Environment

Submitted to:
ConocoPhillips Company
Anchorage, Alaska

Submitted by:
AECOM
Fort Collins, Colorado
60307916 task 11000
October 2013

# ConocoPhillips Alaska, Inc.
# Greater Mooses Tooth 1
# Air Quality Impact Analysis

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# 1.0 Introduction

The purpose of this ambient air quality impact analysis is to compare model predicted air quality impacts from the ConocoPhillips Alaska, Inc. (CPAI) Greater Mooses Tooth (GMT) 1 wellsite development project (Project) to applicable National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS) in the near-field and NAAQS/AAAQS and Air Quality Related Values (AQRVs) at locations within the Gates of the Arctic National Park and Preserve and the Alaska National Wildlife Refuge.

This ambient air quality impact analysis covers various activities related to the construction, and routine operation of a wellsite, access road, pipelines and ancillary facilities to support the development of petroleum resources within the GMT Unit in the National Petroleum Reserve in Alaska (NPRA). CPAI proposes to develop initially 9 wells but, over time, in an extreme best case, could develop up to 33 wells on a single wellsite designated GMT1.

The proposed GMT1 Project is located in the northeastern portion of the NPRA immediately west of the Colville River Delta. The GMT1 wellsite is approximately 14 miles west of the CPAI operated Alpine field on the North Slope of Alaska. GMT1 will be the first wellsite developed in the recently established Greater Mooses Tooth Unit. A map of the GMT1 Project area is provided in **Figure 1-1**.

## 1.1 Project Description

### 1.1.1 Existing Development

Development in the Colville River Delta began with the Alpine CD1 and CD2 wellsites and associated facilities. Oil production from CD1 commenced in November 2000 and from CD2 in November 2001. In January 2003, the Bureau of Land Management (BLM) and cooperating agencies (U.S. Army Corps of Engineers [USACE], the USEPA, the U.S. Coast Guard [USCG] and the State of Alaska) initiated the Alpine Satellite Development Plan (ASDP) Environmental Impact Statement (EIS) for five proposed drill sites (CD3 through CD7) (BLM 2004). The Final EIS was issued in September 2004 and the BLM's Record of Decision, which governs the two drill sites located on BLM lands (GMT1 and GMT2, formerly known as CD6 and CD7), was issued in November 2004.

On August 23, 2004, CPAI requested prioritization of permits for CD3 and CD4 to meet the construction schedule for those two wellsites. Most permits were issued by December 2004 and construction of CD3 and CD4 began in January 2005 and production began in 2006. Permitting for CD5 was completed in 2012 and construction is on-going.

### 1.1.2 Proposed Development

CPAI proposes placement of 72.5 acres of fill material to construct the GMT1 wellsite, an access road, pipeline valve pads, pipelines, bridge abutments, communication equipment, communication lines and power lines for oil and gas production. The proposed GMT1 Project will consist of the following components:

GMT1 wellsite facilities include:

- 11.8-acre gravel pad with space for 33 wells;
- Emergency shutdown valve skid;
- Test separator;
- Electrical control module;
- Pig launching/receiving facility;

- Chemical injection module (including tanks, containment, and truck loading facility);
- Production heater;
- Communication tower; and
- Lighting as needed.

Other Project components will include:

- 7.8-mile gravel road from CD5 to GMT1;
- 18.7-acre Clover Material Source;
- Two rig capable bridges (350 feet and 40 feet);
- 8.4 miles of pipelines from GMT1 to CD5 on new Vertical Support Members (VSMs);
- 3.3-mile-long pipeline rack on new VSMs from CD4 to CD1;
- Pipeline tie-ins at CD5 and CD1; and
- 8.4-mile power and fiber optic communication lines from CD5 supported by pipeline horizontal support members.

A close up map of the GMT1 Project area and the GMT1 Project Wellsite are shown in **Figure 1-2** and **Figure 1-3**, respectively.

## 1.2 Overview of the Ambient Air Quality Impact Analysis

This air quality impact analysis addresses the impacts on ambient air quality and AQRVs from air contaminant emissions that could result from the GMT1 Project construction and future operation. Cumulative impacts from the GMT1 Project and Reasonably Foreseeable Development (RFD) sources are also quantified. In this document, the potential ambient air quality impacts have been quantified and compared to applicable state and federal standards, and AQRV impacts (impacts on visibility [regional haze] and atmospheric deposition) have been quantified and compared to applicable thresholds as defined in the Federal Land Managers' (FLMs') Air Quality Related Values Workgroup (FLAG) guidance document (FLAG 2010), and other state and federal agency guidance. This ambient air quality impact analysis also describes the development of the GMT1 Project construction and routine operations emissions inventory and how that inventory has been translated into several dispersion modeling scenarios selected for their potential to produce the highest air quality impacts from among all possible scenarios.

