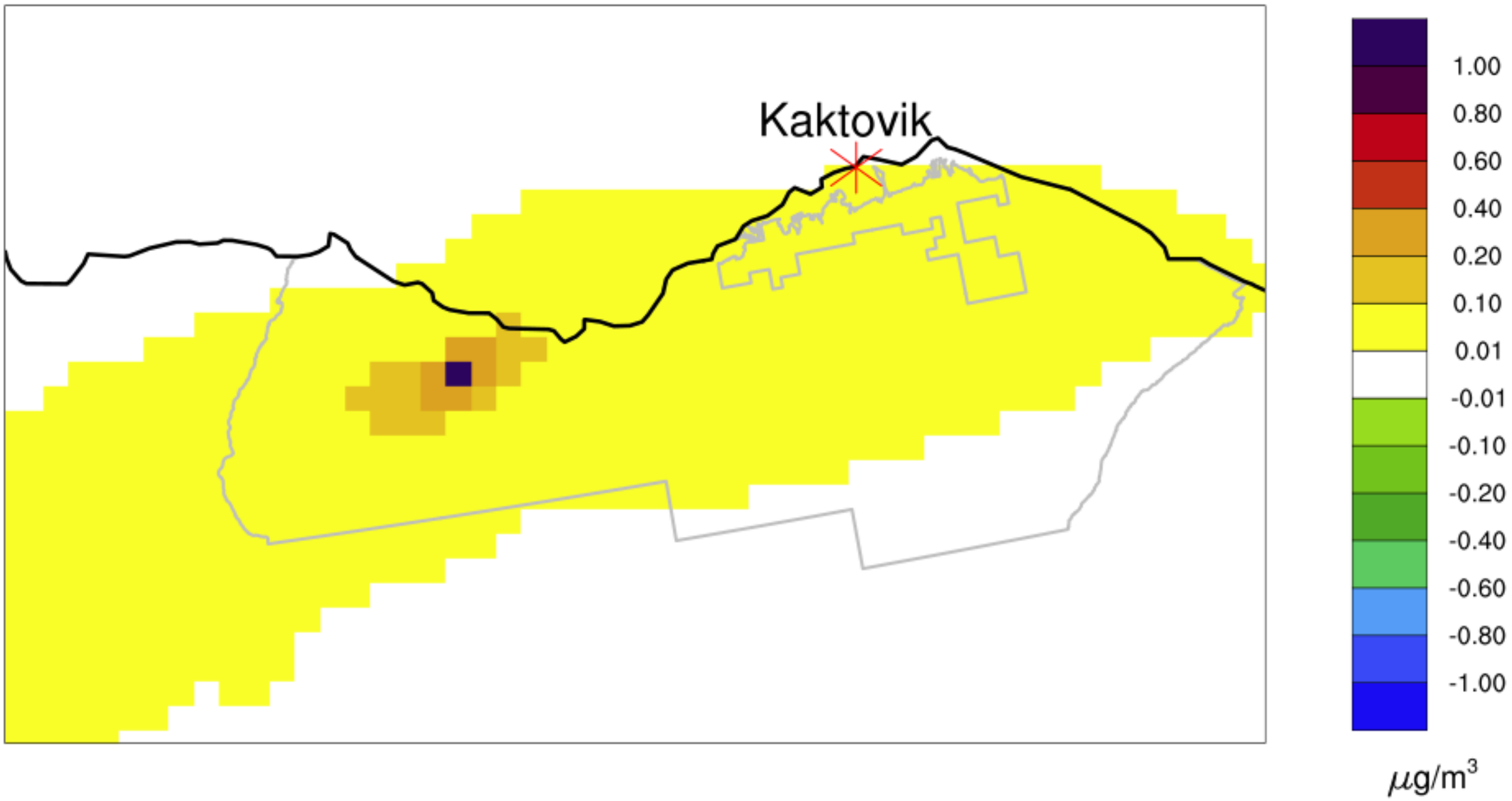
Annual average $PM_{2.5}$ concentration
No Action Alternative-Cumulative



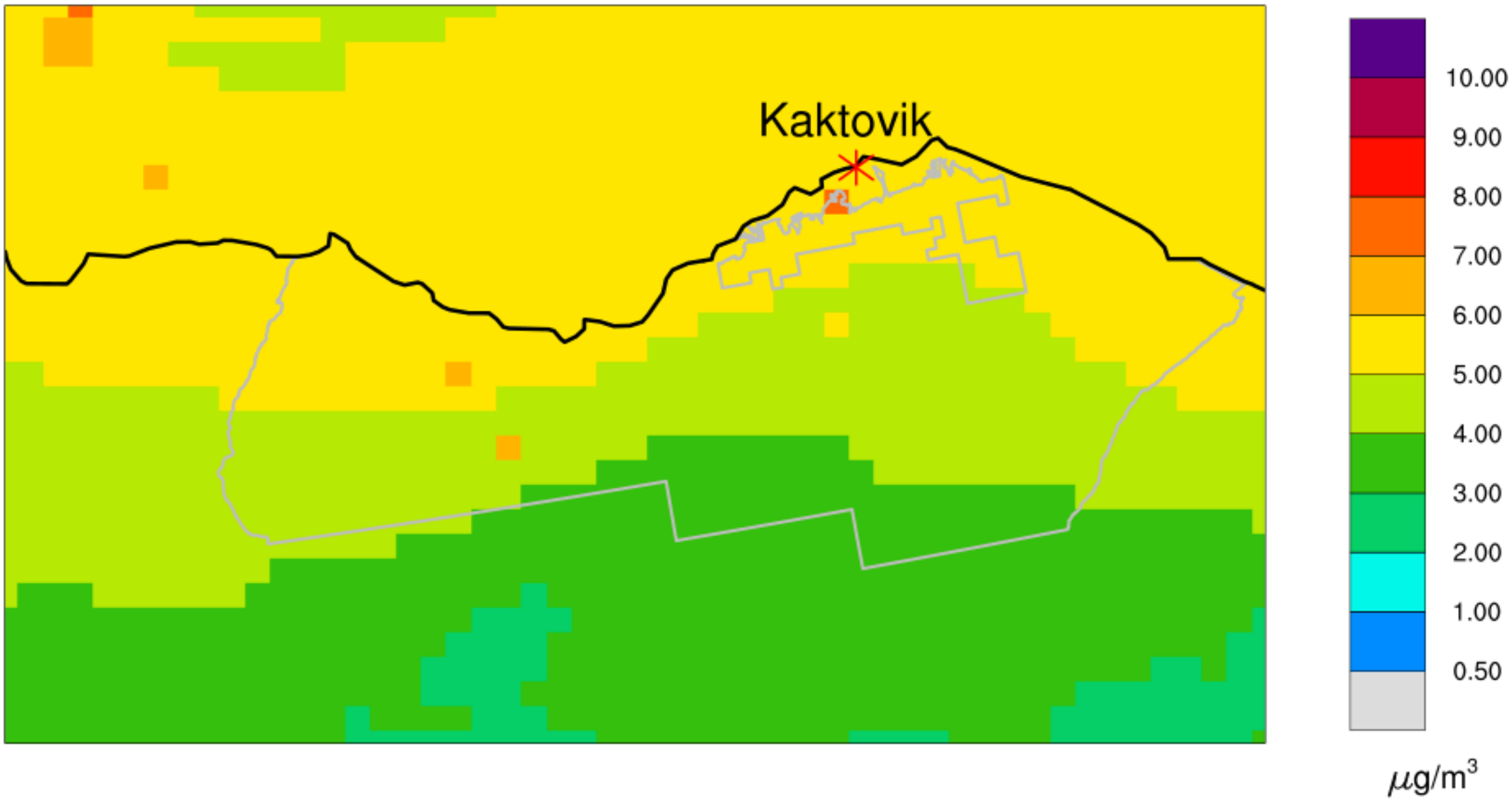
Annual average $PM_{2.5}$ concentration
High Development Scenario-Indirect Impact



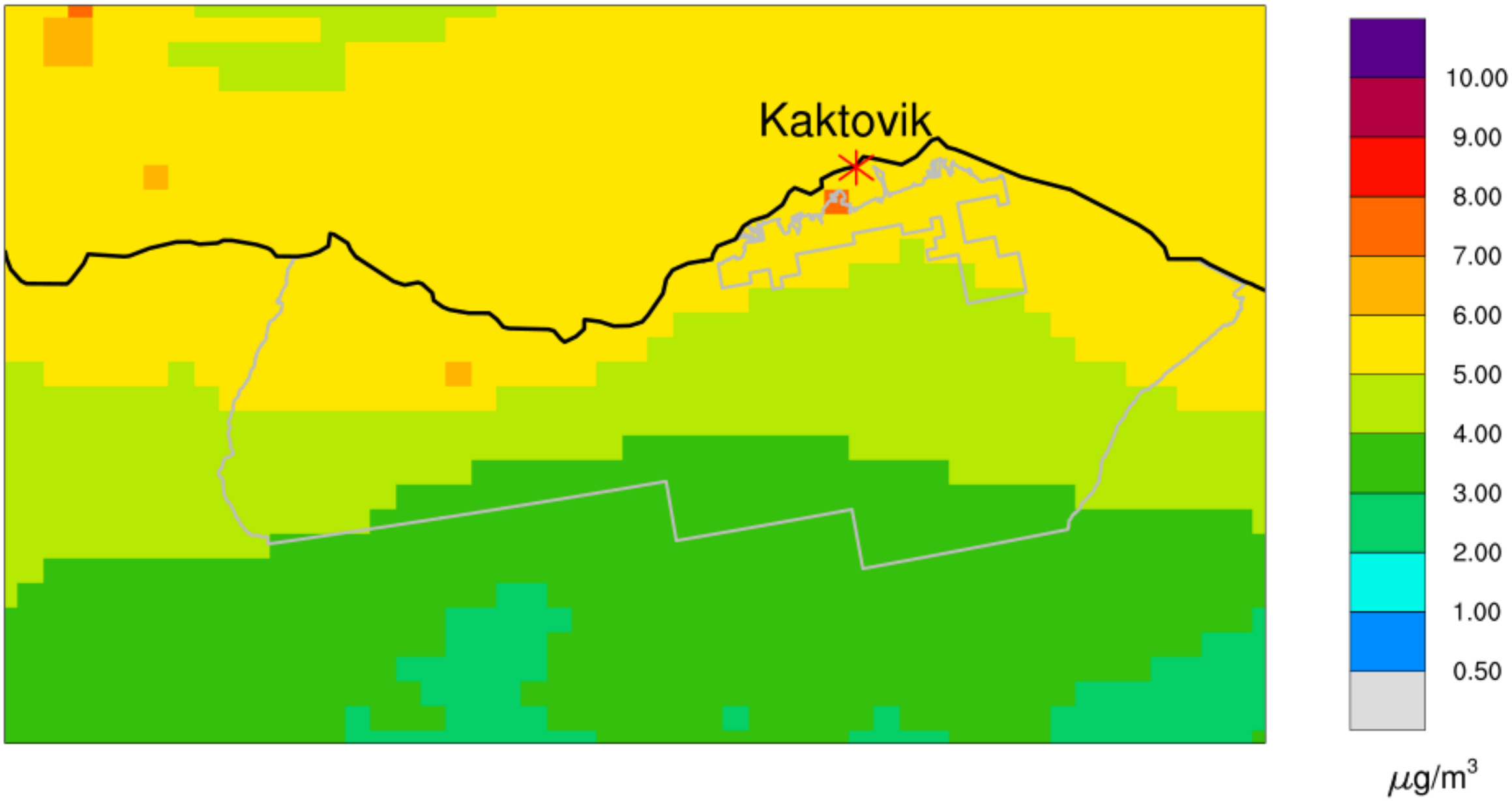
Annual average $PM_{2.5}$ concentration
Low Development Scenario-Indirect Impact



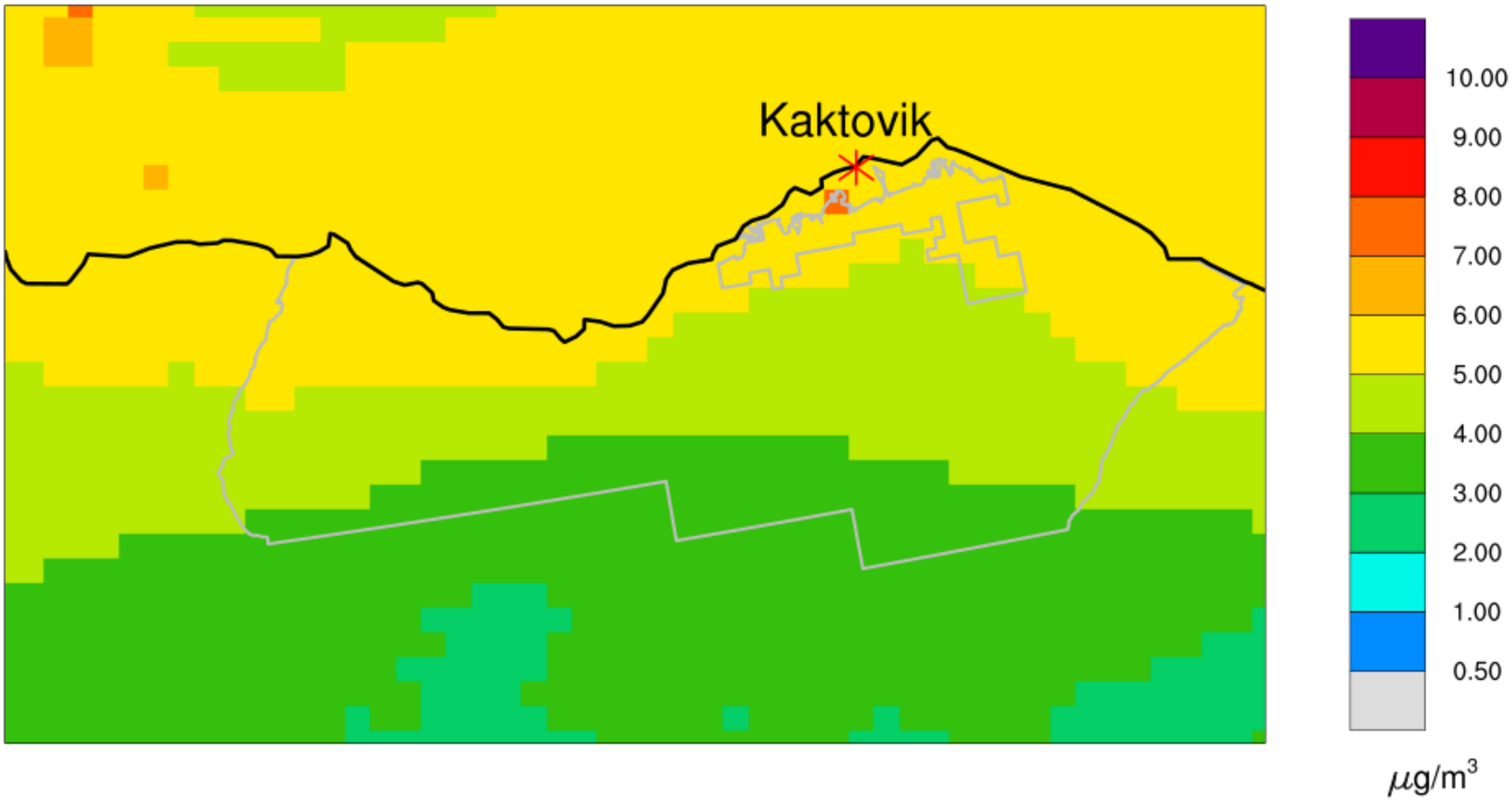
8th highest daily average $PM_{2.5}$ concentration
High Development Scenario-Cumulative



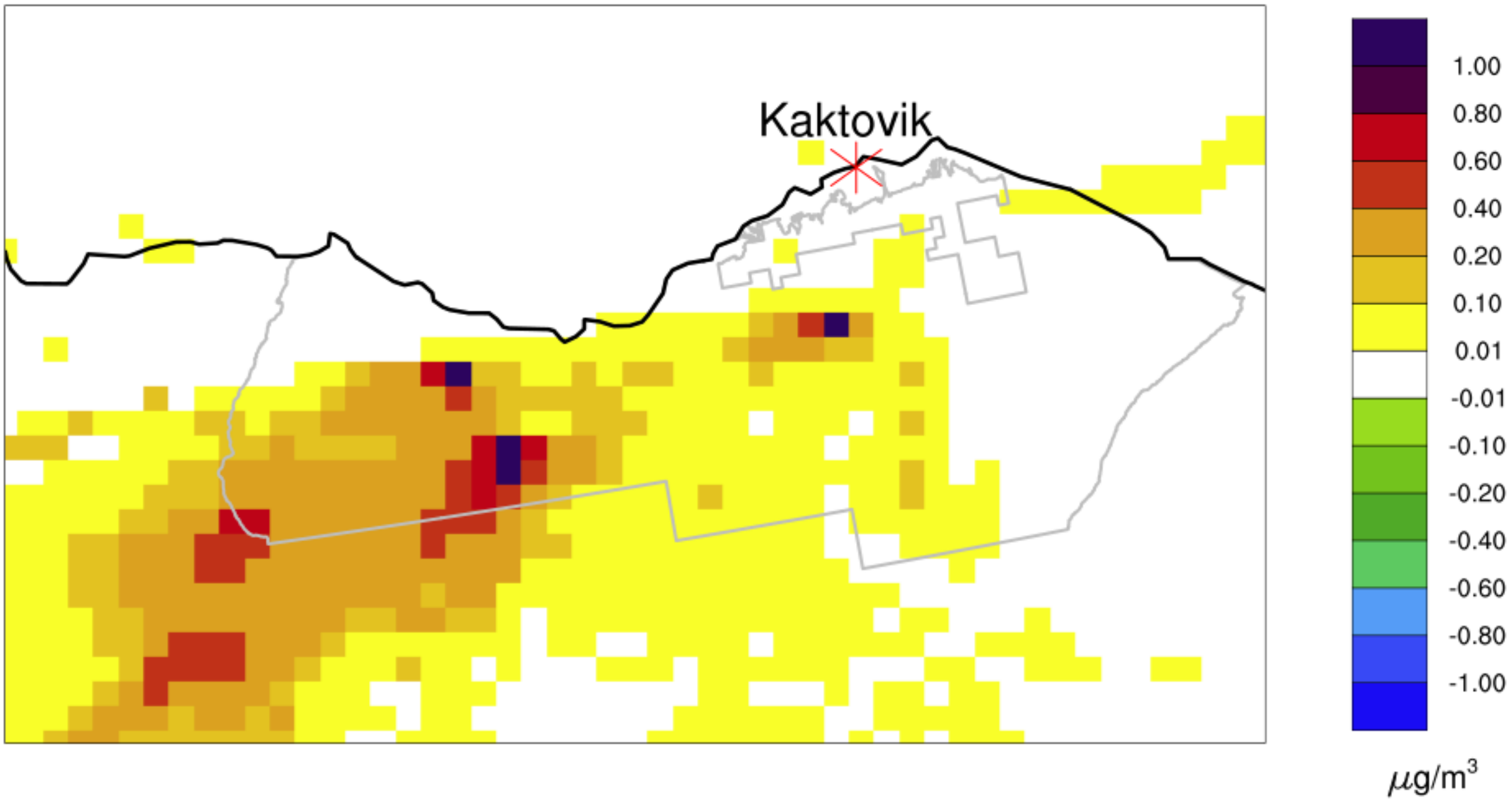
8th highest daily average $PM_{2.5}$ concentration
Low Development Scenario-Cumulative



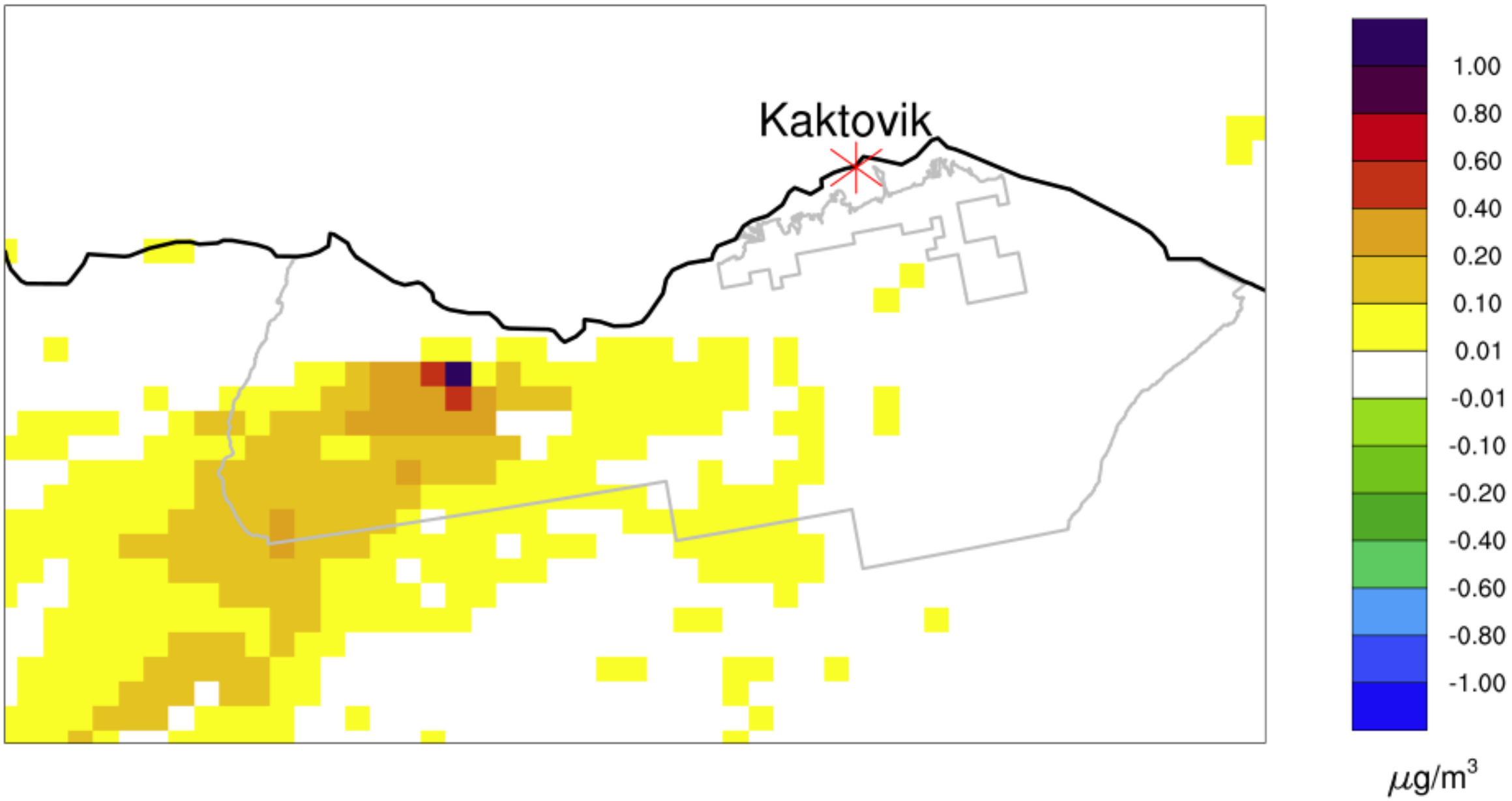
8th highest daily average $PM_{2.5}$ concentration
No Action Alternative-Cumulative



8th highest daily average $PM_{2.5}$ concentration
High Development Scenario-Indirect Impact



8th highest daily average $PM_{2.5}$ concentration
Low Development Scenario-Indirect Impact



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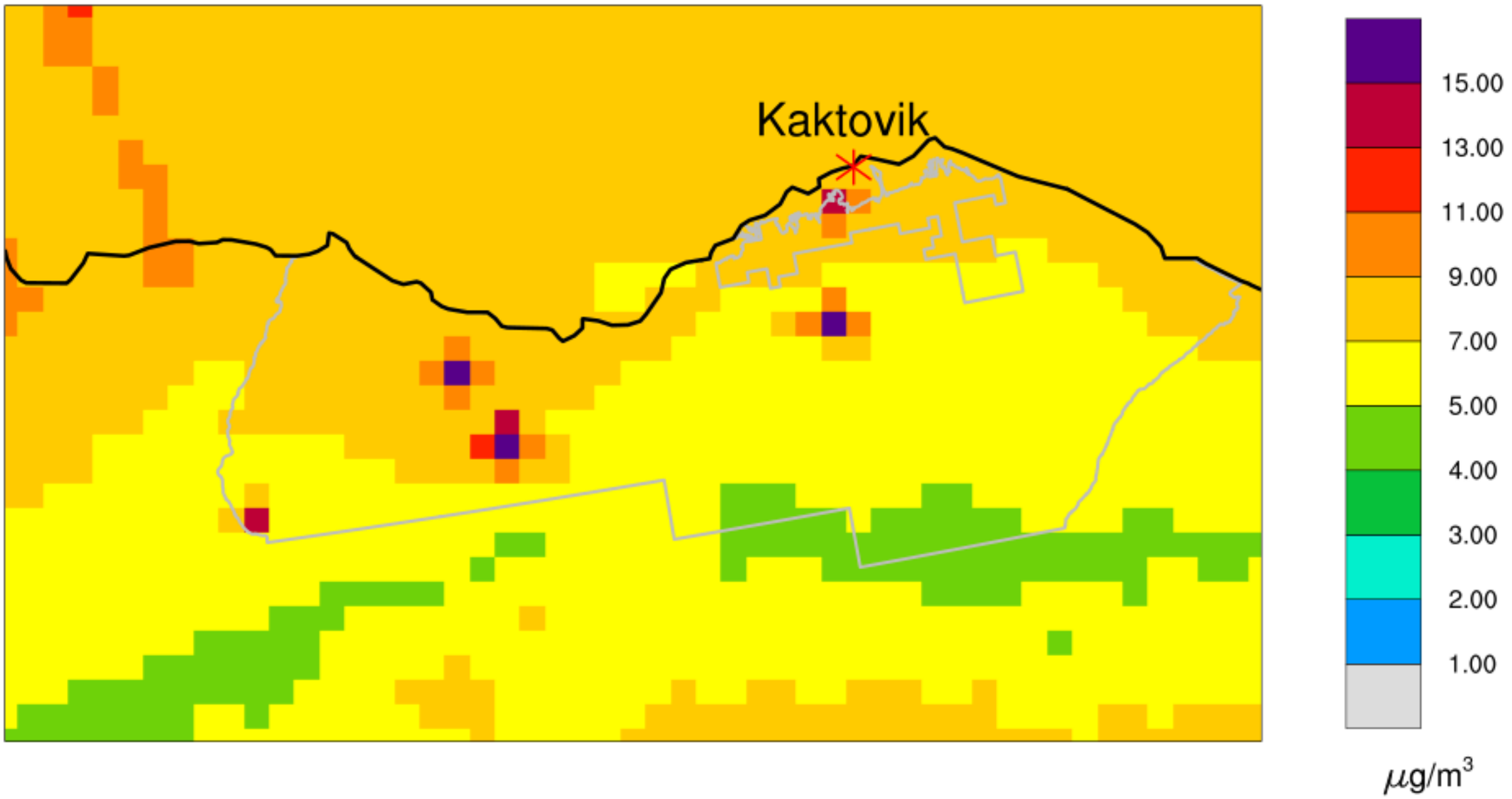

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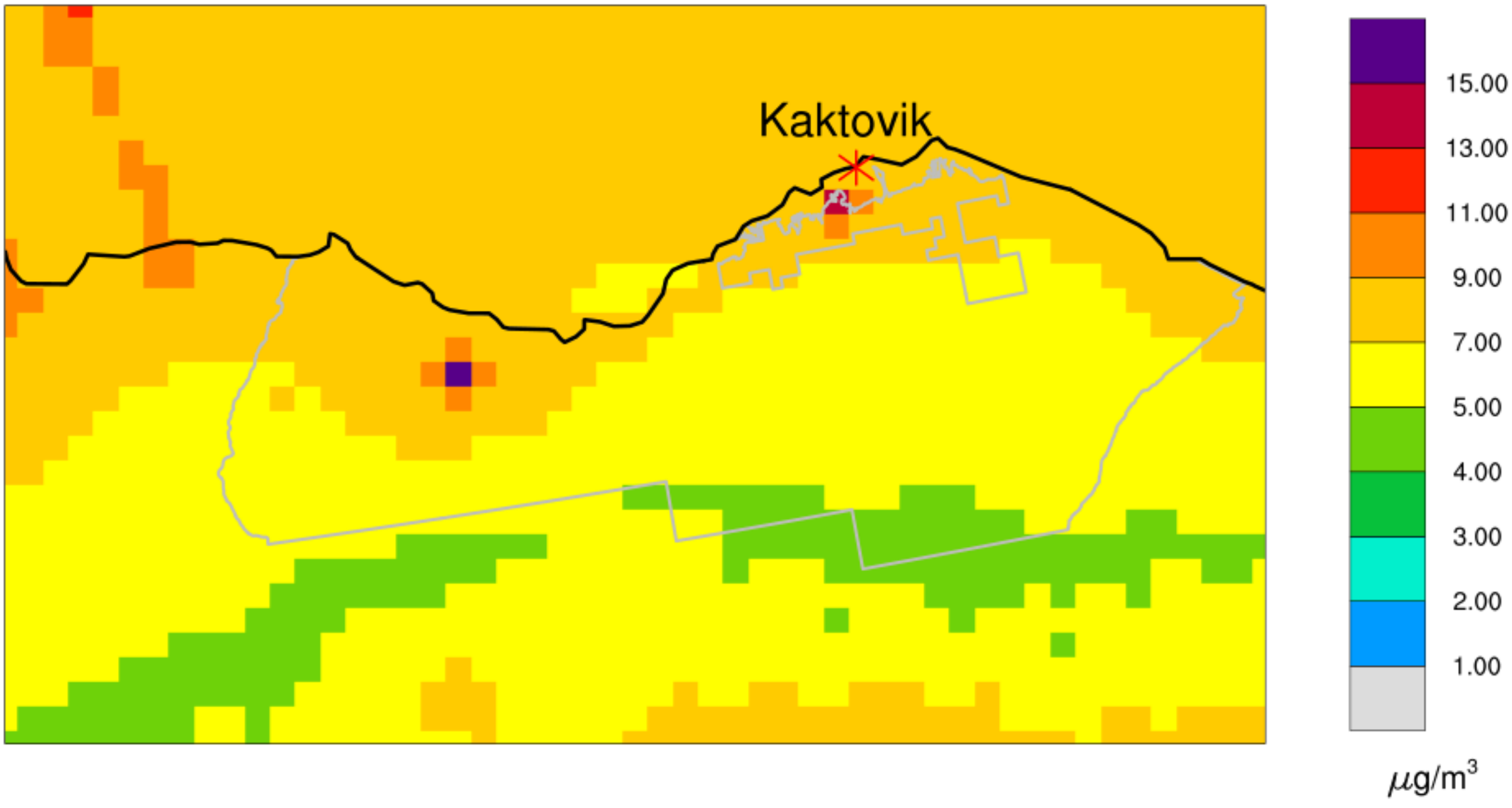
Low Development Scenario-Cumulative



