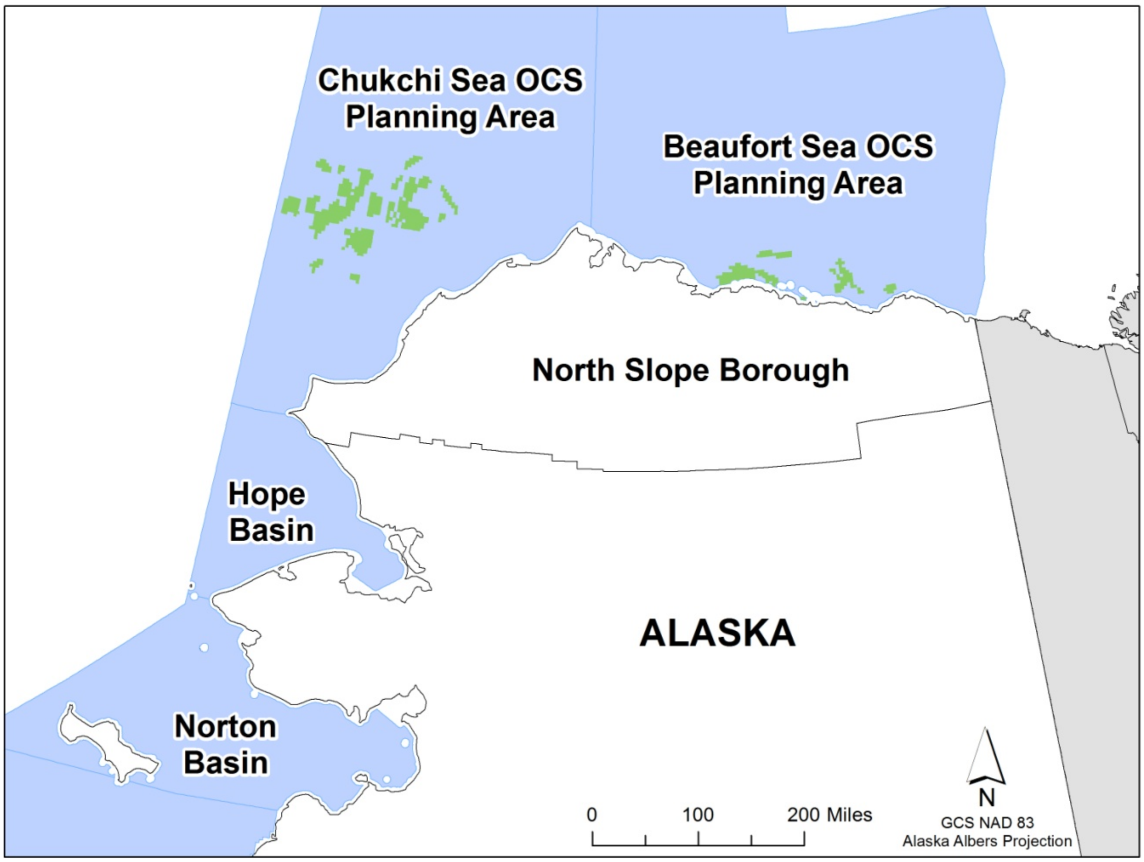
OCS Study
BOEM 2017-029

Arctic Air Quality Modeling Study – Final Near-Field Dispersion Modeling Report



U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska OCS Region

Eastern Research Group, Inc.
8950 Cal Center Drive, Suite 230
Sacramento, CA 95826

[Page Intentionally Left Blank]

OCS Study
BOEM 2017-029

Arctic Air Quality Modeling Study – Final Near-Field Dispersion Modeling Report

Prepared by:

Eastern Research Group, Inc.
8950 Cal Center Drive, Suite 230
Sacramento, CA 95826

Prepared for:

U.S. Department of Interior
Bureau of Ocean Energy Management
Alaska OCS Region
3801 Centerpoint Drive, Suite 500
Anchorage, AK 99503-5823

BOEM
Bureau of Ocean Energy Management
U.S. Department of the Interior
Bureau of Ocean Energy Management
Alaska OCS Region

ERG
Eastern Research Group, Inc.
8950 Cal Center Drive, Suite 230
Sacramento, CA 95826

July 14, 2017

Disclaimer

Study concept, oversight, and funding were provided by the US Department of the Interior, Bureau of Ocean Energy Management, Environmental Studies Program, Washington, DC, under Contract Number M13PC00014. This report has been technically reviewed by BOEM and it has been approved for publication. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

This report discusses a conservative "full build-out scenario" that describes air emissions sources associated with potential future oil and gas exploration, development, and production activities on the Beaufort Sea and Chukchi Sea Outer Continental Shelf. The elements of this scenario are included for the purpose of analysis and do not necessarily represent expected activities.

May be cited as:

Do, B., L. Dayton, N. Hilliard, and P. Fields Simms. 2017. Arctic Air Quality Modeling Study – Final Near-Field Modeling Report. Prepared by Eastern Research Group, Incorporated for U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2017-029, 59 pp.

Authors:

Bebhinn Do
Lindsay Dayton
Noel Hilliard
Paula Fields Simms

Abbreviations and Acronyms

ADM	atmospheric near-field dispersion modeling
AERMAP	AERMOD terrain preprocessor
AERMET	meteorological pre-processor for AERMOD
AERMOD	American Meteorological Society/United States Environmental Protection Agency regulatory model for dispersion
AERSCREEN	AERMOD screening model
AKOCSR	Alaska Outer Continental Shelf Regional Office
AQRP	Air Quality Regulatory Program
AQRV	air quality-related value
BOEM	Bureau of Ocean Energy Management
CAA	Clean Air Act
COARE	Coupled Ocean-Atmosphere Response Experiment
DNPP	Denali National Park and Preserve
USDOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency
ERG	Eastern Research Group, Inc.
LRRS	Long-Range Radar Site
MIR	maximum incremental reactivity
MMIF	Meso-scale Model Interface program
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NSB	North Slope Borough
NWS	National Weather Service
OCD	Offshore Coastal Dispersion
OCS	Outer Continental Shelf
OCSLA	OCS Lands Act
ppb	parts per billion
PLUVUE II	Plume Visibility Model
PSD	prevention of significant deterioration
SIL	significant impact level
SIP	State Implementation Plan
USFWS	United States Fish and Wildlife Service
VISCREEN	Plume Visual Impact Screening Model
WRF	Weather Research and Forecasting model
$\mu g/m^3$	micrograms per cubic meter

Pollutants

CO	carbon monoxide
NO	nitric oxide
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen (NO and NO_2)
O_3	ozone
Pb	lead
$PM_{2.5}$	particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers
PM_{10}	particulate matter with an aerodynamic diameter less than or equal to 10 micrometers
SO_2	sulfur dioxide

Table of Contents

List of Tables

List of Figures

[Page Intentionally Left Blank]

1.0 INTRODUCTION

The Bureau of Ocean Energy Management (BOEM) Alaska Outer Continental Shelf Regional Office (AKOCSR) has the delegated authority to regulate stationary sources of emissions from oil and gas activities proposed within the Chukchi Sea and Beaufort Sea Outer Continental Shelf (OCS) Planning Areas adjacent to the North Slope Borough (NSB) of Alaska. Proposed operators on the Arctic OCS are required to comply with the U.S. Department of Interior (USDOI)/BOEM Air Quality Regulatory Program (AQRP), established under 30 CFR Part 550, Subpart C, and BOEM has the obligation to implement the authority provided in OCS Lands Act (OCSLA) Section 5(a)(8). Figure 1 shows the Alaska OCS area, where the overlaid box represents the study area (i.e., 4 km photochemical grid modeling domain) and the green shading represent select historical leased areas.

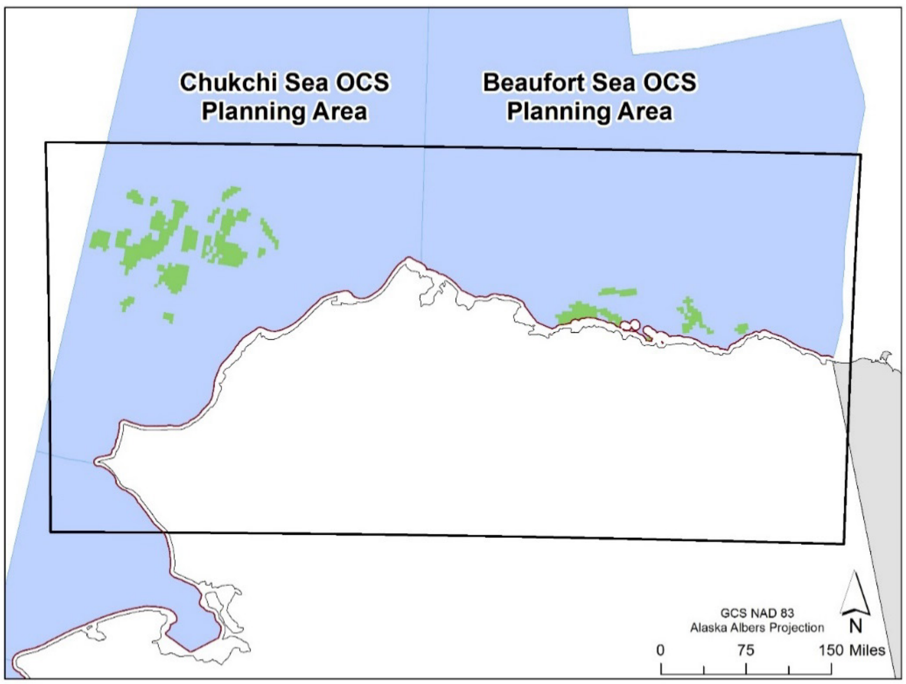


Figure 1. Regional Map Depicting OCS Planning Areas. The black outlined box notes the bounds of the Arctic Air Quality Modeling Study Modeling Domain

1.1 Objectives

The overall objective of the BOEM Arctic Air Quality Impact Assessment Modeling Study (Arctic Air Quality Modeling Study) is to enable BOEM to assess potential air quality impacts on the Alaska OCS resulting from offshore oil and gas exploration, development, and production and related onshore activities.

BOEM recognizes that OCS sources and associated activities have the potential to impact air quality, not only on a local scale (within approximately 50 kilometers (km) of the source), but also on a regional scale (greater than 50 km from the source). This report addresses how modeling can assess the local scale impacts (near-field). Far-field impacts are addressed with photochemical grid modeling under a separate task and report (i.e., Task 5).

To assess impact at the local scale, near-field modeling was conducted. Each source was modeled separately to determine each source's contribution to ambient air quality concentrations compared to the level of the respective air quality standards described in Section 1.2. These individual source impacts can be combined to provide an estimate of the cumulative impacts of activities on the North Slope and in the offshore areas. With the inclusion of the potential new sources under a full build-out scenario, the modeling can also be used to provide an initial check of any new projects. BOEM can find comparable sources to estimate a potential impact range for the new source and compare it to the submitted plan estimates. To facilitate this, the modeling results were used to develop a database for BOEM that can be used to provide the potential range of impact for a combination of sources to help assess the accuracy of future plans. As new modeling runs are completed, the impact information can be added to supplement future estimates.

This report summarizes the modeling procedures used for the impact runs and summarizes the modeling results in the database.

1.2 Air Quality Standards and Air Quality Related Values

The U.S. Environmental Protection Agency (USEPA) sets National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and environment. Currently, there are 6 criteria pollutants: ozone (O_3), sulfur dioxide (SO_2), nitrogen (NO_2), carbon monoxide (CO), lead (Pb), and particulate matter. The particulate matter NAAQS are set with respect to either the concentration of particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers (PM_{10}) or for particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers ($PM_{2.5}$). After promulgation of a NAAQS, USEPA designates nonattainment areas and states are required to submit State Implementation Plans (SIPs) to USEPA. A SIP must contain emission control plans and a demonstration that the nonattainment area will achieve the NAAQS by the required date. Table 1 at the end of this section summarizes the current levels of the NAAQS.

There is currently only one designated nonattainment area in Alaska—the Fairbanks North Star Borough, which is a nonattainment area for $PM_{2.5}$. This area is over 200 miles from the NSB. Alaska also has three maintenance areas—Anchorage Municipality (CO and PM_{10}), Fairbanks North Star Borough (CO), and Juneau City and Borough (PM_{10}), all of which are at least 200 miles from the southern border of the NSB.

There are no regulatory ozone or $PM_{2.5}$ monitors currently operating in the NSB, which results in an "unclassifiable" designation for ozone and $PM_{2.5}$ NAAQS. At the start of the study, the, USEPA had not completed the designation process for the newly issued 2010 1-hour NO_2 NAAQS and 2010 1-hour SO_2 NAAQS. Designations for these standards have been made effective prior to the completion of this study, with no new areas for the state of Alaska.

The USEPA categorizes attainment areas into Class I, Class II, and Class III Areas. The Clean Air Act (CAA) designated 156 Class I areas consisting of National Parks and Wilderness Areas that warrant special protection for air quality and air quality related values (AQRVs). The Class I areas, compared to Class II areas, have lower prevention of significant deterioration (PSD) air quality increments that new sources may not exceed, and are protected against excessive increases in several AQRVs, including visibility impairment, acid (sulfur and nitrogen) deposition, and nitrogen eutrophication. There are currently no Class III areas in the U.S., and areas that are not designated as Class I areas are by default designated as Class II areas. Table 1 summarizes the PSD increments for Class II areas along with the related NAAQS.

The Regional Haze Rule has a goal of natural visibility conditions by 2064 in Class I areas, and states must submit Regional Haze Rule SIPs that demonstrate progress towards that goal. Figure 2 displays the locations of the mandatory Class I areas in Alaska. The Class I area nearest to the NSB, Denali National Park and Preserve (DNPP), is located over 200 miles to the south of the NSB border; therefore, no Class I impact analyses are needed to be performed as part of this analysis.

This air quality dispersion modeling report addresses the methods for estimating the impacts from the new oil and gas production for the Arctic OCS for demonstration of compliance with the NAAQS and PSD increments listed in Table 1. Although a lead NAAQS exists, the total lead emissions in the study area are less than one ton per year, with only 0.135 tons per year from the projected offshore sources (Fields Simms, et al., 2014). This level of emissions should not have a significant impact on air quality in the NSB.