**Figure 1-1 Overview of the Greater Mooses Tooth 1 Project Area**

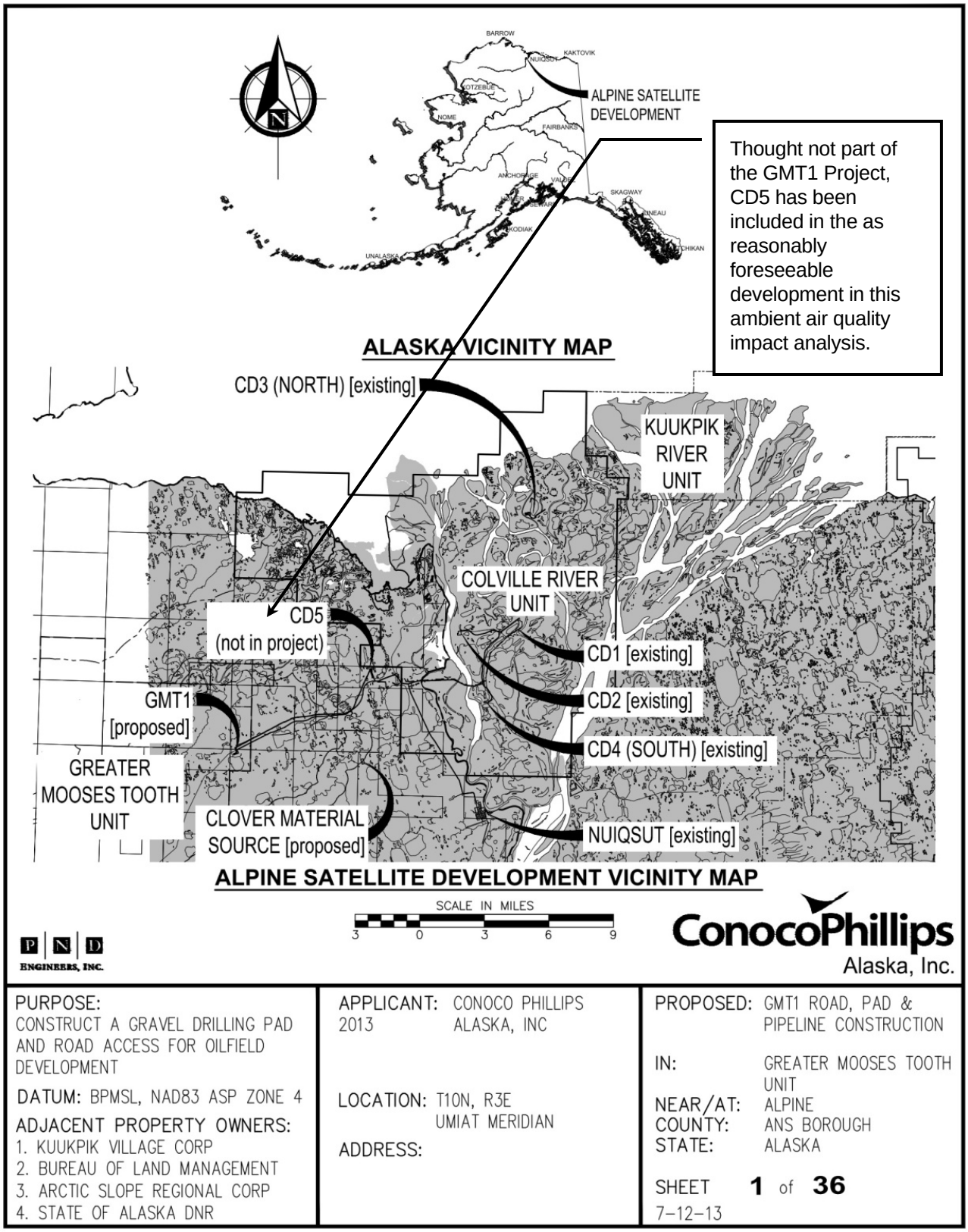


**Figure 1-2 Map of the GMT1 Project Location and Associated Facilities**

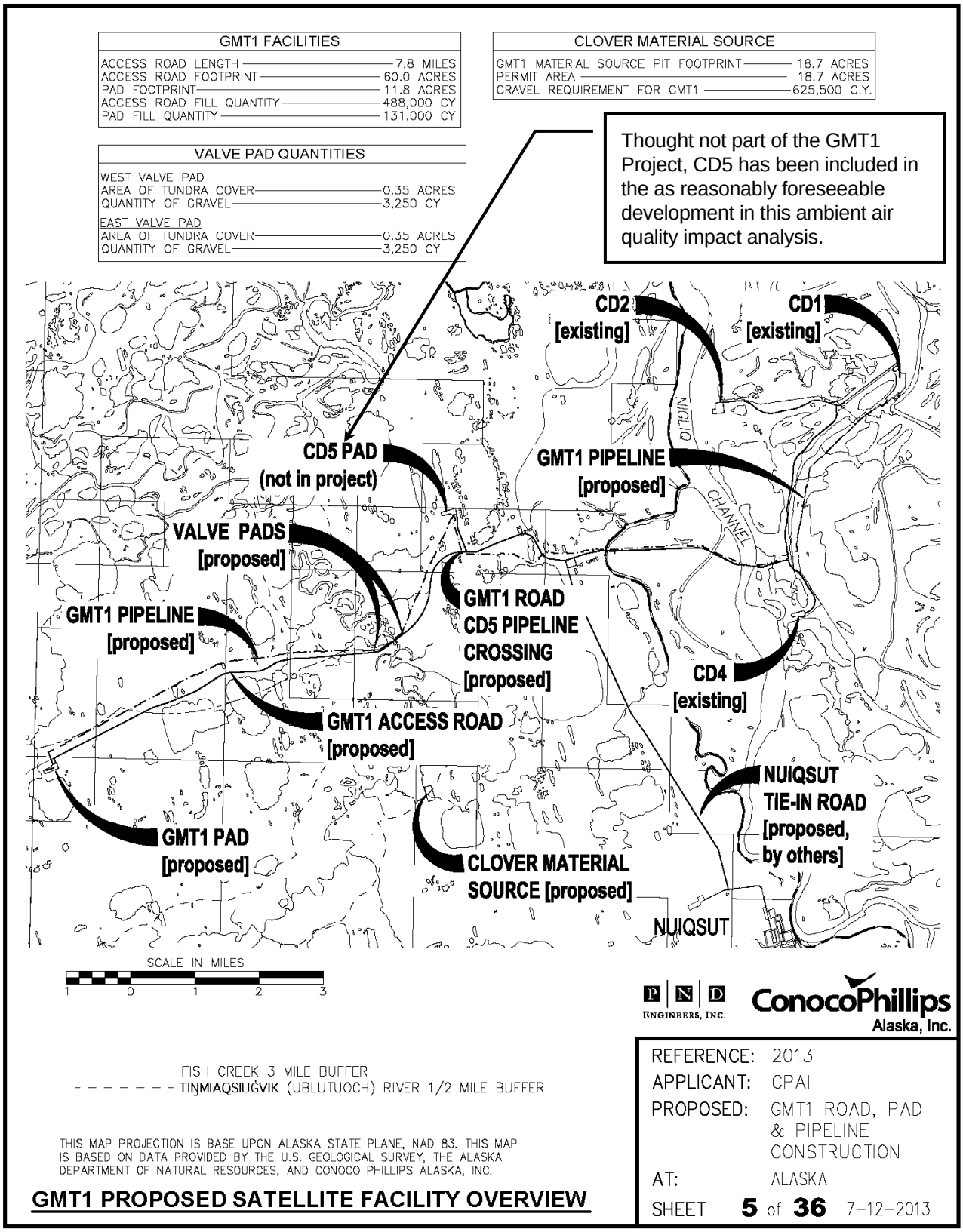
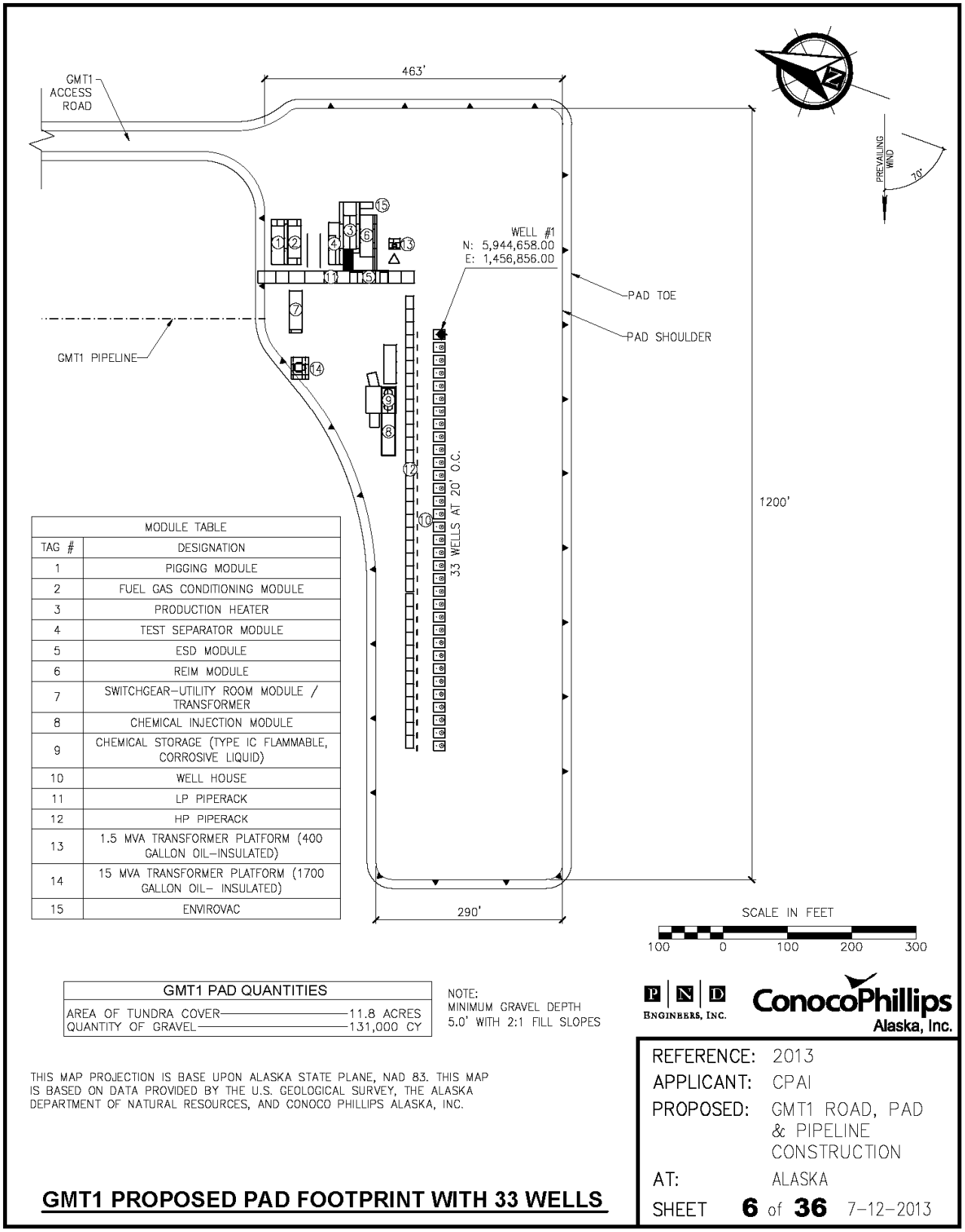