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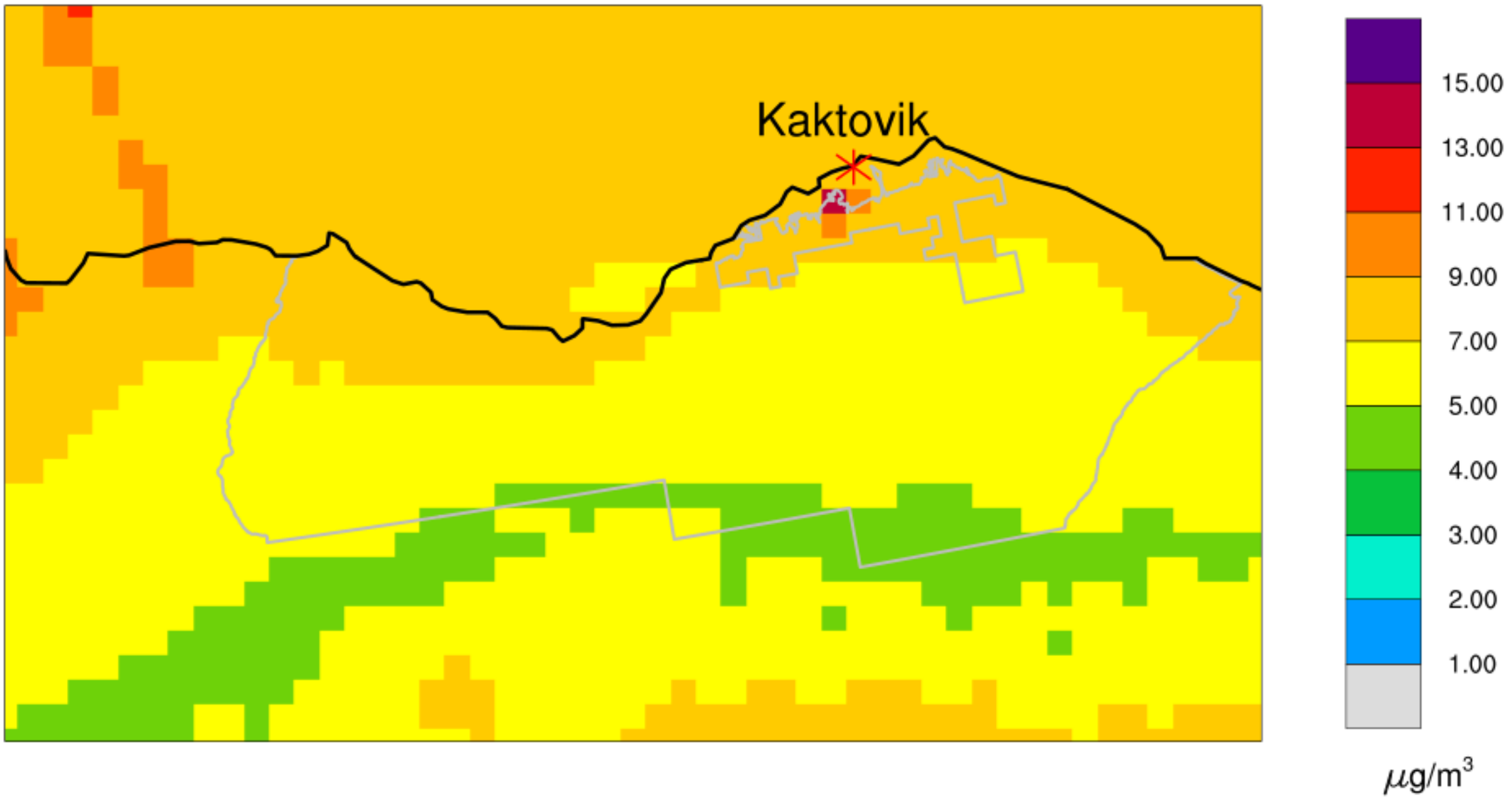
No Action Alternative-Cumulative



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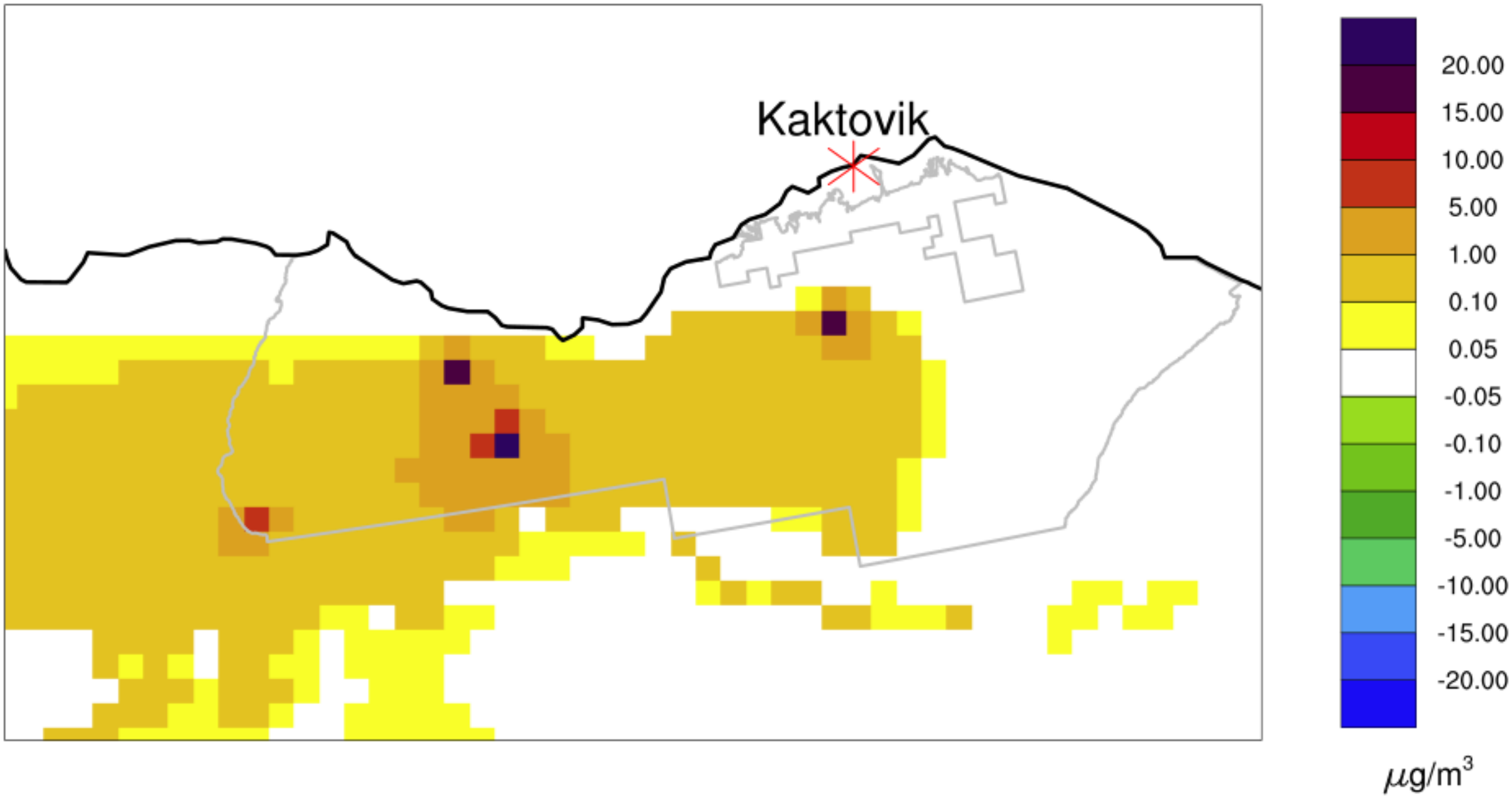

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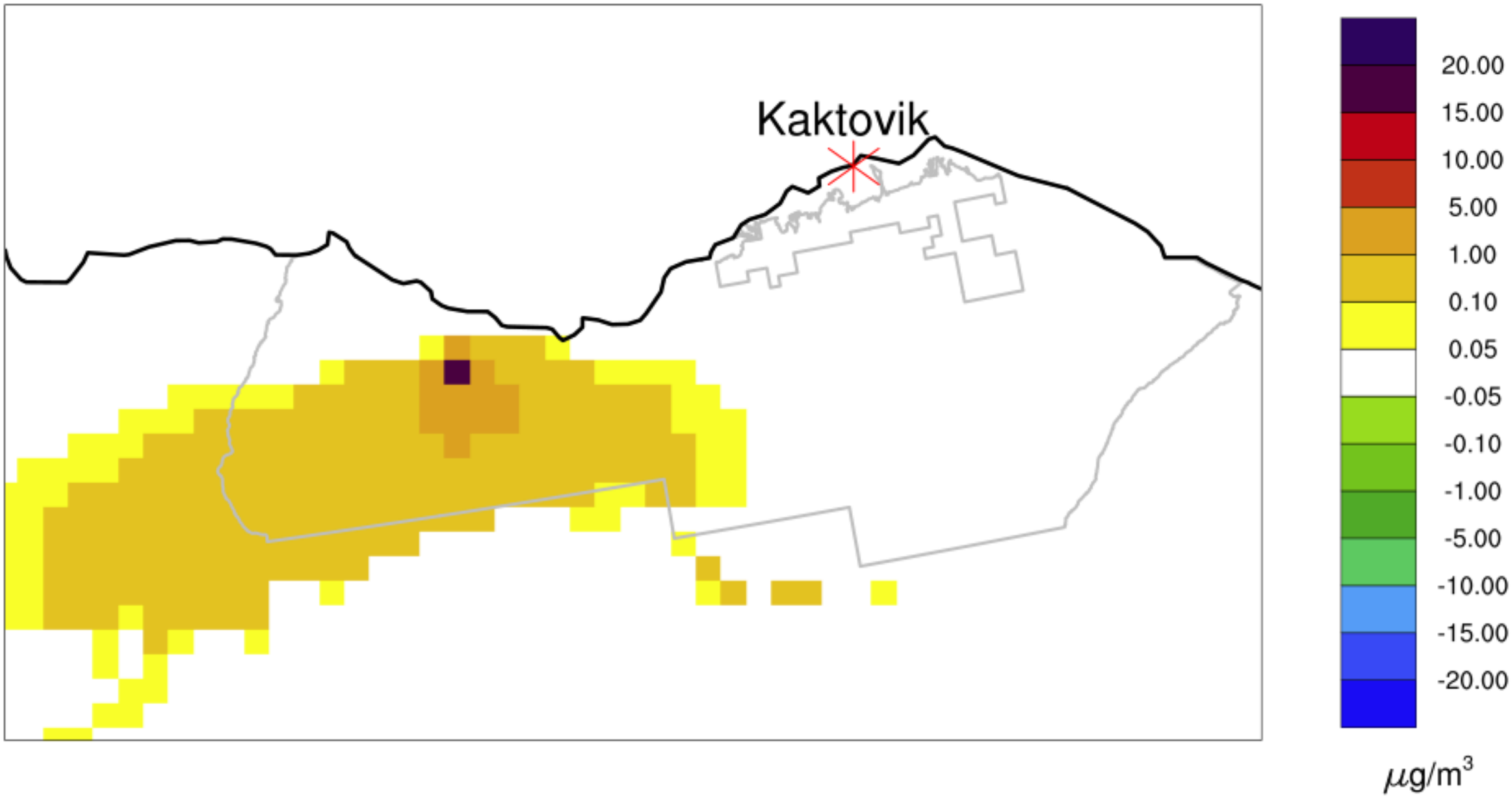
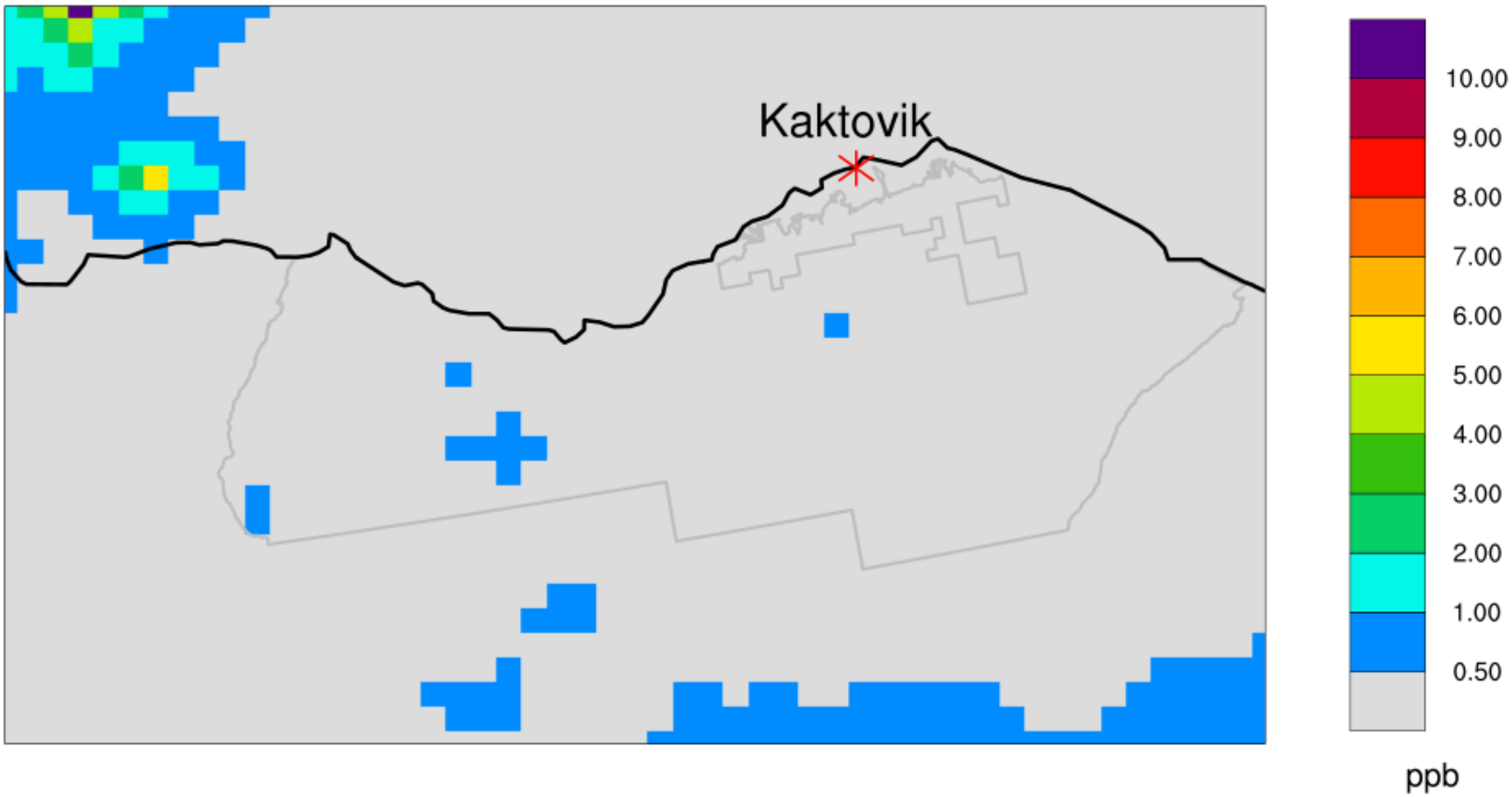
Low Development Scenario-Indirect Impact



The 4th highest 1 hour daily max SO_2 concentration
High Development Scenario-Cumulative



The 4th highest 1 hour daily max SO_2 concentration
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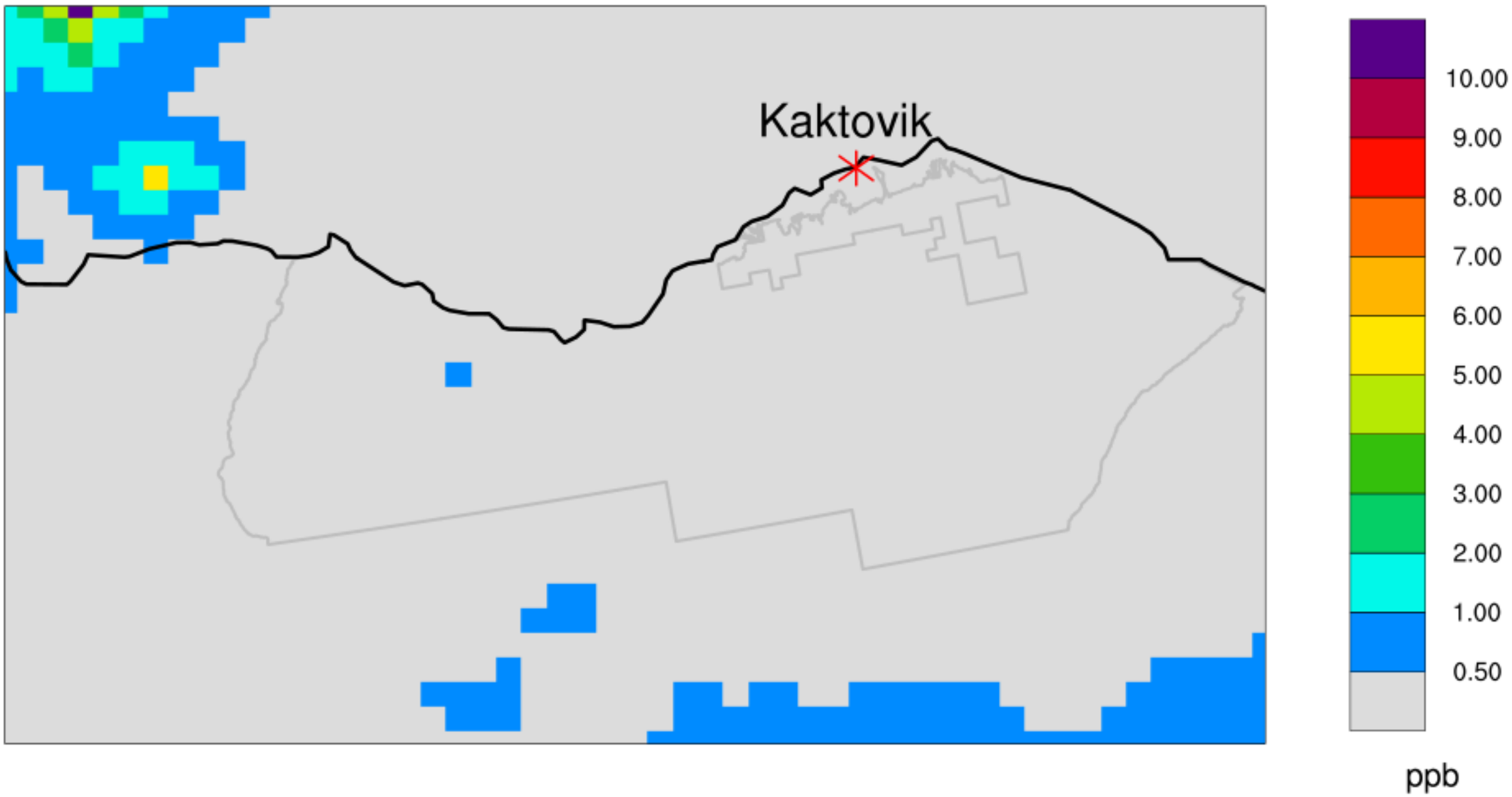

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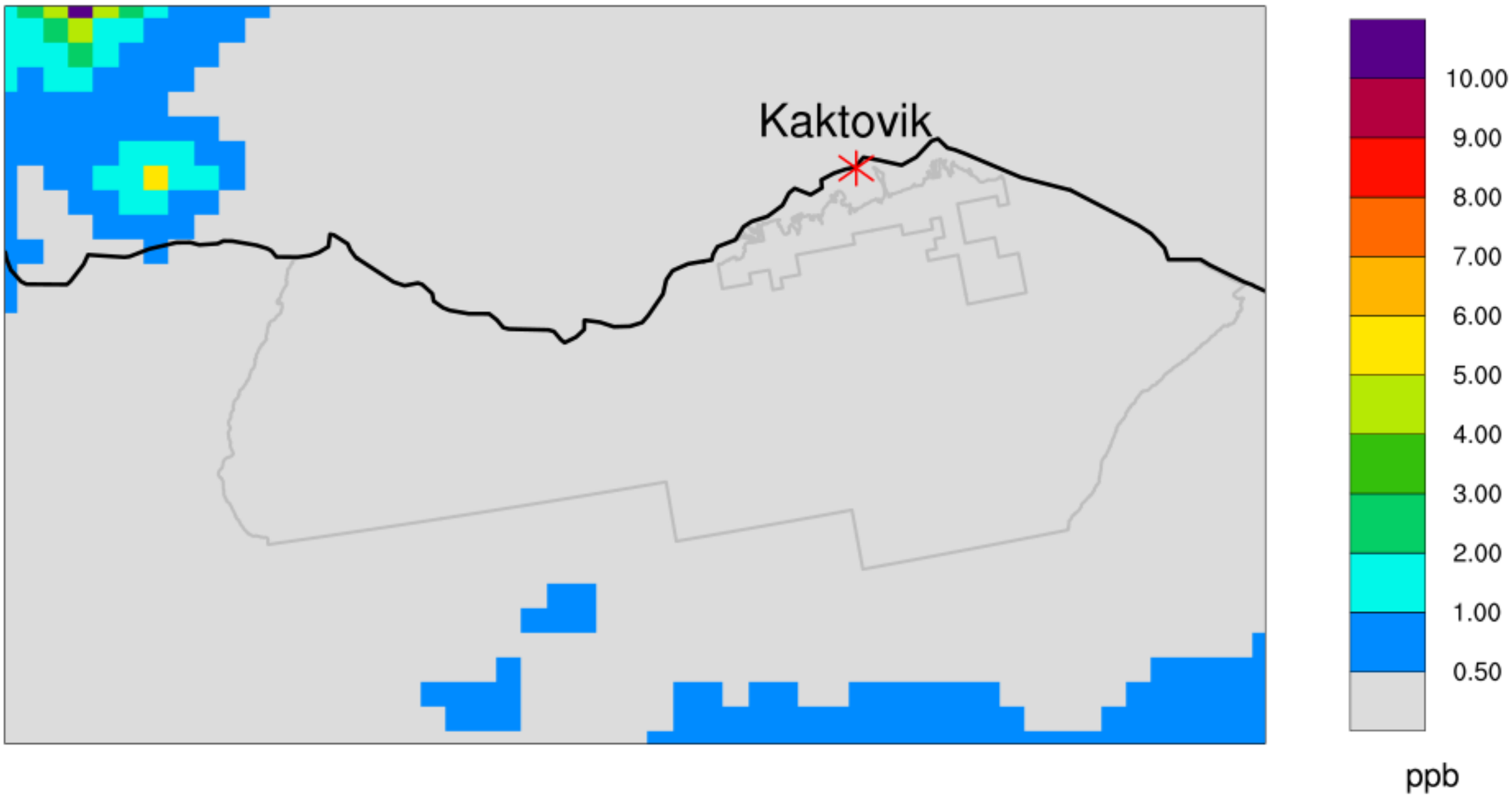

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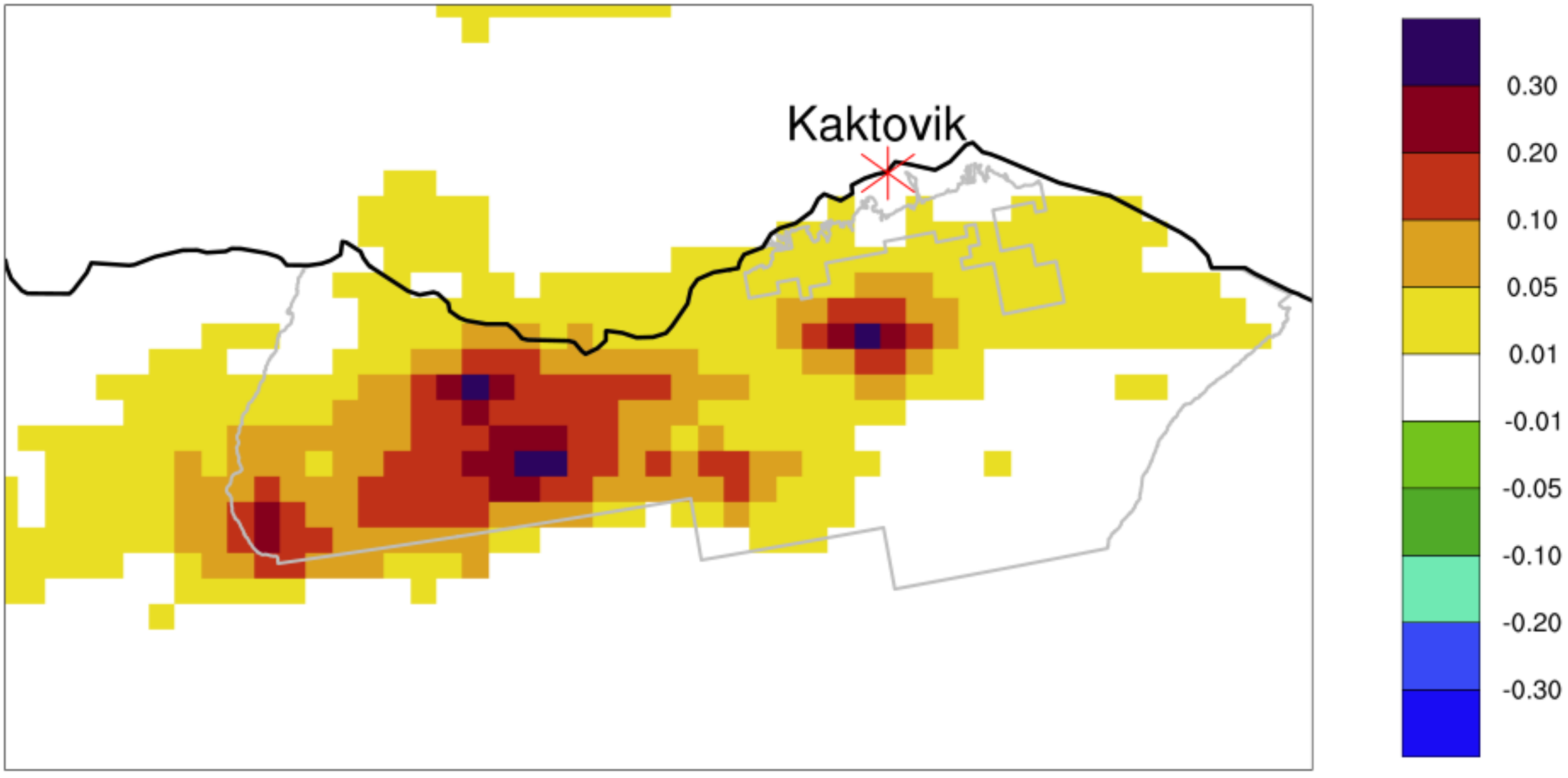
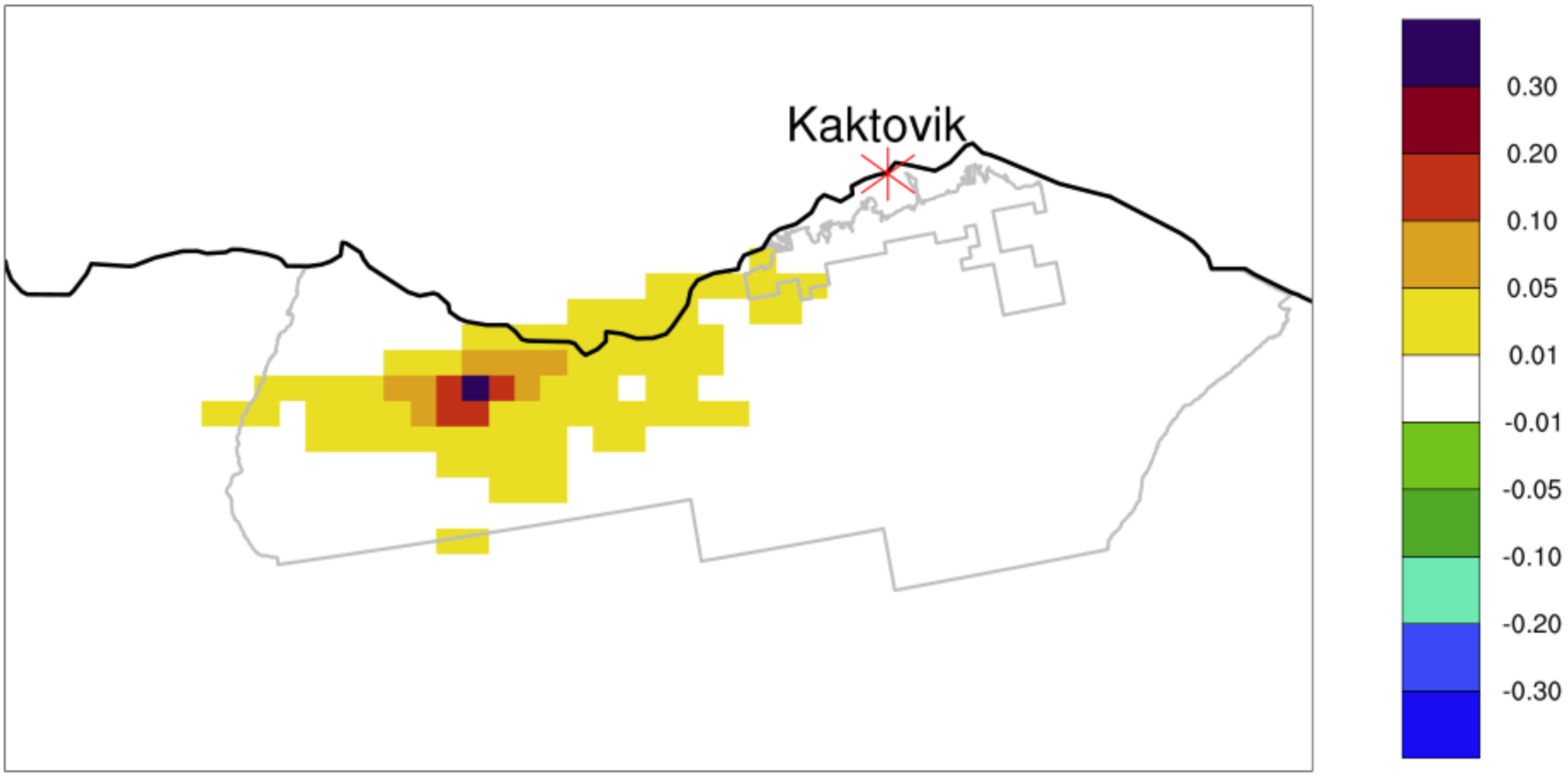
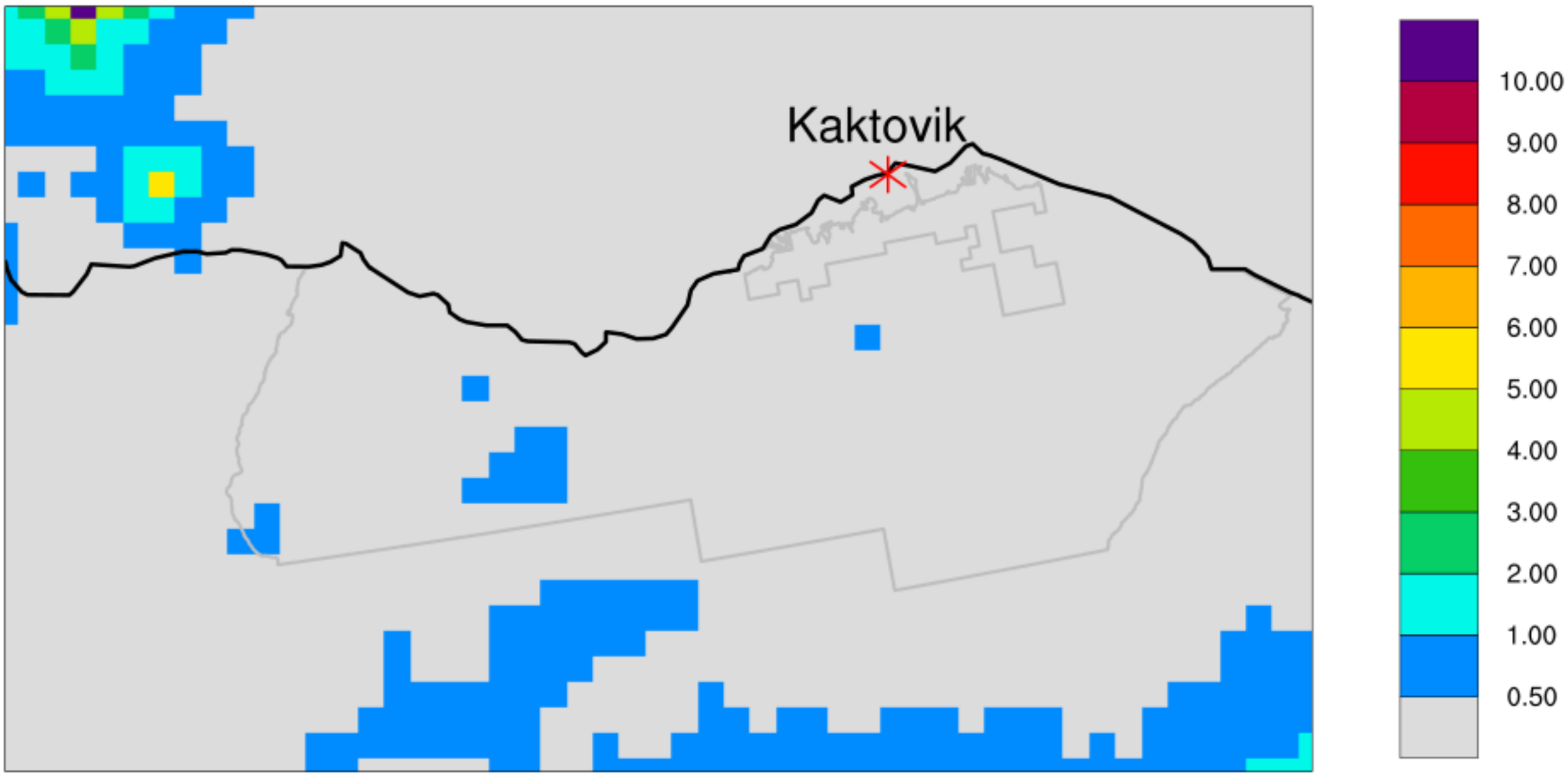