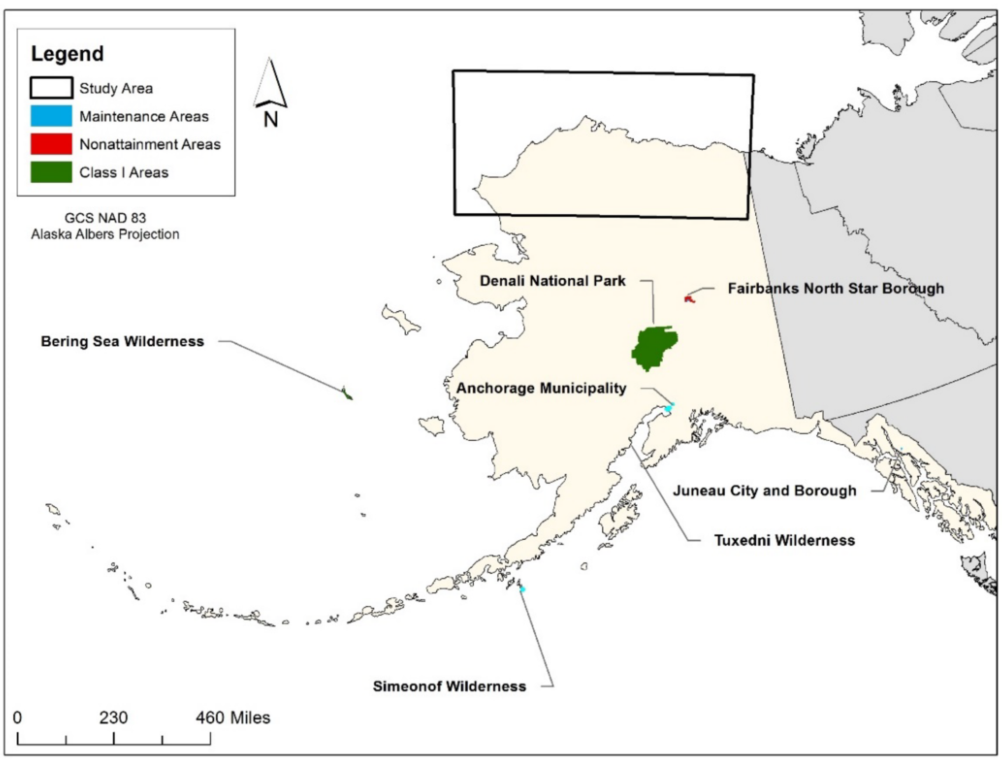


Figure 2. Alaska Class I, Nonattainment, and Maintenance Areas

Table 1. Current NAAQS Levels and PSD Increments (μg/m³)

Pollutant		Averaging Time	NAAQS Level[a]	Significant Impact Level (SIL)[b]	PSD Increment for Class II[c]
Carbon Monoxide		1-hour	40,000	2,000	-
		8-hour	10,000	500	-
Nitrogen Dioxide		1-hour	188	7.5	-
		Annual	100	1	25
Lead		3-month rolling average	0.15	-	-
Ozone		8-hour	137	0.1	-
Particulate Matter	$PM_{2.5}$	24-hour	35	1.2	9
		Annual	12	0.3	4
	PM_{10}	24-hour	150	5	30
		Annual	-	1	17
Sulfur Dioxide		1-hour	196	7.9	-
		3-hour	1,300	25	512
		24-hour	365	5	91
		Annual	-	1	20

[a] Source:40 CFR 50

[b] Source for CO, PM_{10}, NO_2 (annual), and SO_2 (annual, 24-hr and 3-hr):40 CFR 51.165(b)(2).
Source 1-hr SO_2: USEPA's "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program, August 23, 2010."
Source 1-hr NO_2: USEPA's "General Guidance for Implementation of the 1-hour NO_2 NAAQS in Prevention of Significant Deterioration Permits, Including an Interim 1-hour NO_2 Significant Impact Level, June 28, 2010."

[c] Source:40 CFR 51.166

2.0 AIR QUALITY MODEL SELECTION

Available guidance (U.S. Forest Service 2010; USDA, 2011) outlines the procedures for air quality and AQRV analysis and identified the models to use for AQRV assessments. The available guidance identified three models for near-field analysis:

- Plume Visual Impact Screening Model (VISCREEN)/ Plume Visibility Model (PLUVUE II)
- AERMOD Screening model (AERSCREEN)
- American Meteorological Society/Environmental Protection Agency regulatory model for dispersion (AERMOD).

VISCREEN/PLUVUE II (USEPA, 1992a, USEPA, 1992b) are plume blight models for AQRVs and PSD permitting. These models estimate visual impacts by detailing the change in color and contrast along a specific view point. AERSCREEN (USEPA, 2011a) is a single source screening model based on AERMOD that provides a quick model setup and runtime, while providing conservative modeling results. However, neither of these models provides a comparison to the NAAQS and therefore do not fulfill the needs of this study.

The last model recommended by the guidance is AERMOD, which is the USEPA-preferred near-field model for modeling sources over land. The AERMOD Modeling System consists of three basic components: AERMOD terrain preprocessor (AERMAP) (processes terrain data and develops elevations for the receptor grid/sources) (USEPA, 2004c), AERMOD meteorological data preprocessor (AERMET) (USEPA, 2004b), and the AERMOD dispersion model (estimates the ambient concentrations) (USEPA, 2004a). There are also several additional components used to process data and develop the parameters needed by these modules. However, the new sources to be modeled in the analysis are oil and gas production platforms to be developed on the OCS, not over land.

The USEPA Guideline on Air Quality Models (40 CFR Part 51, Appendix W, hereafter *USEPA's Guideline*) and BOEM air quality regulations at 50 FR 12248 recommend the Offshore Coastal Dispersion (OCD) model (Chang and Hahn, 1997; DiCristofaro and Hanna, 1989) for offshore/overwater sources. The OCD model is specially formulated to incorporate overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline. However, the OCD model is no longer maintained, with the last revision made in January 2000. Not only does this mean that the model science has not kept up with the latest advances (e.g., plume meander for low wind conditions, calculations for the 98th and 99th percentile concentrations necessary for comparisons with the recent 1-hour NO_2 and SO_2 NAAQS revisions), but also the model has not been updated to run on modern operating systems.

To address the shortcomings in the OCD model, efforts have been made to adapt AERMOD for the overwater environment. This was achieved through the development of the AERMOD-Coupled Ocean-Atmosphere Response Experiment (COARE) model preprocessor. The COARE component of the system is a data preprocessor that applies an air-sea flux algorithm to overwater meteorological measurements, or predicted hourly meteorological data from Meso-scale Model Interface program (MMIF) (Brashers and Emery, 2014), to estimate surface energy fluxes, and then assembles these estimates and other measurements for subsequent dispersion model simulations with AERMOD.

As part of this study, the AERMOD model was rigorously compared to the OCD and CALPUFF models for the overwater environment. Based on this comparison, the WRF-MMIF-AERMOD system was selected for overwater modeling. The model justification report (Brashers, 2017) provides the full analysis for the selection of the WRF-MMIF-AERMOD system for overwater modeling. For the atmospheric near-field dispersion modeling (ADM) conducted for this study, the latest version of AERMOD was used for the near-field modeling. The meteorological data used to run AERMOD, along with the approach for processing the meteorological data, is discussed in more detail in Section 4.

3.0 AERMOD CONFIGURATION

3.1 Meteorology

AERMOD requires hourly surface meteorological data as inputs. *USEPA's Guideline* specifies that a minimum of one year of site-specific data, or five years of representative National Weather Service (NWS) data should be used. *USEPA's Guideline* also states that additional years (up to five) should be used when available to account for year-to-year variation in meteorological conditions when modeling with site-specific data.

The meteorological dataset used for the Arctic Air Quality Modeling Study was developed under Task 2 of this study (Brashers, et al., 2016). Because of the harsh conditions, meteorological monitoring in the North Slope rarely produces complete annual records. Task 2 efforts focused on using meteorological modeling to produce the necessary meteorological inputs for the project. The results of Task 2 are five years (2009-2013) of Weather Research Forecasting Model (WRF) simulations that can be used for ADM modeling and other modeling tasks. These hind-cast WRF runs provide a complete dataset for each year including upper air values. The model performance of each annual run was determined and documented under Task 2 (Brashers, et al., 2016).

MMIF was used to output the needed meteorological data from the WRF modeling output. MMIF was run in "direct" mode, created a file in the proper format for running AERMOD. This method was supported by the model justification report (Brashers, 2017).

3.2 Receptors

To estimate the impact of the emissions changes from baseline emissions to the full build-out scenario, each new source and sources projected to have increased/decreased emissions were examined individually, with separate receptor fields. Initial receptor placement consisted of receptors along the shoreline and along the state seaward boundary at 500-meter intervals for all sources. ERG constructed an initial receptor list with 500-meter spacing and used a subset of these locations for each modeling run. The receptors also omit the Seashore Islands. Receptors were also placed in center of the North Slope communities (Figure 3) to quantify the onshore impacts in population areas.

The shoreline receptors follow a generalized coastline definition (1:20,000,000 resolution) (U.S. Census Bureau, 2014a), rather than a strict shoreline definition that would follow every coastal feature (1:500,000 resolution) (U.S. Census Bureau, 2014b). This simplifies the receptor placement by not strictly following large coastal features such as bays, lagoons, and mouths of rivers. Figure 4 provides an example of this generalization along the shoreline. The receptors, shown with 500-meter spacing receptors, cut across the mouth of a bay and take a straight-line path instead of strictly following the coast. Elevation for all receptors was set at sea level for the study area.

As part of the final ADM deliverable under Task 4, a database with the impact at each receptor for each source will be provided to BOEM. These source specific impacts can then be added for each receptor to obtain a cumulative impact at each receptor.

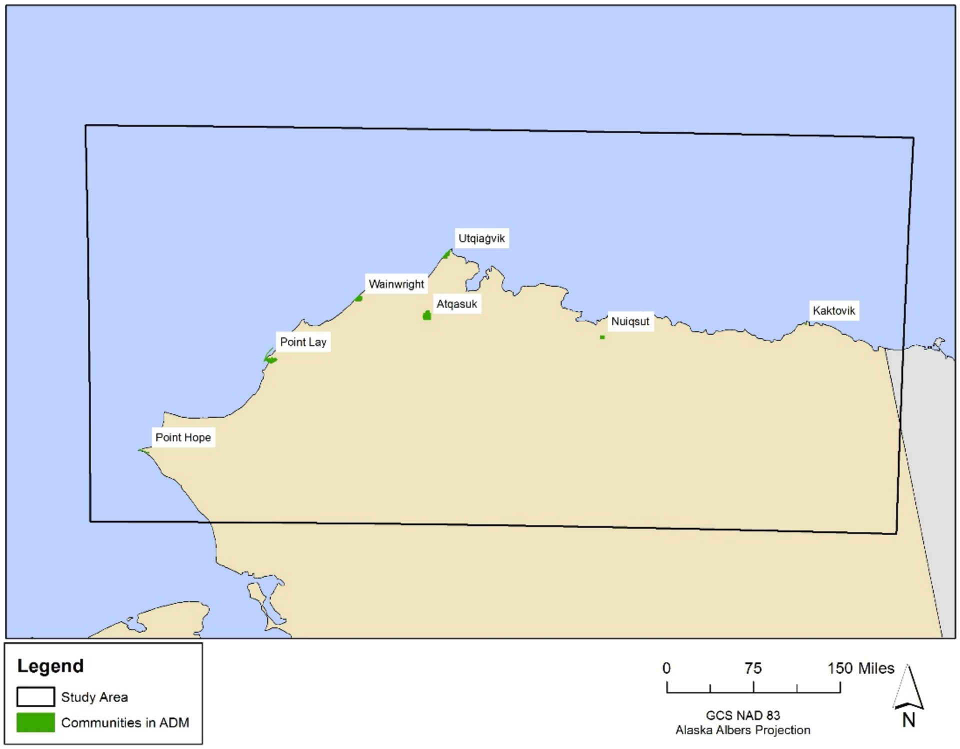


Figure 3. North Slope Communities included in the Near-field Dispersion Modeling

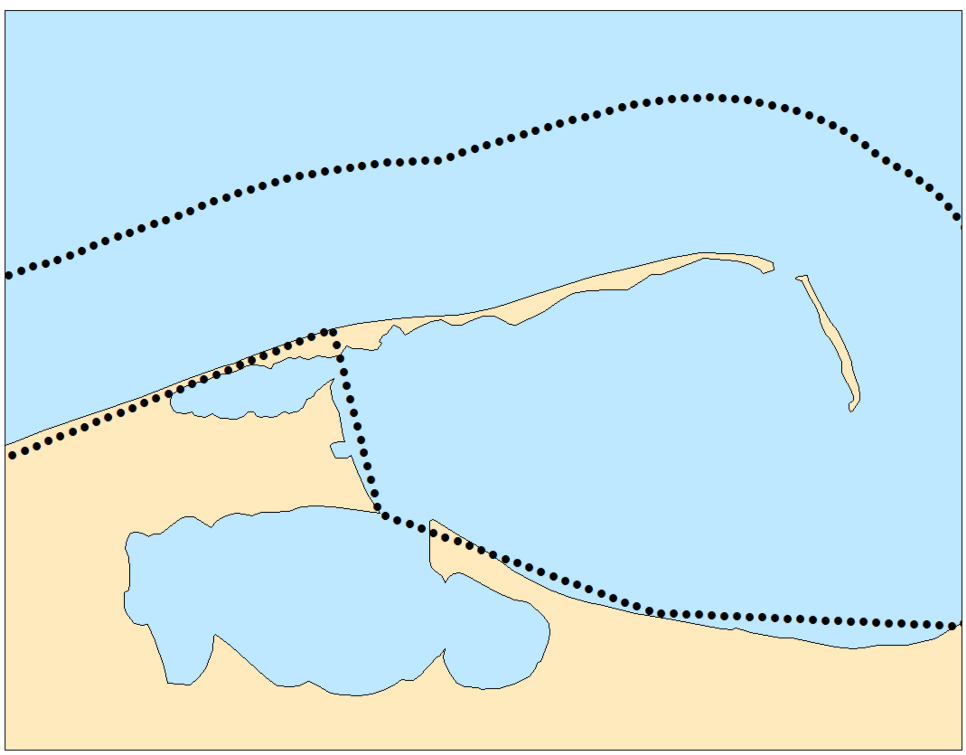


Figure 4. Example of Generalized Shoreline Receptors Along the North Slope

3.3 Modeling Approach

ERG utilized the same model setup and meteorological data to determine the impacts from each pollutant.