**Figure 1-3 Plot Plan of the GMT1 Wellsite**




| MODULE TABLE | |
|---|---|
| TAG # | DESIGNATION |
| 1 | PIGGING MODULE |
| 2 | FUEL GAS CONDITIONING MODULE |
| 3 | PRODUCTION HEATER |
| 4 | TEST SEPARATOR MODULE |
| 5 | ESD MODULE |
| 6 | REIM MODULE |
| 7 | SWITCHGEAR–UTILITY ROOM MODULE / TRANSFORMER |
| 8 | CHEMICAL INJECTION MODULE |
| 9 | CHEMICAL STORAGE (TYPE IC FLAMMABLE, CORROSIVE LIQUID) |
| 10 | WELL HOUSE |
| 11 | LP PIPERACK |
| 12 | HP PIPERACK |
| 13 | 1.5 MVA TRANSFORMER PLATFORM (400 GALLON OIL–INSULATED) |
| 14 | 15 MVA TRANSFORMER PLATFORM (1700 GALLON OIL– INSULATED) |
| 15 | ENVIROVAC |

# 2.0 Project Emission Inventory

This chapter discusses the emissions of $NO_x$, CO, VOC, $SO_2$, $PM_{10}$, $PM_{2.5}$, GHGs and HAPs expected to result from construction, operation and routine maintenance of the wellsite, access road, pipelines and ancillary facilities related to the GMT1 Project. The emissions inventory for the full GMT1 Project is presented in **Section 2.1**. **Section 2.2** discusses the refinements and assumptions made in order to translate these emissions into a worst-case modeled emissions inventory for the GMT1 Project.

Through the course of conducting the ambient air quality impact analysis some errors to our original assumptions were discovered regarding GMT1 Project emissions inventory. So the following changes to operational assumptions were made:

- The daily fuel consumption of the non-mobile drilling support equipment was based on a dual rig operation (the February – March 2011 CD3 project). Since the GMT1 Project is a single rig operation, the support equipment fuel consumption was halved to 950 gallons per day. Large engine tiers were also revised to Tier 2 and Tier 3 based on anticipated manufacture dates of the engines.
- The sulfur content of the non-mobile drilling support equipment was reduced to reflect the use of ultra low-sulfur diesel (ULSD) fuel for all diesel equipment related to the Project.
- It was originally assumed that the rig camp, which operates with the drill rig on the GMT1 wellsite, would operate under its own power. It was subsequently determined that the camp would be electrified along with the drill rig and would not typically have emissions.
- Emissions from the man-camps located in Nuiqsut erroneously assumed one engine per camp would typically be operating. Data supplied by ConocoPhillips in early September indicated that one camp would be electrified and the other camp would not. To correct this oversight, the emissions for one of the Nuiqsut man camps was set to zero.
- It was originally assumed that the cement units which are included in the Ball Mill module associated with drilling activities would both operate 8,760 hours per year contrary to the way these units are currently permitted throughout the Alpine field and contrary to what is known about these units. The cement units that are part of the Ball Mill only operate for very limited periods of time while a new well is being drilled. Historical usage indicates these units operate less than 122 hours per well. Therefore, the hours of operation on these units was set to 500 hours per year each consistent with the way they have been historically operated and permitted.

In addition to these operational assumptions the following minor adjustments were made with negligible change to the emissions estimates:

- Global warming potentials were adjusted to match those in Intergovernmental Panel on Climate Change (IPCC) Assessment Report 4.
- The condensable portion of the particulate emissions inventory was segregated in order to speciate carbon emissions for the far-field modeling.
- Added HAP estimates to the aircraft emissions and reduced the climb out altitude from 3,000 to 1,000 feet.
- Subdivided annual $CO_2e$ and HAP emissions into monthly estimates.
- Fixed well venting emissions calculations to properly reference the constituent weight percent values as opposed to the mol percent values.