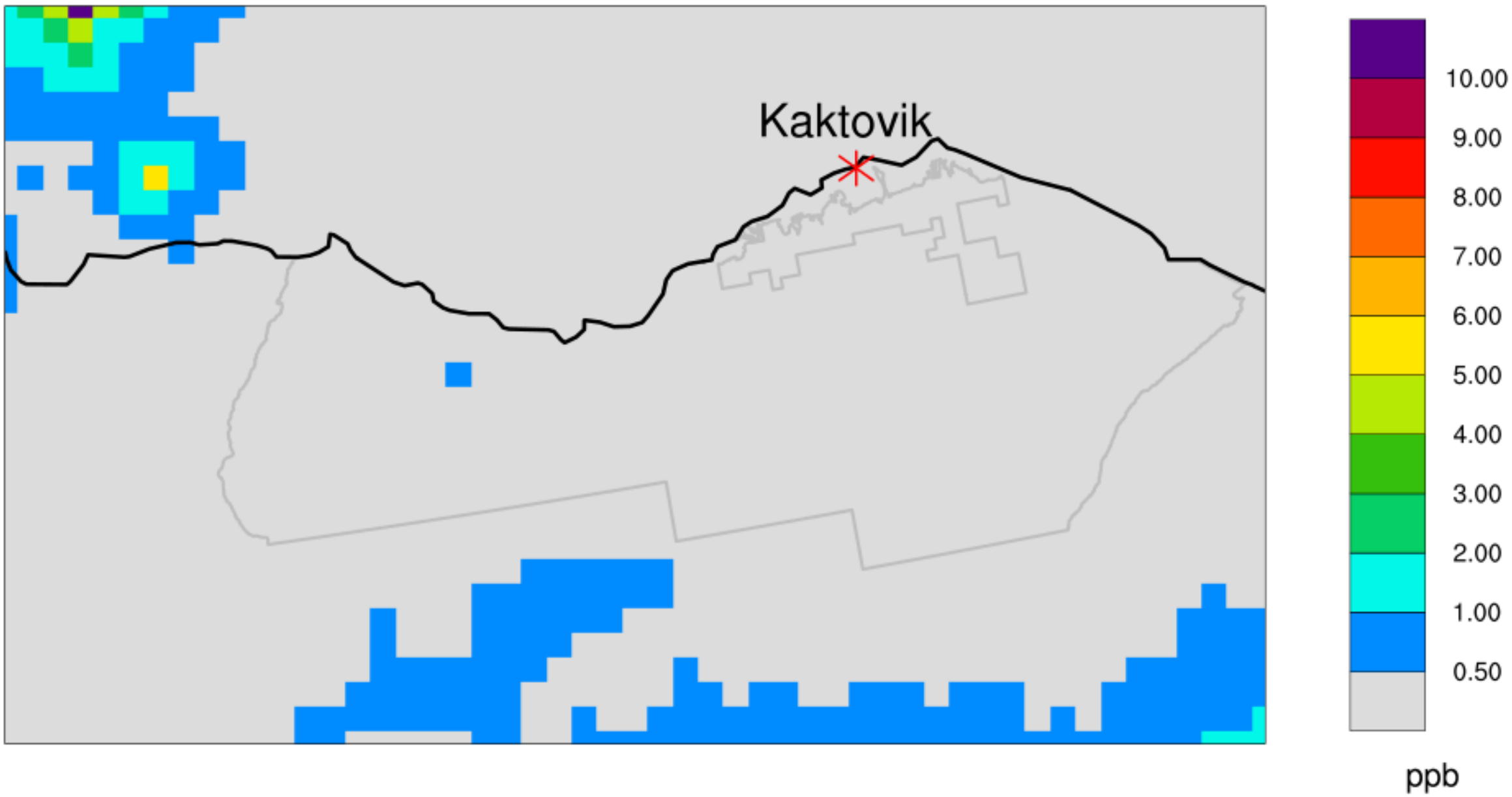
The 4th highest 1 hour daily max SO_2 concentration
Low Development Scenario-Indirect Impact



The 2nd highest 3hr average SO_2 concentration
High Development Scenario-Cumulative



The 2nd highest 3hr average SO_2 concentration
Low Development Scenario-Cumulative



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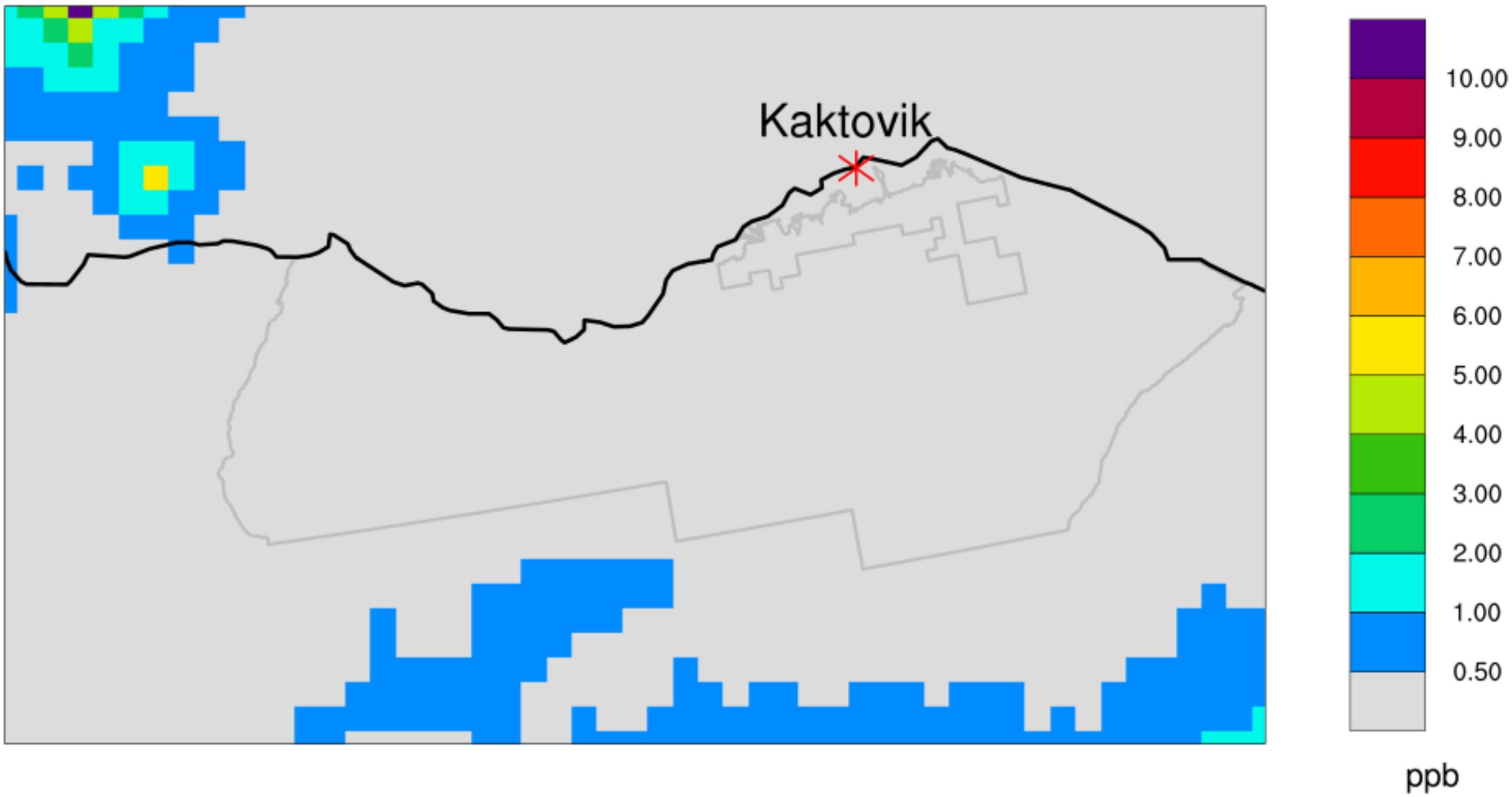

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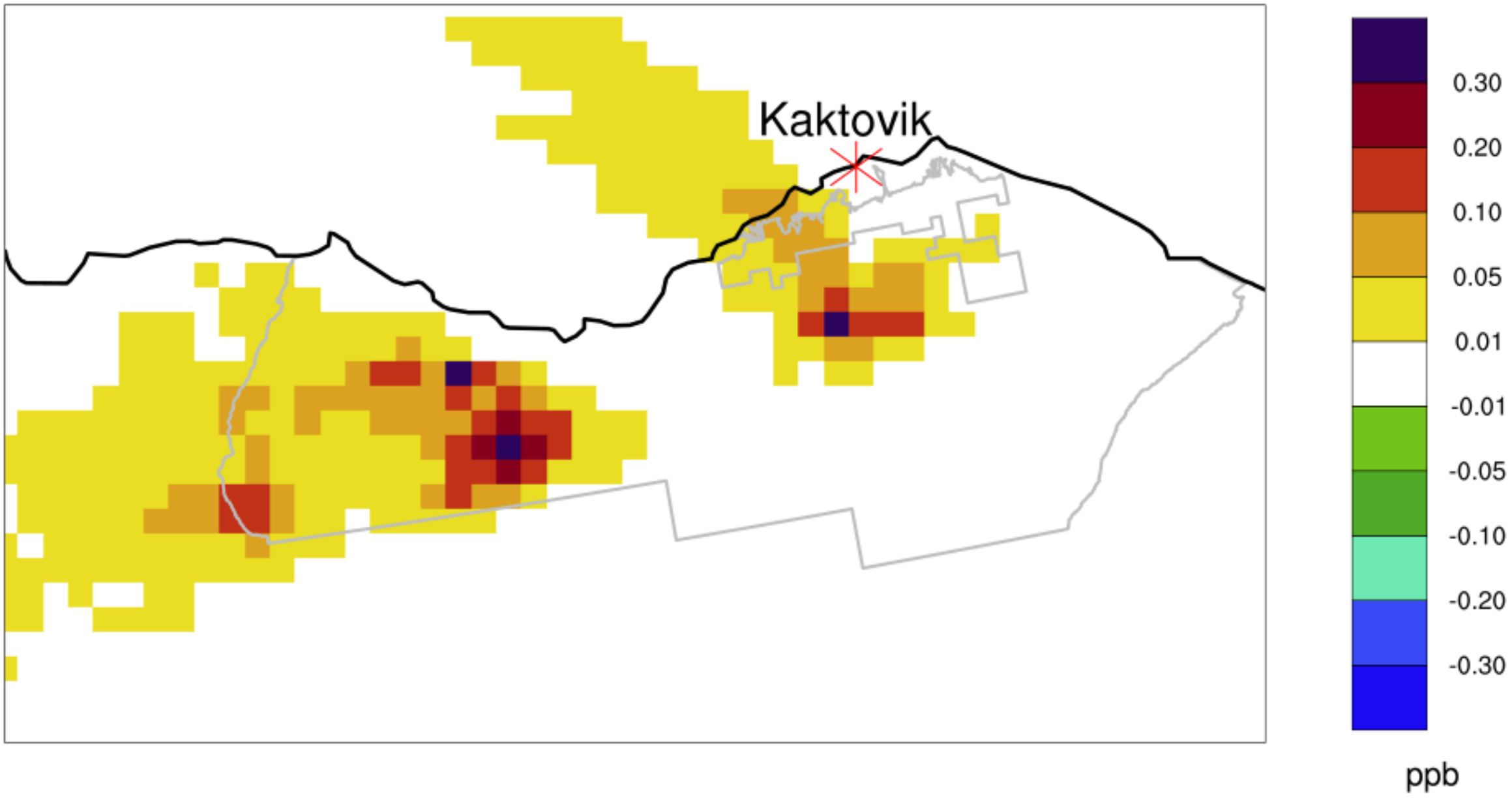
High Development Scenario-Indirect Impact



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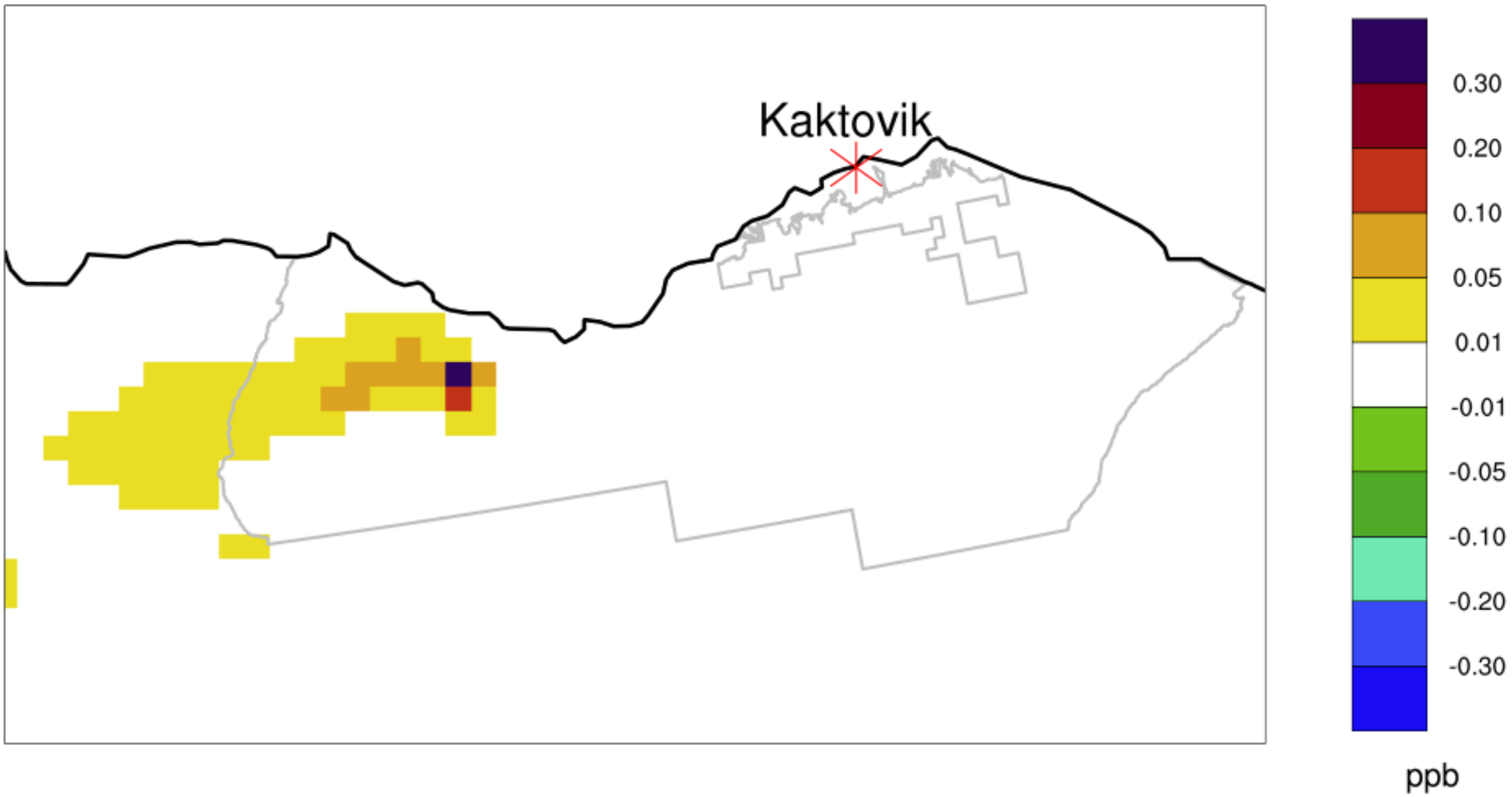
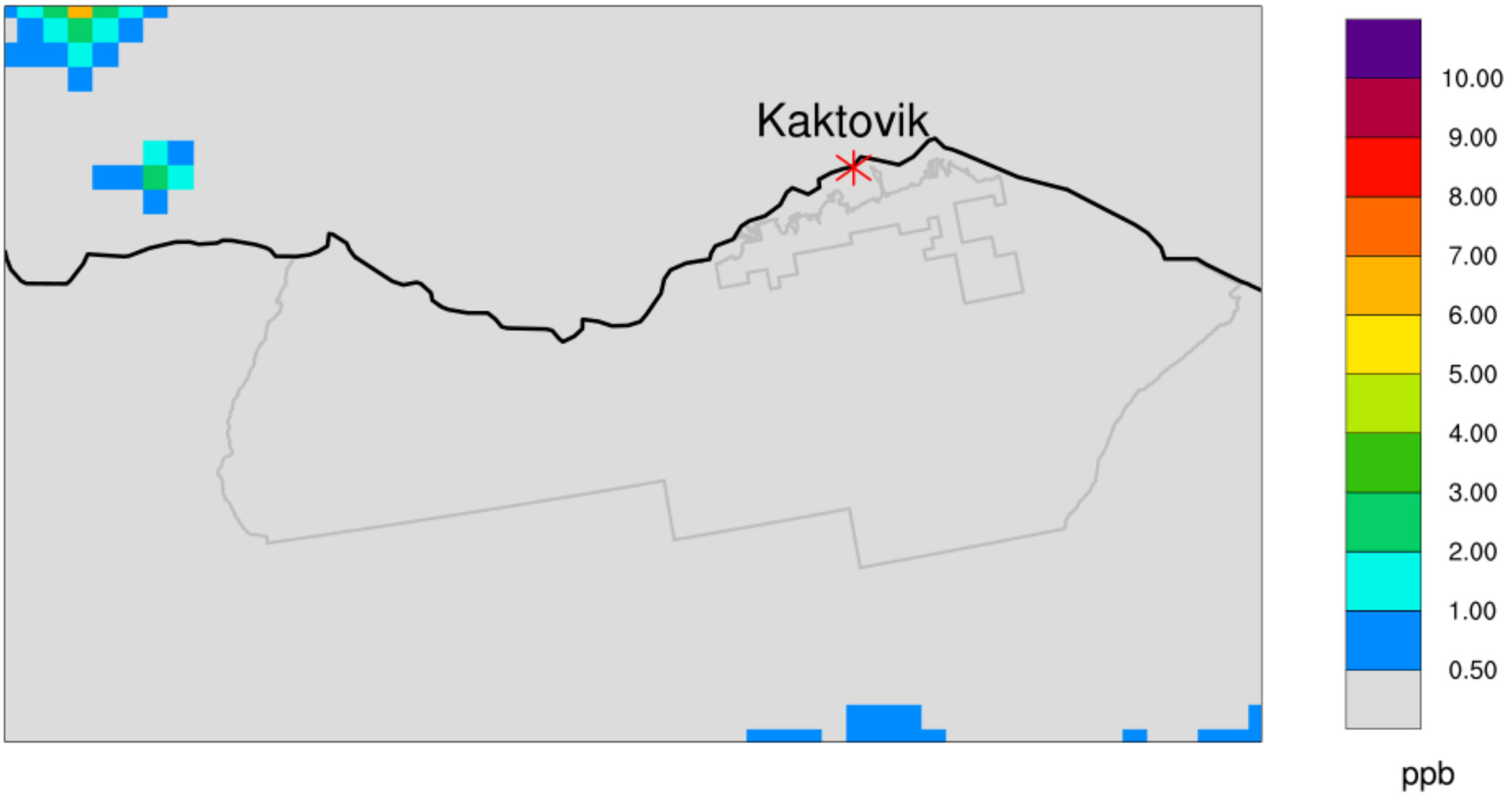
Low Development Scenario-Indirect Impact



The 2nd highest daily average SO_2 concentration
High Development Scenario-Cumulative



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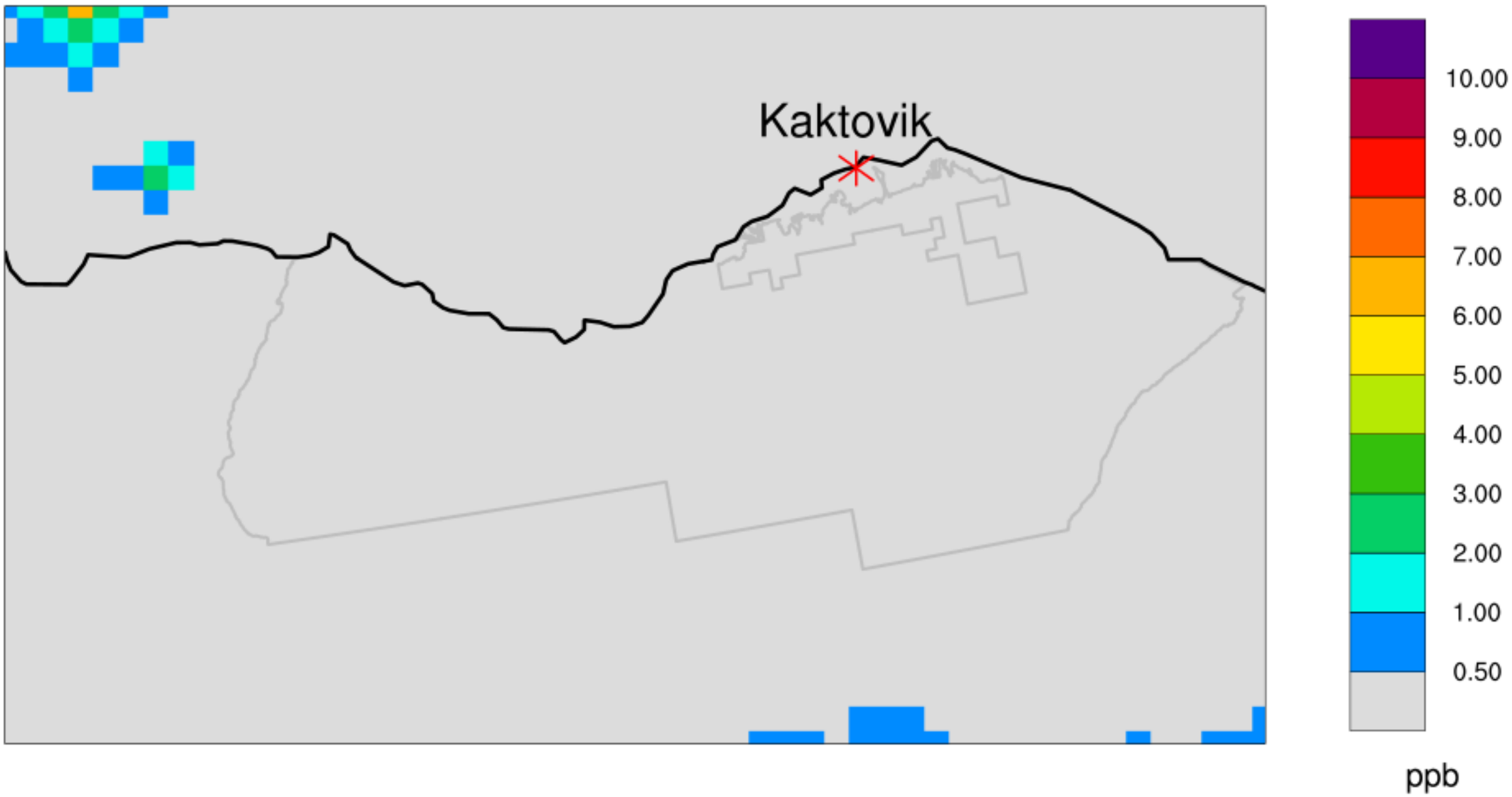