When modeling oxides of nitrogen (NO_x), an additional option is specified to estimate the NO_2 values, because emissions from combustion sources are partly nitric oxide (NO) and partly NO_2 with additional NO_2 created due to atmospheric reactions after the gas leaves the stack. The NAAQS and increments were developed for NO_2; therefore, a methodology to estimate how much of the released NO is converted to NO_2 is needed in order to compare a modeled concentration to an NO_2 standard or increment.

USEPA's Guideline discuses a tiered approach to modeling the annual average NO_2 impacts:

- Tier 1: Assumes total conversion of NO to NO_2.
- Tier 2: Multiplies Tier 1 result by empirically-derived NO_2/NO_x ratio (e.g., national default ratio of 0.8 (1-hour) and 0.75 (annual)).
- Tier 3: Detailed analysis on Case-by-Case Basis.

Tier 1 calculations represent the most conservatively high estimates of NO_2 and was used to for the study.

The study area is coastal and relatively flat. Therefore, AERMOD was run using the flat terrain option. For modeling purposes, the rural/urban classification of an area is determined by either the dominance of a specific land use or by population data in the study area. Due to the rural nature of the North Slope, the area was flagged as rural.

3.4 Modeling Emissions Inventory

The emissions inventory used in the ADM was developed under Task 3 of the Arctic Air Quality Modeling Study and includes all anthropogenic sources of emissions. The emissions inventory is described in detail in the Arctic Air Quality Modeling Study: Emissions Inventory – Final Task Report (Fields Simms, 2014).

Anthropogenic sources of emissions include stationary point and area sources located in North Slope communities and oil fields, on-road motor vehicles, nonroad equipment, marine vessels and other offshore (oil and gas-related) sources in state waters. For the Alaska OCS region, anthropogenic sources include airports and unpaved road dust for portions of the Dalton Highway and other roads located in communities and the oil fields.

Point source locations are defined in the inventory by latitude and longitude coordinates. All other sources are attributed to an area or line and are documented in GIS shapefiles.

The inventory includes estimated emissions for a baseline scenario and a "full build-out" scenario. The baseline scenario is representative of the emissions from sources for which the most recent credible relatable information was available (generally, 2011 or 2012). The full build-out emissions inventory covers potential future sources and activities that are expected to continue for an extended period of time. The full build-out scenario projection reflects a future defined by BOEM (BOEM, 2014), which includes potential increases in future emissions from all stages of oil production (e.g., seismic surveys, exploratory drilling, platform construction, pipe laying, and active production platforms) that may occur in support of projected annual production of crude oil of 204 million barrels per year in the Chukchi Sea and 132 million barrels per year in the Beaufort Seas. Also, the full build-out scenario includes potential increases in future emissions from certain onshore sources (e.g., construction emissions, new processing plants, and increased fugitive emissions from pipelines) due to this increase production. Sources that are not affected by the full build-out scenario are held constant from the baseline scenario.

New sources included in the full build-out scenario include six offshore drilling sites (two sites in the Chukchi Sea and four sites in the Beaufort Sea) and the construction of Liberty Island (offshore gravel island). The initial estimated locations of these sources, as provided by BOEM (BOEM, 2014), are shown in Figure 5. The placement of onshore sources was determined by ERG in consultation with BOEM.

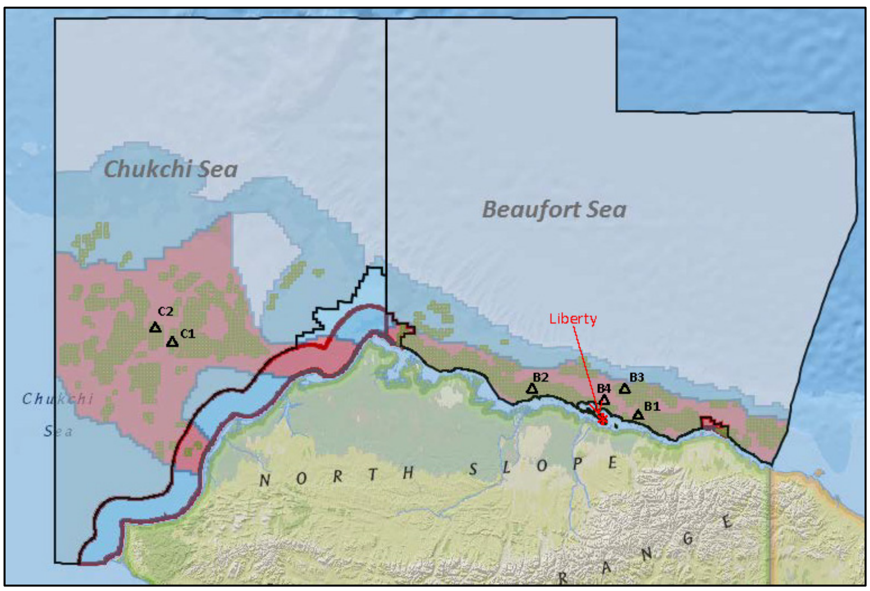


Figure 5. Initial Placement of New Offshore Sources

As discussed in Section 1.1.2, the objective of this study task is to assess near-field impacts. For the onshore assessment, emissions from sources located within 50 km of the shoreline, as well as emissions from all onshore emission sources within the significant impact area, were modeled. As shown in Figure 3, most of the projected offshore sources in the Beaufort Sea lie within approximately 50 km of the shoreline. However, the two projected offshore sources in the Chukchi Sea are beyond 50 km of the shoreline. As a result, the modeling domain for the Chukchi Sea projected sources extends past 50 km into the NSB to assess any significant impacts of the full build-out scenario. This approach is consistent with other NEPA and PSD permitting modeling activities. Onshore sources projected to increase under the full build-out scenario adjacent to the Chukchi Sea were modeled to assess the impact of the increased emissions.

For all projected sources, ERG conducted modeling runs for the emissions level present at the different stages of development (e.g., drilling, maximum production) across all five years of meteorological data developed under Task 2 modeling.

The appropriate short-term and long-term emission rates were modeled for the corresponding short-term and long-term NAAQS assessments. Since there is no SIL for VOC, and VOC is integral to the formation of ozone, the categories that reported only VOC emissions (i.e., gas stations and wastewater treatment) were compared to the ozone standard SIL to gauge the significance of the impact. This comparison assumes a worst-case scenario of 100% conversion of VOC to ozone. Carter (2009) updates the maximum incremental reactivity (MIR), which specify the method for calculating a species' ozone-forming potential. The MIR is expressed as a ratio of the ozone formed to the VOC omitted. Carter (2009) developed MIRs for various VOCs which range from 0.014 (methane) to 11.37 (propene), depending on the species. Without additional information on the make of VOCs in the study area, a 1:1 ratio was deemed a conservative estimate.

4.0 ATMOSPHERIC NEAR-FIELD DISPERSION MODELING RESULTS

As noted in Section 3.4, emissions are categorized based on the release shape: point, area, and line. Point sources are facilities with distinct release sources (i.e., stacks) that have characteristics specified in the inventory (e.g., stack height, release temperature, exit velocity). Area sources are a group of related sources that release emissions over an area. For this study, population centers were modeled as area sources to capture the broad release area of the emissions. Line sources are sources whose emissions are released over a distance best represented by a line. For example, fugitive dust emissions from the James Dalton highway were modeled as lines. The following sections summarize the modeling results for point, area, and line emission categories.

The accompanying database provides impact and emissions information by source category and facility, where appropriate. All reported impacts are the maximum value of the highest reported concentration at each receptor, also known as the high first high (H1H) value. Significance comparisons are made by comparing the H1H values to the SILs noted in Table 1. The database contains the separate significance determinations for the shoreline receptors, as well as separate determinations for the state seaward boundary and community receptors.

4.1 Point Sources

Point sources encompass a wide range of source categories and emissions resulting from both onshore and offshore activities. Table 2 summarizes the categories of point sources and the emissions included for each source. The emission categories correspond to the emission categories noted in the emission inventory database. Each of the source categories is discussed below.

Table 2. Summary of Point Source Categories and Included Emissions

Source Category	Included Emissions
Aircraft	Exhaust
Electricity Generating Facility	All Subcategories
Gas Stations	All Subcategories
Oil and Gas - Offshore Activities	Construction Helicopter
	Drilling Helicopters

Table 2. Summary of Point Source Categories and Included Emissions

Source Category	Included Emissions
	Drilling Vessels
	Production Helicopter
	Production
	Production - Liberty Island Construction
Oil and Gas - Onshore Activities	Combustion/Incineration
	Flaring
	Fugitives
	Miscellaneous Small Units
	Storage Tanks
	Taps Pipeline
	Construction – Nonroad - Oil and Gas – Chukchi New Facilities
	Construction – Nonroad – Projected Oil and Gas Processing
	Construction Helicopter
	Drilling Aircraft
	Drilling Helicopters
	Oil and Gas - Chukchi New Facilities
	Production Helicopter
	Projected Oil and Gas Processing
	Survey Helicopters
	Production - Projected Oil and Gas Processing
Other Facilities	All Subcategories
Special Analysis Star Platforms	Special Analysis
Support Operations - Oil and Gas	All Subcategories
Waste Incineration/Combustion/Landfills	All Subcategories
Wastewater Treatment Plant	All Subcategories

4.1.1 Aircraft

The aircraft category includes exhaust emissions from aircraft at the major commercial airports, military installations, and private air strips located in the modeling domain. Figure 6 shows the locations of the aircraft sources modeled. Table 3 lists the sources and shows the inventories (i.e., baseline or full build-out) that the source was modeled for. Those sources with a check for the baseline inventory and an "●" for the full build-out remained unchanged between the two inventories (i.e., unaffected by the theoretical increase oil and gas production).

Table 4 summarizes the range of maximum impacts (high, first high) from the airports based on the modeling, as well as the inventory in which the pollutant appears. Modeling results show that impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts). Impacts are generally less than their respective SILs and 1% of the NAAQS.

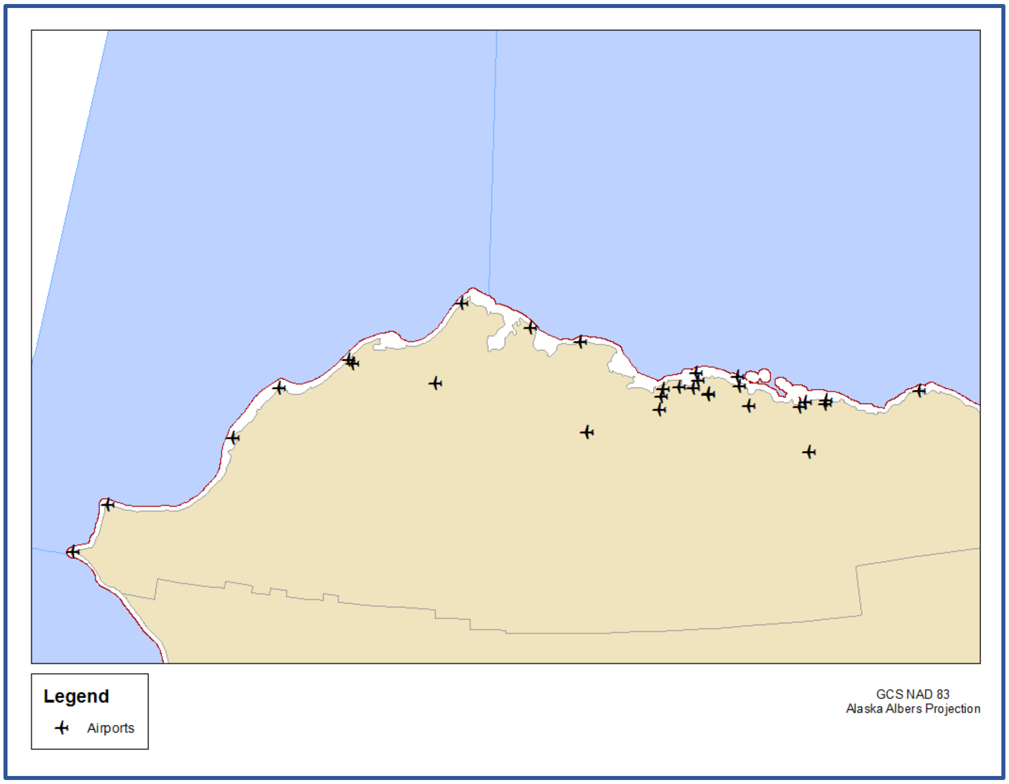


Figure 6. Location of Airports

Table 3. Summary of Aircraft Sources

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Aircraft	Alpine Airstrip	11624811	✓	●
Aircraft	Atqasuk Edward Burnell	10571711	✓	●
Aircraft	Badami Airport	AA8	✓	✓
Aircraft	Barter Island LRRS Airport	BTI	✓	✓
Aircraft	Bullen Point Air Force Station	11273111	✓	●
Aircraft	Cape Lisburne LRRS	10567811	✓	●
Aircraft	Cape Simpson, AK: Cape Simpson Airport	11295211	✓	●
Aircraft	CD-3 Airstrip	11625311	✓	●
Aircraft	Central Pad	16091411	✓	●
Aircraft	Deadhorse Airport	SCC	✓	✓
Aircraft	Helmericks Airport	22AK	✓	✓
Aircraft	ICY CAPE AFS	11080911	✓	●
Aircraft	Inigok	11159811	✓	●
Aircraft	Inigok	16092111	✓	●
Aircraft	Kavik River Airport	VIK	✓	✓
Aircraft	Lonely Air Station	11609311	✓	●

Table 3. Summary of Aircraft Sources

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Aircraft	Nikaitchuq Operations Center	16092611	✓	●
Aircraft	Northstar	11658011	✓	●
Aircraft	Nuiqsut Airport	NUI	✓	✓
Aircraft	Oooguruk Tie in Pad	11623111	✓	●
Aircraft	PAD-66	11068711	✓	●
Aircraft	Point Hope	10567611	✓	●
Aircraft	Point Lay LRRS Airport	PIZ	✓	✓
Aircraft	Point McIntyre	11624711	✓	●
Aircraft	Point Thomson Airstrip	16092711	✓	●
Aircraft	Spy Island Drill-Site	16093511	✓	●
Aircraft	Ugnu-Kuparuk Airport	UUK	✓	✓
Aircraft	Wainwright Airport	AIN	✓	✓
Aircraft	Wainwright Airstrip	11623911	✓	●
Aircraft	Wiley Post-Will Rogers / Utqiaġvik Airport	BRW	✓	✓

● in "Full Build-Out" column means the emissions remained unchanged from baseline.