Aside from these items which impacted the emissions estimates, some cosmetic changes were made to the spreadsheets to include missing footnotes and add additional subcategories to the summary sheets to enhance understanding of the source subgroups that were included in each major category (i.e.,

GMT1 Construction, GMT1 Routine operations, GMT1 Future Construction, and GMT1 Well Intervention) and how they were translated into emissions for modeling translated into a modeled emissions inventory representing a limited number of worst-case scenarios.

## 2.1 GMT1 Project Emissions Inventory Summary

The following figures show the Emissions Inventory developed for the GMT1 Project. **Figure 2-1** through **Figure 2-15** show the total emissions during the entire construction period (October 2015 to December 2018), as well as emissions related specifically the Infill Drilling Construction and emissions during a typical production year. Emissions from routine operations extend beyond December 2018. **Figure 2-16** details in which spreadsheet(s) emissions from each activity were calculated.

**Figure 2-1 $NO_x$ Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 0.0 | 0.0 | 0.0 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 18.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 2.5 | 3.2 | 1.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.6 | 3.8 | 2.6 | 0.5 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.4 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 1.6 | 5.8 | 4.7 | 3.3 | 2.3 | 1.8 | 0.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 4.0 | 3.2 | 2.5 | 2.2 | 1.8 | 0.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.2 | 13.2 | 12.5 | 0.0 | 10.1 | 15.8 | 11.9 | 0.0 | 1.2 | 1.2 | 1.2 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 1.1 | 4.3 | 1.1 | 0.0 | 1.1 | 4.3 | 1.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.4 | 1.0 | 0.9 | 1.1 | 0.8 | 0.7 | 0.8 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.2 | 1.0 | 0.9 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 0.7 | 0.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **GMT1 Routine Operations** | Permanent Line Heater | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| **GMT1 Future Construction** | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 19.4 | 37.1 | 37.5 | 22.8 | 37.2 | 44.2 | 34.8 | 18.6 | 19.3 | 19.3 | 19.3 | 0.3 | 0.0 | 1.3 | 22.1 | 21.3 | 25.8 | 28.1 | 25.5 | 26.7 | 25.4 | 24.7 | 24.5 | 24.6 | 24.1 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 310 | 291 | 255 | 239 | 238 | 226 | 210 | 201 | 209 | 215 | 221 | 226 | 250 | 274 | 280 | 264 | 250 | 231 | 209 | 191 | 171 | 152 | 128 | 105 | 81.5 | 58.4 | 52.6 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-2 $NO_x$ Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 | 2.2 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 | 3.4 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 77.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 81.9 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 | 6.8 |
| | **Rolling Total (ton per year) =** | 93.4 | | | | | | | | | | | | 81 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-3 CO Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 0.0 | 0.0 | 0.0 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 3.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 1.3 | 1.6 | 0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.7 | 1.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.5 | 1.7 | 1.4 | 1.0 | 0.8 | 0.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.4 | 1.2 | 1.0 | 0.8 | 0.7 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.1 | 9.5 | 9.3 | 0.0 | 7.3 | 11.7 | 8.9 | 0.0 | 0.6 | 0.6 | 0.6 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 4.2 | 16.8 | 4.2 | 0.0 | 4.2 | 16.8 | 4.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.9 | 0.7 | 0.6 | 0.7 | 0.6 | 0.4 | 0.4 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.8 | 0.7 | 0.6 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 8.2 | 30.7 | 19.1 | 5.3 | 18.6 | 34.9 | 18.6 | 4.1 | 4.6 | 4.6 | 4.6 | 0.2 | 0.1 | 0.4 | 5.1 | 4.9 | 7.5 | 8.8 | 7.6 | 8.2 | 7.5 | 7.1 | 6.9 | 7.0 | 6.7 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 154 | 145 | 115 | 101 | 101 | 89.6 | 63.5 | 52.5 | 56.5 | 59.5 | 62 | 64.4 | 71.2 | 77.8 | 80.9 | 79.3 | 77.9 | 73.9 | 68.6 | 64.6 | 59.9 | 55.9 | 49.6 | 43.5 | 37.4 | 31.6 | 29 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-4 CO Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 | 1.8 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 30.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 33.5 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| | **Rolling Total (ton per year) =** | 43.1 | | | | | | | | | | | | 42 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-5 $SO_2$ Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 0.00 | 0.00 | 0.00 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 1.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Aircraft Activity in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 40' Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Ublutuoch River Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pipeline Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Power Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Fiber Optic Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Seasonal Ice Road Construction | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.00 | 0.03 | 0.02 | 0.00 | 0.02 | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Blasting Emissions | 0.13 | 0.50 | 0.13 | 0.00 | 0.13 | 0.50 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | GMT1 Facilities Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Vertical Support Member (VSM) Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **GMT1 Routine Operations** | Permanent Line Heater | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Routine Operations - Mobile Equipment Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Routine Operations - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE |
| **GMT1 Future Construction** | Infill Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total (ton per month) =** | 1.32 | 1.73 | 1.36 | 1.21 | 1.36 | 1.74 | 1.35 | 1.2 | 1.2 | 1.2 | 1.2 | 0 | 0 | 0.01 | 1.21 | 1.21 | 1.21 | 1.22 | 1.21 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 1.22 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 14.9 | 13.6 | 11.8 | 11.7 | 11.7 | 11.5 | 11 | 10.9 | 10.9 | 10.9 | 10.9 | 11 | 12.2 | 13.4 | 13.4 | 12.3 | 11.2 | 10 | 8.89 | 7.74 | 6.59 | 5.45 | 4.28 | 3.11 | 1.95 | 0.78 | 0.76 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-6 $SO_2$ Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Aircraft Activity in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 40' Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Ublutuoch River Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pipeline Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Power Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Fiber Optic Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Seasonal Ice Road Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Blasting Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Construction Fugitive Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | GMT1 Facilities Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Vertical Support Member (VSM) Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GMT1 Routine Operations | Permanent Line Heater | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| | Routine Operations - Mobile Equipment Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | Infill Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total (ton per month) =** | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.12 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| | **Rolling Total (ton per year) =** | 0.68 | | | | | | | | | | | | 0.82 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-7 $PM_{10}$ Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 0.0 | 0.0 | 0.0 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.1 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 1.1 | 1.1 | 0.0 | 0.9 | 1.4 | 1.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.1 | 0.4 | 0.1 | 0.0 | 0.1 | 0.4 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | 9.1 | 9.1 | 9.1 | 9.1 | NE | NE | NE | NE | NE | NE | NE | NE | 60.3 | 59.6 | 59.2 | 59.2 | NE | NE | NE | NE | NE | NE | NE | NE | NE | 59.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 11.2 | 11.2 | 11.2 | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 1.4 | 2.9 | 2.7 | 1.5 | 2.7 | 3.4 | 2.7 | 1.3 | 10.5 | 10.5 | 10.5 | 9.1 | 0.0 | 0.1 | 1.5 | 1.4 | 1.8 | 1.9 | 1.8 | 1.9 | 62.2 | 61.3 | 60.9 | 61.0 | 1.7 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 59.7 | 11.2 | 11.2 | 11.2 | 0.1 | 0.1 | 0.1 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 59.2 | 57.8 | 54.9 | 53.7 | 53.6 | 52.6 | 51.1 | 50.2 | 50.8 | 102 | 153 | 204 | 256 | 257 | 258 | 257 | 256 | 255 | 253 | 252 | 250 | 248 | 198 | 148 | 98.4 | 96.8 | 96.4 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-8 $PM_{10}$ Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | 59.2 | 11.2 | 11.2 | 11.2 | NE | NE | NE | NE | NE | NE | NE | NE | 59.2 | 59.2 | 59.2 | 59.2 | NE | NE | NE |
| | Fugitive Equipment Leaks | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 | 59.6 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 59.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 121 | 11.2 | 11.2 | 11.2 | 0.1 | 0.1 | 0.1 | 60.1 | 60.1 | 60.1 | 60.1 | 60.1 | 119 | 119 | 119 | 119 | 60.1 | 60.1 | 60.1 |
| | **Rolling Total (ton per year) =** | 155.8 | | | | | | | | | | | | 958 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-9 $PM_{2.5}$ Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 0.0 | 0.0 | 0.0 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.1 | 0.3 | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.2 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 1.1 | 1.1 | 0.0 | 0.8 | 1.3 | 1.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | 1.4 | 1.4 | 1.4 | 1.4 | NE | NE | NE | NE | NE | NE | NE | NE | 6.7 | 6.6 | 6.6 | 6.6 | NE | NE | NE | NE | NE | NE | NE | NE | 6.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.7 | 1.7 | 1.7 | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 1.3 | 2.5 | 2.6 | 1.5 | 2.6 | 3.0 | 2.5 | 1.3 | 2.8 | 2.8 | 2.8 | 1.4 | 0.0 | 0.1 | 1.5 | 1.4 | 1.7 | 1.9 | 1.7 | 1.9 | 8.5 | 8.4 | 8.3 | 8.3 | 1.7 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 7.0 | 1.7 | 1.7 | 1.7 | 0.1 | 0.1 | 0.1 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 26.9 | 25.6 | 23.2 | 22.1 | 22.0 | 21.1 | 20.1 | 19.3 | 19.9 | 25.6 | 31.2 | 36.7 | 43.6 | 45.3 | 45.7 | 44.7 | 43.8 | 42.5 | 41.0 | 39.7 | 38.3 | 36.8 | 30.2 | 23.7 | 17.1 | 15.5 | 15.1 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-10 $PM_{2.5}$ Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GMT1 Routine Operations | Permanent Line Heater | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | 6.6 | 1.7 | 1.7 | 1.7 | NE | NE | NE | NE | NE | NE | NE | NE | 6.6 | 6.6 | 6.6 | 6.6 | NE | NE | NE |
| | Fugitive Equipment Leaks | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Future Construction | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 | 6.6 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 9.2 | 1.7 | 1.7 | 1.7 | 0.1 | 0.1 | 0.1 | 7.1 | 7.1 | 7.1 | 7.1 | 7.1 | 13.6 | 13.6 | 13.6 | 13.6 | 7.1 | 7.1 | 7.1 |
| | **Rolling Total (ton per year) =** | 15.0 | | | | | | | | | | | | 111.1 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-11 VOC Project Emissions Inventory During Construction**