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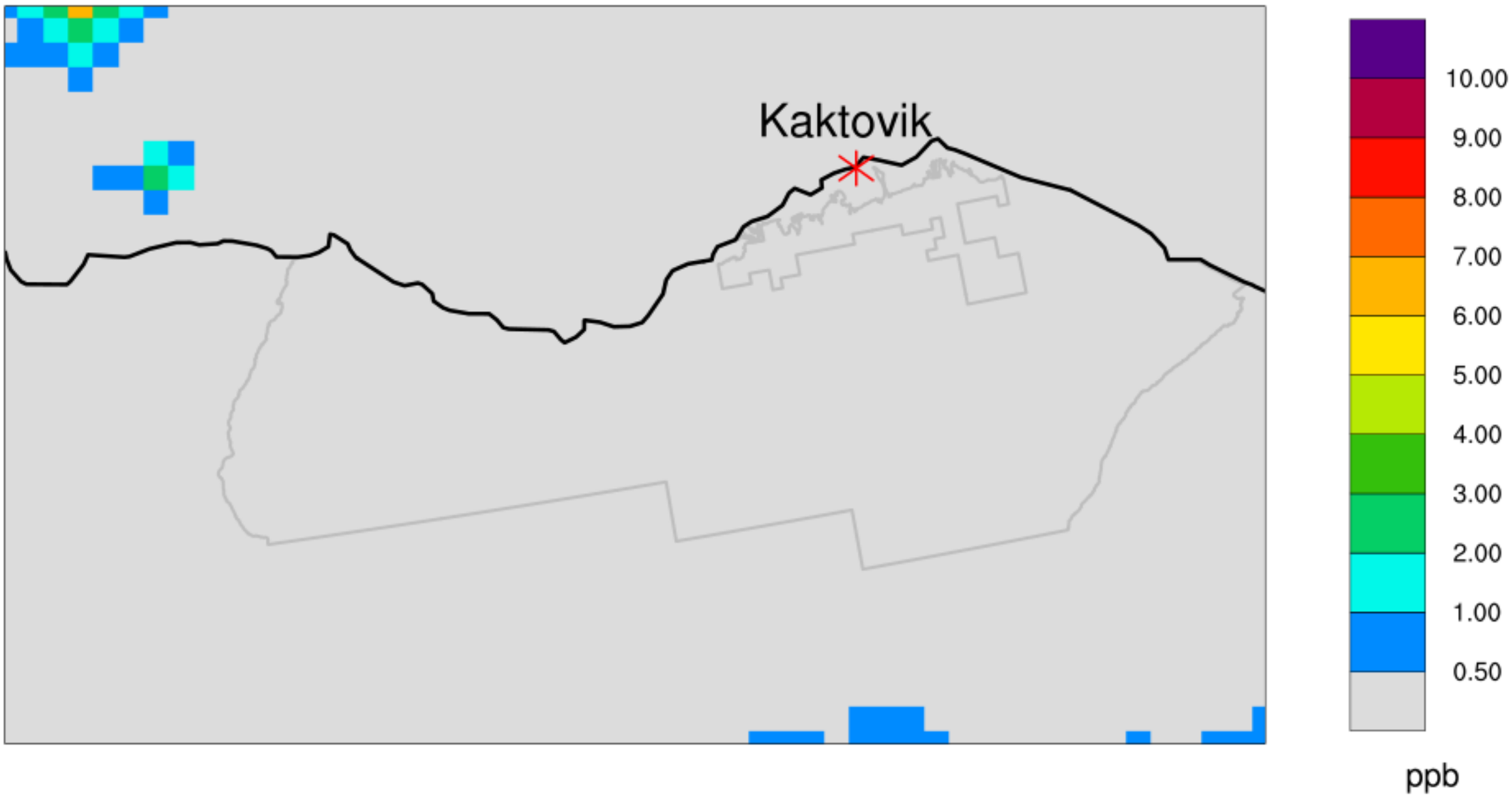

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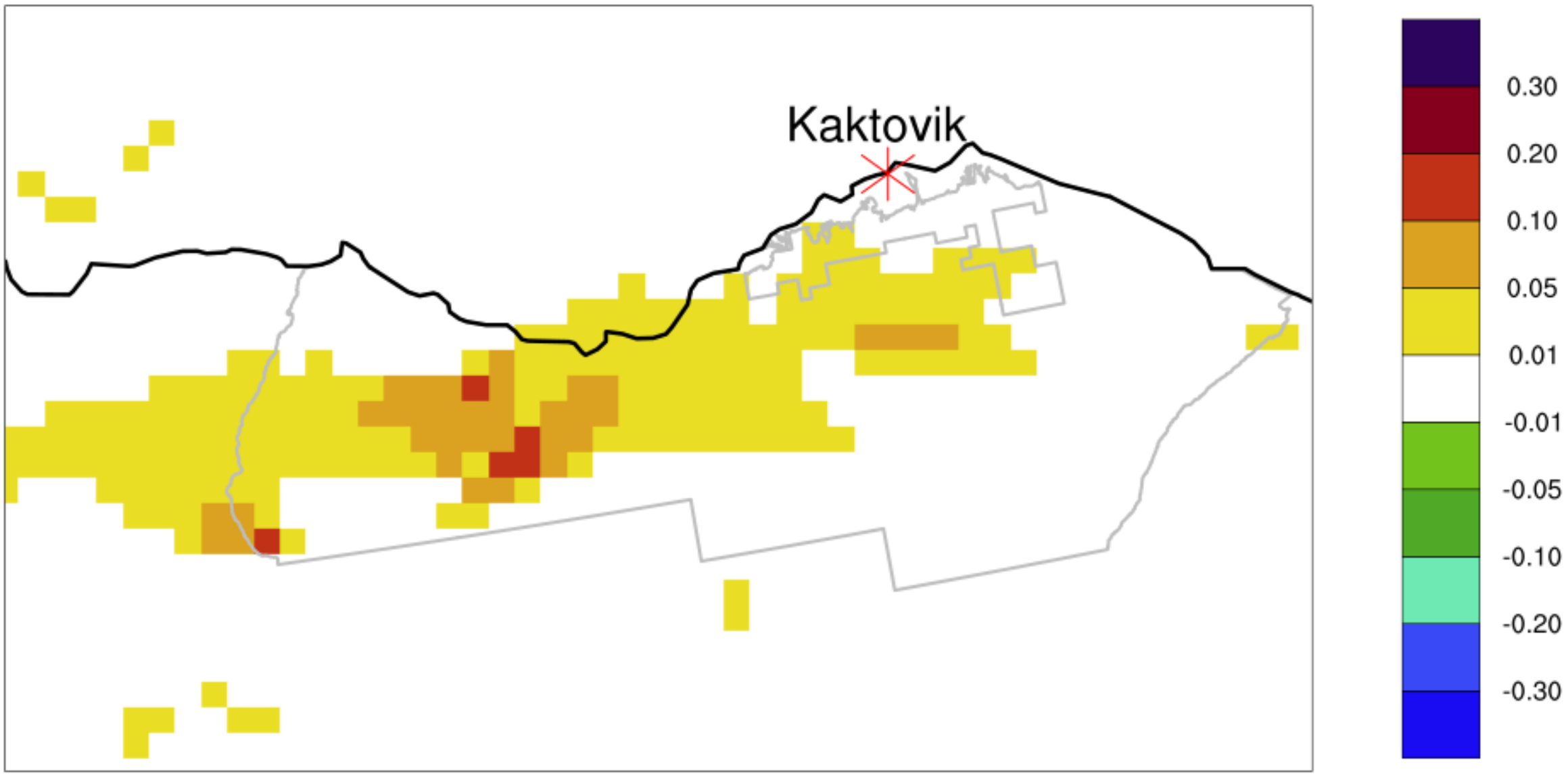

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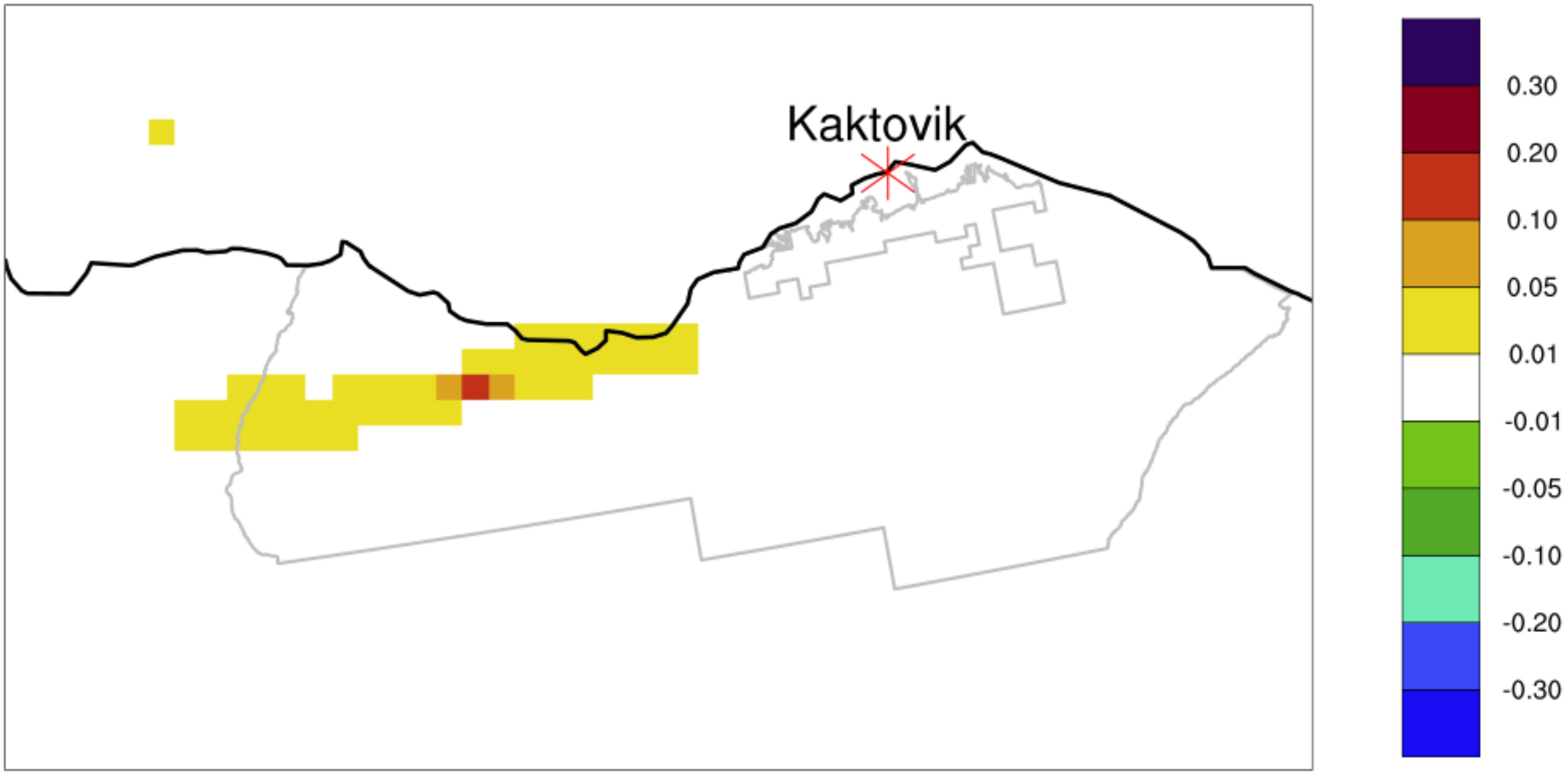
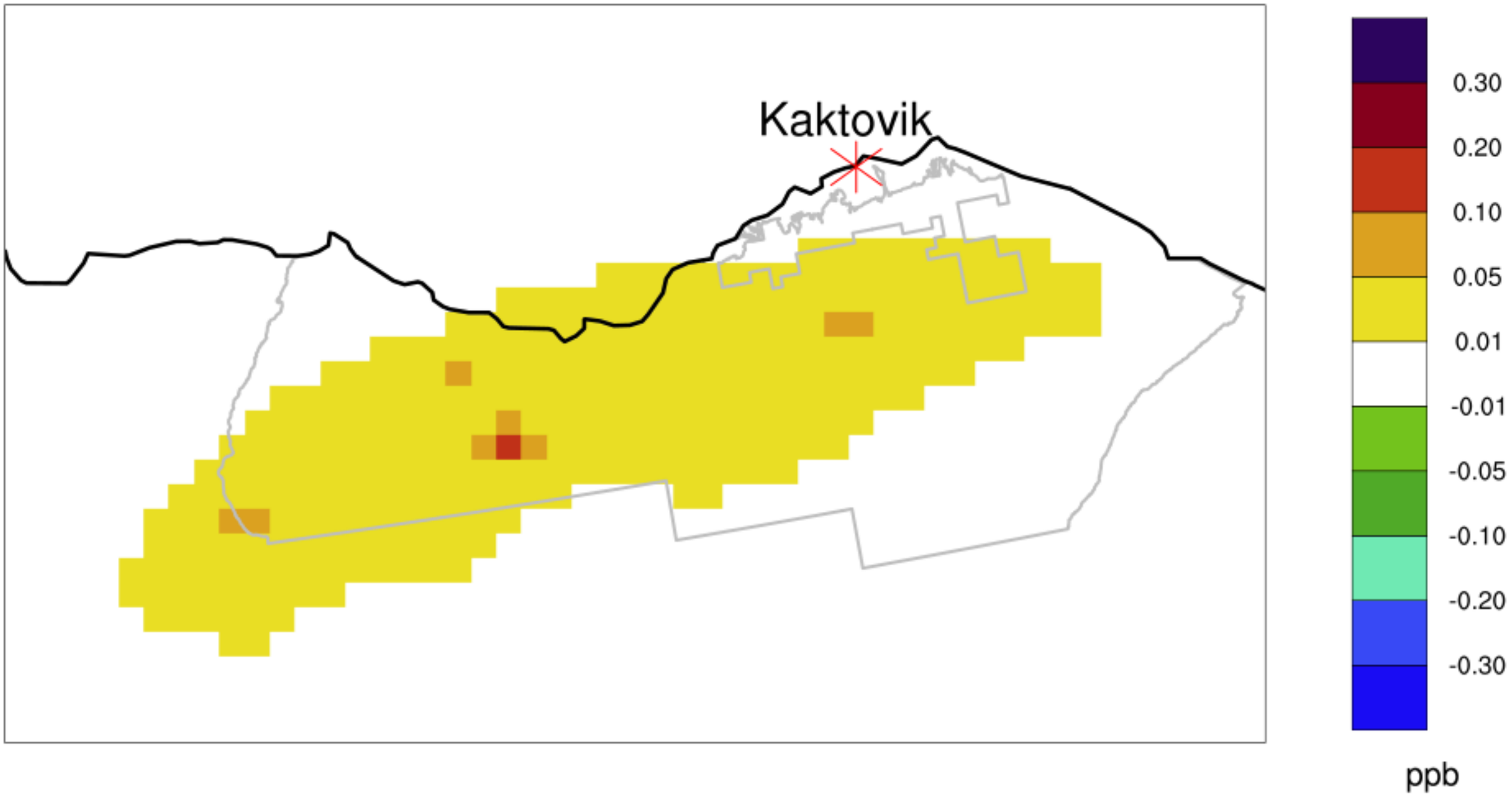


Annual average SO_2 concentration
High Development Scenario-Cumulative

Annual average SO_2 concentration
Low Development Scenario-Cumulative

Annual average SO_2 concentration
No Action Alternative-Cumulative

Annual average SO_2 concentration
High Development Scenario-Indirect Impact



Annual average SO_2 concentration
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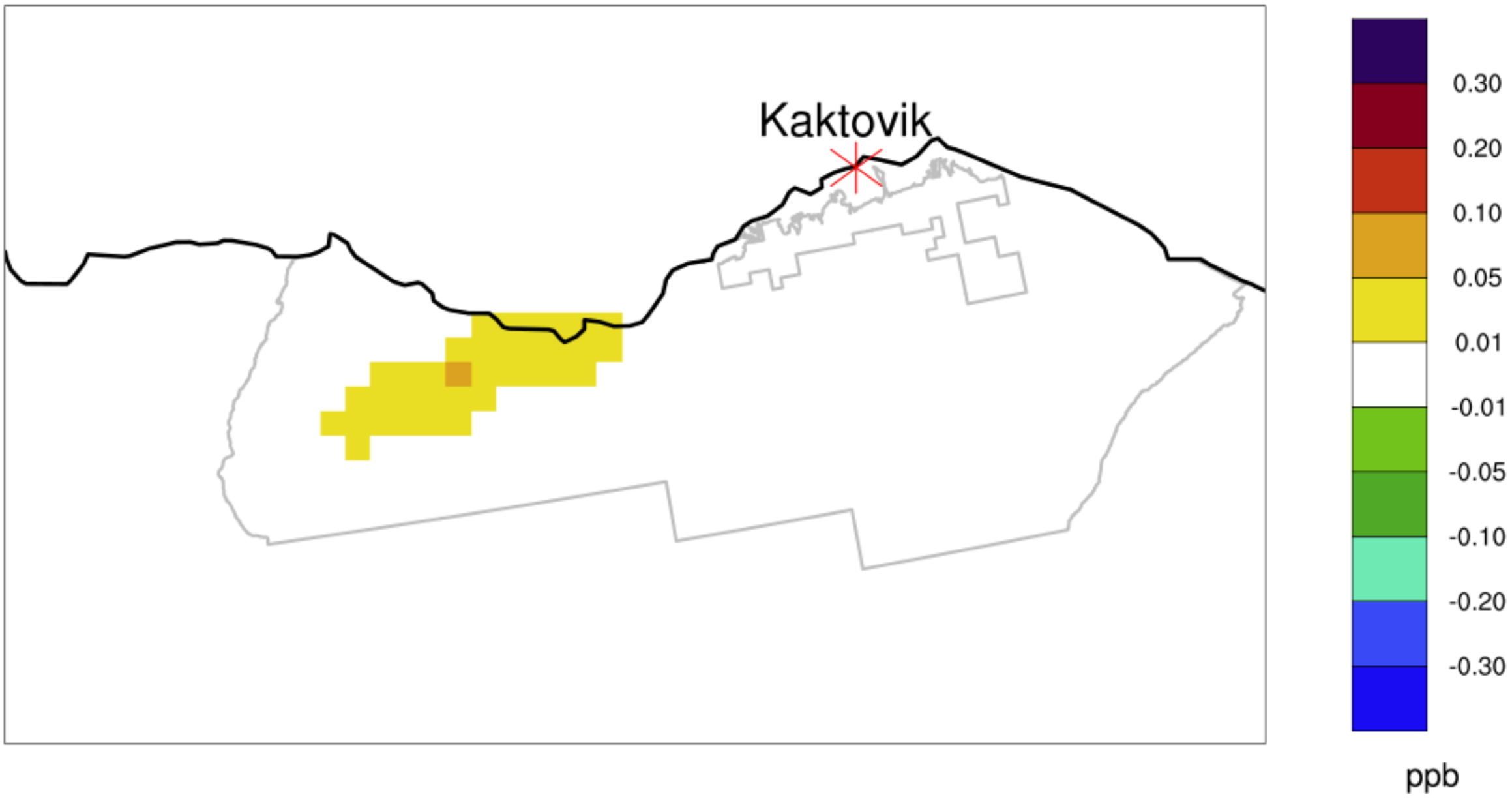
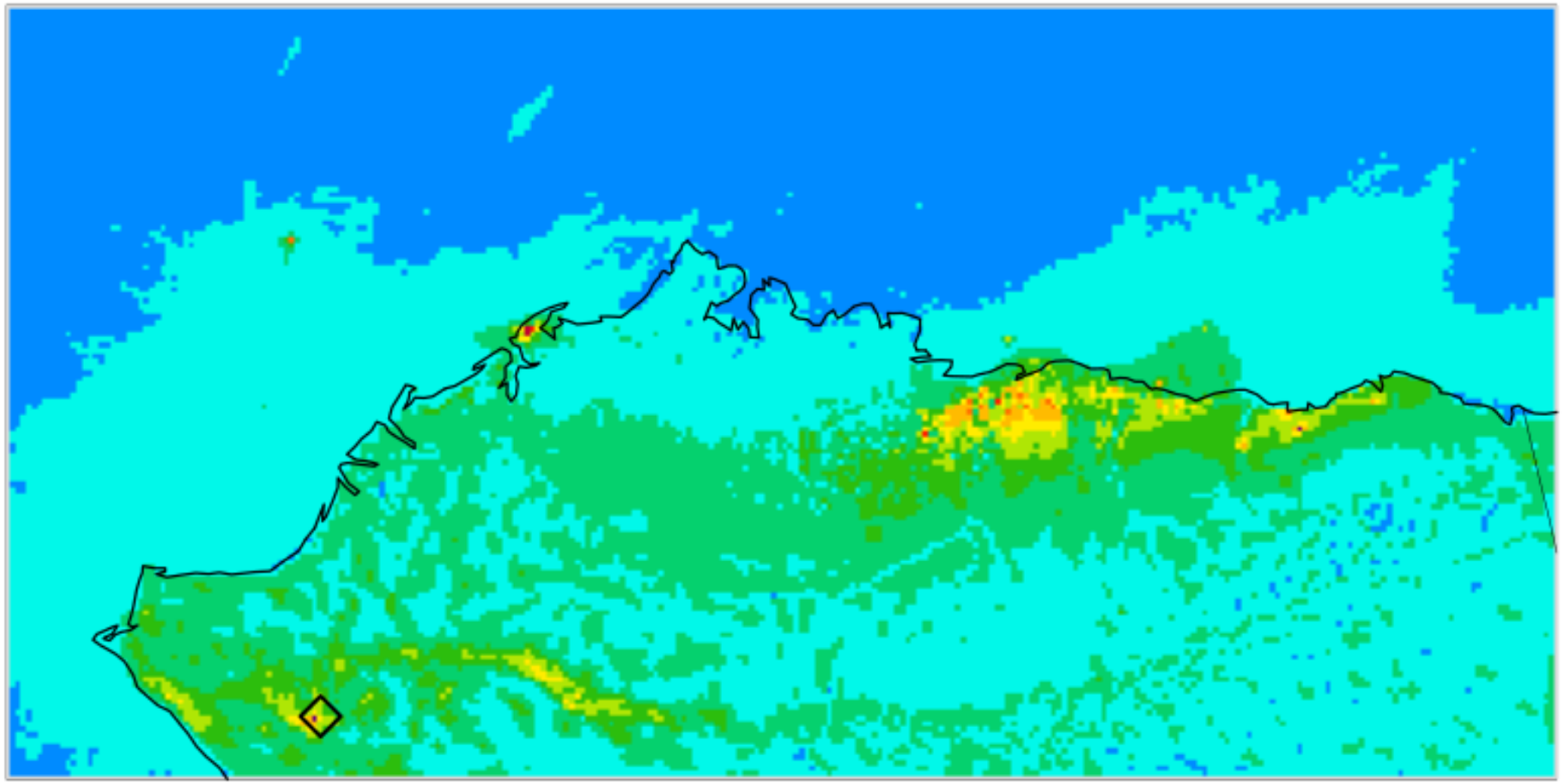
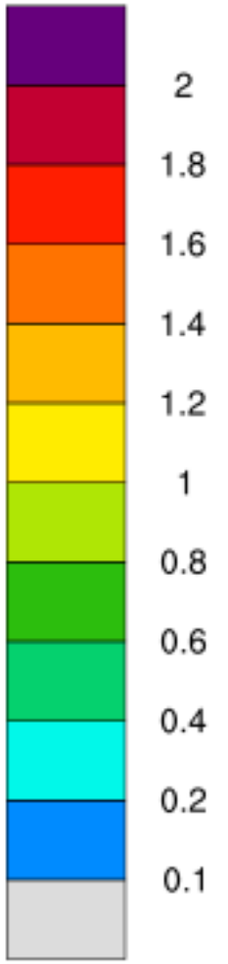


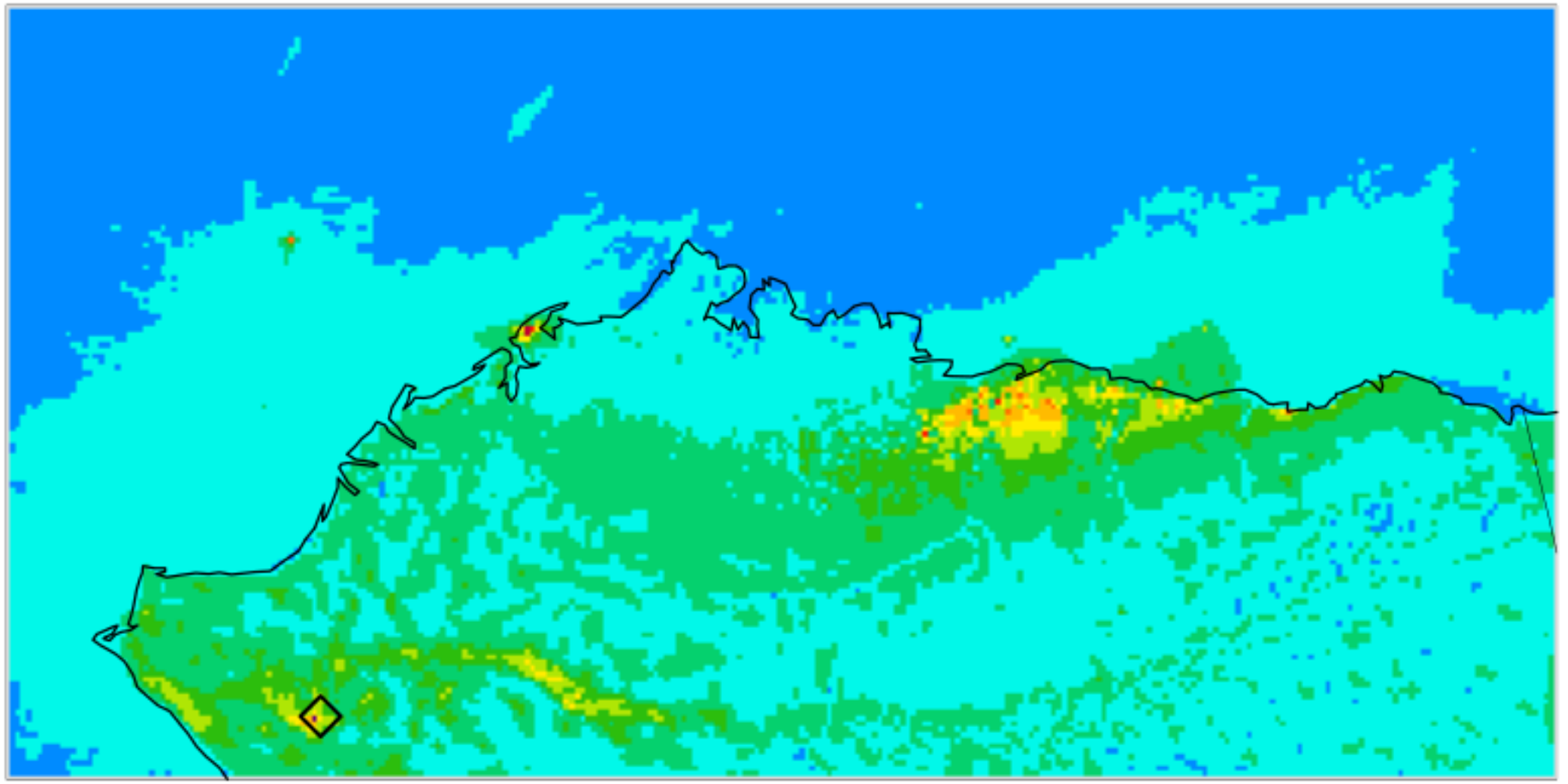
Annual Sum NDEP
High Development Scenario - Cumulative

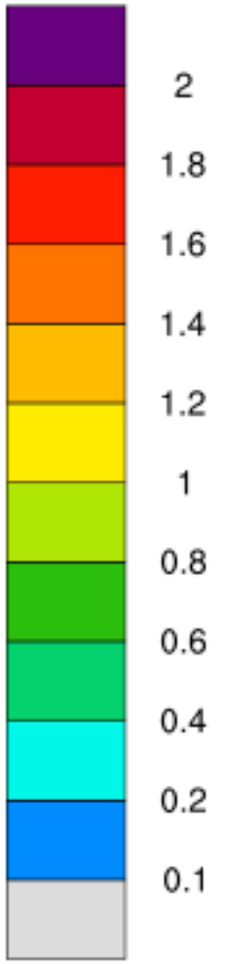




◇ max(56,12) = 2.076 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

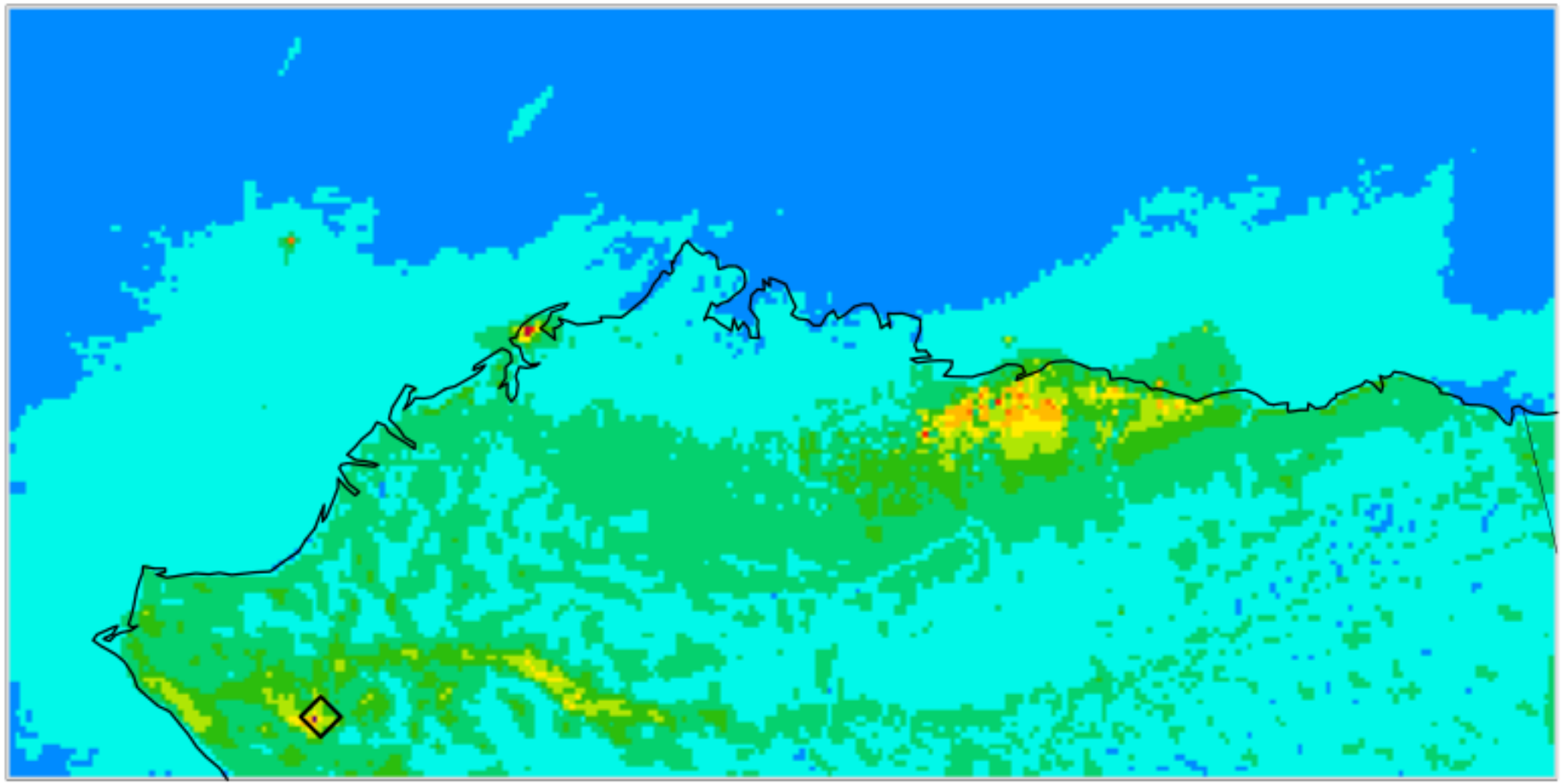
Annual Sum NDEP
Low Development Scenario - Cumulative