Table 4. Summary of Aircraft Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m^3)				
		1 Hour	3-Hour	8-Hour	24-hour	Annual
CO	Baseline	[< 0.001 - 1.238]	--	[< 0.001 - 0.616]	--	--
	Full Build-Out	[< 0.001 - 31.705]	--	[< 0.001 - 15.781]	--	--
NO_2	Baseline	[< 0.001 - 0.496]	--	--	--	[< 0.001 - 0.002]
	Full Build-Out	[< 0.001 - 0.593]	--	--	--	[< 0.001 - 0.007]
PM_{10}	Baseline	--	--	--	[< 0.001 - 0.002]	--
	Full Build-Out	--	--	--	[< 0.001 - 0.002]	--
$PM_{2.5}$	Baseline	--	--	--	[< 0.001 - 0.001]	[< 0.001]
	Full Build-Out	--	--	--	[< 0.001 - 0.001]	[< 0.001]
SO_2	Baseline	[< 0.001 - 0.056]	[< 0.001 - 0.042]	--	[< 0.001 - 0.011]	[< 0.001]
	Full Build-Out	[< 0.001 - 0.231]	[< 0.001 - 0.163]	--	[< 0.001 - 0.052]	[< 0.001 - 0.002]

4.1.2 Electricity Generation

Electricity generating facilities (power plants) are located in each of the North Slope communities and two additional power plants are located in the oil and gas fields (Deadhorse Facility and North Slope Generating Power Plant). The Deadhorse Facility is included with the onshore oil and gas sources (Section 4.1.5). Inventory emissions represent total emissions from all facility processes. Figure 7 and Table 5 identify which power plants were modeled.

Table 6 summarizes the range of maximum modeled impacts from power plants. Modeling results show that impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts), and are less than the SILs and 1% of the NAAQS for all locations for all emission scenarios.

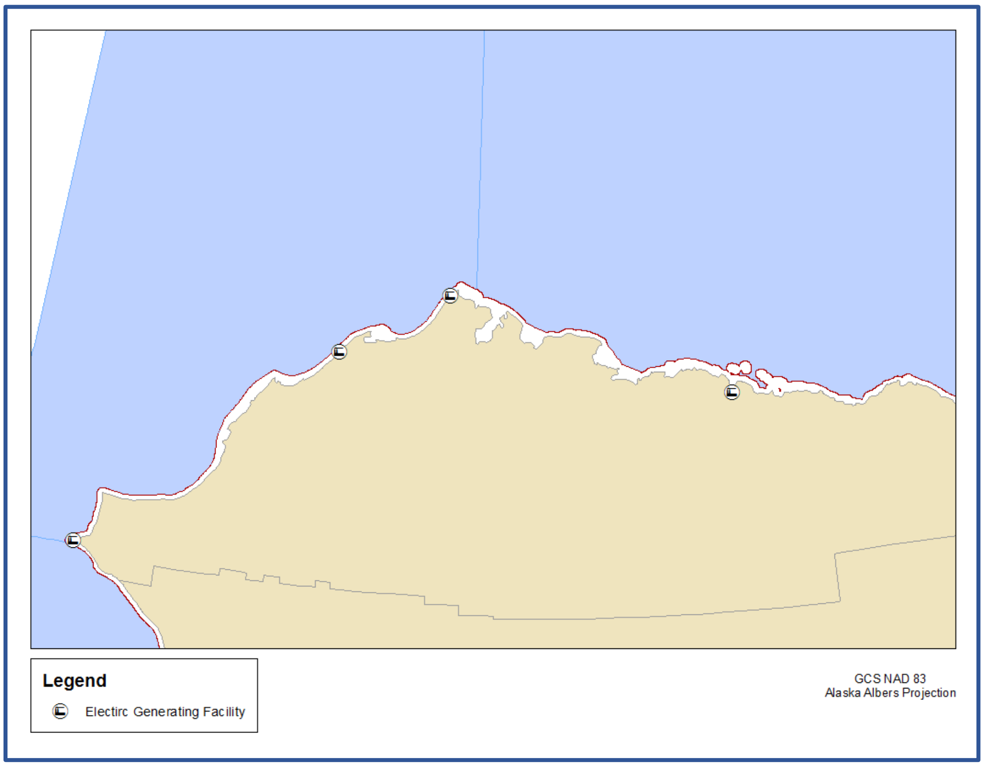


Figure 7. Location of Electricity Generating Facilities

Table 5. Summary of Electricity Generating Facilities Modeled

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Electricity Generating Facility	Utqiaġvik Power Plant	10573111	✓	✓
Electricity Generating Facility	North Slope Generating Power Plant	10572911	✓	✓
Electricity Generating Facility	Point Hope Power Plant	10572511	✓	✓
Electricity Generating Facility	Wainwright Power Plant	10572711	✓	✓
Electricity Generating Facility	NSB - Atqasuk Power Plant	PAL 000354	✓	●
Electricity Generating Facility	NSB - Kaktovik Power Plant	AQ0353ORL01	✓	✓
Electricity Generating Facility	NSB - Nuiqsut Power Plant	NUIQSUT PP	✓	✓
Electricity Generating Facility	NSB - Point Lay Power Plan	PAL 000351	✓	●

● in "Full Build-Out" column means the emissions remained unchanged from baseline.

Table 6. Summary of Electric Generation Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m³)				
		1 Hour	3-Hour	8-Hour	1 Hour	Annual
CO	Baseline	[< 0.001 - 0.007]	--	[< 0.001 - 0.003]	--	--
	Full Build-Out	[< 0.001 - 0.274]	--	[< 0.001 - 0.114]	--	--
NO_2	Baseline	[0.002 - 0.026]	--	--	--	[< 0.001]
	Full Build-Out	[0.002 - 0.017]	--	--	--	[< 0.001]
PM_{10}	Baseline	--	--	--	[< 0.001]	--
	Full Build-Out	--	--	--	[< 0.001]	--
$PM_{2.5}$	Baseline	--	--	--	[< 0.001]	[< 0.001]
	Full Build-Out	--	--	--	[< 0.001]	[< 0.001 - 0.010]
SO_2	Baseline	[< 0.001 - 0.002]	[< 0.001 - 0.002]	--	[< 0.001]	[< 0.001]
	Full Build-Out	[< 0.001 - 0.002]	[< 0.001 - 0.002]	--	[< 0.001]	[< 0.001]

4.1.3 Fuel Dispensing

Fueling dispensing stations (i.e., gas stations and standalone refueling pumps) are located in each of the North Slope communities, with an additional station in the oil and gas fields (Figure 8). The inventories contained total VOC emissions from each of the refueling stations. Table 7 identifies the fuel dispensing stations that were modeled.

The fuel dispensing stations had no change in emissions between the baseline and the full build-out scenario (Table 8). Therefore, the results summarized in Table 9 are the same for the baseline and full build-out scenario. Since there is not a NAAQS VOCs, but VOCs are an integral component to the ozone level, the VOC impacts were compared to the ozone SIL to provide a rough gauge of significance. Assuming a conversion ratio of 1:1, all impacts were less than the ozone SIL of 0.1 $\mu g/m^3$.

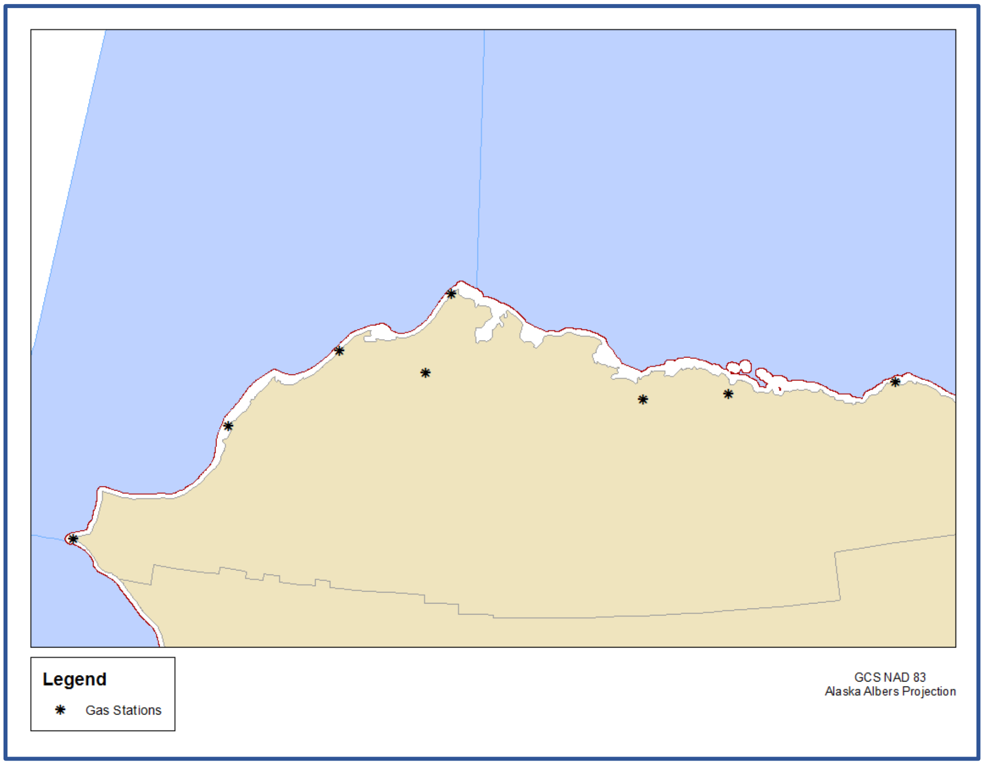


Figure 8. Location of Fuel Dispensing Sources

Table 7. Summary of Fuel Dispensing Sources Modeled

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Gas Stations	Atqasuk Fueling Pumps	ATQASUK FP	✓	●
Gas Stations	Utqiaġvik Fueling Station	BARROW FS	✓	●
Gas Stations	Kaktovik Fueling Pumps	KAKTOVIK FP	✓	●
Gas Stations	Nuiqsut Fueling Pumps	NUIQSUT FP	✓	●
Gas Stations	Oil and Gas Field Refueling	Oil GAS FR	✓	●

Table 7. Summary of Fuel Dispensing Sources Modeled

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Gas Stations	Point Hope Fueling Pumps	POINT HOPE FP	✓	●
Gas Stations	Point Lay Fueling Pumps	POINT LAY FP	✓	●
Gas Stations	Wainwright Fueling Pumps	WAINWRIGHT FP	✓	●

● in the “Full Build-Out” column means the emissions remained unchanged from baseline.

Table 8. Summary of Fuel Dispensing Emissions

Facility	Total Emissions (tpy)	
	Baseline	Full Build-Out
Atqasuk Fueling Pumps	0.04	0.04
Utqiaġvik Fueling Station	1.70	1.70
Kaktovik Fueling Pumps	0.05	0.05
Nuiqsut Fueling Pumps	0.03	0.03
Oil and Gas Field Refueling	1.97	1.97
Point Hope Fueling Pumps	0.11	0.11
Point Lay Fueling Pumps	0.03	0.03
Wainwright Fueling Pumps	0.13	0.13

Table 9. Summary of Fuel Dispensing Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m^3)
		8-Hour
VOC	Baseline	[<0.001 – 0.071]
	Full Build-Out	[<0.001 – 0.071]

4.1.4 Offshore Oil and Gas

Emissions of offshore oil and gas activities were calculated for each stage of production. That is, emissions were tabulated separately for construction, production, and vessel support. Results include all emissions to provide a maximum total impact for each source. Table 10 identifies the offshore oil and gas sources that were modeled, with their locations noted in Figure 9. Sources with checks in the full build-out column only in Table 10 are new sources estimated because of the theoretical increase in oil and gas production.

Table 11 summarizes the range of maximum impacts (high first high) seen from offshore oil and gas activities. The 9.2 µg/m^3 impact was seen at the Beaufort facility, and exceeded the NO_2 1-hour interim SIL. However, the facility maximum impact represents less than 5% of the 1-hour NO_2 NAAQS. Modeled impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts). The modeled impact for all other offshore oil and gas facilities were less than 1% of the NAAQS (Table 12). In addition, three theoretical platforms were included in the full build-out scenario to examine the impact to onshore air quality (Table 13).

The results of the offshore oil and gas source modeling were also analyzed to provide separate impact estimates for the drilling, construction, and production stages. Table 14 contains the results by stages for the shoreline receptors.