| | | | | | Year 1 | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 0.0 | 0.0 | 0.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.3 | 0.2 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.1 | 0.4 | 0.4 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.3 | 0.2 | 0.2 | 0.2 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 1.0 | 0.9 | 0.0 | 0.7 | 1.2 | 0.9 | 0.0 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | NE | NE | NE | 0.0 | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **GMT1 Routine Operations** | Permanent Line Heater | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| **GMT1 Future Construction** | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 1.5 | 2.6 | 2.9 | 1.8 | 2.8 | 3.1 | 2.7 | 1.5 | 1.6 | 1.6 | 1.6 | 0.1 | 0.0 | 0.1 | 1.8 | 1.7 | 2.1 | 2.3 | 2.1 | 3.8 | 3.7 | 3.6 | 3.6 | 3.6 | 3.5 | 2.1 | 2.1 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.7 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 23.8 | 22.3 | 19.8 | 18.8 | 18.7 | 17.9 | 17.1 | 16.6 | 18.8 | 20.9 | 22.9 | 24.8 | 28.4 | 31.9 | 33.9 | 34.2 | 34.2 | 33.8 | 33.2 | 32.8 | 30.8 | 28.9 | 26.8 | 24.7 | 22.7 | 20.6 | 20.0 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-12 VOC Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | | Typical Production Year | | | | | | | | | | | | Infill Drilling | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Aircraft Activity in Nuiqsut | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | 40' Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Ublutuoch River Bridge Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Pipeline Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Power Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Fiber Optic Line Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Seasonal Ice Road Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Blasting Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Construction Fugitive Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | GMT1 Facilities Installation | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Vertical Support Member (VSM) Construction | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Developmental Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| **GMT1 Routine Operations** | Permanent Line Heater | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Routine Operations - Mobile Equipment Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 | 1.4 |
| **GMT1 Future Construction** | Infill Drilling | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| | Infill Drilling Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 | 0.7 |
| | Infill Drilling Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Infill Drilling - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Mobile Support Equipment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions - Fugitive Dust Emissions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | NE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | Well Interventions | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 4.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | **Total (ton per month) =** | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 7.0 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| | **Rolling Total (ton per year) =** | 23.6 | | | | | | | | | | | | 37.9 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-13 HAPs Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Aircraft Activity in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 40' Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Ublutuoch River Bridge Construction | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pipeline Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Power Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Fiber Optic Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Seasonal Ice Road Construction | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.08 | 0.09 | 0.09 | 0.00 | 0.02 | 0.02 | 0.02 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Blasting Emissions | NE | NE | NE | 0.00 | NE | NE | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | GMT1 Facilities Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Vertical Support Member (VSM) Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GMT1 Routine Operations | Permanent Line Heater | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| | Routine Operations - Mobile Equipment Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Routine Operations - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| GMT1 Future Construction | Infill Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total (ton per month) =** | 0.11 | 0.12 | 0.13 | 0.05 | 0.06 | 0.07 | 0.06 | 0.04 | 0.04 | 0.04 | 0.04 | 0.02 | 0.02 | 0.02 | 0.05 | 0.05 | 0.07 | 0.08 | 0.07 | 0.17 | 0.17 | 0.17 | 0.17 | 0.17 | 0.16 | 0.2 | 0.2 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.13 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 0.77 | 0.68 | 0.59 | 0.5 | 0.5 | 0.51 | 0.52 | 0.53 | 0.67 | 0.8 | 0.93 | 1.06 | 1.2 | 1.35 | 1.53 | 1.68 | 1.81 | 1.92 | 2.02 | 2.13 | 2.13 | 2.1 | 2.1 | 2.1 | 2 | 2 | 1.9 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-14 HAPs Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | Emission Producing Activities | Typical Production Year 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Infill Drilling 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GMT1 Construction | Use of 2 Camps in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Aircraft Activity in Nuiqsut | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 40' Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Ublutuoch River Bridge Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Pipeline Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Power Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Fiber Optic Line Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Seasonal Ice Road Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Blasting Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Construction Fugitive Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | GMT1 Facilities Installation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Vertical Support Member (VSM) Construction | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Developmental Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| GMT1 Routine Operations | Permanent Line Heater | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| | Routine Operations - Mobile Equipment Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| GMT1 Future Construction | Infill Drilling | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| | Infill Drilling Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| | Infill Drilling Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Infill Drilling - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Mobile Support Equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions - Fugitive Dust Emissions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | NE | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | Well Interventions | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | **Total (ton per month) =** | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.19 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 | 0.24 |
| | **Rolling Total (ton per year) =** | 1.6 | | | | | | | | | | | | 3 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-15 $CO_2e$ Project Emissions Inventory During Construction**