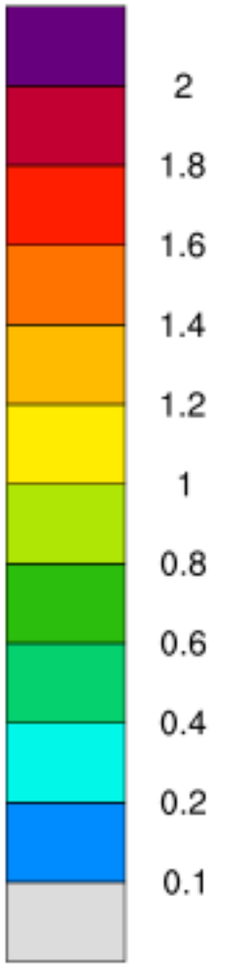




◇ max(56,12) = 2.075 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

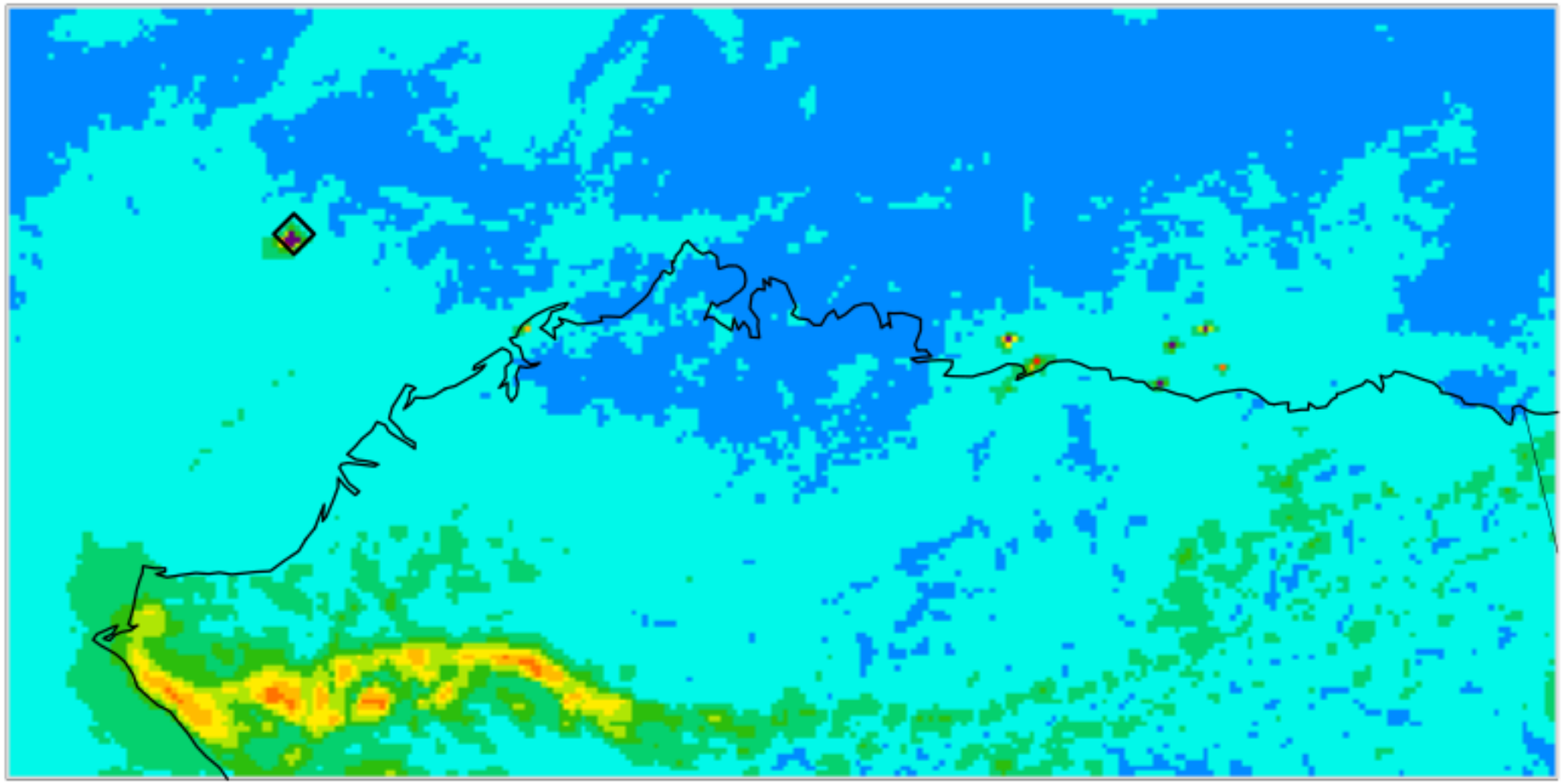
Annual Sum NDEP
No Action Alternative - Cumulative

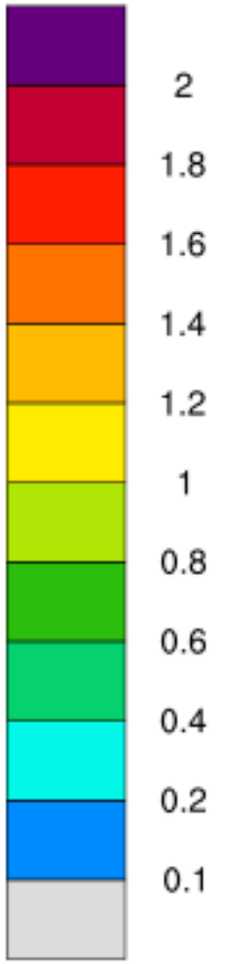




◇ max(56,12) = 2.075 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

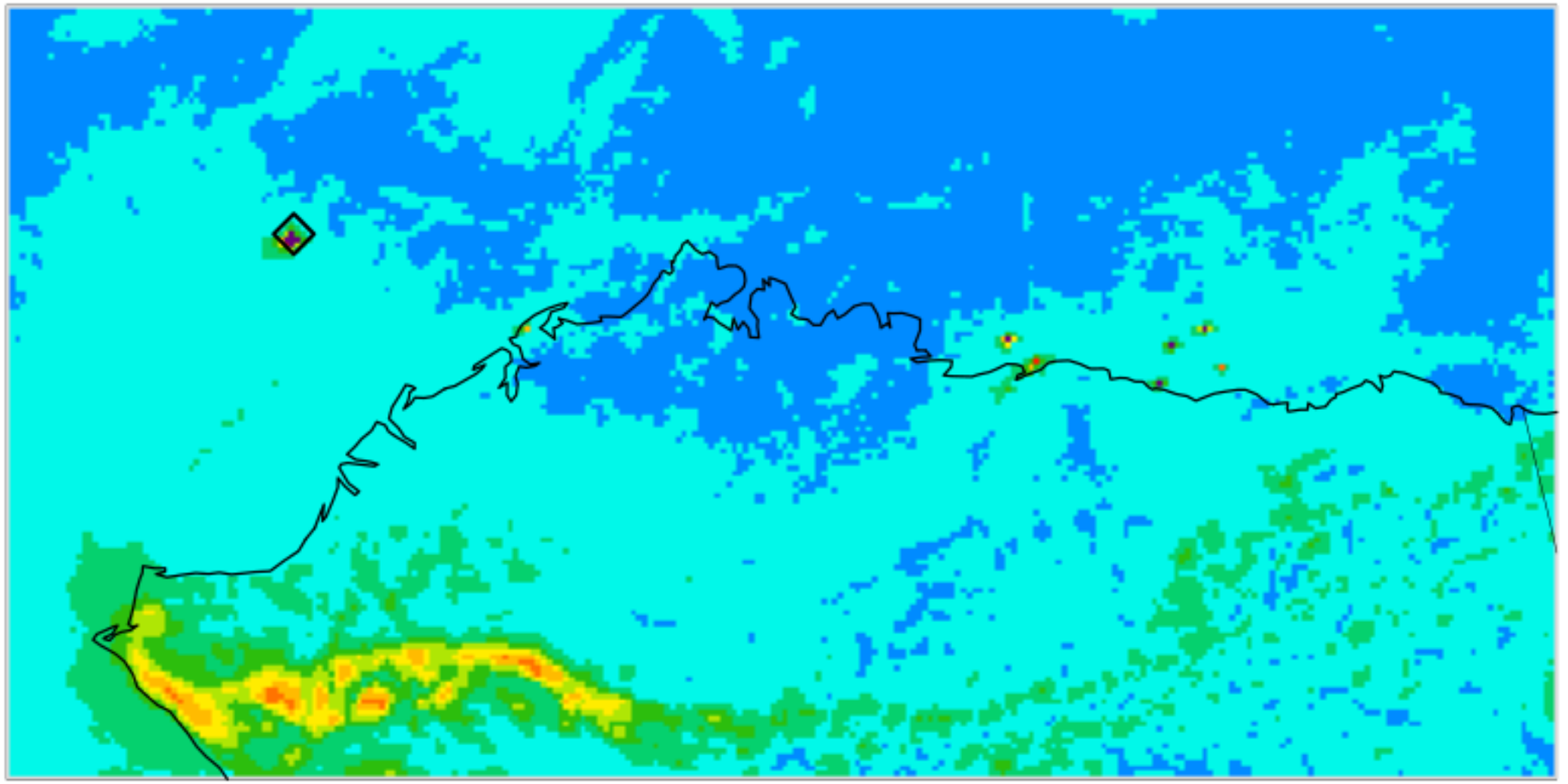
Annual Sum SDEP
High Development Scenario - Cumulative

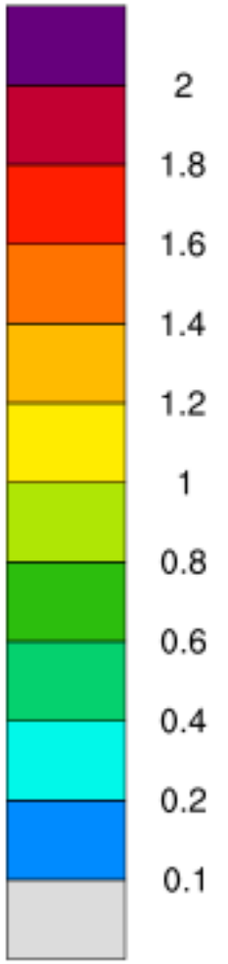




◇ max(52,98) = 15.218 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

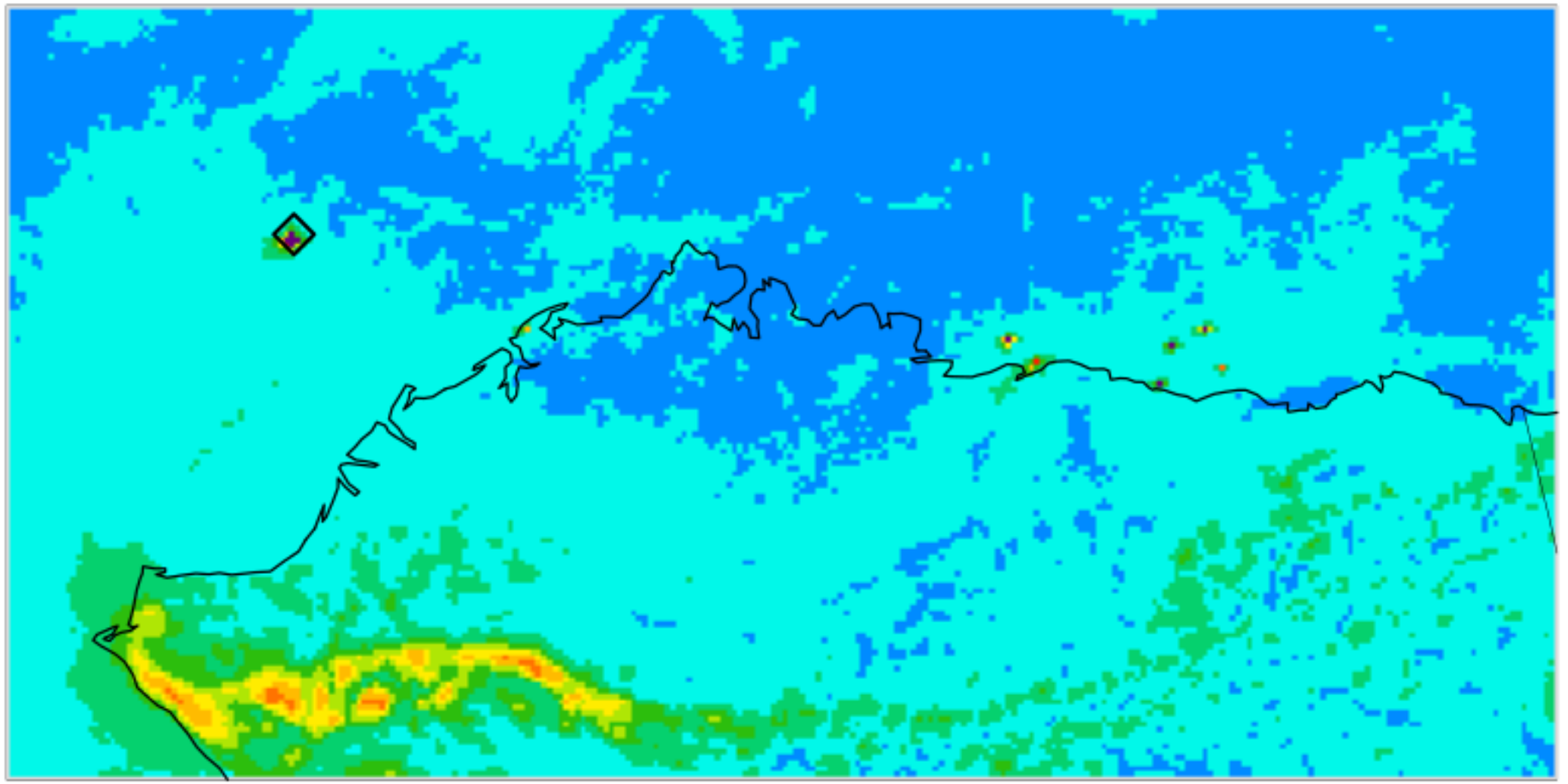
Annual Sum SDEP
Low Development Scenario - Cumulative

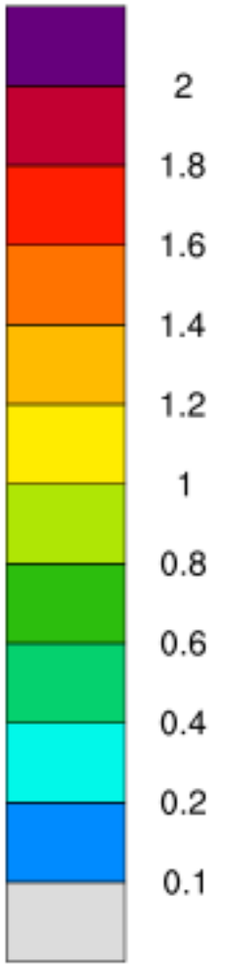




◇ max(52,98) = 15.218 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

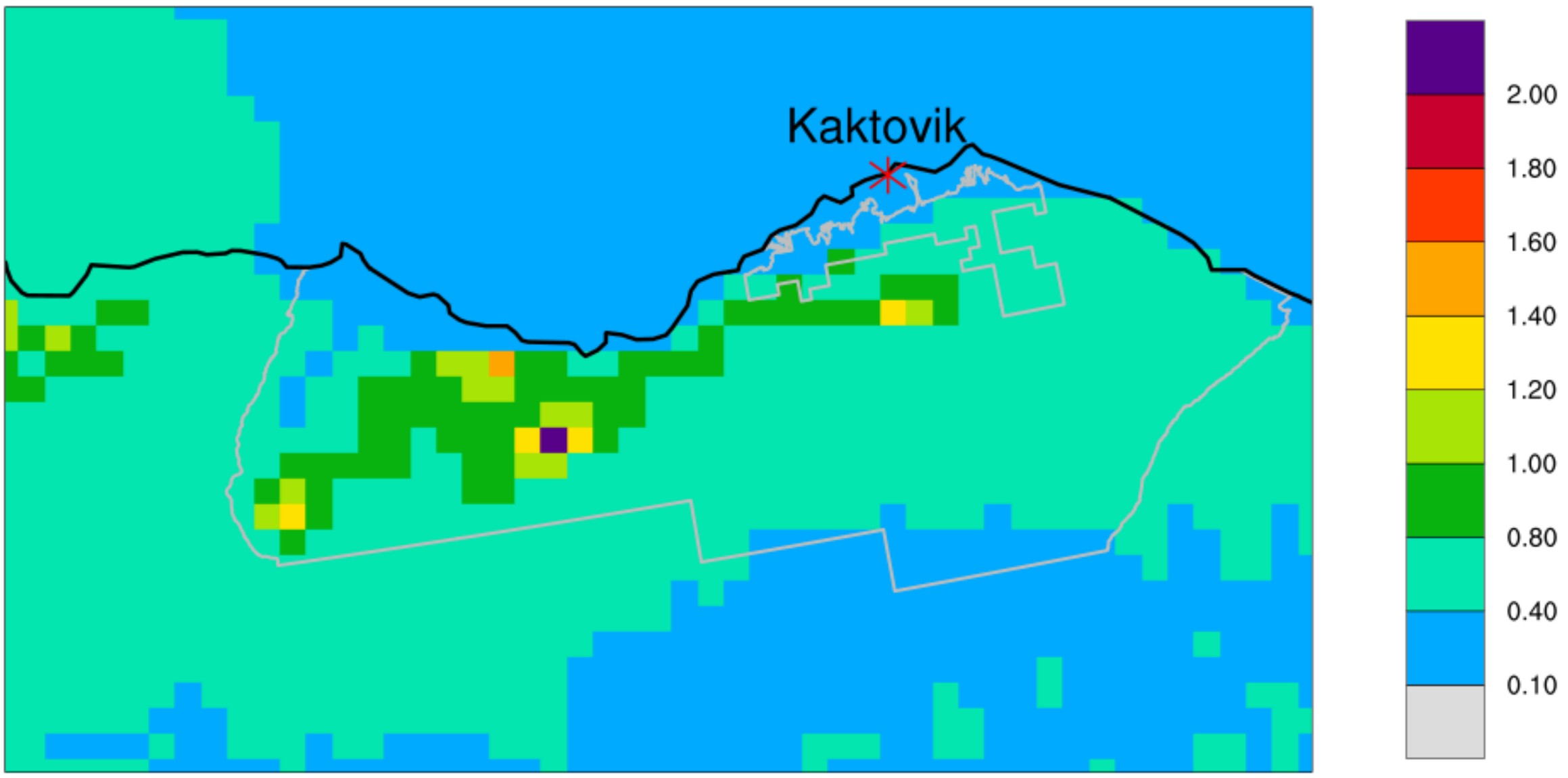
Annual Sum SDEP
No Action Alternative - Cumulative



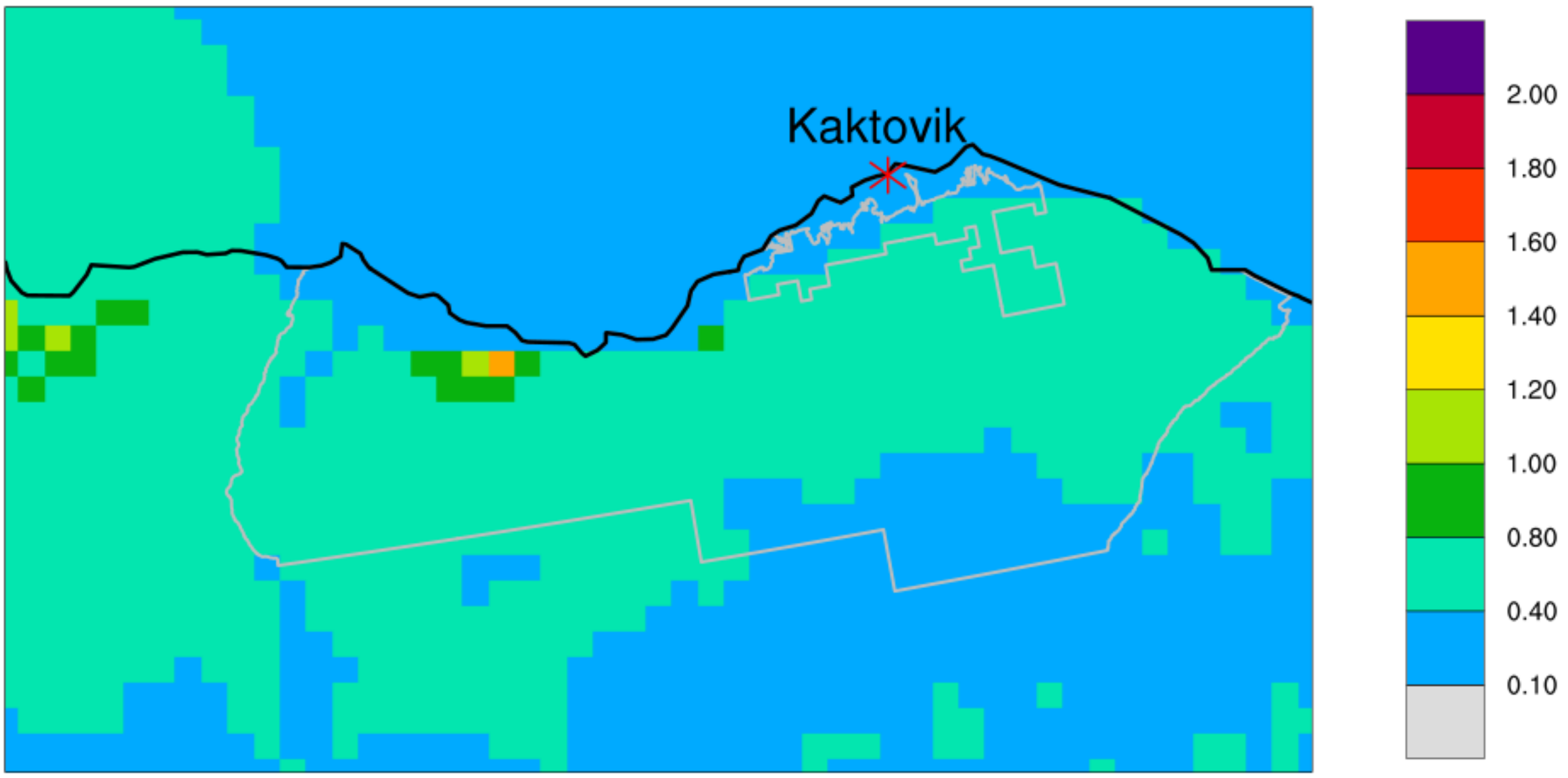


◇ max(52,98) = 15.218 kg/ha-yr
○ min(1,1) = 0.000 kg/ha-yr

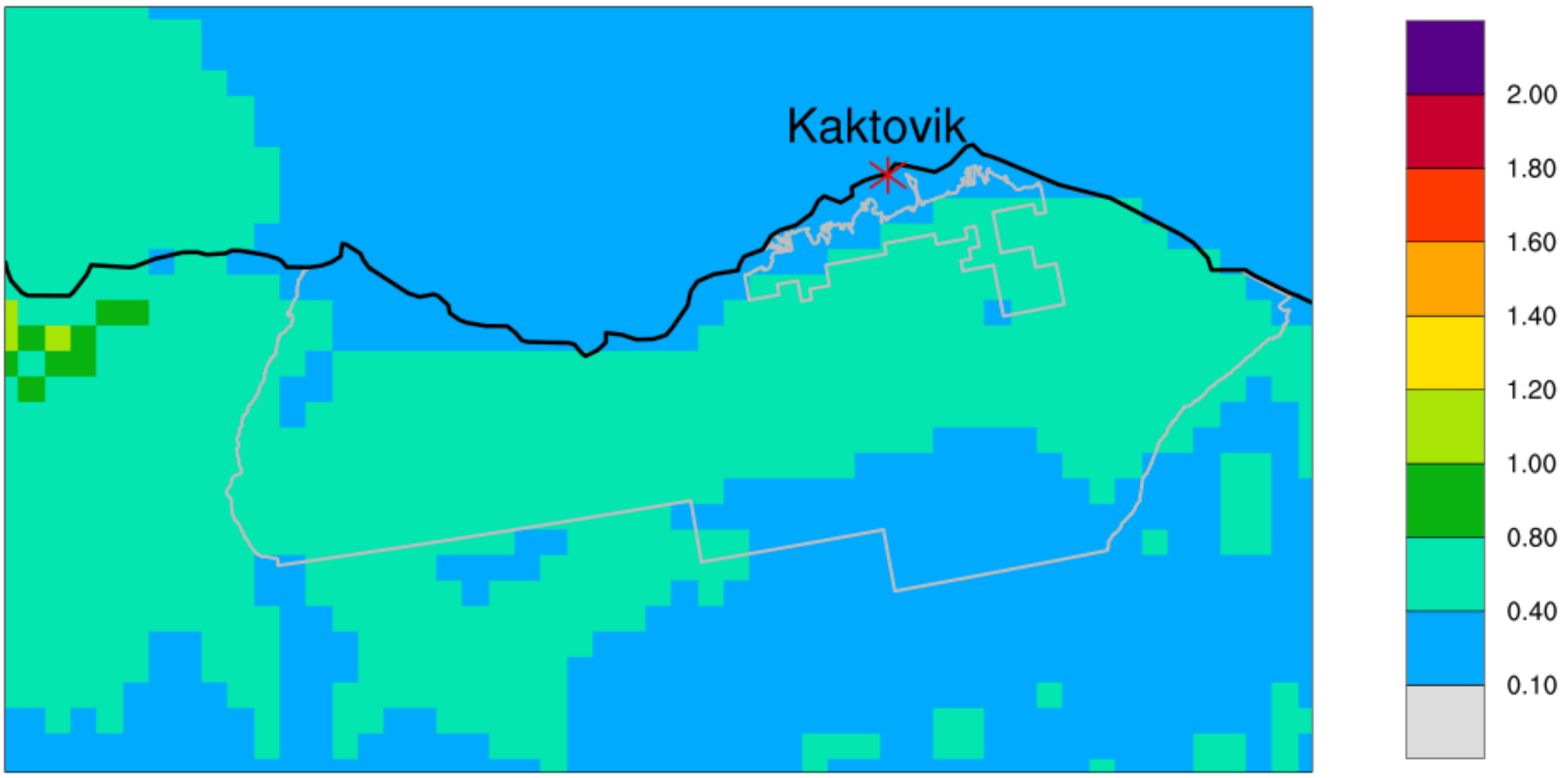
Annual Sum NDEP
High Development Scenario - Cumulative



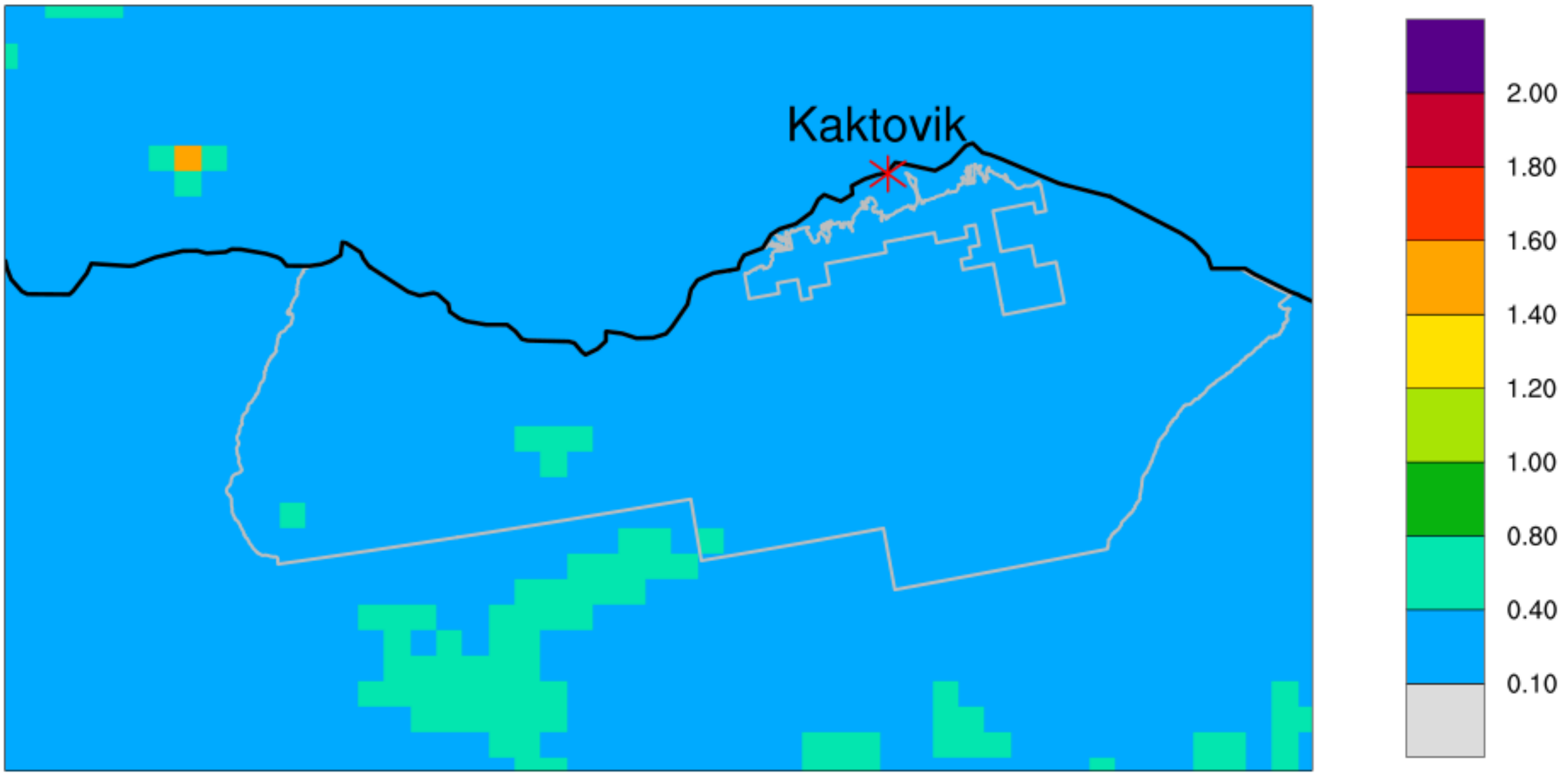
Annual Sum NDEP
Low Development Scenario - Cumulative