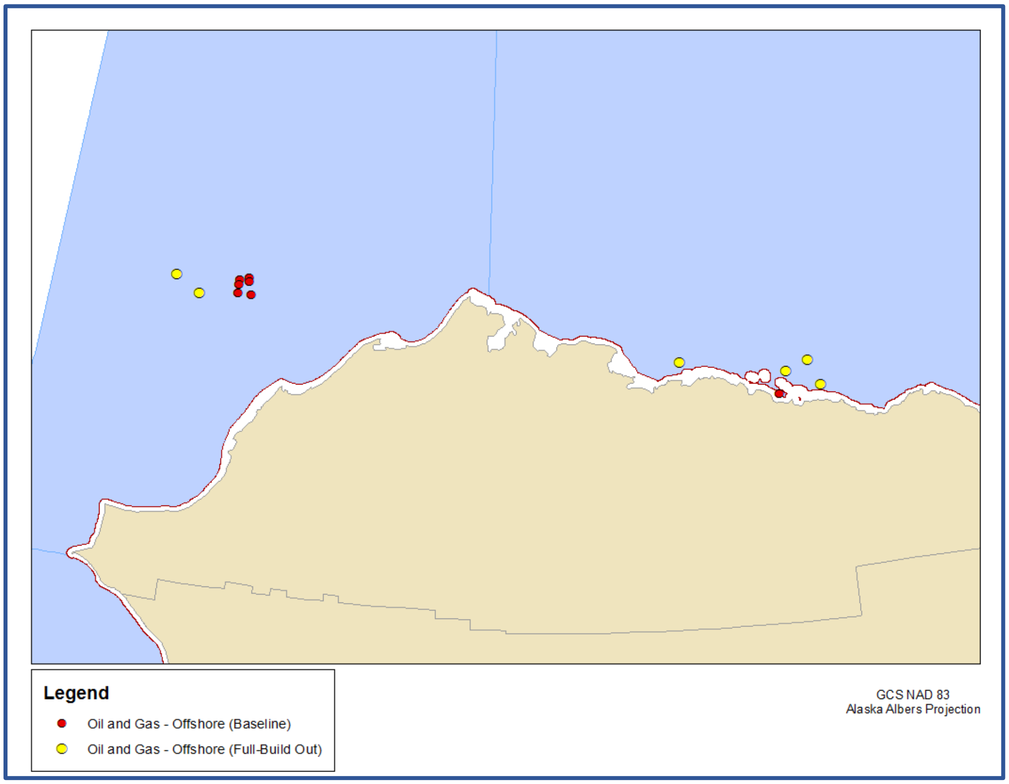


Figure 9. Location of Offshore Oil and Gas Activities

Table 10. Summary of Offshore Oil and Gas Activity Sources

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Oil and Gas - Offshore Activities	B1	B1		✓
Oil and Gas - Offshore Activities	B2	B2		✓
Oil and Gas - Offshore Activities	B3	B3		✓
Oil and Gas - Offshore Activities	B4	B4		✓
Oil and Gas - Offshore Activities	Beaufort	BEAUFORT Y01650	✓	●
Oil and Gas - Offshore Activities	Beaufort-Drilling	Y01650	✓	●
Oil and Gas - Offshore Activities	C1	C1		✓
Oil and Gas - Offshore Activities	C2	C2		✓
Oil and Gas - Offshore Activities	CHUKCHI Y02267	CHUKCHI Y02267	✓	●
Oil and Gas - Offshore Activities	CHUKCHI Y02278	CHUKCHI Y02278	✓	●
Oil and Gas - Offshore Activities	CHUKCHI Y02280	CHUKCHI Y02280	✓	●
Oil and Gas - Offshore Activities	CHUKCHI Y02294	CHUKCHI Y02294	✓	●
Oil and Gas - Offshore Activities	CHUKCHI Y02321	CHUKCHI Y02321	✓	●
Oil and Gas - Offshore Activities	CHUKCHI Y02324	CHUKCHI Y02324	✓	●

Table 10. Summary of Offshore Oil and Gas Activity Sources

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02267	✓	●
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02278	✓	●
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02280	✓	●
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02294	✓	●
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02321	✓	●
Oil and Gas - Offshore Activities	Chukchi-Drilling	Y02324	✓	●
Oil and Gas - Offshore Activities	Liberty Island	LIBERTY ISLAND		✓

Table 11. Summary of Offshore Oil and Gas Offshore Shoreline Impacts

Pollutant	Inventory	Range of Impact (μg/m^3)				
		1 Hour	3-Hour	8-Hour	1 Hour	Annual
CO	Baseline	--	--	--	--	--
	Full Build-Out	[< 0.001 - 0.397]	--	[< 0.001 - 0.092]	--	--
NO_2	Baseline	--	--	--	--	--
	Full Build-Out	[< 0.001 - 0.740]	--	--	--	[< 0.001]
PM_{10}	Baseline	--	--	--	--	--
	Full Build-Out	--	--	--	[< 0.001 - 0.002]	--
$PM_{2.5}$	Baseline	--	--	--	--	--
	Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
SO_2	Baseline	--	--	--	--	--
	Full Build-Out	[< 0.001 - 0.167]	[< 0.001 - 0.103]	--	[< 0.001 - 0.018]	[< 0.001]

Table 12. Summary of Offshore Oil and Gas Activity Impacts as a Percentage of the NAAQS

Pollutant	Inventory	Percentage of NAAQS				
		1-Hour	3-Hour	8-Hour	24-Hour	Annual
CO	Baseline	[<1%]	--	[<1%]	--	--
	Full Build-Out	[<1%]	--	[<1%]	--	--
NO_2	Baseline	[4.90%]	--	--	--	[<1%]
	Full Build-Out	[<1% - 4.90%]	--	--	--	[<1%]
PM_{10}	Baseline	--	--	--	[<1%]	--
	Full Build-Out	--	--	--	[<1%]	--
$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
	Full Build-Out	--	--	--	[<1%]	[<1%]
SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	--
	Full Build-Out	[<1%]	[<1%]	--	[<1%]	--

Table 13. Summary of Oil and Gas Offshore Shoreline Impacts – Special Analysis Sources

Pollutant	Inventory	Range of Impact (µg/m³)				
		1 Hour	3-Hour	8-Hour	1 Hour	Annual
CO	Baseline	--	--	--	--	--
	Full Build-Out	[0.010 - 0.029]	--	[0.003 - 0.007]	--	--
NO_2	Baseline	--	--	--	--	--
	Full Build-Out	[< 0.001 - 0.002]	--	--	--	[< 0.001]
PM_{10}	Baseline	--	--	--	--	--
	Full Build-Out	--	--	--	[< 0.001]	--
$PM_{2.5}$	Baseline	--	--	--	--	--
	Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
SO_2	Baseline	--	--	--	--	--
	Full Build-Out	[0.010 - 0.029]	[0.006 - 0.014]	--	[0.001 - 0.003]	[< 0.001]

Table 14. Summary of Offshore Oil and Gas Offshore Impacts at the Shoreline, by Stage

Source Name	Pollutant	Inventory	Range of Impact (µg/m^3)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
Construction	CO	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001]	--	[<0.001]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001]	--	--	--	[<0.001]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	[<0.001]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001]	[<0.001]	--	[<0.001]	[<0.001]
Drilling	CO	Baseline	[<0.001 - 0.165]	--	[<0.001 - 0.042]	--	--
		Full Build-Out	[<0.001 - 0.165]	--	[<0.001 - 0.042]	--	--
	NO_2	Baseline	[<0.001 - 1.074]	--	--	--	[<0.001 - 0.002]
		Full Build-Out	[<0.001 - 1.074]	--	--	--	[<0.001 - 0.002]
	PM_{10}	Baseline	--	--	--	[<0.001 - 0.003]	--
		Full Build-Out	--	--	--	[<0.001 - 0.003]	--
	$PM_{2.5}$	Baseline	--	--	--	[<0.001 - 0.001]	[<0.001]
		Full Build-Out	--	--	--	[<0.001 - 0.001]	[<0.001]
	SO_2	Baseline	[<0.001 - 0.001]	[<0.001]	--	[<0.001]	[<0.001]
		Full Build-Out	[<0.001 - 0.001]	[<0.001]	--	[<0.001]	[<0.001]
Production	CO	Baseline	--	--	--	--	--
		Full Build-Out	[0.041]	--	[0.010]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.083]	--	--	--	[<0.001]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	[<0.001]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.035]	[0.020]	--	[0.003]	[<0.001]

4.1.5 Onshore Oil and Gas

Similar to the offshore sources, emissions of onshore oil and gas activities were calculated for each stage of production. That is, emissions were tabulated separately for construction, production, and vessel support. Results include all emissions to provide a maximum total impact for each source. Emissions by each category are provided in the accompanying database. Table 15 notes the offshore oil and gas sources that were modeled, with their locations noted in Figure 10.

Table 16 summarizes the range of maximum modeled impacts from onshore oil and gas sources. Modeling results show that impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts). The impact from each pollutant was compared to its NAAQS. The 17.4 μg/m^3 impact was seen at the new Chukchi Sea Processing Facility (PROJ_CHUKCHI_SEA_PRO), and exceeded the NO_2 1-hour SIL. However, the facility maximum impact represents less than 10% of the 1-hour NO_2 NAAQS. The impact for all other offshore oil and gas facilities were less than 1% of the NAAQS (Table 17).

The results of the onshore oil and gas source modeling were also analyzed to provide separate impact estimates for the drilling, construction, and production stages. Table 18 contains the results by stage for the shoreline receptors.

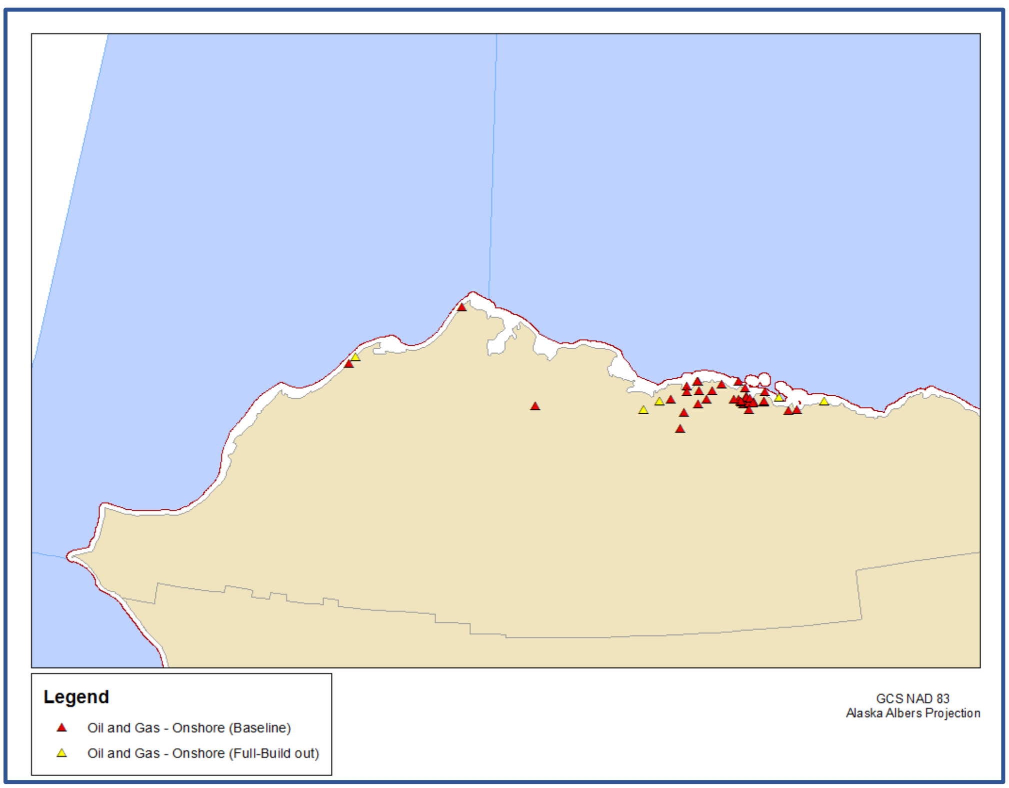


Figure 10. Location of Onshore Oil and Gas Activities

Table 15. Summary of Onshore Oil and Gas Activities

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Onshore Oil & Gas	Alpine Central Processing Facility	541611	✓	✓
Onshore Oil & Gas	Badami Development Facility (formerly BPXA)	7950011	✓	●
Onshore Oil & Gas	Badami RTU 3 Flare Project	AQ0789CP01	✓	●
Onshore Oil & Gas	Base Operations Center (BOC)	10573011	✓	●
Onshore Oil & Gas	BPXA Central Compressor Plant	1073911	✓	●
Onshore Oil & Gas	BPXA Central Gas Facility	7734811	✓	●
Onshore Oil & Gas	BPXA Crude Oil Topping Unit, Prudhoe Bay Operations Center, Tarmac Camp	10572811	✓	●
Onshore Oil & Gas	BPXA Endicott Production Facility	1074911	✓	●
Onshore Oil & Gas	BPXA Flow Station #1	7736411	✓	●
Onshore Oil & Gas	BPXA Flow Station #2	1134611	✓	●
Onshore Oil & Gas	BPXA Flow Station #3	7734611	✓	●
Onshore Oil & Gas	BPXA Gathering Center #1	7734511	✓	●
Onshore Oil & Gas	BPXA Gathering Center #2	973011	✓	●
Onshore Oil & Gas	BPXA Gathering Center #3	7735711	✓	●
Onshore Oil & Gas	BPXA Greater Prudhoe Bay Skid 50 Pad Transfer Station - Generator	AQ1108ORL01P	✓	●
Onshore Oil & Gas	BPXA Lisburne Production Center	994011	✓	●
Onshore Oil & Gas	BPXA Milne Point S Pad (CHOPS)	AQ1165ORL01P	✓	●
Onshore Oil & Gas	BPXA Northstar Prod Facility	863311	✓	✓
Onshore Oil & Gas	BPXA Seawater Injection Plant	1091411	✓	●
Onshore Oil & Gas	BPXA Seawater Treatment Plant	7734011	✓	●
Onshore Oil & Gas	CD-5 Satellite at Alpine	PROJ CD 5 SAT		✓
Onshore Oil & Gas	ConocoPhilips Drill Site #S Palm Development Project	AQ0739ORL02P	✓	●
Onshore Oil & Gas	ConocoPhilips Meltwater Development Project	AQ0607ORL02P	✓	●
Onshore Oil & Gas	ConocoPhilips Tarn Development Project	AQ0838ORL02P	✓	●
Onshore Oil & Gas	ConocoPhillips Alaska Inc.- KRU CPF1	864611	✓	✓
Onshore Oil & Gas	ConocoPhillips Alaska Inc. - KRU CPF2	1073611	✓	●
Onshore Oil & Gas	ConocoPhillips Alaska Inc. - KRU CPF3	994111	✓	●
Onshore Oil & Gas	ConocoPhillips Alaska Inc.- KRU STP	7737211	✓	●
Onshore Oil & Gas	Deadhorse	SCC	✓	✓
Onshore Oil & Gas	Grind and Inject Facility (BPXA)	AQ0168TVP02	✓	●
Onshore Oil & Gas	Milne Point Production Facility (MPU)	1133711	✓	✓
Onshore Oil & Gas	Moose's Tooth	PROJ MOOSE TOOTH		✓
Onshore Oil & Gas	Nanuq Inc. Arctic Wolf Camp	AQ1192PL201P	✓	●
Onshore Oil & Gas	New Chukchi Sea Processing Facility	PROJ CHUKCHI SEA PRO		✓
Onshore Oil & Gas	Nikaitchuq Development	15559011	✓	●
Onshore Oil & Gas	Northstar Caribou Crossing Compressor Facility	AQ0427TVP02	✓	●

Table 15. Summary of Onshore Oil and Gas Activities

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Onshore Oil & Gas	PBU Central Power Station (CPS)	7734911	✓	●
Onshore Oil & Gas	Pioneer Natural Resources Alaska - Oooguruk Tie-in Pad	12661711	✓	●
Onshore Oil & Gas	Point Thomson	PROJ PT THOMSON		✓
Onshore Oil & Gas	Prudhoe Bay Operations Center / Main Construction Camp (PBOC/MCC)	10572311	✓	●
Onshore Oil & Gas	PS #01, TAPS Pump Station	541311	✓	✓

● in the "Full Build-Out" column means the emissions remained unchanged from baseline.