| | | Year 1 | | | | | | | | | | | | | | | Year 2 | | | | | | | | | | | | Year 3 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 0 | 0 | 0 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 667 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Aircraft Activity in Nuiqsut | 8 | 8 | 8 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 40' Bridge Construction | 0 | 0 | 0 | 0 | 768 | 192 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ublutuoch River Bridge Construction | 0 | 0 | 0 | 0 | 530 | 663 | 398 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Pipeline Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 708 | 975 | 660 | 121 | 60 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Line Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 92 | 73 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fiber Optic Line Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 58 | 58 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Seasonal Ice Road Construction | 0 | 368 | 1335 | 1068 | 736 | 506 | 405 | 101 | 0 | 0 | 0 | 0 | 0 | 286 | 921 | 737 | 568 | 498 | 399 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 58 | 2944 | 2824 | 0 | 2266 | 3560 | 2698 | 0 | 336 | 336 | 336 | 84 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blasting Emissions | 21 | 84 | 21 | 0 | 21 | 84 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Construction Fugitive Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | 0 | 0 | 0 | 0 | 0 | 0 |
| | GMT1 Facilities Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 228 | 299 | 223 | 211 | 253 | 188 | 159 | 190 | 76 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 241 | 305 | 252 | 232 | 56 | | | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Support Member (VSM) Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 149 | 64 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Flowback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 49 | 6 | 6 | 6 | 6 | 6 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| **GMT1 Routine Operations** | Permanent Line Heater | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 |
| | Routine Operations - Mobile Equipment Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Routine Operations - Fugitive Dust Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 37 | 37 | 37 | 37 | 37 | 37 |
| **GMT1 Future Construction** | Infill Drilling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Infill Drilling Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Infill Drilling Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Infill Drilling - Fugitive Dust Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Flowback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions - Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions - Fugitive Dust Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total (ton per month) =** | 754 | 4071 | 4855 | 1744 | 4997 | 5680 | 4197 | 777 | 1012 | 1012 | 1012 | 93 | 9 | 295 | 1597 | 1413 | 2537 | 3051 | 2405 | 3062 | 2735 | 2574 | 2525 | 2556 | 2442 | 2850 | 2850 | 2807 | 2807 | 2807 | 2807 | 2807 | 2807 | 1192 | 1192 | 1192 | 1192 | 1192 | 1192 |
| | **Rolling Total (ton per year) =** | na | na | na | na | na | na | na | na | na | na | na | na | 30203 | 29459 | 25682 | 22424 | 22092 | 19632 | 17002 | 15210 | 17496 | 19219 | 20781 | 22294 | 24757 | 27189 | 29744 | 30997 | 32391 | 32661 | 32417 | 32819 | 32564 | 32636 | 31254 | 29921 | 28557 | 27307 | 25650 |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-16 $CO_2e$ Project Emissions Inventory During a Typical Production Year and During the Infill Drilling Period**

| | | Typical Production Year | | | | | | | | | | | | Infill Drilling | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Emission Producing Activities** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** |
| **GMT1 Construction** | Use of 2 Camps in Nuiqsut | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Aircraft Activity in Nuiqsut | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | 40' Bridge Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Ublutuoch River Bridge Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Pipeline Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Power Line Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Fiber Optic Line Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Seasonal Ice Road Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Gravel Roads, Pad Construction and Gravel Mining | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blasting Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Construction Fugitive Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | GMT1 Facilities Installation | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Vertical Support Member (VSM) Construction | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Developmental Drilling Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Flowback | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **GMT1 Routine Operations** | Permanent Line Heater | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 | 1150 |
| | Routine Operations - Mobile Equipment Emissions | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| | Routine Operations - Fugitive Dust Emissions | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Fugitive Equipment Leaks | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 | 37 |
| **GMT1 Future Construction** | Infill Drilling | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 | 1252 |
| | Infill Drilling Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 | 302 |
| | Infill Drilling Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 | 87 |
| | Infill Drilling - Fugitive Dust Emissions | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE | NE |
| | Well Flowback | 0 | 0 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| **GMT1 Well Interventions** | Well Interventions - Non-Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 302 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions - Mobile Support Equipment | 0 | 0 | 0 | 0 | 0 | 87 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions - Fugitive Dust Emissions | 0 | 0 | 0 | 0 | 0 | NE | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Well Interventions | 0 | 0 | 0 | 0 | 0 | 6395 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **Total (ton per month) =** | 1192 | 1192 | 1192 | 1192 | 1192 | 7982 | 1192 | 1192 | 1192 | 1192 | 1192 | 1192 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 | 2839 |
| | **Rolling Total (ton per year) =** | 21094 | | | | | | | | | | | | 34071 | | | | | | | | | | | |