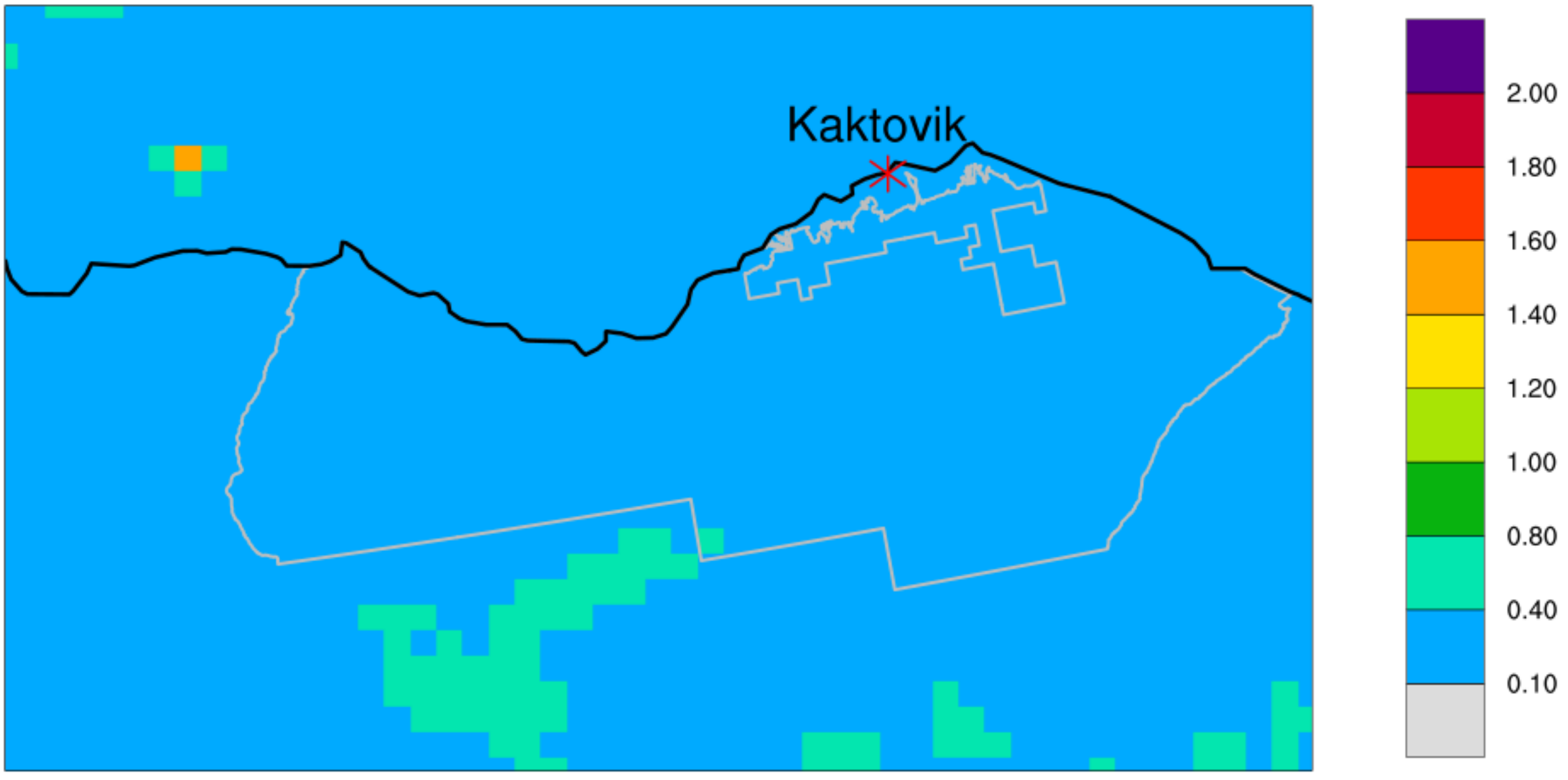
Annual Sum NDEP
No Action Alternative - Cumulative



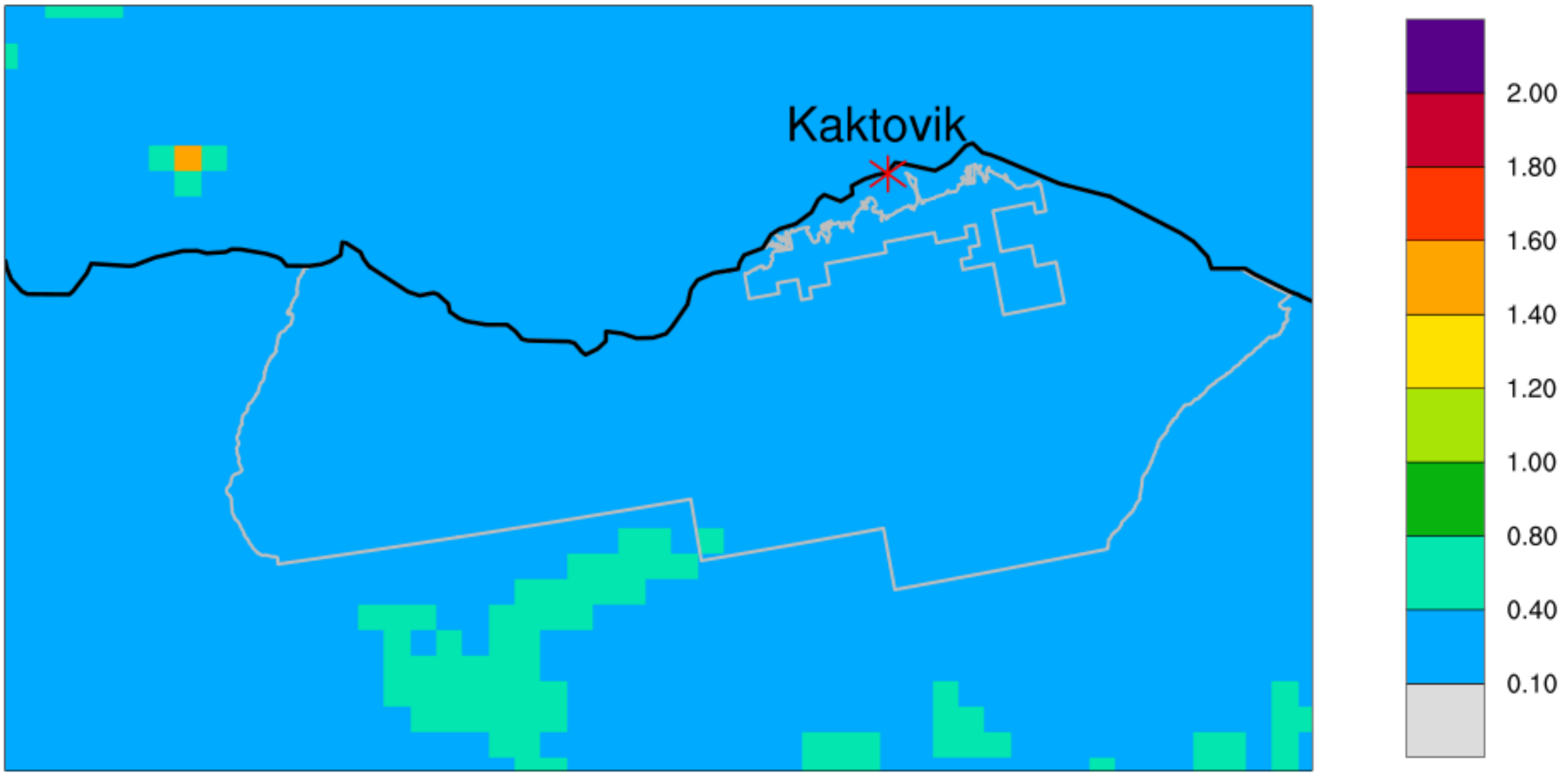
Annual Sum SDEP
High Development Scenario - Cumulative



Annual Sum SDEP
Low Development Scenario - Cumulative



Annual Sum SDEP
No Action Alternative - Cumulative



Appendix S

Bureau of Land Management Energy Substitution Model

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Abbreviations and Acronyms

AEO	Annual Energy Outlook
BLM	Bureau of Land Management
BOEM	Bureau of Ocean Energy Management
DOE	Department of Energy
EIA	Energy Information Administration
IEA	International Energy Agency
LNG	Liquefied Natural Gas
MarketSim	Market Simulation Model
NEMS	National Energy Modeling System
OCS	Outer Continental Shelf
UNLV	University of Nevada, Las Vegas

1. Background

The Energy Substitution Model (EnergySub) was developed by the BLM as a tool to compare unobservable long-run market conditions with and without onshore mineral production projected under a reasonable foreseeable development (RFD) scenario. The BLM developed this model to simulate potential market responses associated with onshore oil, gas, and coal related management actions, including possible substitution between various energy sources and changes in energy prices and consumption, given long-run market conditions projected by the U.S. Energy Administration (EIA).[1] The EnergySub model is not a national forecasting model and it was not designed to be a replacement for the National Energy Modeling System (NEMS) developed and maintained by the EIA, or the long-term energy projections they produce with it. EnergySub was adapted from Bureau of Ocean Energy Management's (BOEM) Market Simulation Model (MarketSim), which assesses potential market impacts associated with the development of offshore oil and gas resources along the Outer Continental Shelf (OCS).[2] Although EnergySub includes substantive updates to enable the model to simulate changes in onshore mineral development, it retains much of the overall structure and functionality of the MarketSim model.

2. Model Overview

EnergySub is an excel-based partial equilibrium model that uses a series of supply and demand equations with a set of assumed long-run elasticities and partial adjustment parameters to create a mathematical representation of U.S. energy markets. This model was adapted from BOEM's MarketSim model to simulate end-use consumption of oil, natural gas, coal and electricity by the domestic residential, commercial, industrial and transportation sectors; production of primary energy fuel sources; and the power sector's generation of electricity from renewable and nonrenewable fuel sources. Although the model primarily represents domestic energy markets, it captures interactions with foreign markets through the inclusion of imports and exports of coal and natural gas and its mathematical representation of a global oil market with aggregated foreign supply and demand.

EnergySub calibrates its supply and demand equations to an initial market equilibrium that reflects projected long-run market conditions developed by the EIA. The EIA is the statistical and analytical branch of the Department of Energy and operates within the U.S. Federal statistical system as the single federal government authority on energy statistics. EIA's Office of Energy Analysis maintains and operates the National Energy Modeling System (NEMS) to produce U.S. energy statistics that are widely regarded to be best available data and are used regularly by Members of Congress, government agencies, industry participants, and other industry observers. [3] While MarketSim, calibrates to long-run projections of market conditions from a special NEMS run where future OCS leasing and development are constrained, EnergySub calibrates to EIA projections published in the Annual Energy Outlook (AEO). AEO projections reflect EIA's best assessment of how U.S. and foreign energy markets will operate

[1] The EIA is the statistical and analytical branch of the Department of Energy and operates within the U.S. Federal statistical system as the single federal government authority on energy statistics. Their mandate is to collect, analyze, and disseminate energy information to inform and promote policymaking, efficient markets, and public understanding of energy and its interactions with the economy and the environment.
[2] See Industrial Economics, Inc. (2017).
[3] NEMS is a modular energy-economy modeling system that captures interactions of macroeconomic changes and energy supply, demand, and prices. An overview of NEMS and detailed information on its 13 modules is publicly available on EIA's website at www.eia.gov/outlooks/aeo/nems/documentation/.

through 2050 based on key assumptions. Since the AEO focuses on domestic energy market conditions, EnergySub's baseline supplements AEO data with additional information from EIA's Short Term Energy Outlook, the International Energy Agency's World Energy Outlook, and natural gas pipeline imports data derived by Industrial Economics, Inc. in order to model interactions with foreign markets in greater detail (EIA 2023a, IEA 2022, EIA 2023d, IEc 2023).

Onshore production volumes for federal oil, natural gas, and coal from the RFD are then used to shock the supply side of EnergySub's initial market equilibrium, causing the model to solve its system of equation for new equilibrating prices for electricity and primary energy fuel sources in each year of the production scenario. [4] Solving for these equilibrating prices yields a new market equilibrium where quantities of electricity, oil, gas, and coal supplied equal those demanded, while accounting for substitution between alternative energy fuel sources.

Energy markets are highly volatile and projections about future market conditions are inherently uncertain. EIA acknowledges that future changes in technologies, demographics, resources, and regulations may affect future market conditions, but they avoid speculating about unknown events when developing long-run market forecasts. EnergySub was not developed to be a forecasting model and its results should not be interpreted as projections of future market conditions that replace those developed by EIA using NEMS. Despite the uncertainty in future market conditions and the amount of recoverable oil reserves which could be economically produced from the Coastal Plains, simulations from EnergySub are useful because they enable analysts to observe potential market responses to changes in production by comparing long-run market conditions forecasted by EIA with and without oil associated with BLM management decisions.

3. Model Framework

As mentioned above, EnergySub uses a series of equations with assumed long-run supply and demand elasticities and partial adjustment parameters to represent the markets for oil, natural gas, coal, and electricity generation. These elasticities and adjustment parameters facilitate the market equilibrating process that moves the modeled energy market from observable short-run conditions towards long-run equilibrium conditions in each year of the simulation. While these long-run conditions cannot be directly observed, they can be inferred from short-run market conditions and the model's underlying parameters. The following sections outline EnergySub's supply and demand equations and describes how the model equilibrates.

4. Oil Market

EnergySub models a simplified world oil market with sector detail for the domestic market, a single supply equation for foreign oil, and a small number of demand equations that represent non-U.S. consumption of oil produced from both U.S. and non-U.S. sources. While EnergySub can distinguish to a limited degree where oil in the domestic market is produced (i.e., AK onshore, AK offshore, lower-48 onshore, lower-48 offshore), the foreign oil market is represented as a single market made up of supply and demand for oil from U.S. and non-U.S. sources. The estimation of impacts to foreign submarkets within the global oil market is beyond the modeling capabilities of EnergySub.

[4] EnergySub extrapolates baseline energy projections through the life of the production scenario when the modeled time period extends beyond the AEO 2050 baseline projections.

The equations that follow below illustrate how EnergySub estimates U.S. oil demand by the residential, commercial, industrial and transportation sectors[5], foreign oil demand, U.S. oil supply, foreign oil supply, oil imports delivered to the U.S. by tanker, U.S. crude oil exports, and U.S. exports of refined petroleum products.

4.1 U.S. Oil Demand

$$Q_{Doi,t} = A_{oi,t} \cdot P_{o,t}^{\eta_{oi}} \cdot \prod_{j} P_{j,t}^{\eta_{oji}} + (1 - \gamma_{Doi}) Q_{Doi,t-1}$$

for each U.S. end-use sector i; and $j = g$ (gas), c (coal), and e (electricity) where:

$Q_{Doi,t}$ represents the quantity of oil demanded in sector i at time t,
$A_{oi,t}$ is a constant calibrated to the AEO market projections,
$P_{o,t}$ is the price of oil at time t,
η_{oi} is the long-run price elasticity of oil demand in sector i,
$P_{j,t}$ is the price of energy source j at time t,
η_{oji} is the long-run elasticity of demand for oil with respect to the price of energy source j in sector I, and
γ_{Doi} is the rate at which demand for oil in sector i adjusts.[6]

The four U.S. end-use sectors i are residential, commercial, industrial, and transportation. To estimate cross-price effects in the industrial and other sectors, EnergySub uses a single weighted average minemouth price of coal (instead of the separate regional coal prices described in Section 7 below).[7]

4.2 Foreign Oil Demand

$$Q_{Dox,t} = A_{ox,t} \cdot P_{o,t}^{\eta_{ox}} + (1 - \gamma_{Dox}) Q_{Dox,t-1}$$

Where:

$Q_{Dox,t}$ represents the quantity of foreign oil demand at time t,
$A_{ox,t}$ is a constant calibrated to the AEO market projections,
$P_{o,t}$ is the price of oil at time t,
η_{ox} is the long-run price elasticity of foreign oil demand, and
γ_{Dox} is the rate at which non-U.S. oil demand adjusts.

Foreign oil demand is strictly a function of the oil price, and no other prices, domestic or foreign. EnergySub specifies three categories of foreign oil demand: (1) foreign demand for U.S. crude oil, (2) foreign demand for U.S. refined products, and (3) foreign demand for foreign oil. The model assumes that these three categories are mutually exclusive.

[5] Oil used for electricity generation is separate from the primary market for oil and oil consumption associated with generating electricity is represented in the electricity section of the model.
[6] Note that this deviates from standard notation used in the empirical literature on demand and supply estimation by using gammas to represent adjustment rather than persistence.
[7] The model uses the weighted average price of coal, using industrial sector consumption as weights.

4.3 U.S. Oil Supply

$$Q_{Sou,t} = B_{ou,t} \cdot P_{o,t}^{\eta ou} + (1 - \gamma_{Sou}) Q_{Sou,t-1}$$

for each domestic oil source u = lower 48 onshore non-tight oil, lower 48 onshore tight oil, lower 48 offshore, Alaska onshore, Alaska offshore, biofuels, natural gas plant liquids, other, or rest of world; where:

$Q_{Sou,t}$ represents the quantity of oil supplied from U.S. source u at time t,
$B_{ou,t}$ is a constant calibrated to the AEO market projections,
$P_{o,t}$ is the price of oil at time t,
η_{ou} is the long-run elasticity of oil supply from source u, and
γ_{Sou} is the rate at which U.S. oil supply u adjusts.

Consistent with the EIA classification, the term "oil" includes all liquid fuels that are close substitutes for petroleum products (e.g., biofuels).

4.4 Foreign Oil Supply

$$Q_{Soy,t} = B_{oy,t} \cdot P_{o,t}^{\eta oy} + (1 - \gamma_{Soy}) Q_{Soy,t-1}$$

Where:

$Q_{Soy,t}$ represents the quantity of non-U.S. oil supplied at time t,
$B_{oy,t}$ is a constant calibrated to the AEO market projections,
$P_{o,t}$ is the price of oil at time t,
η_{oy} is the long-run elasticity of non-U.S. oil supply, and
γ_{Soy} is the rate at which non-U.S. oil supply adjusts.

Foreign oil supply is estimated in EnergySub's equilibrating equations as a separate value that represents tanker imports and pipeline imports combined, consistent with *AEO* reporting.

4.5 Oil Imports Delivered via Pipeline

EnergySub uses the equations outlined above to find changes in oil market consumption, production, and prices under a given development scenario. The model's calculation for oil imports from Canada is similar to the foreign oil supply formula except with its own parameter, elasticity, and adjustment rate.

$$Q_{Soc,t} = B_{oc,t} \cdot P_{o,t}^{\eta oc} + (1 - \gamma_{Soc}) Q_{Soc,t-1}$$

Where:

$Q_{Soc,t}$ represents the quantity of Canadian pipeline oil imports supplied at time t,
$B_{oc,t}$ is a constant calibrated to the AEO market projections,
$P_{o,t}$ is the price of oil at time t,
η_{oc} is the long-run elasticity of Canadian pipeline oil imports, and
γ_{Soc} is the rate at which the supply of Canadian pipeline oil imports adjusts.

4.6 U.S. Crude Oil Exports

As described above, EnergySub models oil as a global market with supply (i.e., production) and demand (i.e., consumption) specified separately for the U.S. and the rest of the world. To facilitate the estimation

of changes in oil exports, EnergySub's demand equations specify the three categories of foreign demand identified above: (1) foreign demand for U.S. crude oil, (2) foreign demand for U.S. refined petroleum products, and (3) foreign demand for foreign oil. The first of these items represents U.S. crude oil exports. Therefore, to estimate the impact of a given BLM development scenario on U.S. crude oil exports, EnergySub calculates the difference between foreign demand for U.S. crude oil between the development scenario and the AEO baseline projections.

4.7 U.S. Exports of Refined Petroleum Products

EnergySub estimates U.S. exports of refined petroleum products based on the specification of foreign demand for refined petroleum products in the model's equilibrating equations.[8] For a given development scenario, the change in U.S. refined petroleum product exports is equal to the estimated change in foreign demand for U.S. refined petroleum products. This approach is similar to that outlined above for U.S. exports of crude oil, which EnergySub estimates based on the change in foreign demand for U.S. crude oil.

5. Natural Gas Market

EnergySub represents the U.S. natural gas market with exports and imports. This stands in contrast to the oil market, which EnergySub simulates as a global market due to the relatively low cost of transporting oil and the large volume of oil traded on international markets. Natural gas use for electricity generation is represented elsewhere in the electricity section of the model. The equations that follow specify EnergySub's estimation of U.S. natural gas demand, demand for U.S. natural gas exports, and U.S. natural gas supply.

5.1 U.S. Natural Gas Demand

$$Q_{Dgi,t} = A_{gi,t} \cdot P_{g,t}^{\eta gi} \cdot \prod_{j} P_{j,t}^{\eta gji} + (1 - \gamma_{Dgi}) Q_{Dgi,t-1}$$

for each U.S. end-use sector i; and $j = o$ (oil), c (coal), and e (electricity) where:

$Q_{Dgi,t}$ represents the quantity of natural gas demanded in sector i at time t,
$A_{gi,t}$ is a constant calibrated to the AEO market projections,
$P_{g,t}$ is the price of natural gas at time t,
η_{gi} is the long-run price elasticity of natural gas demand in sector i,
$P_{j,t}$ is the price of energy source j at time t,
η_{gji} is the long-run elasticity of demand for natural gas with respect to the price of energy source j in sector I, and
γ_{Dgi} is the rate at which demand for natural gas in sector i adjusts.

The U.S. natural gas demand sectors represented in EnergySub include the residential, commercial, industrial, and transportation sectors. As in the oil market, EnergySub uses a single weighted average minemouth price of coal instead of separate regional coal prices to estimate cross-price effects in the industrial sector.

[8] As noted above, this category of foreign demand represents one of three included in the model. The other two categories are foreign demand for U.S. crude oil and foreign demand for foreign oil.

5.2 Demand for U.S. Natural Gas Exports

$$Q_{Dgx,t} = A_{gx,t} \cdot P_{g,t}^{\eta gx} + (1 - \gamma_{Dgx}) Q_{Dgx,t-1}$$

Where:

$Q_{Dgx,t}$ represents the quantity of U.S. natural gas exports at time t,
$A_{gx,t}$ is a constant calibrated to the AEO market projections,
$P_{g,t}$ is the price of natural gas at time t,
η_{gx} is the long-run price elasticity of export demand for U.S. natural gas, and
γ_{Dgx} is the rate at which export demand for natural gas adjusts.

U.S. natural gas exports are dependent only upon the domestic price of natural gas and no other prices, domestic or international.

5.3 U.S. Natural Gas Supply

$$Q_{Sgu,t} = B_{gu,t} \cdot P_{g,t}^{\eta gu} + (1 - \gamma_{Sgu}) Q_{Sgu,t-1}$$

for each domestic or imported natural gas source u = lower 48 conventional, lower 48 unconventional, lower 48 offshore, Alaska onshore, Alaska offshore, other (e.g., synthetic natural gas and coke oven gas), pipeline imports, and LNG imports, where:

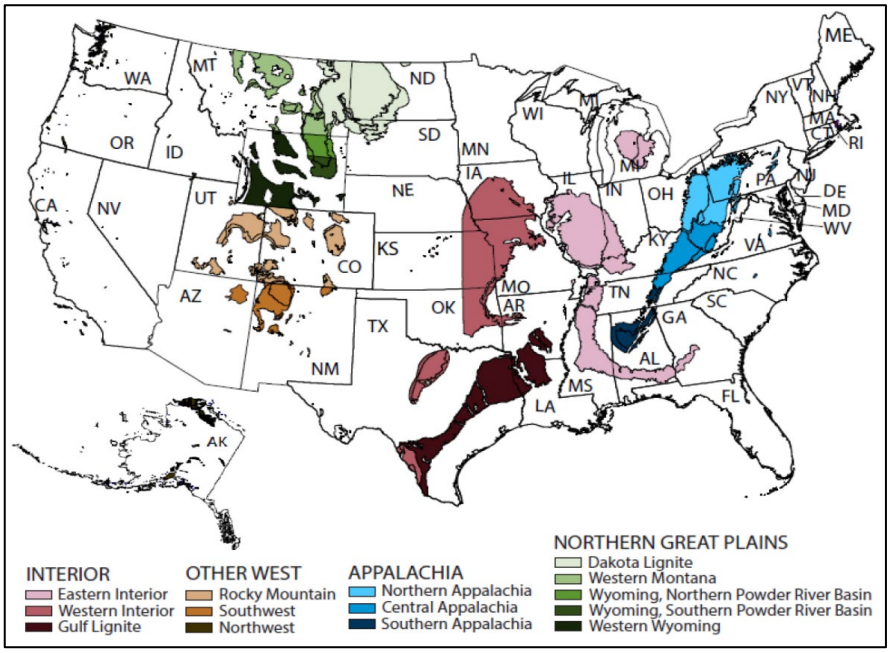
$Q_{Sgu,t}$ represents the quantity of natural gas supplied to the U.S. market from domestic or imported source u at time t,
$B_{gu,t}$ is a constant calibrated to the AEO market projections,
$P_{g,t}$ is the price of natural gas at time t,
η_{gu} is the long-run elasticity of natural gas supply to the U.S. market from source u, and
γ_{Sgu} is the rate at which natural gas from source u adjusts.

6. Coal Market

EnergySub represents the U.S. coal market as 14 separate sub-markets defined according to the region where coal is produced, with exports. The model also includes imports as exogenous to the model. The 14 coal markets in EnergySub correspond to the coal supply regions represented in the Coal Market Module of EIA's NEMS, shown below in Figure 1. These supply regions are modeled separately to account for differences in the sulfur content, thermal value, rank, and production method of different coals. Because coal characteristics often differ by region (e.g, the Southern Powder River Basin region produces *only* low-sulfur, surface mined subbituminous coal), this approach (in most cases) implicitly captures the important differences between domestic sources of coal. With 14 distinct coal markets (one for each supply region), EnergySub estimates 14 equilibrium coal prices for each year.

Coal use for electricity generation is represented elsewhere in the electricity section of the model. The equations that follow present the model's estimation of U.S. coal demand, demand for U.S. coal exports, and U.S. coal supply.

Figure 1. EnergySub Coal Supply Regions



6.1 U.S. Coal Demand

$$Q_{Dcir,t} = A_{cir,t} \cdot P_{cr,t}^{\eta ci} \cdot \prod_{j} P_{j,t}^{\eta cji} + (1 - \gamma_{Dci}) Q_{Dcir,t-1}$$

for each U.S. end-use sector i, for each coal supply region r; and $j = g$ (gas), o (oil), and e (electricity) where:

$Q_{Dcir,t}$ represents the quantity of coal demanded in sector i from coal supply region r at time t,
$A_{cir,t}$ is a constant calibrated to the AEO market projections,
$P_{cr,t}$ is the minemouth price of coal from supply region r at time t,
η_{ci} is the long-run price elasticity of coal demand in sector i,
$P_{j,t}$ is the price of energy source j at time t,
η_{cji} is the long-run elasticity of demand for coal with respect to the price of energy source j in sector I, and
γ_{Dci} is the rate at which demand for coal in sector i adjusts.

Other than the electricity sector, whose coal demand is modeled separately, EnergySub's domestic demand sectors for coal include industrial and other.

6.2 Demand for U.S. Coal Exports

$$Q_{Dcrx,t} = A_{crx,t} \cdot P_{cr}^{\eta cx} + (1 - \gamma_{Dcx}) Q_{Dcrx,t-1}$$

for each coal supply region, *r*, where:

$Q_{Dcrx,t}$ represents the quantity of U.S. coal exports from coal supply region *r* at time *t*,
$A_{crx,t}$ is a constant calibrated to the AEO market projections,
$P_{cr,t}$ is the minemouth price of coal from supply region *r* at time *t*,
η_{cx} is the long-run price elasticity of export demand for U.S. coal, and
γ_{Dcx} is the rate at which export demand for coal adjusts.

Coal exports in EnergySub are only dependent upon the domestic minemouth price of coal from each coal supply region. No other energy prices, domestic or international, affect exports of coal.

6.3 U.S. Coal Supply

$$Q_{Scr,t} = B_{cr,t} \cdot P_{cr,t}^{\eta cr}$$

for each coal supply region, *r*, where:

$Q_{Scr,t}$ represents the quantity of coal supplied to the U.S. market from coal supply region *r* at time *t*,
$B_{cr,t}$ is a constant calibrated to the AEO market projections,
$P_{cr,t}$ is the minemouth price of coal for coal supply region *r* at time *t*,
η_{cr} is the long-run elasticity of coal supply to the U.S. market from coal supply region *r*, and
γ_{Sc} is the rate at which coal supply adjusts.