.

Table 16. Summary of Onshore Oil and Gas Activities Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m³)				
		1 Hour	3-Hour	8-Hour	24-hour	Annual
CO	Baseline	[< 0.001 - 0.595]	--	[< 0.001 - 0.326]	--	--
	Full Build-Out	[< 0.001 - 105.475]	--	[< 0.001 - 49.455]	--	--
NO_2	Baseline	[< 0.001 - 3.471]	--	--	--	[< 0.001 - 0.066]
	Full Build-Out	[< 0.001 - 17.428]	--	--	--	[< 0.001 - 3.974]
PM_{10}	Baseline	--	--	--	[< 0.001 - 0.031]	--
	Full Build-Out	--	--	--	[< 0.001 - 0.225]	--
$PM_{2.5}$	Baseline	--	--	--	[< 0.001 - 0.022]	[< 0.001 - 0.061]
	Full Build-Out	--	--	--	[< 0.001 - 0.163]	[< 0.001 - 0.008]
SO_2	Baseline	[< 0.001 - 0.016]	[< 0.001 - 0.014]	--	[< 0.001 - 0.007]	[< 0.001]
	Full Build-Out	[< 0.001 - 7.263]	[< 0.001 - 4.740]	--	[< 0.001 - 1.712]	[< 0.001 - 0.061]

Table 17. Summary of Onshore Oil and Gas Activity Impacts as a Percentage of the NAAQS

Pollutant	Inventory	Percentage of NAAQS				
		1-Hour	3-Hour	8-Hour	24-Hour	Annual
CO	Baseline	[<1%]	--	[<1%]	--	--
	Full Build-Out	[<1%]	--	[<1%]	--	--
NO_2	Baseline	[<1%]	--	--	--	[<1%]
	Full Build-Out	[<1% - 2.45%]	--	--	--	[<1%]
PM_{10}	Baseline	--	--	--	[<1%]	--
	Full Build-Out	--	--	--	[<1%]	--
$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
	Full Build-Out	--	--	--	[<1%]	[<1%]
SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	--
	Full Build-Out	[<1% - 4.08%]	[<1%]	--	[<1%]	--

Table 18. Summary of Onshore Oil and Gas Offshore Shoreline Impacts, by Stage

Source Name	Pollutant	Inventory	Range of Impact (µg/m³) 1-Hour	3-Hour	8-Hour	24-Hour	Annual
Construction	CO	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001 - 0.001]	--	[<0.001]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001 - 0.001]	--	--	--	[<0.001]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<0.001]	[<0.001]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<0.001]	[<0.001]	--	[<0.001]	[<0.001]
Drilling	CO	Baseline	[<0.001 - 0.008]	--	[<0.001 - 0.004]	--	--
		Full Build-Out	[<0.001 - 0.009]	--	[<0.001 - 0.005]	--	--
	NO_2	Baseline	[<0.001 - 0.007]	--	--	--	[<0.001]
		Full Build-Out	[<0.001 - 0.008]	--	--	--	[<0.001]
	PM_{10}	Baseline	--	--	--	[<0.001]	--
		Full Build-Out	--	--	--	[<0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	[<0.001]	[<0.001]
		Full Build-Out	--	--	--	[<0.001]	[<0.001]
	SO_2	Baseline	[<0.001 - 0.001]	[<0.001 - 0.001]	--	[<0.001]	[<0.001]
		Full Build-Out	[<0.001 - 0.002]	[<0.001 - 0.001]	--	[<0.001]	[<0.001]
Production	CO	Baseline	[0.003]	--	[0.001]	--	--
		Full Build-Out	[<0.001 - 0.002]	--	[<0.001]	--	--
	NO_2	Baseline	[0.002]	--	--	--	[<0.001]
		Full Build-Out	[<0.001 - 0.002]	--	--	--	[<0.001]
	PM_{10}	Baseline	--	--	--	[<0.001]	--
		Full Build-Out	--	--	--	[<0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	[<0.001]	[<0.001]
		Full Build-Out	--	--	--	[<0.001]	[<0.001]
	SO_2	Baseline	[<0.001]	[<0.001]	--	[<0.001]	[<0.001]
		Full Build-Out	[<0.001]	[<0.001]	--	[<0.001]	[<0.001]

4.1.6 Waste Incineration and Landfills

Municipal solid waste (i.e., paper, plastics, wood, glass, rubber, leather, textiles, and food wastes) is widely burned in the North Slope landfills to reduce the overall waste volume and to discourage scavenging by wild animals. Table 19 identifies the waste incineration, combustion, and landfills sources that were modeled, with their locations identified in Figure 11.

Table 20 summarizes the range of maximum modeled impacts from municipal solid waste sources. When the impact from each pollutant was compared to its NAAQS, all facilities were less than 1% of the NAAQS (Table 21).

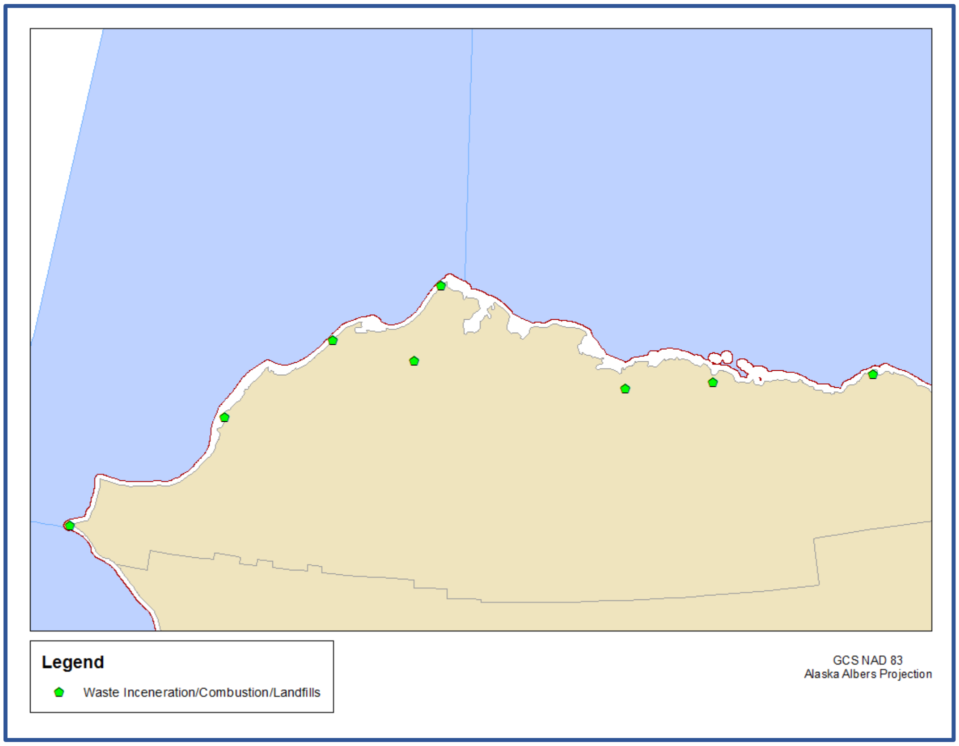


Figure 11. Location of Waste Incineration and Landfill Sites

Table 19. Summary of Waste Incineration and Landfill Sources

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Waste Incineration/Combustion/Landfills	NSB - Atqasuk LF	SW3A006 16	✓	●
Waste Incineration/Combustion/Landfills	NSB - Utqiaġvik TOS	AQ0831MSS01	✓	●
Waste Incineration/Combustion/Landfills	NSB - Kaktovik LF	SW3A076 16	✓	●
Waste Incineration/Combustion/Landfills	NSB - Nuiqsut LF	SW3A034 16	✓	●
Waste Incineration/Combustion/Landfills	NSB - Point Hope LF	SW3A035 16	✓	●
Waste Incineration/Combustion/Landfills	NSB - Point Lay LF	SW3A037 16	✓	●
Waste Incineration/Combustion/Landfills	NSB - Wainwright LF	SW3A053 16	✓	●
Waste Incineration/Combustion/Landfills	Peak Base Shop, Peak Wellex, and Nabors Base Camp Facilities	AQ1282ORL04	✓	●

● in the "Full Build-Out" column means the emissions remained unchanged from baseline.

Table 20. Summary of Waste Incineration and Landfill Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m^3)				
		1 Hour	3-Hour	8-Hour	24-Hour	Annual
CO	Baseline	[< 0.001 - 11.696]	--	[< 0.001 - 2.878]	--	--
	Full Build-Out	[0.001 - 631.600]	--	[< 0.001 - 155.408]	--	--
NO_2	Baseline	[< 0.001 - 0.826]	--	--	--	[< 0.001 - 0.004]
	Full Build-Out	[< 0.001 - 0.826]	--	--	--	[< 0.001 - 0.195]
PM_{10}	Baseline	--	--	--	[< 0.001 - 0.340]	--
	Full Build-Out	--	--	--	[< 0.001 - 0.340]	--
$PM_{2.5}$	Baseline	--	--	--	[< 0.001 - 0.252]	[< 0.001 - 0.010]
	Full Build-Out	--	--	--	[< 0.001 - 0.252]	[< 0.001 - 0.010]
SO_2	Baseline	[< 0.001 - 0.138]	[< 0.001 - 0.085]	--	[< 0.001 - 0.021]	[< 0.001]
	Full Build-Out	[< 0.001 - 7.431]	[< 0.001 - 4.612]	--	[< 0.001 - 1.148]	[< 0.001 - 0.032]

Table 21. Summary of Waste Incineration and Landfill Shoreline Impacts as a Percentage of the NAAQS

Pollutant	Inventory	Percentage of NAAQS				
		1-Hour	3-Hour	8-Hour	24-Hour	Annual
CO	Baseline	[<1%]	--	[<1%]	--	--
	Full Build-Out	[<1% - 1.58%]	--	[<1% - 1.55%]	--	--
NO_2	Baseline	[<1%]	--	--	--	[<1%]
	Full Build-Out	[<1% - 12.31%]	--	--	--	[<1%]
PM_{10}	Baseline	--	--	--	[<1%]	--
	Full Build-Out	--	--	--	[<1%]	--
$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
	Full Build-Out	--	--	--	[<1%]	[<1%]
SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	--
	Full Build-Out	[<1% - 3.79%]	[<1%]	--	[<1%]	--

4.1.7 Wastewater Treatment

Wastewater treatment plants are located in each of the North Slope communities (Figure 12). Table 22 identifies the wastewater treatment plants that were modeled. Inventory emissions represented total VOC emissions from each of the wastewater treatment plants. Wastewater treatment facilities saw no change in emissions between the baseline and the full build-out scenario (Table 23). Therefore, the modeling results for the baseline and full build-out scenario are the same.

Table 24 summarizes the range of maximum modeled impacts. Since there is not a NAAQS VOCs, but VOCs are an integral component to the ozone level, the VOC impacts were compared to the ozone SIL to provide a rough gauge of significance. Assuming a conversion ratio of 1:1, all impacts were less than the ozone SIL of 0.1 µg/m^3.

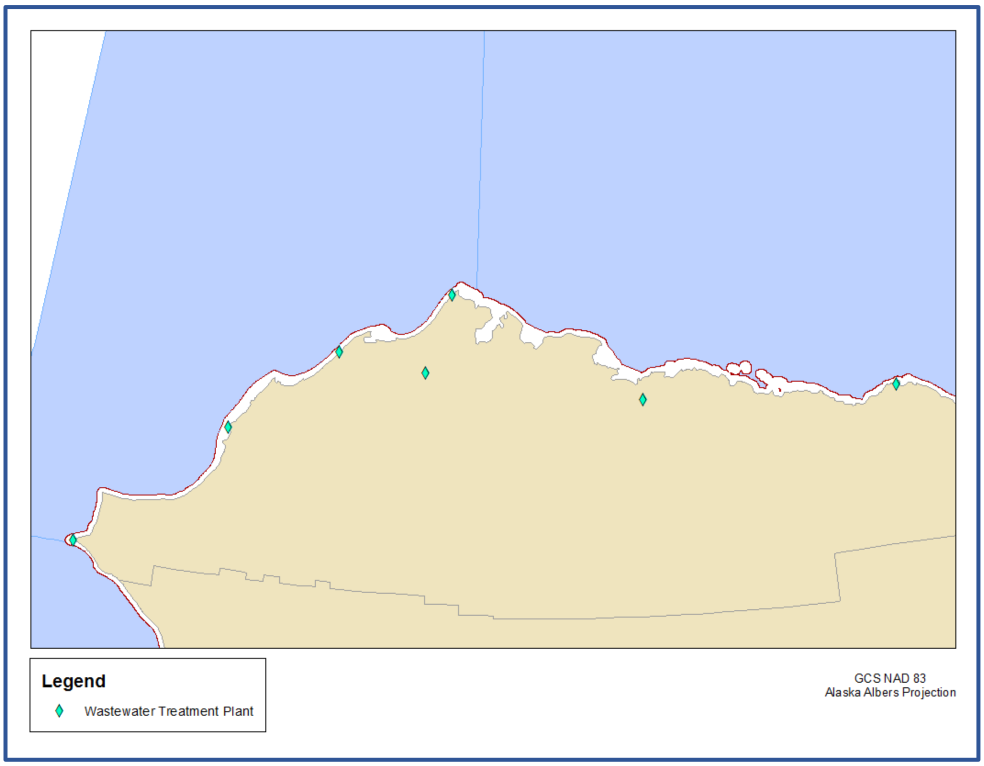


Figure 12. Location of Wastewater Treatment Plants

Table 22. Summary of Wastewater Treatment Plants

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Wastewater Treatment Plant	NSB - Atqasuk WWTP	ATQASUK WWTP	✓	●
Wastewater Treatment Plant	NSB - UtqiaġvikWWTP	BARROW WWTP	✓	●
Wastewater Treatment Plant	NSB - Kaktovik WWTP	KAKTOVIK WWTP	✓	●
Wastewater Treatment Plant	NSB - Nuiqsut WWTP	NUIQSUT WWTP	✓	●
Wastewater Treatment Plant	NSB - Point Hope WWTP	POINT HOPE WWTP	✓	●
Wastewater Treatment Plant	NSB - Point Lay WWTP	POINT LAY WWTP	✓	●
Wastewater Treatment Plant	NSB - Wainwright WWTP	WAINWRIGHT WWTP	✓	●

● in the "Full Build-Out" column means the emissions remained unchanged from baseline.