**NE - No Emissions of this pollutant for this source.**

**Figure 2-17 GMT1 Project Activities Information Regarding the Location of Emissions Calculations**

| | Activity | Spreadsheet(s) in Which Emissions Are Calculated | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | GMT1 Construction Equipment Emissions | GMT1 Fugitive Dust Emissions | GMT1 Well Flowback Emissions | GMT1 Permanent Operations Criteria and GHG Emissions | GMT1 Drilling Inventory Emissions | GMT1 Permanent Operations HAP Emissions | GMT1 Mobile Drilling Inventory Emissions |
| GMT1 Construction | Use of 2 Camps in Nuiqsut | X | | | | | | |
| | Aircraft Activity in Nuiqsut | X | | | | | | |
| | 40' Bridge Construction | X | | | | | | |
| | Ublutuoch River Bridge Construction | X | | | | | | |
| | Pipeline Installation | X | | | | | | |
| | Power Line Installation | X | | | | | | |
| | Fiber Optic Line Installation | X | | | | | | |
| | Seasonal Ice Road Construction | X | | | | | | |
| | Gravel Roads, Pad Construction and Gravel Mining | X | | | | | | |
| | Blasting Emissions | X | | | | | | |
| | Construction Fugitive Emissions | | X | | | | | |
| | GMT1 Facilities Installation | X | | | | | | |
| | Alpine ACF and CD5 Facilities Installation Related to GMT1 | X | | | | | | |
| | Vertical Support Member (VSM) Construction | X | | | | | | |
| | Developmental Drilling | | | | | X | | |
| | Developmental Drilling Non-Mobile Support Equipment | | | | | X | | |
| | Developmental Drilling Mobile Support Equipment | | | | | | | X |
| | Well Flowback | | | X | | | | |
| GMT1 Routine Operations | Permanent Line Heater | | | | X | | X | |
| | Routine Operations - Mobile Equipment Emissions | | | | X | | | |
| | Routine Operations - Fugitive Dust Emissions | | X | | | | | |
| | Fugitive Equipment Leaks | | | | X | | | |
| GMT1 Future Construction | Infill Drilling | | | | | X | | |
| | Infill Drilling Non-Mobile Support Equipment | | | | | X | | |
| | Infill Drilling Mobile Support Equipment | | | | | | | X |
| | Infill Drilling - Fugitive Dust Emissions | | X | | | | | |
| | Well Flowback | | | X | | | | |
| GMT1 Well Interventions | Well Interventions - Non-Mobile Support Equipment | | | | | X | | |
| | Well Interventions - Mobile Support Equipment | | | | | | | X |
| | Well Interventions - Fugitive Dust Emissions | | X | | | | | |
| | Well Interventions | | | | X | | X | |

### 2.1.1 GMT1 Construction Project Emissions Inventory

Emissions related to construction activities are a result of:

- fuel combustion in the nonroad and onroad equipment associated with the construction activities,
- heaters and engine generators (including the drill rig camp generator),
- fugitive road dust,
- airport emissions, and
- blasting emissions.

Emissions of criteria pollutants ($NO_x$, CO, VOC, $SO_2$, $PM_{10}$, $PM_{2.5}$) as well as carbon dioxide ($CO_2$) from nonroad construction equipment were calculated based on the emissions calculation procedures described in "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition", July 2010, EPA-420-R-10-018. According to the document referenced above, 98.4% of THC is non-methane hydrocarbon (NMHC). Therefore, emissions of methane ($CH_4$) were calculated based on the total hydrocarbon (THC) emissions by applying a factor of (1-0.984) to the THC emissions. Emissions of nitrous oxide ($N_2O$) were calculated based on emission factors presented in Table 13.1 of The Climate Registry's General Reporting Protocol and a higher heating value (HHV) of 138,000 Btu/gallon for diesel. Emissions of greenhouse gases (GHGs) expressed as carbon dioxide equivalents ($CO_2e$) were calculated from emissions of $CO_2$, $CH_4$ and $N_2O$ by applying the 100-year global warming potentials (GWPs) from Intergovernmental Panel on Climate Change's (IPCC's) Fourth Assessment Report (AR4). Emissions of hazardous air pollutants (HAPs) from nonroad engines were calculated based on emission factors presented in AP-42 Table 3.3-2 and Table 3.4-3.

Emissions of $NO_x$, CO, VOC, $SO_2$, $PM_{10}$, $PM_{2.5}$, $CO_2$, $CH_4$, $N_2O$ and HAPs from onroad equipment were estimated based on EPA's MOVES2010b motor vehicle emissions estimation program. Year 2011 is used as the base year for the North Slope Borough. The latest county-specific MOVES2010b input data available from Alaska Department of Environmental Conservation (ADEC) was used. MOVES generates emission factors in the units of grams per mile (g/mi) which are then multiplied by the average speed of vehicles (in this case, 20 miles per hour) to obtain hourly emissions. Emissions of GHGs (CO2e) were calculated from emissions of $CO_2$, $CH_4$ and $N_2O$ by applying the 100-year GWPs from IPCC's AR4.

Emissions of $NO_x$, CO, $SO_2$, $PM_{10}$ (filterable), and $PM_{2.5}$ (filterable) from heaters (boilers) were calculated based on emission factors presented in AP-42 Table 1.3-1. Emissions of $SO_2$ were estimated based on a fuel sulfur content of 15 ppmw. Emissions of VOC were based on emission factors presented in AP-42 Table 1.3-3. Emissions of HAPs were based on emission factors presented in AP-42 Table 1.3-9 and 1.3-10. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.7 ($CH_4$ and $N_2O$). Emission factors were converted from the units of lb/1,000 gal to lb/MMBtu using a higher heating value of 140,000 Btu/gal for diesel. The rated heat input and daily/weekly/annual activity levels for the boilers were provided by CPAI.

Emissions of $NO_X$, CO, $SO_2$, TOC, $PM_{10}$, and $PM_{2.5}$ from engines were calculated based on emission factors presented in AP-42 Table 3.3-1. Emissions of $SO_2$ were estimated based on a fuel sulfur content of 15 ppmw. Emissions of HAPs were based on emission factors presented in AP-42 Table 3.3-2. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.9 ($CH_4$ and $N_2O$). Emission factors were converted from the units of lb/MMBtu to lb/hp-hr using a brake specific fuel consumption of 7,000 Btu/hp-hr. The rated heat input and daily/weekly/annual activity levels for the engines were provided by CPAI.

Emissions related to air traffic were estimated based on data provided by the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS). The EDMS emissions assume three (3) landing take-offs (LTOs) per week to/from each airport. Emissions also assume one (1) LTO/week for the months of October-April. It is assumed that one (1) heater is required for ground support equipment. Plane emissions include ground taxiing, take off, and flight up to 1,000 feet altitude. The emissions are presented for October 2015 through December 2018. Emissions of GHGs include $CO_2$ only as appropriate emission factors for $N_2O$ and $CH_4$ were not found.

Emissions of $NO_x$ and CO associated with blasting were estimated based on emission factors presented in AP-42 Section 13.3. Emissions of $PM_{10}$ and $PM_{2.5}$ resulting from blasting were calculated based on emission factors presented in AP-42 Section 11.9. Emissions of $CO_2$ resulting from blasting were calculated based on methods presented in Australian Greenhouse Office (AGO) Factors and Methods Workbook, December 2012, Section 2.3. Emissions of GHGs include $CO_2$ only as appropriate emission factors for $N_2O$ and $CH_4$ were not found. Weekly emissions were based on a blasting frequency of 5 blasts per week and blasting is estimated to occur over a 12 week period.