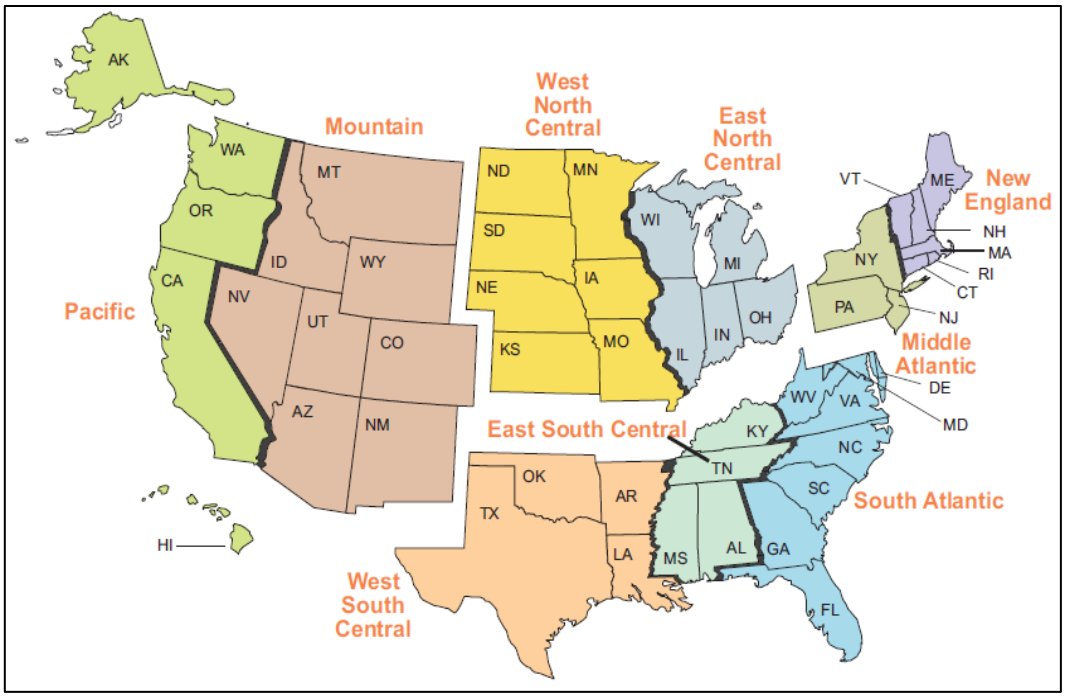
As noted above, EnergySub treats coal imports as exogenous. For each BLM development scenario, imports are assumed to be the same as under the baseline scenario. The model makes this simplifying assumption because imports are projected to make up a *de minimis* fraction (less than 1 percent) of U.S. coal demand according to the AEO and imports do not align with the 14 coal markets specified in the model.

7. Electricity Market

Equations in EnergySub represent the U.S. electricity market and models U.S. exports and imports of electricity as net imports. EnergySub's electricity sector also represents an end-use sector with demand for oil, natural gas, and coal as a fuel source for generating commercial electricity. The equations below present EnergySub's approach for estimating U.S. electricity demand, U.S. electricity supply, and demand for fossil fuels for electricity generation.

To depict the use of coal for electricity generation with greater spatial detail, EnergySub divides the electricity supply market into nine regions based on the U.S. Census Divisions, shown in Figure 2 below. Each electricity supply region is also modeled to receive coal from the 14 separate coal supply regions described above, resulting in a total of 126 total coal supply-electricity supply region combinations.

Figure 2. EnergySub Electricity Supply Regions



7.1 U.S. Electricity Demand

$$Q_{Dei,t} = A_{ei,t} \cdot P_{e,t}^{\eta ei} \cdot \prod_{j} P_{j,t}^{\eta eji} + (1 - \gamma_{Dei}) Q_{Dei,t-1}$$

for each U.S. electricity end-use sector i; and $j = g$ (gas), c (coal), and o (oil), where:

$Q_{Dei,t}$ represents the quantity of electricity demanded in sector i at time t,
$A_{ei,t}$ is a constant calibrated to the AEO market projections,
$P_{e,t}$ is the price of electricity at time t,
η_{ei} is the long-run price elasticity of electricity demand in sector i,
$P_{j,t}$ is the price of energy source j at time t,
η_{eji} is the long-run elasticity of demand for electricity with respect to the price of energy source j in sector i, and
γ_{Dei} is the rate at which demand for electricity in sector i adjusts.

The U.S. demand sectors for electricity in EnergySub include (1) residential, (2) commercial, (3) industrial, (4) transport, and (5) other. As in the oil and gas markets, EnergySub uses a single weighted average minemouth price of coal instead of separate regional coal prices to estimate cross-price effects in the industrial and other sectors.

7.2 U.S. Electricity Supply

EnergySub uses a separate approach for estimating electricity derived from natural gas, oil, and coal than electricity derived from other sources. While the quantity of electricity generated from gas, oil, and coal is dependent on fossil fuel prices, changes in these prices do not directly factor into the generation of

electricity from non-fossil energy sources.[9] In addition, EnergySub accounts for the cost of transporting coal from each coal supply region to each electricity supply region by adding the coal transportation cost to the minemouth price of coal, which yields an estimate of the delivered price of coal. To account for this difference in the economics of electricity generation for different types of power producers, EnergySub specifies electricity supply separately for three classes of generation as follows:

$$Q_{Sej,t} = C_{j,t} \cdot (P_{e,t}/P_{j,t})^{\eta ej} + (1 - \gamma_{Sej})Q_{Sej,t-1}$$

for *j* = oil and natural gas, where:

$Q_{Sej,t}$ represents the quantity of electricity supplied from fossil fuel energy source *j* at time *t*,
$C_{j,tt}$ is a constant calibrated to the AEO market projections,
$P_{e,t}$ is the price of electricity at time *t*,
$P_{j,t}$ is the price of fossil fuel energy source *j* at time *t*,
η_{ej} is the long-run elasticity of electricity supply from fuel *j*, and
γ_{Sej} is the rate at which electric power from fossil energy *j* adjusts.

$$Q_{Secrz,t} = C_{crz,t} \cdot [P_{e,t}/(P_{cr,t}+T_{crz})]^{\eta ec} + (1 - \gamma_{Sec})Q_{Secrz,t-1}$$

for *c* = coal, for each coal supply region *r* and each electricity supply region *z*, where:

$Q_{Secrz,t}$ represents the quantity of electricity supplied from coal supply region *r* to electricity supply region *z* at time *t,*
$C_{crz,t}$ is a constant calibrated to the AEO market projections,
$P_{e,t}$ is the price of electricity at time *t*,
$P_{cr,t}$ is the minemouth price of coal from supply region *r* at time *t*,
T_{crz} represents the transportation cost of coal from coal supply region *r* to electricity supply region *z,*
η_{ec} is the long-run elasticity of electricity supply from coal, and
γ_{Sec} is the rate at which electric power from coal adjusts.

As noted above, EnergySub accounts for the cost of transporting coal between each of the 14 coal supply regions and each of the nine electricity supply regions. The model therefore includes estimates of the per-ton cost of transporting coal (T_{crz}) for all 126 combinations of coal supply and electricity supply regions.

$$Q_{Sel,t} = C_{l,t} \cdot P_{e,t}{}^{\eta el} + (1 - \gamma_{Sel})Q_{Sel,t-1}$$

for *l* = nuclear, hydro, wind, solar, other electric, net imports, where:

$Q_{Sel,t}$ represents the quantity of electricity supplied from source *l* at time *t*,
$C_{l,t}$ is a constant calibrated to the AEO market projections,

[9] All else equal, renewable electricity generation in EnergySub simulations will increase as fossil fuel prices rise, but the effect is indirect. For a given level of electricity demand, fossil fuel-based generators will supply less electricity as fossil fuel prices rise, which will shift generation toward renewables.

$P_{e,t}$ is the price of electricity at time t,
η_{el} is the long-run elasticity of electricity supply from source l, and
γ_{Sel} is the rate at which electric power from source l adjusts.

7.3 Demand for Fossil Fuels to Produce Electricity

7.3.1 Oil and Natural Gas

$$Q_{Dje,t} = K_{j,t} \cdot Q_{Sej,t}$$

for j = oil and natural gas, where:

$Q_{Dje,t}$ represents the quantity of energy source j used to produce electricity at time t,
$K_{j,t}$ is a constant calibrated to the AEO market projections, and
$Q_{Sel,t}$ represents the quantity of electricity supplied from source l at time t

7.3.2 Coal

$$\sum_z Q_{Dcerz,t} = K_{cr,t} \cdot \sum_z Q_{Secrz,t}$$

for c= coal, where:

$\sum_z Q_{Dcerz,t}$ is the sum of demand for coal from coal supply region r for electricity production across all z electricity production regions at time t,

$K_{cr,t}$ is a constant calibrated to the AEO market projections, and

$\sum_z Q_{Secrz,t}$ is the sum of coal supplied for electricity production from coal supply region r across all z electricity production regions at time t.

8. Model Calibration

For a given set of elasticities, adjustment parameters, market quantities, and prices in the baseline projections of market conditions through 2050, EnergySub uses the series of supply and demand equations outlined above to calculate the parameters A, B, C, and K in these equations. These parameters, having been calculated from data that reflects a baseline market equilibrium, calibrate the model's supply and demand equations directly to the market conditions observed in the baseline projections.

EnergySub has extensive data requirements and needs detailed long-run forecasts for the supply, demand, and prices of electricity and energy fuel sources to derive its calibration parameters and benchmark the system of equations to projected equilibrium market conditions. EnergySub relies heavily on long-run projections developed by EIA for the Annual Energy Outlook because these data represent the most complete impartial data set for long-run U.S. energy market conditions and are developed with rigger using methods and assumptions that are well documented. While other projections for energy market conditions through 2050 exist, AEO data are widely accepted as best available information.

9. Equilibration

Onshore production volumes for federal oil, natural gas, and/ or coal from the RFD are used to shock the supply side of EnergySub's initial market equilibrium, moving its system of equation from a state of equilibrium into disequilibrium. Production under each year of the RFD can be introduced into the model as either a component of or incremental to the equilibrium supply projections for that year. While production under the RFD may represent incremental production from production in the current year, supply projections from the AEO reflect EIA's best guess at future U.S. production from all proved and unproven reserves regardless of mineral ownership or current leasing status. These supply projections reflect total future production and do not disaggregate onshore production from federal and non-federal mineral reserves. EIA may, however, exclude federal mineral resources in areas known to be closed to development from the proved and unproven reserves from which they estimate potential production.

Once EnergySub enters a state of disequilibrium, users can initiate the model's equilibration process to simulate how markets may respond to the introduced changes in the U.S. supply of oil, natural gas, and/ or coal. EnergySub's equilibration calculation selects $P_{o,t}$, $P_{g,t}$, $P_{cr,t}$, and $P_{e,t}$, for each period *t* such that the quantity of oil, natural gas, coal (by coal supply region), and electricity supplied equals the quantity demanded in each period *t*. For coal, the national market not only needs to be in equilibrium but the quantity of coal supplied by each coal supply region *r* at period *t* must equal the quantity of coal demanded from coal supply region *r* at each period *t*. The model specifies these equilibrium conditions as follows:

World Oil Market

$$Q_{Doe,t} + Q_{Dox,t} + \sum_i Q_{Doi,t} = Q_{Soy,t} + \sum_u Q_{Sou,t}$$

where:

$Q_{Doe,t}$ is the U.S. demand for oil to produce electricity at time *t*,

$Q_{Dox,t}$ is foreign demand for oil at time *t*,

$\sum_i Q_{Doi,t}$ is the U.S. demand for oil across all other end use sectors *i* at time *t*,

$Q_{Soy,t}$ is the oil supply from foreign sources at time *t*, and

$\sum_u Q_{Sou,t}$ is the domestic oil supply from all domestic sources at time *t*.

U.S. Natural Gas Market (with exports and imports)

$$Q_{Dge,t} + \sum_i Q_{Dgi,t} + Q_{Dgx,t} = \sum_u Q_{Sgu,t}$$

where:

$Q_{Dge,t}$ is the U.S. demand for natural gas to produce electricity at time *t*,

$\sum_i Q_{Dgi,t}$ is U.S. demand for natural gas across all end use sectors *i* at time *t*,

$Q_{Dgx,t}$ is the demand for U.S. natural gas exports at time *t*, and

$\sum_u Q_{Sgu,t}$ is the supply of natural gas from all *u* domestic sources at time *t*.

U.S. Coal Markets, by Supply Region

$$\sum_{z} Q_{Dcerz,t} + \sum_{i} Q_{Dcir,t} + Q_{Dcxr,t} = Q_{Scr,t}$$

where:

$\sum_z Q_{Dcerz,t}$ is the quantity of coal demanded from coal supply region *r* across all electricity production regions *z* at time *t*,

$\sum_i Q_{Dcir,t}$ is the quantity of coal demanded from each coal supply region *r* across all end-use sectors *i* at time *t*,

$Q_{Dcxr,t}$ is the quantity of coal demanded for exports from each coal supply region *r* at time *t*, and

$Q_{Scr,t}$ is the quantity of coal supplied by each coal supply region *r* at time *t*.

U.S. Electricity Market (with net imports)

$$\sum_{i} Q_{Dei,t} = \sum_{j} Q_{Sej,t} + \sum_{z} \sum_{r} Q_{Secrz,t} + \sum_{l} Q_{Sel,t}$$

where:

$\sum_i Q_{Dei,t}$ is the demand for electricity across all end-use sectors *i* at time *t*,

$\sum_j Q_{Sej,t}$ is the supply of fossil fuel electricity (excluding coal), for all other *j* fossil fuel sources at time *t*,

$\sum_r \sum_z Q_{Secrz,t}$ is the supply of coal-fired electricity across all $r \times z$ electricity production regions at time *t*, and

$\sum_l Q_{Sel,t}$ is the supply of renewable electricity across all *l* renewable sources at time *t*.

The equilibration process is initiated once the RFD Scenarios for onshore federal oil, natural gas, and coal is introduced into the model. The RFD serves as a supply shock, moving the system of equations into a state of disequilibrium. These supply shocks can reflect an increase or decrease in the future supply of the corresponding energy source depending on whether production under the RFD is incremental to or a component of projected baseline supply. Once EnergySub's system of equations is moved out of equilibrium, the model uses reduced gradient methods to solve its system of equation for new equilibrating prices for electricity and energy fuel sources. Solving for these new prices yields equilibrium supply and demand quantities, accounting for substitution between energy fuel sources. When zero disparity between supply and demand across all 17 fuel markets is achieved, EnergySub saves the market-clearing prices and proceeds to the next year in the production scenario to perform the same equilibration.

10. Adjustment Rates and Elasticities

All elasticities and adjustment rates in EnergySub have default values that were obtained from the literature, derived from NEMS supply curves, inferred from NEMS output, or obtained from BOEM's

MarketSim Model.[10] The sections below document the default adjustment rates and elasticities used in EnergySub when modeling alternative production scenarios in support of the CPSEIS.

To the extent possible, EnergySub relies upon values from peer-reviewed studies in the empirical economics literature. Reliance on peer-reviewed data is central to ensuring that EnergySub's simulated market responses reflect the best information available. In the few cases where peer-reviewed values are not available, elasticity estimates were derived from NEMS outputs or from expert input.

10.1 Adjustment Rates

EnergySub includes a series of adjustment rates in the supply and demand equations to capture the transition from short-run to long-run market effects. These adjustment rates account for the portion of demand or supply that is allowed to change from one year to the next. No data on the adjustment rates for specific energy sources are readily available. In the absence of such data, EnergySub assumes that adjustment rates are related to the retirement of energy producing and consuming capital (i.e., equipment that produces energy or consumes energy), as indicated by their average lifespan. Adjustment rates can also be set to 1 by users and allowed to drop out of the supply and demand equations. This may be required when there are very large year over changes in the supply of energy fuel sources which outpace the retirement of existing capital.

10.2 Demand Elasticities

EnergySub's demand elasticities measure changes in the consumption of energy and energy sources relative to a percent change in price. EnergySub utilizes own-price and cross-price demand elasticities for each energy source included in the model to capture the complex interactions between different segments of U.S. energy markets. For each major energy consuming sector (e.g., the residential sector), BLM prioritized using own-price and cross-price demand elasticities from the same empirical study to ensure that each sector's simulated responses were based on price sensitivities derived using the same methods, assumptions, and data. The selection of demand elasticities also considered the quality of the estimates produced by each study. BLM's assessment of quality for individual elasticity estimates considered, among other factors, (1) whether they are statistically significant, (2) methods by which they were derived, and (3) the richness of the data supporting each estimate (e.g., whether they are based on a multi-year panel or reflect energy market data for a single year).

Based on these criteria, EnergySub relies heavily on own-price and cross-price demand elasticities from Serletis *et al.* (2010) for the residential and commercial sectors and Jones (2014) for the industrial sector. Serletis *et al.* (2010) investigate inter-fuel substitution possibilities for energy demand across four fuels (i.e., oil, gas, electricity, and coal) using EIA data for the 1960–2007 period. Based on these data, Serletis *et al.* estimated own-price and cross-price elasticities for the commercial, residential, and industrial sectors, using a flexible translog functional form. Across most sectors, Serletis *et al*. produced statistically significant elasticity values of the expected sign.

Jones (2014) focuses on inter-fuel substitution in the industrial sector, using EIA data for the 1960–2011 period for the same fuels included in Serletis *et al.* (2010) plus biomass. Jones specifies a dynamic linear logit model to estimate own-price and cross-price elasticities, and within this framework, estimates both short-run and long-run elasticities. In addition, to assess the role of biomass in industrial sector inter-fuel

[10] Many of the elasticities used from the BOEM MarketSim model were provided by energy economist Dr. Stephen Brown (2011) of the University of Nevada, Las Vegas (UNLV). See Industrial Economics, Inc. (2017).

substitution, Jones develops two sets of models, one including the four energy sources traditionally included in industrial sector energy models (i.e., natural gas, oil, coal, and electricity) and another that includes these energy sources plus biomass. Jones finds that the addition of biomass reduces both the own-price and cross-price elasticities of demand for the four traditionally modeled fuels. The effect is most significant for those values associated with electricity. In both models, the four traditional energy sources are found to be substitutes with each other with the exception of electricity and oil; the cross-price elasticities for these energy sources are not statistically significant.

Table 1 presents the default own-price and cross-price demand elasticities used in EnergySub for the residential, commercial, industrial, and transport sectors. The table also shows the default elasticity values for miscellaneous demand sectors included in EnergySub (e.g., natural gas demand in U.S. export markets). As indicated in the table, EnergySub uses results from Serletis *et al*. (2010) as defaults for the commercial and residential sectors, except for the elasticity of demand for natural gas with respect to the price of oil and the elasticity of demand for oil with respect to the price of natural gas. The estimates for these cross-price elasticities in Serletis *et al.* were of the unexpected sign (negative) and were not statistically significant. Therefore, in lieu of Serletis *et al.*, EnergySub uses results from Newell and Pizer (2008) for these values, for both the commercial and residential sectors. Newell and Pizer (2008) estimate these cross-price relationships for the commercial sector only. While EnergySub would ideally use default values specific to the residential sector, alternative values for these cross-price elasticities were not readily available for the residential sector. Given the similarities between the commercial and residential sectors, EnergySub uses these two cross-price demand elasticities from Newell and Pizer (2008) as a reasonable approximation of the corresponding residential sector values.

For the industrial sector, EnergySub relies almost exclusively on demand elasticities from Jones (2014) as defaults. Although Serletis *et al.* (2010) estimate elasticity values for the industrial sector, the values in Jones (2014) are based on fuel consumption data that exclude fuel use for purposes other than energy (e.g., petroleum products used as lubricants). As described above, Jones (2014) estimates long-run demand elasticities with two specifications, one including biomass as a substitute and another excluding biomass. Based on the statistical significance of the elasticities with biomass included, EnergySub uses the elasticities from the specification that includes biomass. The two exceptions to this are the cross-price elasticity of demand for oil with respect to the price of electricity and the cross-price elasticity of electricity in response to oil prices, as Jones' estimates for these values are not statistically significant. For these values, EnergySub uses estimates from Serletis *et al.* (2010).

Table 3 also shows EnergySub's default own-price demand elasticities for the transport sector and various miscellaneous demand categories. For these categories, EnergySub relies upon elasticity values from multiple sources. For oil demand in the transportation sector, EnergySub uses a U.S.-specific elasticity value obtained from Dahl's (2012) review of price elasticities estimated for more than 100 countries. This value represents the average of the elasticity values identified in the empirical literature. For non-U.S. oil demand, EnergySub applies the value reported in a Huntington *et al.* (2019) review of crude oil demand elasticities in major industrializing economies. For U.S. natural gas exports, EnergySub uses estimates from Dahl's prior (2010) review of the elasticity literature as defaults.

Two categories for which appropriate demand elasticity values were not identified in the literature are miscellaneous coal demand and demand for U.S. coal exports. EnergySub uses the same industrial sector value obtained from Jones (2014) for the former and assumes a value of -1.00 for the latter.

Table 1. EnergySub Default Demand Elasticities

	ELASTICITY WITH RESPECT TO CHANGE IN OIL PRICE	ELASTICITY WITH RESPECT TO CHANGE IN GAS PRICE	ELASTICITY WITH RESPECT TO CHANGE IN ELECTRICITY PRICE	ELASTICITY WITH RESEPCT TO CHANGE IN COAL PRICE
Commercial Sector[1]				
Oil	-0.939	0.2	1.08	-
Natural Gas	0.07	-0.296	0.419	-
Electric	0.092	0.041	-0.134	-
Coal	-	-	-	-
Residential Sector[1]				
Oil	-1.002	0.2	1.151	-
Natural Gas	0.07	-0.313	0.507	-
Electric	0.214	0.072	-0.287	-
Coal	-	-	-	-
Industrial Sector[2]				
Oil	-0.264	0.249	0.01	0.090
Natural Gas	0.172	-0.468	0.178	0.050
Electric	0.009	0.118	-0.125	0.061
Coal	0.440	0.351	0.652	-1.468
Miscellaneous Demand Categories				
Oil – Transport Sector[3]	-0.300	-	-	-
Oil – Rest of World Demand for US Crude[4]	-0.15	-	-	-
Oil – Rest of World Demand for US Refined Products[4]	-0.15			
Oil – Rest of World Demand for non-US oil[4]	-0.15			
Natural Gas – Transport[5]	-	-1.00	-	-
Natural Gas – US Export Markets[6]	-	-0.89	-	-
Electricity – Transport[5]	-	-	-1.00	-
Electricity – "Other"[7]	-	-	-0.18	-
Coal – Other[8]	-	-	-	-1.468
Coal – US Export Markets[5]	-	-	-	-1.00

Notes:

1. Commercial and residential sector values are from Serletis *et al.* (2010), except for the cross-price elasticity for gas in response to oil prices and the cross-price elasticity of oil in response to gas prices. For these latter two values, EnergySub uses demand elasticities from Newell and Pizer (2008). Also, Deryugina et al. (2020) estimate a range of residential elasticity values for electricity consistent with the value in Serletis et al. (2010).
2. For the industrial sector, EnergySub uses demand elasticities from Jones (2014), except for the cross-price elasticity of electricity in response to oil prices and the cross-price elasticity of oil in response to electricity prices. For these values, EnergySub uses demand elasticities from Serletis *et al*. (2010).
3. Dahl (2012)
4. Huntington *et al.* (2019)
5. Assumed to be -1.00.
6. Dahl (2010)
7. Assumed to be average of own-price elasticity values for industrial, commercial, and residential sectors.
8. Industrial sector value from Jones (2014).

10.3 Supply Elasticities

EnergySub includes default supply elasticities, summarized in Table 2, for every production category modeled for a given fuel (e.g., onshore tight oil production in the lower 48 states). These supply elasticities measure how responsive energy producers are to changes in market prices. Consistent with the demand elasticities summarized above, several of EnergySub's supply elasticities were obtained from the economic literature, with data sources varying by fuel type.

For tight oil and other lower 48 onshore oil, EnergySub uses elasticities from a recent study by Newell and Prest (2019). The paper specifically compares the price responses of conventional and unconventional (tight) oil drilling and production. Using micro-data for more than 150,000 oil wells in Texas, North Dakota, California, Oklahoma, and Colorado, Newell and Prest (2019) estimate the elasticity of well drilling and the elasticity of oil production, separately for conventional and unconventional wells. To estimate drilling elasticities, they use multiple model specifications, estimating changes in drilling activity as a function of price in some cases and as a function of revenue in other cases. The production elasticities estimated by Newell and Prest (2019), however, all represent the change in production as a function of the change in revenue, rather than price. To align the supply elasticities in EnergySub with the specification of supply, EnergySub uses the elasticity of well drilling with respect to the oil price from Newell and Prest (2019), which they estimate separately for both conventional and unconventional wells.

Luchansky and Monks (2009) serves as the source for EnergySub's default supply elasticity for domestic biodiesel. This paper uses monthly data for 1997 through 2006 to estimate the market supply and demand for ethanol at the national level. Applying these data to four specifications of supply, Luchansky and Monks (2009) estimated supply elasticities ranging from 0.224 to 0.258. EnergySub uses the midpoint of this range (0.24) as the default supply elasticity for biodiesel.

For a number of oil supply elasticities, EnergySub relies on values included in BOEM's MarketSim model based on expert input provided to BOEM by three energy economists: Dr. Charles Mason of the University of Wyoming, Dr. Seth Blumsack of Penn State University, and Dr. Gavin Roberts of Weber State University. EnergySub relies on input provided to BOEM by these experts for the oil supply elasticities related to lower 48 offshore, rest-of-world oil production, Canadian pipeline imports, natural gas plant liquids, and other oil production. For oil production in Alaska, EnergySub uses supply elasticities derived from specialized simulations of NEMS, as described in detail below.

For gas production, EnergySub draws on a variety of sources for elasticities, depending on the production source. For domestic onshore conventional and unconventional shale gas production in the lower 48, EnergySub uses values from Newell, Prest & Vissing (2019), who use data from approximately 62,000 gas wells drilled in Texas between 2000-2015 to determine price-responsiveness across the supply process. The study assesses the decision to drill the well, well completion, and produce gas over time and, of these, finds drilling activity to be the most responsive to changes in price. EnergySub makes use of the gas price response values broken out for conventional and unconventional wells, though the study notes that these values may not differ significantly from each other statistically. For offshore production in the lower 48, EnergySub uses the same 0.19 elasticity as for offshore oil production in the lower 48, obtained through the expert input process described above. For onshore and offshore production in Alaska, EnergySub uses elasticity values derived from specialized simulations of NEMS, as detailed below. For other gas production, EnergySub applies the supply elasticity reported in Brown (1998).

Table 2. EnergySub Default Supply Elasticities

FUEL	SOURCE/ SUPPLY ELASTICITY			
Oil	Lower 48 Onshore Non-Tight[1]	0.93	Other[2]	0.67
	Lower 48 Onshore Tight[1]	0.73	Biodiesel[4]	0.24
	Lower 48 Offshore[2]	0.19	Rest of World[2]	0.28
	Alaska Onshore[3]	0.42	Natural Gas Plant Liquids[2]	0.67
	Alaska Offshore[3]	0.58	Canadian Pipeline Imports[2]	0.38
Natural Gas	Lower 48 Conventional[5]	0.75	Alaska Offshore[3]	1.29
	Lower 48 Unconventional[5]	0.68	Other[7]	0.51
	Lower 48 Offshore[6]	0.19	Pipeline Imports[8]	0.52
	Alaska Onshore[3]	1.29	LNG Tanker Imports[9]	1.00
Electricity	Oil[10]	0.22	Hydro[3]	0.05
	Natural Gas[3]	1.50	Wind Onshore[3]	0.65
	Coal[10]	0.27	Wind Offshore[3]	0.01
	Nuclear[3]	0.53	Solar[3]	2.03
	Other Electric[3]	0.68	Imports[3]	0.36
Coal	Northern Appalachia[11]	2.66	WY PRB – North[10]	5.50
	Central Appalachia[11]	4.62	WY PRB – South[11]	3.15
	Southern Appalachia[11]	1.50	Western Wyoming[11]	0.73
	East Interior[11]	7.40	Rocky Mountain[11]	2.43
	West Interior[11]	0.47	Arizona/New Mexico[11]	3.78
	Gulf Lignite[11]	1.72	Alaska/Washington[11]	0.60
	Dakota Lignite[11]	4.46	Imports[3]	1.00
	Western Montana[11]	5.46		

Notes:
1. Newell and Prest (2019).
2. Expert input from C. Mason, G. Roberts, & S. Blumsack, as cited in Industrial Economics Inc. (2021).
3. Derived from AEO (2020).
4. Luchansky and Monks (2009).
5. Newell, Prest & Vissing (2019)
6. Assumed to be the same as Oil, Lower 48 Offshore
7. Brown (1998).
8. Derived from specialized NEMS run of the AEO 2015 provided to DOI by EIA.
9. Assumed value.
10. Derived from AEO 2018, as provided by BOEM (2018).
11. Derived from NEMS 2019 Reference Case supplemental data provided to BLM by EIA.

For coal supply, EnergySub uses supply elasticities unique to each of the 14 coal supply regions, as derived from annual supply curve data generated by NEMS' Coal Market Module (CMM).[11] The annual supply curve data provided by EIA represent 41 distinct coals for a given year for combinations of coal supply region, sulfur content, mining method, and rank. For example, the Central Appalachia coal supply region has five different supply curves for a given year, representing a mix of low- and medium-sulfur coal, underground and surface mines, and premium and bituminous coals. In addition, the annual supply curve for each of the 41 coals is represented as 11 data points, with each data point representing production at a given price point.

Using the EIA data, we estimated supply elasticities for each of the 41 coal types, for every year between 2019 and 2040. To generate elasticity values, we applied the standard econometric method of regressing the log-transformed price on the log-transformed quantity, which yielded the elasticity of supply as the

[11] While not publicly available, EIA provided these supply curve data for the purposes of this project and provides them to other modelers on a regular basis.

coefficient. Each regression was performed over the three central points of the appropriate supply curve. The following equation displays this regression:

$$\ln(Q_{s,t}) = \beta_{s,t}\ln(P_{s,t}) + \beta_0$$

Where:

$Q_{s,t}$ represents the quantity supplied on supply curve *s* in year *t,*

$\beta_{s,t}$ represents the elasticity of supply for supply curve *s* in year *t*[12],

$P_{s,t}$ represents the price of coal on supply curve *s* in year *t*, and

β_0 represents the regression constant.

Running the above regression for each of the 41 supply curves for every year between 2019 and 2040 yields an initial set of elasticities. To convert the year-specific and supply curve-specific results to regional supply elasticities, we developed a weighted average coal supply elasticity for each of the 14 coal supply regions across all years, using the quantity associated with the coals produced by each coal supply region as weights. Table 4 above displays the results of the supply elasticity calculation for each coal supply region.