Table 23. Summary of Wastewater Treatment Plant VOC Emissions

Facility	Total Emissions (tpy)	
	Baseline	Full Build-Out
NSB - Atqasuk WWTP	0.011	0.011
NSB - UtqiaġvikWWTP	0.407	0.407
NSB - Kaktovik WWTP	0.013	0.013
NSB - Nuiqsut WWTP	0.029	0.029
NSB - Point Hope WWTP	0.036	0.036
NSB - Point Lay WWTP	0.015	0.015
NSB - Wainwright WWTP	0.034	0.034

Table 24. Summary of Wastewater Treatment Plants Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m^3) 8-Hour
VOC	Baseline	[<0.001 - 0.002]
	Full Build-Out	[<0.001 - 0.002]

4.1.8 Other Facilities

The “other facility” category in the emissions inventory generally contains industrial and commercial/institutional fuel combustion sources not contained in any other category. These sources include schools, Long-Range Radar Sites (LRRS) operated by the U.S. Air Force, and other smaller combustion sources not included in the National Emissions Inventory. Emissions are generally the result of the combustion of natural gas and distillate fuel oil for heating or energy needs. Table 25 identifies the sources that were modeled, with their locations identified in Figure 13.

Table 26 summarizes the range of maximum modeled impacts from these sources. Modeling results show that impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts).

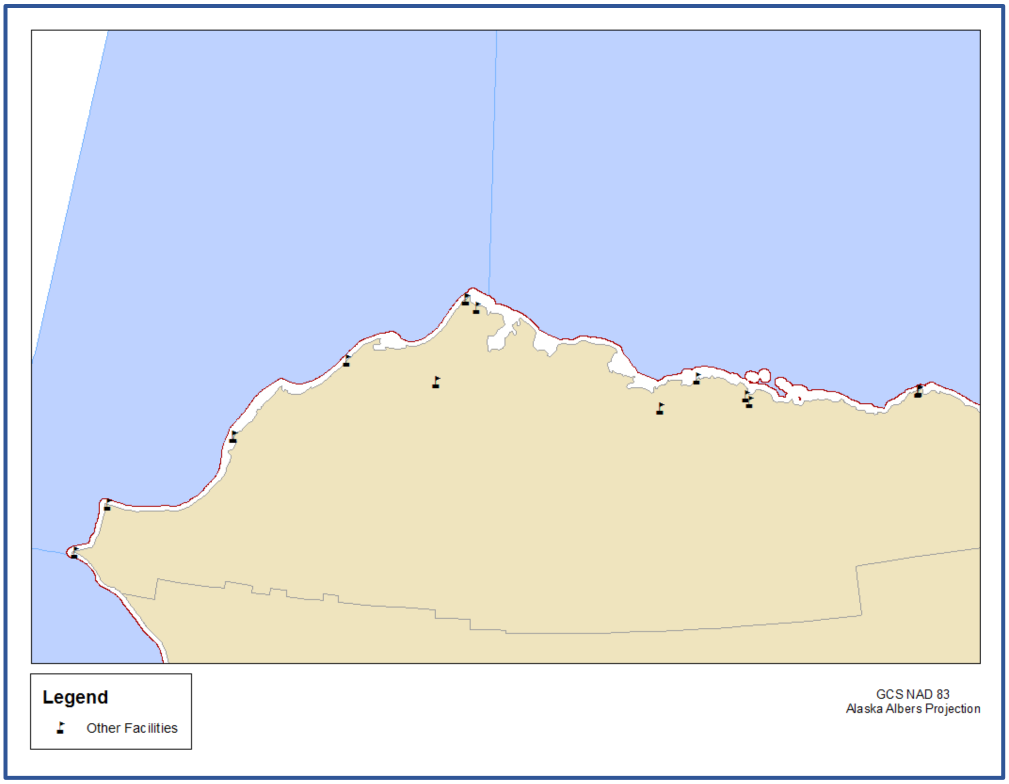


Figure 13. Location of Other Emission Sources Modeled

Table 25. Summary of Other Sources Modeled

Data Category	Facility Name	EIS Facility ID	Baseline	Full Build-Out
Other Facilities	Aeronautical Radio - East Utqiaġvik Gas Field	AERONAUTICAL RADIO	✓	●
Other Facilities	Alak School	AIN SCH	✓	●
Other Facilities	Harold Kaveolook School	KAK SCH	✓	●
Other Facilities	Kari School	PIZ SCH	✓	●
Other Facilities	Meade River School	ATQ SCH	✓	●
Other Facilities	NSB - Service Area 10 Incinerator Plant	SERVICE AREA 10 IP	✓	✓
Other Facilities	Nuiqsut Trapper School	NUI SCH	✓	●
Other Facilities	Peak Base Shop, Peak Wellex, and Nabors Base Camp Facilities	AQ1282ORL04	✓	✓
Other Facilities	Tikigaq School	PHO SCH	✓	●
Other Facilities	UIC/NARL Complex - Water Plant	NARL	✓	✓
Other Facilities	USAF - Barter Island LRRS	PAL 000378	✓	●
Other Facilities	USAF - Cape Lisburne LRRS	PAL 000379	✓	●
Other Facilities	USAF - Oliktok LRRS	PAL 000384	✓	●
Other Facilities	USAF - Point Utqiaġvik LRRS	PAL 000385	✓	✓

● in the “Full Build-Out” column means the emissions remained unchanged from baseline.

Table 26. Summary of Other Source Shoreline Impacts

Pollutant	Inventory	Range of Impact (µg/m³)				
		1 Hour	3-Hour	8-Hour	1 Hour	Annual
CO	Baseline	[< 0.001 - 0.014]	--	[< 0.001 - 0.003]	--	--
	Full Build-Out	[< 0.001 - 0.234]	--	[< 0.001 - 0.115]	--	--
NO_2	Baseline	[< 0.001 - 0.022]	--	--	--	[< 0.001]
	Full Build-Out	[< 0.001 - 0.022]	--	--	--	[< 0.001 - 0.023]
PM_{10}	Baseline	--	--	--	[< 0.001]	--
	Full Build-Out	--	--	--	[< 0.001]	--
$PM_{2.5}$	Baseline	--	--	--	[< 0.001]	[< 0.001]
	Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
SO_2	Baseline	[< 0.001 - 0.002]	[< 0.001 - 0.001]	--	[< 0.001]	[< 0.001]
	Full Build-Out	[< 0.001 - 0.002]	[< 0.001]	--	[< 0.001]	[< 0.001]

4.2 Area Sources

Areas sources encompass several unique onshore activities. Table 27 summarizes the area source categories and the emissions included for each source. Each of these source categories is discussed in the following sections.

Most of the communities had very little change in emissions between the baseline and the full build-out scenario, which led to little change in modeled impacts from these sources. Table 28 summarizes the range of maximum impacts seen from these sources. Results of modeling show that impacts correlated well with total emissions (i.e., higher emissions resulted in higher impacts). The impact from each pollutant was compared to its NAAQS. The 11.037 $\mu g/m^3$ impact was seen at the new Man Camp, and exceeded the SO_2 1-hour SIL. The facility maximum impact represents less than 6% of the 1-hour SO_2 NAAQS. The impact for all other area sources were less than 1% of the NAAQS (Table 29).

Table 27. Summary of Area Sources

Source Name		Emissions Included
Prudhoe Bay Oil and Gas Activities		Oil and Gas Activities Unpaved Roads Onroad Emissions
Chukchi Facilities		Unpaved Roads Nonroad (Construction) Emissions Onroad Emissions
Man Camp		Total Emissions
Geological and Geophysical Surveys		Survey vessels
Communities	Atqasuk Utqiaġvik Kaktovik Nuiqsut Point Hope Point Lay Wainwright	Commercial/Institutional Heating Residential Heating Unpaved Roads Nonroad emissions Onroad Emissions

Table 28. Summary of Area Source Shoreline Impacts

	Pollutant	Inventory	Range of Impact (µg/m³)				
			1-Hour	3-hour	8 Hour	24-hour	Annual
Prudhoe Bay	CO	Baseline	[0.0013 - 0.0015]	-	[< 0.001]	-	-
		Full Build-Out	-	-	-	-	-
	NO_2	Baseline	[< 0.001]	-	-	-	[< 0.001]
		Full Build-Out	-	-	-	-	-
	PM_{10}	Baseline	-	-	-	[0.008 - 0.018]	-
		Full Build-Out	-	-	-	-	-
	$PM_{2.5}$	Baseline	-	-	-	[< 0.001]	[< 0.001]
		Full Build-Out	-	-	-	-	-
	SO_2	Baseline	[< 0.001]	[< 0.001]	-	[< 0.001]	[< 0.001]
		Full Build-Out	-	-	-	-	-
Chukchi Facilities	CO	Baseline	-	-	-	-	-
		Full Build-Out	[23.155]	-	[4.701]	-	-
	NO_2	Baseline	-	-	-	-	-
		Full Build-Out	[39.670]	-	-		[0.064]
	PM_{10}	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[0.376]	-
	$PM_{2.5}$	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[0.222]	[0.005]
	SO_2	Baseline	-	-	-	-	-
		Full Build-Out	[0.078]	[0.0405]	-	[0.010]	[< 0.001]
Man Camp	CO	Baseline	-	-	-	-	-
		Full Build-Out	[36.593]	-	[7.421]	-	-
	NO_2	Baseline	-	-	-	-	-
		Full Build-Out	[1.895]	-	-		[0.141]
	PM_{10}	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[1.173]	-
	$PM_{2.5}$	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[0.649]	[0.010]
	SO_2	Baseline	-	-	-	-	-
		Full Build-Out	[11.037]	[5.438]	-	[1.250]	[0.009]
Geological and Geophysical Surveys	CO	Baseline	[< 0.001]	-	[< 0.001]	-	-
		Full Build-Out	-	-	-	-	-
	NO_2	Baseline	[0.0019]	-	-	-	[< 0.001]

Table 28. Summary of Area Source Shoreline Impacts

	Pollutant	Inventory	Range of Impact (µg/m³) 1-Hour	3-hour	8 Hour	24-hour	Annual
		Full Build-Out	-	-	-	-	-
	PM_{10}	Baseline	-	-	-	[< 0.001]	-
		Full Build-Out	-	-	-	-	-
	$PM_{2.5}$	Baseline	-	-	-	[< 0.001]	[< 0.001]
		Full Build-Out	-	-	-	-	-
	SO_2	Baseline	[< 0.001]	[< 0.001]	-	[< 0.001]	[< 0.001]
		Full Build-Out	-	-	-	-	-
Communities	CO	Baseline	[0.001 - 0.263]	-	[< 0.001]	-	-
		Full Build-Out	[< 0.001 - 0.258]	-	[< 0.001 - 0.104]	-	-
	NO2	Baseline	[< 0.001 - 0.013]	-	-	-	[< 0.001]
		Full Build-Out	[< 0.001 - 0.011]	-	-	-	[< 0.001]
	PM10	Baseline	-	-	-	[0.0015 - 0.549]	-
		Full Build-Out	-	-	-	[< 0.001 - 0.549]	-
	PM25	Baseline	-	-	-	[< 0.001 - 0.055]	[< 0.001 - 0.007]
		Full Build-Out	-	-	-	[< 0.001 - 0.055]	[< 0.001 - 0.007]
	SO2	Baseline	[< 0.001 - 0.024]	[< 0.001 - 0.015]	-	[< 0.001 - 0.008]	[< 0.001 - 0.001]
		Full Build-Out	[< 0.001]	[< 0.001]	-	[< 0.001]	[< 0.001]

Table 29. Summary of Area Source Shoreline Impacts as a Percentage of the NAAQS

	Pollutant	Inventory	Range of Impact (µg/m³)				
			1-Hour	3-hour	8 Hour	24-hour	Annual
Man Camp	CO	Baseline	-	-	-	-	-
		Full Build-Out	[<1%]	-	[<1%]	-	-
	NO_2	Baseline	-	-	-	-	-
		Full Build-Out	[1.01%]	-	-		[<1%]
	PM_{10}	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[<1%]	-
	$PM_{2.5}$	Baseline	-	-	-	-	-
		Full Build-Out	-	-	-	[1.85%]	[<1%]
	SO_2	Baseline	-	-	-	-	-
		Full Build-Out	[5.63%]	[<1%]	-	[<1%]	--

4.3 Line Sources

Line sources generally represent vehicles, vessel-based emissions (e.g., roadways, shipping lanes), or one of the many pipeline systems in the study area used to distribute extracted oil and gas. Table 30 summarizes the area source categories and the emissions included for each source.

Many of the sources modeled as lines appear only in the full build-out scenario because they are associated with potential new production in the study area. Table 31 summarizes the range of maximum modeled impacts from these sources. Modeling results show that impacts correlate well with total emissions (i.e., higher emissions resulted in higher impacts). The impact from each pollutant was compared to its NAAQS. Some NO_2 impact are over 1% of the NAAQS (i.e., Beaufort pipeline, Chukchi pipeline, and Liberty Island), but do not exceed 4% of the NAAQS. All sources were less than 1% of the NAAQS (Table 32).

Table 30. Summary of Line Sources

Source Name	Emissions Included
Shipping Lanes	Commercial Marine Vessels Drilling Vessels Resupply
Liberty Island (offshore pipeline)	Nonroad (Construction) Emissions Onroad Emissions
Dutch Harbor	Total Emissions
TAPs	TAP Fugitive Unpaved Roads Nonroad Helicopter Surveillance Exhaust Onroad Emissions
Feeder lines	Helicopter Surveillance
Surveys	Helicopter (LTO and Exhaust) Emissions Survey vessels
James Dalton Highway	Road Dust Emissions Onroad Emissions
Beaufort Pipeline	Pipeline Emissions Unpaved Roads Nonroad Emissions Onroad Emissions
Chukchi Pipeline	Pipeline Emissions Unpaved Roads Nonroad (Construction) Emissions Onroad Emissions

Table 31. Summary of Line Sources Shoreline Impacts

Source Name	Pollutant	Inventory	Range of Impact (µg/m³)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
Beaufort Pipeline	CO	Baseline	--	--	--	--	--
		Full Build-Out	[0.147 - 3.905]	--	[0.025 - 1.794]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.263 - 6.989]	--	--	--	[< 0.001 - 0.031]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[0.003 - 0.180]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[< 0.001 - 0.066]	[< 0.001 - 0.002]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[< 0.001 - 0.014]	[< 0.001 - 0.009]	--	[< 0.001 - 0.003]	[< 0.001]
Chukchi Pipeline	CO	Baseline	--	--	--	--	--
		Full Build-Out	[0.011 - 2.073]	--	[0.002 - 0.487]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.020 - 3.711]	--	--	--	[< 0.001 - 0.005]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[< 0.001 - 0.049]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[< 0.001 - 0.017]	[< 0.001]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[< 0.001 - 0.007]	[< 0.001 - 0.004]	--	[< 0.001 - 0.001]	[< 0.001]
Dutch Harbor	CO	Baseline	--	--	--	--	--
		Full Build-Out	[< 0.001]	--	[< 0.001]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.002]	--	--	--	[< 0.001]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[< 0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
	SO_2	Baseline	--	--	--	--	--

Table 31. Summary of Line Sources Shoreline Impacts

Source Name	Pollutant	Inventory	Range of Impact (µg/m³)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
		Full Build-Out	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
Feeder Lines	CO	Baseline	[< 0.001 - 0.001]	--	[< 0.001]	--	--
		Full Build-Out	[< 0.001]	--	[< 0.001]	--	--
	NO_2	Baseline	[≤ 0.001]	--	--	--	[< 0.001]
		Full Build-Out	[<0.001]	--	--	--	[< 0.001]
	PM_{10}	Baseline	--	--	--	[< 0.001]	--
		Full Build-Out	--	--	--	[< 0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	[< 0.001]	--
		Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
	SO_2	Baseline	--	--	--	[< 0.001]	[< 0.001]
		Full Build-Out	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
James Dalton Highway	CO	Baseline	[< 0.001]	--	[< 0.001]	--	--
		Full Build-Out	[< 0.001]	--	[< 0.001]	--	--
	NO_2	Baseline	[< 0.001]	--	--	--	[< 0.001]
		Full Build-Out	[< 0.001]	--	--	--	[< 0.001]
	PM_{10}	Baseline	--	--	--	[0.026 - 0.029]	--
		Full Build-Out	--	--	--	[0.026 - 0.029]	--
	$PM_{2.5}$	Baseline	--	--	--	[0.002]	[< 0.001]
		Full Build-Out	--	--	--	[0.002]	[< 0.001]
	SO_2	Baseline	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
		Full Build-Out	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
Liberty Island	CO	Baseline	--	--	--	--	--
		Full Build-Out	[0.555]	--	[0.195]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.935]	--	--	--	[0.002]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[0.010]	
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[0.007]	[< 0.001]

Table 31. Summary of Line Sources Shoreline Impacts

Source Name	Pollutant	Inventory	Range of Impact (µg/m³) 1-Hour	3-Hour	8-Hour	24-Hour	Annual
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.002]	[0.001]	--	[< 0.001]	[< 0.001]
Shipping Lanes	CO	Baseline	[< 0.001 - 0.194]	--	[< 0.001 - 0.074]	--	--
		Full Build-Out	[< 0.001 - 3.780]	--	[< 0.001 - 0.707]	--	--
	NO_2	Baseline	[< 0.001 - 1.731]	--	--	--	[< 0.001 - 0.018]
		Full Build-Out	[< 0.001 - 24.906]	--	--	--	[< 0.001 - 0.031]
	PM_{10}	Baseline	--	--	--	[< 0.001 - 0.011]	--
		Full Build-Out	--	--	--	[< 0.001 - 0.034]	--
	$PM_{2.5}$	Baseline	--	--	--	[< 0.001 - 0.009]	[< 0.001]
		Full Build-Out	--	--	--	[< 0.001 - 0.017]	[< 0.001]
	SO_2	Baseline	[< 0.001 - 0.351]	[< 0.001 - 0.275]	--	[< 0.001 - 0.070]	[< 0.001 - 0.004]
		Full Build-Out	[< 0.001 - 0.351]	[< 0.001 - 0.275]	--	[< 0.001 - 0.070]	[< 0.001 - 0.004]
Surveys	CO	Baseline	[< 0.001]	--	[< 0.001]	--	--
		Full Build-Out	--	--	--	--	--
	NO_2	Baseline	[< 0.001]	--	--	--	[< 0.001]
		Full Build-Out	--	--	--	--	--
	PM_{10}	Baseline	--	--	--	[< 0.001]	--
		Full Build-Out	--	--	--	--	--
	$PM_{2.5}$	Baseline	--	--	--	[< 0.001]	[< 0.001]
		Full Build-Out	--	--	--	--	--
	SO_2	Baseline	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
		Full Build-Out	--	--	--	--	--
TAPs	CO	Baseline	[0.008]	--	[0.002]	--	--
		Full Build-Out	[0.007]	--	[0.002]	--	--
	NO_2	Baseline	[0.018]	--	--	--	[< 0.001]
		Full Build-Out	[0.017]	--	--	--	[< 0.001]
	PM_{10}	Baseline	--	--	--	[< 0.001]	--
		Full Build-Out	--	--	--	[< 0.001]	--
	$PM_{2.5}$	Baseline	--	--	--	[< 0.001]	[< 0.001]

Table 31. Summary of Line Sources Shoreline Impacts

Source Name	Pollutant	Inventory	Range of Impact (µg/m³)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
		Full Build-Out	--	--	--	[< 0.001]	[< 0.001]
	SO_2	Baseline	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]
		Full Build-Out	[< 0.001]	[< 0.001]	--	[< 0.001]	[< 0.001]

Table 32. Summary of Line Sources Shoreline Impacts as a Percentage of the NAAQS

Source Name	Pollutant	Inventory	Range of Impact (μg/m³)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
Beaufort Pipeline	CO	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<1% -3.72%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
Chukchi Pipeline	CO	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[0.01% -1.97%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
Dutch Harbor	CO	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	--	--
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	--	--	--	--	--
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
Feeder Lines	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	[<1%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	--	--	--	[<1%]	[<1%]
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--

Table 32. Summary of Line Sources Shoreline Impacts as a Percentage of the NAAQS

Source Name	Pollutant	Inventory	Range of Impact (µg/m^3)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
James Dalton Highway	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	[<1%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	
		Full Build-Out	--	--	--	[<1%]	
	SO_2	Baseline	[<1%]	[<1%]	[<1%]	[<1%]	
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
Liberty Island	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	[<1% -13.24%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	--
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	--
Shipping Lanes	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	[<1%]	--	--	--	[<1%]
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	[<1%]
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]
Surveys	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	--	--	--	--	--
	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	--	--	--	--	--
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	--	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
		Full Build-Out	--	--	--	--	--
	SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	[<1%]
		Full Build-Out	--	--	--	--	--
TAPs	CO	Baseline	[<1%]	--	[<1%]	--	--
		Full Build-Out	[<1%]	--	[<1%]	--	--
	NO_2	Baseline	[<1%]	--	--	--	[<1%]
		Full Build-Out	[<1%]	--	--	--	[<1%]

Table 32. Summary of Line Sources Shoreline Impacts as a Percentage of the NAAQS

Source Name	Pollutant	Inventory	Range of Impact (μg/m^3)				
			1-Hour	3-Hour	8-Hour	24-Hour	Annual
	PM_{10}	Baseline	--	--	--	[<1%]	--
		Full Build-Out	--	--	--	[<1%]	--
	$PM_{2.5}$	Baseline	--	--	--	[<1%]	[<1%]
		Full Build-Out	--	--	--	[<1%]	[<1%]
	SO_2	Baseline	[<1%]	[<1%]	--	[<1%]	[<1%]
		Full Build-Out	[<1%]	[<1%]	--	[<1%]	[<1%]

5.0 OVERALL SUMMARY OF RESULTS

Overall, the results of the ADM analysis showed low estimated air quality impacts from the criteria air pollutants at the shoreline. This is largely due to low emissions from sources or large distance from the receptors. The modeling was designed for a conservatively high estimate of impact, in that the maximum hourly emission rate was used and comparison to both the NAAQS and SIL used the maximum, or high first high, impact for assessment. In addition, NO_2 modeling runs assumed a full conversion of NO to NO_2, which would provide a conservatively high estimate. Only estimates of these 1-hour NO_2 impacts showed any source over the SIL; however, these source impacts were ultimately a small percentage of the NAAQS and unlikely to cause a violation of the NAAQS at these conservatively high levels. Offshore sources had slightly higher impacts at the seaward boundary receptor locations, particularly for NO_2. However, the values were still comparable to shoreline values with respect to the percentage of the NAAQS.

As noted in Section 1.1, the individual source modeling results could be combined to provide an estimate of cumulative impact in an area. As new plans are submitted, BOEM can use the select similar sources from the modeling results and combine them to develop a rough estimate of the impacts of the proposed project. This could be used in project planning to suggest projects that might cause high impacts and warrant controls or other mitigation measures. The impact estimates could also be compared to submitted plan impact levels as a quality check. That is, the estimated impact can serve as a baseline level to compare the projects against to gauge whether plan impacts seem too high or low. For example, the modeled NO_2 estimates assume all NO_x is retained as NO_2, and as such are conservatively high. If a submitted project's estimates fall above an impact estimated from this modeling, even after accounting for any differences in emission levels and distances to the point of impact, it would suggest the modeling needs further review.

6.0 REFERENCES

BOEM, 2014. *AQScenarioSummary-rev.docx*. Provided by H. Crowley, U.S. Department of the Interior, Bureau of Ocean Energy Management (May 12).

Brashers, Bart and C. Emery, 2014. *Draft User's Manual - The Mesoscale Model Interface Program (MMIF) Version 3.1*, 2014-06-06. Prepared for OAQPS, Research Triangle Park, NC 27711, USEPA Contract No. EP-D-07-102, Work Assignments 2-06, 4-06, 5-08, and 10-1.

August 2014. Available at: http://www.epa.gov/ttn/scram/models/relat/mmif/MMIFv3.1_Users_Manual.pdf

Brashers, B.; Knapik, J.; McAlpine, J.D.; Sturtz, T.; Morris, R. 2016. Arctic Air Quality Modeling Study – Meteorological Model Performance Evaluation: 2009-2013 BOEM Arctic WRF Dataset. Prepared by Ramboll Environ U.S. Corporation for U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2015-049, 50 pp.

Brashers, B. 2017. Model Justification Report, BOEM Arctic Air Quality Impact Assessment Modeling Study. Ramboll Environ U.S. Corporation for U.S. Department of the Interior, Bureau of Ocean Energy Management. January 2017.

Carter WPL. 2009. Updated Maximum Incremental Reactivity Scale and Hydrocarbon Bin Reactivities For Regulatory Applications. California Air Resources Board Contract 07-339; 2009.

Chang, J.C. and K.J. Hahn, 1997. *User's Guide for the Offshore and Coastal Dispersion (OCD) Model* Version 5. MMS Contract No. 1435-96-PO-51307, November, 1997. Available from: http://www.epa.gov/ttn/scram/dispersion_prefrec.htm#ocd

DiCristofaro, D.C. and S.R. Hanna, 1989. OCD *The Offshore and Coastal Dispersion Model, Version 4*, Volume I: User's Guide. MMS Contract No. 14-12-001-30396, November 1989.

Fields Simms, P., R. Billings, M. Pring, R. Oommen, D. Wilson, and M. Wolf. 2014. *Arctic Air Quality Modeling Study: Emissions Inventory – Final Task Report*. Prepared by Eastern Research Group, Inc., Sacramento, CA for U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Alaska OCS Region, Anchorage, AK. OCS Study BOEM 2014-1001. 169 pp.

USDA, 2011. *Memorandum of Understanding* among the U.S. Department of Agriculture, U.S. Department of The Interior, and U.S. Environmental Protection Agency, Regarding Air Quality Analyses and Mitigation for Federal Oil and Gas Decisions Through the National Environmental Policy Act Process, June 2011.

USEPA, 1992a, *User's Manual for the Plume Visibility Model PLUVUE II (Revised)*. Publication No. EPA-454/B-92-008. OAQPS, Research Triangle Park, NC 27771, October 1992. Available at: http://www.epa.gov/ttn/scram/userg/other/PluvueUG.pdf

USEPA, 1992b. *Workbook for Plume Visual Impact Screening And Analysis (Revised)*. Publication No. EPA-454/R-92-023. OAQPS, Research Triangle Park, NC 27771, October 1992. Available at: http://www.epa.gov/ttn/scram/userg/screen/WB4PlumeVisualOCR.pdf

USEPA, 2004a. *User's Guide for the AMS/EPA Regulatory Model – AERMOD*. Publication No. EPA-454/B-03-001. OAQPS, Research Triangle Park, NC 27771, September 2004.

USEPA, 2004b. *User's Guide for the AERMOD Meteorological Preprocessor (AERMET)*. Publication No. EPA-454/B-03-002. OAQPS, Research Triangle Park, NC 27771, November 2004.

USEPA, 2004c. *User's Guide for the AERMOD Terrain Preprocessor (AERMAP)*. Publication No. EPA-454/B-03-003. OAQPS, Research Triangle Park, NC 27771, September 2004.

USEPA, 2011 AERSCREEN User's Guide. Publication No. EPA-454/B-11-001. OAQPS, Research Triangle Park, NC 27771, March 2011. Available from: http://www.epa.gov/ttn/scram/models/screen/aerscreen_userguide.pdf

USEPA, 2011a. *AERSCREEN User's Guide*. Publication No. EPA-454/B-11-001. OAQPS, Research Triangle Park, NC 27771, March 2011. Available at: http://www.epa.gov/ttn/scram/models/screen/aerscreen_userguide.pdf

USFWS, 2014. *Memorandum from Acting Regional Chief, National Wildlife Refuge System (NWSRS) Region 7 to Chief, FWS Branch of Air Quality*, re: Alaska Region of the U.S. Fish and Wildlife Service Sensitive Class II Areas. Available at http://www.fws.gov/alaska/nwr/map.htm

U.S. Forest Service, National Park Service, and US Fish and Wildlife Service. 2010. Federal land managers' air quality related values work group (FLAG): phase I report—revised (2010). Natural Resource Report NPS/ NRPC/NRR—2010/232. National Park Service, Denver, Colorado. Available at https://www.nature.nps.gov/air/Pubs/pdf/flag/FLAG_2010.pdf

The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island communities.

The Bureau of Ocean Energy Management Mission

The Bureau of Ocean Energy Management (BOEM) works to manage the exploration and development of the nation's offshore resources in a way that appropriately balances economic development, energy independence, and environmental protection through oil and gas leases, renewable energy development and environmental reviews and studies.