Where appropriate economic research does not exist or could not be obtained for a specific supply elasticity value, projections from the *AEO* were used to infer these values.[13] Elasticity estimates may be inferred from the *AEO* projection for a given year by comparing the differences in energy prices between two scenarios with the differences in energy quantities. For a given energy source and fuel, an annual inferred elasticity value was calculated three times: (1) based on the low oil price case vs. the high oil price case, (2) the low price case vs. the reference case, and (3) the reference case vs. the high price case, for all *AEO* projection years from 2017 through 2040. The formula for this annual inferred elasticity is as follows.

$$\eta_t = \frac{\ln\left(\frac{Q_{A,t}}{Q_{B,t}}\right)}{\ln\left(\frac{P_{A,t}}{P_{B,t}}\right)}$$

Where η_t is the inferred elasticity in year *t*, $Q_{A,t}$ and $Q_{B,t}$ represent the quantities supplied in year *t* for cases *A* and *B* respectively (each case is compared with both of the other cases), and $P_{A,t}$ and $P_{B,t}$ are the prices at time *t* for cases *A* and *B*. The resulting series of inferred elasticities are averaged, excluding extreme outlier results derived from the *AEO* data.[14]

For a limited number of producing sectors, elasticity values were unavailable from the literature and the data generated by the constrained NEMS run or recent editions of the AEO yielded elasticity values that

[12] Coal supply elasticities are also represented as η_{cr} in Equation 1.

[13] In some cases, the supply elasticities were derived from prior releases of the AEO rather than AEO 2020 when results from the 2020 data resulted in unrealistic elasticity values.

[14] More specifically, elasticities were estimated based on differentials between the low-price case and reference case, the reference case and the high-price case, and the low-price case and the high-price case. They then were averaged across these three variants and across years.

appeared unrealistically high or were insufficient to support estimation of a supply elasticity. In such cases, EnergySub uses a default supply elasticity of 1.0.

11. Limitations

As described above, EnergySub uses a system of equations to create a mathematical representation of complex energy markets which enables analysts to gain insights into the potential market impacts associated with BLM management decisions. While the methods applied in EnergySub are transparent and well documented, EnergySub is subject to limitations like any other model that tries to simplify real world phenomenon.

EnergySub is not a national forecasting model or a replacement for EIA's NEMS model or the energy projections they develop with it. As designed, EnegySub assesses energy market impacts associated with a specific production scenario at a relatively high level and lacks much of the detail that enables NEMS to disaggregate energy supply and demand to a fine degree (e.g., for individual residential uses of natural gas, such as home heating and cooking). EnergySub includes a simpler representation of supply and demand decisions than NEMS, with supply and demand responses for a given energy source estimated based on its price and the price of substitutes. In contrast, NEMS simulates energy supply and demand decisions based on a number of factors not explicitly represented in EnergySub. On the demand side, such factors may include projected changes in building shell characteristics over time and demand for the underlying services that energy supports (e.g., transportation services), while on the supply side such factors may include mineral ownership, differences in drilling costs across basins or the physical characteristics of oil in different basins (e.g., API gravity or sulfur content). Although many of these factors are captured implicitly in EnergySub modeling through the model's calibration to the long-run market conditions developed with the more detailed NEMS model, EnergySub is unable to provide insight into effects on narrowly defined segments of foreign or domestic energy submarkets, or how more nuanced aspects of producer or consumer decision-making may affect energy market conditions.

Related to the level of detail in which EnergySub represents individual energy markets, its electricity market represents the supply and demand for power at a high level, both temporally and across different sources of energy. While EnergySub assesses all energy markets—including electricity—on an annual basis, more detailed models of electricity markets capture variation in demand and the composition of electricity supply between peak, off-peak, and shoulder periods during the year. More detailed models, like NEMS, also capture temporal variations in the availability of renewable electricity resources, and the extent to which generation from these resources coincides with peak electricity demand. Because different electricity production technologies may be on margin at different times of the day, the representation of timing of renewable energy availability can be an important factor in modeling substitution between renewables and non-renewable fuel source. EnergySub's representation of the electricity sector also does not explicitly include transmission constraints, reliability requirements, or emissions limits (e.g., the regional cap on power sector CO2 emissions for states participating in the Regional Greenhouse Gas Initiative), all of which affect the degree to which fuel switching can occur within electricity supply regions.

Another nuance not captured in EnergySub is imperfect competition. EnergySub uses a simplifying assumption that all energy markets are perfectly competitive, though there are a number of clear departures from perfect competition in the U.S. and across the globe. For example, OPEC engages in non-competitive behavior in world oil markets that affect oil production and the price of oil (and therefore its substitutes). Imperfect competition can also be observed in the U.S. market for electricity, where a

number of domestic policies mandate that a certain portion of the electricity consumed in some jurisdictions be produced from renewable sources. Because EnergySub does not capture these and other elements of imperfect competition, it provides a parsimonious representation of potential market responses which may lead to the overestimation or underestimation of some market metrics.

EnergySub relies on elasticity parameters from empirical literature, across all sectors of the energy market, to model how supply and demand may change in response to changes in prices. Estimates from empirical literature reflect historical relationships between energy prices and the behavioral responses of energy producers and consumers. As energy markets continue to evolve in the future, elasticity parameters reflecting historical behavioral responses may become less representation of future production and consumption responses. For example, as electric heat pumps become more efficient for building heating, the residential and commercial elasticity of demand for electricity (and the cross-price elasticity relationship between natural gas and electricity in these sectors) may change over time. In the transportation sector, cross-price elasticity values for oil and electricity are likely to become increasingly important as electric vehicles becomes a more viable option for many U.S. vehicle owners. Although real-world energy consumption patterns and market responses may change over the long run, elasticities within EnergySub are held constant because simulations for long-run production scenarios cannot be broken into shorter segments with model specifications adjusted manually between different segments of time. Changes in behavior responses of energy producers and consumers over time are, however, implicit in the supply, demand, and price projects from NEMs which EnergySub calibrates to.

BLM acknowledges there are limitations to EnergySub and that some potential market responses may have been over or underestimated. Nevertheless, results from EnergySub modeling still provide valuable insights into how BLM management decisions may affect future energy market conditions.

12. Application of EnergySub to the CPSEIS

EnergySub was used as a tool to compare unobservable long-run market conditions with and without potential oil produced from the Coastal Plains region to gain insights to how oil produced from this region may affect future energy prices, production, and consumption. As discussed above, EnergySub relies on long-run energy projections developed by the EIA to establish an initial market equilibrium that simulated market responses could be calibrated to. EnergySub was calibrated to domestic supply, demand, and price projections for electricity and energy fuel sources from the AEO 2023 Reference case, with supplemental information from EIA's June 2023 Short Term Energy Outlook, the International Energy Agency's 2022 World Energy Outlook, and natural gas pipeline imports data derived by Industrial Economics, Inc. in order to model interactions with U.S. and non-U.S. markets in greater detail (EIA 2023a, IEA 2022, EIA 2023d, IEc 2023). These projections reflect leading energy expert's best assessment of how U.S. and foreign energy markets will operate through 2050 based on key assumptions. Although alternative projections exist, EIA describes the Reference case as an experimental control which serves as a baseline from which the impacts of alternative scenarios and assumptions can be compared against (EIA, 2023c). The BLM considered using alternative energy projections developed as AEO side cases but decided to refrain from introducing its own assumptions about long-term market conditions and calibrated the model to supply and demand projections from the Reference case.[15]

AEO projections for domestic oil and gas production are developed within NEM's Oil and Gas Supply Module based on estimates of total technically recoverable resources within the U.S. AEO 2023 supply

[15] When developing annual energy projections, EIA runs side cases to show how NEMS responds to changes in key input variables compared with the modeled results from the Reference case.

projections include production in Alaska between 2023 and 2050 from both existing fields, expansion fields where operators have announced projects, and undiscovered fields that most likely exist based on the region's geology. AEO 2023 also includes assumptions about future production from the Coastal Plains in ANWR (EIA, 2023c). Since AEO projections reflect what market conditions may look like with production from the Coastal Plains, EnergySub was used to simulate market responses to foregoing oil projected under the RFDs for Alternatives B, C, and D in order to create a counterfactual of what energy market conditions may look like in the absence of oil from the Coastal Plains.

Substitution effects estimated by EnergySub include estimates of alternative energy fuel sources likely to be consumed in place of forgone oil production from the Coastal Plains and net changes in the overall demand for electricity and energy fuel sources over the 30-year planning period. Conversely, these energy substitutions can be interpreted as the consumption of alternative energy sources displaced by oil produced from the Coastal Plains. Simulated market responses also yield insights into how future foreign oil consumption (i.e., foreign demand for U.S. and non-U.S. produced oil) may change in response to changes in the supply of U.S. oil. Substitution effects and changes in foreign oil consumption were there used as inputs to calculate potential net changes in emissions.

12.1 Energy Substitution Effects

EnergySub estimates displaced energy substitutes by converting all consumption of energy into barrel of oil equivalents (BOE) to enable the comparison of energy consumption across fuel sources and energy uses. Estimates of electricity and energy fuel sources potentially displaced by oil produced under Alternatives B, C, and D are reported below in Table 3. Over the 30-year planning period, simulated substitution effects were similar across these three action alternatives. Results from modeling revealed that oil produced from the Coastal Plains would primarily displace oil produced from other domestic reserves, including from Alaska offshore minerals and onshore and offshore minerals in the lower-48, or imported from foreign producers. Approximately 18% of oil produced under Alternatives B, C, and D was simulated to displace oil that would have been produced elsewhere domestically, while 64% of oil likely to be produced under these alternatives was simulated to displace oil that would have otherwise been imported via tankers or pipelines.

Crude oil is a global commodity traded in a world market where prices are determined by global supply and demand. Increased U.S. oil production from Alaska's Coastal Plains was simulated to have a marginal effect on global oil prices, even during peak production under the alternatives. Increases in the U.S. oil supply during peak production were simulated to decrease the price of a barrel of oil by 0.33% (~ 35¢) under Alternative B, 0.32% (~ 32¢) under Alternative C, and 0.17% (~ 15¢) under Alternative D. Although these are small decreases in the per barrel price of oil, they are likely to serve as a catalyst for fuel switching, where consumption of oil increases as energy derived from alternative fuel sources becomes less cost competitive with oil.

These simulations revealed that nearly 11% of oil produced over the next 30 years under each of the action alternatives would displace energy that the residential, commercial, transportation, and electricity sectors would have consumed from other renewable and non-renewable fuel sources had this production been foregone. As shown in table 3, approximately 1.9% of this displaced demand for energy from alternative sources stemmed from reduced consumption of energy derived from burning natural gas and coal. The energy equivalency of about 8% of the oil that would be produced under the alternatives was simulated to replace energy that would have come from biofuels and natural gas liquids, while another

0.9% of oil produced from the Coastal Plains over the next 30 years would crowd out electricity that would have been generated from low-carbon sources – including wind, solar, hydro or nuclear power.

In addition to displacing energy from alternative energy sources, oil production in the Coastal Plains was simulated to increase overall U.S. energy demand over the 30-year planning period. While reductions in the consumption of electricity, coal, and natural gas would be the energy equivalency to slightly less than 3% of oil projected to be produced under the action alternatives, nearly 10% of total oil produced under the alternatives would represent new demand for oil that would have been unrealized at higher prices. The net effect of future oil production in the Coastal Plains on overall energy demand over the 30-year planning period would be positive, ranging from 28 MMBOE under Alternative D to 75MMBOE under Alternative B.

Table 3: Displaced Fuels and Changes in Demand

Substitution Effects 2032 - 2053			
	Alt B	Alt C	Alt D
Percent of Oil from Coastal Plains that:			
Displaces Domestic Oil	17.7%	17.8%	17.9%
Displaces Oil Imports	64.4%	64.4%	64.4%
Displaces Natural Gas	1.5%	1.5%	1.5%
Displaces Natural Gas Imports	0.1%	0.1%	0.1%
Displaces Coal	0.3%	0.3%	0.3%
Displaces Biofuels and NGL	8.0%	7.9%	7.8%
Displaces Electricity from non-Fossil Fuel Sources	0.9%	0.9%	0.9%
Changes in Demand *			
Oil	9.7%	9.7%	9.7%
Natural Gas	-1.3%	-1.3%	-1.3%
Coal	-0.2%	-0.2%	-0.2%
Electricity	-1.1%	-1.1%	-1.0%

*Change in demand does not represent displaced consumption of electricity or energy from substitute energy sources.

12.2 Changes in Foreign Oil Consumption

As outlined in Section 4 (Oil Market), EnergySub models a single foreign oil market using a limited number of supply and demand equations. Foreign oil consumption is equal to non-U.S. demand for U.S. crude oil plus non-U.S. demand for U.S. refined products and non-U.S. demand for oil from non-U.S. sources. Changes in foreign oil consumption are strictly a function of global oil prices, where demand for both U.S. and non-U.S. oil increases as global oil prices decrease.

As discussed above, production under the action alternatives would contribute to lower oil prices. Since oil is a global commodity, lower oil prices are beneficial to domestic and foreign consumers and spur additional demand for oil produced from both U.S. and non-U.S. sources. Price effects associated with peak production were simulated to increase total foreign demand by 17.8 million barrels (MMb) under

Alternative B, 16.7 MMb under Alternative C, and 8.5 MMb under Alternative D. Relative to market conditions where oil from the Coastal Plains is foregone, total foreign demand for oil would increase by 244.4 MMb under Alternatives B, 229.6 MMb under Alternative C, and 92.5 MMb under Alternative D over the 30-year planning period. Although some of this demand constitutes new demand for U.S. crude and refined oil products, approximately 88% of this increased foreign demand was simulated to be met with oil produced from non-U.S. reserves. Since modeling impacts to narrowly defined segments of energy submarkets is beyond the modeling capabilities of EnergySub, it is unclear which foreign and domestic submarkets would increase production to meet this additional demand by non-U.S. consumers.

12.3 Uncertainty

The EnergySub results presented above reflect modeled market responses and energy substitutes that may be displaced by oil from the Coastal Plains. These energy substitutes also reflect the energy source most likely to replace foregone oil if production in the Coastal Plains did not occur. They were derived using baseline projections of what energy markets will look like through 2050 based on current policy, elasticities which provide measures for how supply and demand between alternative energy sources may change in response to changes in prices, and production schedules developed with limited information on the amount of recoverable oil reserves that could be economically produced from the Coastal Plains. Results from the modeling are an estimation of what may happen in the future based on key assumptions about market conditions and production under alternative production scenarios.

Energy markets are dynamic and projections about future market conditions are inherently uncertain because many of the events that shape patterns of energy consumption and production cannot be predicted with certainty. The baseline projections used for this modeling reflect EIA's best assessment of how markets will operate through 2050 under a simplifying assumption that current regulations will not change over the long term (EIA 2023).[16] BLM acknowledges that new laws and policies governing energy production, efficiency, and GHG emissions are likely to be enacted, and that these regulations may have significant implications for energy markets and substitutes in the coming decades. EIA will continue to incorporate new legislation and regulations into its modeling as funding and implementing regulations for them are enacted, and BLM will continue to evaluate the suitability of new data for future calibration of EnergySub.

The EnergySub modeling for the CPSEIS does not account for structural changes that would have to occur within energy markets to meet climate commitments and achieve net-zero emission goals. As the U.S. energy transition progresses, energy production and consumption patterns will change. Energy markets may become increasingly electrified through greater deployment of renewable energy sources and greater demand-side electrification, enabling sectors that have historically been heavily reliant on fossil fuels to reduce their demand and consumption of carbon intensive energy sources. Technological innovation will also play a significant role in transforming how energy will be produced and consumed, though its implications for specific fuel sources and uses are not known at this time since many of the technologies have yet to be developed or economically scaled for widespread adoption.

[16] The version of NEMS used by EIA to produce the AEO 2023 included current legislation and environmental regulations for which implementing regulations were available as of the end of November 2022. The potential effects of proposed or hypothetical federal and state legislation, regulations, and standards—or sections of legislation that have been enacted but lacked funds to execute or did not have the required implementing regulations in place as of the end of November 2022—were not reflected in NEMS when the AEO 2023 projections were developed. Additional information on the assumptions underlying the AEO 2023 Reference case are available at www.eia.gov/outlooks/aeo/assumptions/

While the extent and pace of future decarbonization are uncertain, sensitivity analyses conducted by BOEM in support of its 2024-2029 National Outer Continental Shelf Oil and Gas Leasing program provide insights into the potential substitution effects associated with oil from the Coastal Plains in the context of a more decarbonized energy system.[17] In response to public input provided on BOEM's Proposed National OCS Program, the Bureau performed sensitivity tests to determine the impacts of different net-zero scenarios on MarketSim's results and the corresponding implications for net GHG impacts. These net zero sensitivity analyses examine changes in results using (1) alternative net zero elasticity values only; (2) alternative net zero baseline supply and demand projections by energy source, with no change in elasticity values; and (3) alternative elasticity values combined with alternative net zero baseline supply and demand projections. The elasticity adjustments were adapted from comments and suggestions provided to BOEM by the New York University School of Law's Institute for Policy Integrity. The alternative baseline data were based on different decarbonization scenarios specified by Princeton University's Net-Zero America Project. The results of BOEM's sensitivity analyses showed that simulated substitution effects were more pronounced when MarketSim used a net-zero baseline and elasticities and suggested that the net GHG emissions impact of the 2024-2029 National OCS Program would be much higher under the net zero assumptions applied in the sensitivity analyses. Due to the structural similarities between MarketSim and EnergySub, these findings suggest that oil from the Coastal Plains could displace a greater amount of energy from alternative sources and induce additional energy in the context of an energy system that is more decarbonized than what is reflected in EnergySub's current elasticity values and baseline projections.

The degree to which energy substitutes may change due to a more decarbonized future depends on the degree of future decarbonization. The U.S. will face a number of challenges in reaching net-zero targets by 2050 and reaching these targets will require a substantial year-over-year increase in renewable energy generation capacity, a substantial decrease or wholesale elimination of fossil fuels use or 100% carbon capture for fossil projects, and the widespread adoption of clean energy technologies such as electric vehicles, energy storage, solar, and wind turbines. Each of these would require significant investment by both the public and private sectors. In addition, according to certain estimates, transmission capacity would need to double in the next 15 years and then double again in the following 15.[18] Based on projections developed by NREL, de-carbonizing the power grid by 2035 could cost between $330 billion and $740 billion in additional power system costs.[19] There are also industrial sectors that are difficult to electrify and de-carbonize and remain major carbon emitters. These include heavy industry sectors such as steel and cement manufacturing, which rely heavily on coal, and heavy transportation sectors such as aviation, maritime shipping, and trucking, which largely rely on various refined petroleum products (i.e., jet fuel, marine fuel, and diesel, respectively).[20] Because of these and other challenges associated with

[17] Bureau of Ocean Energy Management. 2023. Economic Analysis Methodology for the 2024-2029 National Outer Continental Shelf Oil and Gas Leasing Proposed Final Program. BOEM 2023-059. Available online at https://www.boem.gov/2024-2029-Economic-Analysis-Methodology.
[18] Hitchens, K. (2022, September 6, 2023). "Transmission will Play Key Role in Our Net Zero Future." from https://www.pcienergysolutions.com/2022/10/19/transmission-will-play-key-role-in-our-net-zero-future/.
[19] NREL (2022). "Exploring the Big Challenge Ahead: Insights on the Path to a Net-Zero Power Sector by 2035." Retrieved September 19, 2023, from https://www.nrel.gov/news/ program/2022/exploring-the-big-challenge-ahead-insights-on-the-path-to-a-net-zero-power-sector-by-2035.html.
[20] Gross, S. (2020). "The Challenge of Decarbonizing Heavy Transport." from https://www.brookings.edu/articles/the-challenge-of-decarbonizing-heavy-transport/.
Gross, S. (2021, August 31, 2023). "The Challenge of Decarbonizing Heavy Industry." from https://www.brookings.edu/articles/the-challenge-of-decarbonizing-heavy-industry/.

achieving net-zero by 2050, the degree to which BLM may be underestimating the substitution effects associated with future development in the Coastal Plains is uncertain.

Even in a low carbon future, fossil fuels are likely to continue to play a role in the U.S.'s energy portfolio. Four of the five decarbonization pathways specified by the Net-Zero America Project forecast that oil and gas consumption would continue beyond 2050, and that carbon capture and sequestration technology would play an important role in offsetting emissions. Under its fifth scenario, oil and gas are phased out by 2050, but oil continues to account for more than 20% of the energy fuel mix until the late 2030's (Larson et al. 2020). Researchers and industry experts are continuing to explore potential pathways for decarbonization and the role of fossil fuels and other energy sources in a low carbon economy is still uncertain. Because the mix of energy sources and level of conservation associated with the energy transition are both uncertain, the ways in which the transition will affect demand for fossil fuels and alternative energy sources is also uncertain.

BLM acknowledges that energy substitutes for oil produced from the Coastal Plains may look significantly different in a low carbon future, and that modeling substitution effects using data that depicts current energy markets and historical market responses produces results that may overestimate some energy market metrics and underestimate others. As the energy transition progresses over the 30-year planning period, substitution between other sources of oil supply (including other domestic production in the Lower 48 and foreign imports) and oil from the Coastal Plains may diminish. However, the timing and degree to which domestic energy markets may become less reliant on these alternative sources of oil is highly uncertain. BLM will continue to evaluate and update its methods for estimating energy substitutes as new energy statistics and information become available.

Krishnan, M., et al. (2022). "Sectors are Unevenly Exposed in the Net-Zero Transition." from https://www.brookings.edu/articles/the-challenge-of-decarbonizing-heavy-transport/.

References

Bureau of Ocean Energy Management. 2018. Supply elasticities derived from *Annual Energy Outlook 2018*, provided to Industrial Economics on July 31 via email transmittal.

Brown SPA. 1998. Global warming policy: some economic implications. Federal Reserve Bank of Dallas Economic Review. Fourth Quarter 1998.

Dahl CA. 2010. Review and critique of elasticities used in the world energy projections plus model. US Department of Energy, Energy Information Administration. Office of Integrated Forecasting and Analysis.

Dahl CA. 2012. Measuring global gasoline and diesel price and income elasticities. Energy Policy. 41: 2–13.

Deryugina, T., MacKay, A., & Reif, J. 2020. The long-run elasticity of electricity demand: Evidence from municipal electric aggregation. *American Economic Journal: Applied Economics*, 12(1):86-114.

[EIA] Energy Information Administration. 2015. Annual energy outlook 2015.

EIA. 2018. Annual energy outlook 2018.

EIA. 2019. Annual Energy Outlook 2019.

EIA. 2020. Annual Energy Outlook 2020.

EIA. 2021. Annual Energy Outlook 2021.

EIA. 2022. Annual Energy Outlook 2022. https://www.eia.gov/outlooks/aeo/narrative/introduction/sub-topic-02.php

EIA. 2022b. Annual Energy Outlook 2022.

EIA. 2023a. Annual Energy Outlook 2023: Data. https://www.eia.gov/outlooks/aeo/tables_ref.php

EIA. 2023b. Assumptions to the Annual Energy Outlook 2023: Oil and Gas Supply Module. www.eia.gov/outlooks/aeo/assumptions/pdf/OGSM_Assumptions.pdf

EIA. 2023c. Annual Energy Outlook 2023: Narrative. https://www.eia.gov/outlooks/aeo/narrative/index.php

EIA. 2023d. Short-term Energy Outlook. Table 3a. International Petroleum and Other Liquids Production, Consumption, and Inventories. Released June 2023. https://www.eia.gov/outlooks/steo/data/browser/#/?v=6

Huntington, H. G., Barrios, J. J., & Arora, V. 2019. Review of key international demand elasticities for major industrializing economies. *Energy Policy*, 133, 110878.

IEA. 2022. World Energy Outlook 2022, World Oil Supply https://www.iea.org/data-and-statistics/data-product/world-energy-outlook-2022-free-dataset

Industrial Economics, Inc. 2021. Consumer surplus and energy substitutes for OCS oil and gas production: the 2021 revised Market Simulation Model (MarketSim). US Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2021-072.

Jones CT. 2014. The role of biomass in US industrial interfuel substitution. Energy Policy. 69:122-126.

Larson E., C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, EJ Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. https://netzeroamerica.princeton.edu/img/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf

Luchansky MS, Monks J. 2009. Supply and demand elasticities in the US ethanol fuel market. Energy Economics. 31(3):403-410.

Newell RG, Pizer WA. 2008. Carbon mitigation costs for the commercial building sector: Discrete–continuous choice analysis of multifuel energy demand. Resource and Energy Economics. 30(4):527-539.

Newell, R.G. and Prest, B.C., 2019. The unconventional oil supply boom: Aggregate price response from microdata. *The Energy Journal*, 40(3).

Newell, R. G., Prest, B.C., & Vissing, A. B. (2019) "Trophy Hunting versus Manufacturing Energy: The Price Responsiveness of Shale Gas." *Journal of the Association of Environmental and Resource Economists*. *6*(2).

Personal communication with Stephen P. A. Brown, University of Nevada at Las Vegas, July 2011.

Serletis A, Timilsina GR, Vasetsky O. 2010. Interfuel substitution in the United States. Energy Economics. 32(3):737-745.

Appendix T

Analysis of Incomplete and Unavailable Information

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Appendix T. Analysis of Incomplete and Unavailable Information

T.1 BACKGROUND

In accordance with CEQ NEPA regulation 40 CFR 1502.21, this appendix catalogues incomplete and unavailable information identified by the joint lead agencies and in public comments submitted on the Draft Leasing SEIS. Each item of incomplete or unavailable information was reviewed to ensure consistency with 40 CFR 1502.21:

40 CFR 1502.21 Incomplete or unavailable information.

(a) 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.

(b) If the incomplete but available 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 unreasonable, the agency shall include the information in the environmental impact statement.

(c) If the information relevant to reasonably foreseeable significant adverse impacts cannot be obtained because the overall costs of obtaining it are unreasonable 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 that 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.

(d) For the purposes of this section, "reasonably foreseeable" includes impacts that 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.

T.2 METHODOLOGY

Information or recommended studies were considered relevant if they could be connected to reasonably foreseeable significant adverse impacts described in the Leasing SEIS. All relevant information 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 was evaluated to determine whether the cost of obtaining the information would be unreasonable or whether the means of obtaining the information are not known.

T.3 ANALYSIS

Common themes emerged during analysis regarding commenter's recommended information and studies:

- **The availability of sufficient information to support sound scientific judgments and reasoned managerial decisions.** 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 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 is selected, significant adverse effects on air quality will likely be avoided.
- **The understanding that certain items of unavailable 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, geophysical and drilling exploration, development and production, and reclamation. It is inherent in the programmatic level of an oil and gas program evaluation that information such as the specific locations or times of exploration or development activities are unknown. Instead, the BLM would thoroughly analyze exploration and development plans when a project proponent submits a project-specific proposal for future on-the-ground activity. 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.

Agency/Commenter: USFWS

Applicable Resource or Use: Birds

Information/recommended study: Recommendation to utilize shorebird and landbird density estimates from the PRISM database to derive possible bird numbers that could be affected by a hypothetical development on the Arctic Coastal Plain.

Is the Information/Study Relevant to Potentially Significant Effects? Yes

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? No

If NO, explain: Permission is required to access the PRISM database for shorebird and landbird data and use is restricted and has not been previously authorized. The Leasing SEIS uses the best available information and data regarding shorebird and landbird density estimates. PRISM data would not contribute additional information or substantially change the analysis, and therefore, the recommended information was is not essential to making a reasoned decision among alternatives.

Agency/Commenter: Government of Yukon

Applicable Resource or Use: Porcupine Caribou Herd (PCH)

Information/Study: During the 2019 EIS, *Frequency of Use Mapping and Application to the Selection of Conservation Areas for PCH Frequency* data layers were provided by the Government of Yukon for use in the EIS. This data supported the identification of areas not available for leasing in the SEIS, however, the Government of Canada was considered with how the information was used in the analysis. Specifically, they noted that the use of data layers describing the frequency of use of habitats by the PCH during calving, post-calving and summer (or other seasons) was warranted and useful in describing critical habitats used by the herd, but there were flaws in the application. Canada noted that the SEIS should be updated to include data from 2016 to present, although they did not think the data would result in significant changes to the periods used within the SEIS.

Is the Information/Study Relevant to Potentially Significant Effects? Yes

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? No

If NO, explain: Updated data was not received from Canada and therefore, could not be incorporated into the SEIS. The 40 percent threshold was used in developing the alternatives for the Final EIS as well as carried over in developing some of the alternatives in the SEIS. The different action alternatives allow different levels of development in areas with different thresholds of annual calving and can be compared based on these differences. As noted above, the inclusion of more recent information is unlikely to significantly change the periods of use and is not essential for making a decision between alternatives.

Agency/Commenter: Sierra Club

Applicable Resource or Use: Polar Bears

Information/Study: The SEIS fails to utilize readily available scientific information that would provide an assessment of the scale of the impacts on polar bears from the program's emissions. Available scientific information is sufficient to quantify the area of Arctic sea ice loss associated with an additional increment of emissions. Moreover, available scientific information is sufficient to quantify the incremental impact of the Program's emissions on cub recruitment for the polar bear subpopulations most imperiled by climate change, including the Southern Beaufort Sea population. BLM should be assessing these incremental impacts not in a vacuum, but rather in the context of whether any substantial increment of additive emissions can be squared with ensuring the recovery of the species, and with the duties imposed under ESA Section 7(a)(1) and by the purposes of the Refuge.

Is the Information/Study Relevant to Potentially Significant Effects? Yes

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? No

If NO, explain: It remains difficult to project potential GHG impacts to polar bears with any reasonable certainty given limitations in existing data and modelling techniques, and the nuanced and variable relationships between polar bears subpopulations and sea ice. Given the similar and very small impact of each action alternative's GHG emissions estimated for polar bear populations in this type of analysis, the incomplete or unavailable information required to reliably estimate such impacts is not essential to a reasoned choice among lease sale alternatives (see Section 3.3.5, Marine Mammals).

Agency/Commenter: Arctic Audubon Society

Applicable Resource or Use: Birds

Information/Study: Show adequate baseline data on snow goose staging activities. Map 3-28 of habitat use is dated (1982-2004) and needs to also include more recent snow goose fall staging area use information; such information is critical for analysis of impacts to this species**.**

Is the Information/Study Relevant to Potentially Significant Effects? Yes

Is the Information/Study Essential to Making a Reasoned Choice Among Alternatives? No

If NO, explain*:* USFWS attempted snow goose surveys in 2022 and 2023, but they were either unsuccessful or incomplete due to weather. More birds may now utilize the western part of the Coastal Plain, but this needs to be confirmed by future surveys. Therefore, the data presented in **Map 3-28** in **Appendix A** represents the best available baseline data for snow goose stating activities and the best available to support making a reasoned choice among alternatives.