### 2.1.2 Developmental Drilling Project Emissions Inventory

Developmental drilling emissions consist of emissions associated with the main Doyon 19 drill rig on highline power and several mobile and stationary units in a supporting role. The Doyon 19 emission units consist of three (3) heaters, two (2) boilers and three (3) engines as deployed in drilling operations for this project. Of these engines , 2 are cement pumps which rarely operate and the remaining engine is a primary power generation engine which operates in spinning reserve incase highline power becomes temporarily unavailable. The stationary support equipment consists of six (6) boilers and fifteen (15) engines. Mobile support equipment consists of eight (8) vacuum trucks, four (4) heavy duty diesel trucks and eight (8) light pickup trucks.

Emissions of $NO_x$, CO, $SO_2$, $PM_{10}$, and $PM_{2.5}$ from boilers in main and support service were calculated based on emission factors presented in AP-42 Table 1.3-1. Emissions of $SO_2$ were estimated based on a fuel sulfur content of 15 ppmw. Emissions of VOC were based on emission factors presented in AP-42 Table 1.3-3. Emissions of HAPs were based on emission factors presented in AP-42 Table 1.3-9 and 1.3-10. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.7 ($CH_4$ and $N_2O$).

Emissions of $NO_x$, CO, VOC, and $PM_{10}$ from engines were calculated based on emission factor data supplied by Caterpillar. Emissions of $PM_{10}$ were assumed to be equal to $PM_{2.5}$. Emissions of $SO_2$ were estimated based on a fuel sulfur content of 15 ppmw. Emissions of HAPs were based on emission factors presented in AP-42 Table 3.3-2. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.9 ($CH_4$ and $N_2O$).

Emissions of $NO_x$, CO, VOC, $SO_2$, $PM_{10}$, $PM_{2.5}$, $CO_2$, $CH_4$, $N_2O$ and HAPs from onroad equipment were estimated based on EPA's MOVES2010b motor vehicle emissions estimation program. The latest county-specific MOVES2010b input data available from ADEC was used. The MOVES generated emission factors (g/mi) were multiplied by the average speed of vehicles (20 miles per hour) to obtain hourly emissions (lb/hr). The daily operating hours per unit for the heavy vehicles were calculated based on the assumption that the vehicle travels 26.2 miles (roundtrip from Alpine to the GMT1 wellsite) and spends one (1) hour at the wellsite daily. The pickup trucks spend only 0.25 hour at the well site. The hourly emissions were used to calculate the daily emissions (tons/day) and the monthly emissions (tons/month).

Developmental drilling also includes emissions from well flowback. Well flowback emissions were based on a simulation conducted using the ProMax 3.2 software. Emission factors (lb/barrel) were developed for the separator vent and tank vent for the pre-production and the production phases of flowback using ProMax 3.2 simulation and these emission factors were multiplied by the hourly fluid volume pumped

(barrels/hour) to obtain hourly emissions. The fluid composition is such that only 40 percent of the fluid consists of hydrocarbons. Each well will experience one (1) flowback with each flowback taking up to three (3) days. A total of 1,000 barrels of fluid volume will be generated during each flowback.

Emissions of GHGs ($CO_2e$) were calculated from emissions of $CO_2$, $CH_4$ and $N_2O$ by applying the 100-year GWPs from IPCC's AR4.

### 2.1.3 Well Interventions Project Emissions Inventory

To be conservative, emissions from well interventions were estimated based on operation of the well frac unit for conservatism, since this unit results in higher emissions than other types of well intervention equipment such as a coil tubing unit. In addition to the boilers and engines associated with the well frac unit, there are several stationary and mobile support equipment units that contribute to this emissions inventory. The well frac unit consists of engines totaling 15,510 hp.

Emissions of $NO_x$, $SO_2$, CO, VOC, $PM_{10}$ and $PM_{2.5}$ from the "small" engines in well intervention service were calculated based on emission factor data provided in AP-42 Table 3.3-1. Emissions from the "large" engines in well intervention service were calculated based on emission factor data provided in AP-42 Table 3.4-1 and 3.4-1. Emissions of HAPs from "small" engines were based on emission factors presented in AP-42 Table 3.3-2 while those for "large" engines were based on AP-42 Table 3.4-3 and Table 3.4-4. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.9 ($CH_4$ and $N_2O$).

The methods used to calculate emissions from the nonroad and mobile support equipment is similar to those described in Section 2.1.3.

### 2.1.4 Routine Operations Project Emissions Inventory

Routine operations emissions inventory consists of mobile equipment associated with transporting workers to and from the site, fugitive particulate emissions resulting from disturbed areas and vehicle travel on unpaved roads, fugitive VOC emissions from the pipeline components and a natural gas fired main production heater.

Emissions of $NO_x$ and CO from the production heater were calculated based on emission factors presented in AP-42 Table 1.4-1. Emissions of VOC, $PM_{10}$ and $PM_{2.5}$ were based on emission factors in AP-42 Table 1.4-2. Emissions of $SO_2$ were based on a mass balance approach and a fuel sulfur content of 40 ppmv. Emissions of HAPs were based on emission factors presented in AP-42 Table 1.4-3 and 1.4-4. Emissions of GHGs were calculated based on emission factors presented in The Climate Registry General Reporting Protocol Chapter 12, Table 12.1 ($CO_2$) and 12.7 ($CH_4$ and $N_2O$).

Emissions of $NO_x$, CO, VOC, $SO_2$, $PM_{10}$, $PM_{2.5}$, $CO_2$, $CH_4$, $N_2O$ and HAPs from onroad sources associated with routine operations were estimated based on EPA's MOVES2010b motor vehicle emissions estimation program. The latest county-specific MOVES2010b input data available from ADEC was used. The MOVES generated emission factors (g/mi) were multiplied by the average speed of vehicles (20 miles per hour) to obtain hourly emissions (lb/hr). The daily operating hours per unit for the heavy vehicles were calculated based on the assumption that the vehicle travels 26.2 miles (roundtrip from Alpine to the GMT1 wellsite) and spends a certain amount of time at the wellsite daily. The mechanics truck spends four (4) hours at the well site while the pickup and crew cab trucks spend one (1) hour at the wellsite. The hourly emissions were used to calculate the daily emissions (tons/day) and the monthly emissions (tons/month).

Fugitive emissions of VOC occur as a result of leaks in pipeline components such as valves, flanges, connectors, pump seals and others. Emission factors to quantify emissions from equipment leaks were taken from Table 2-4 of "Protocol for Equipment Leak Emission Estimates", EPA-453/R-95-017. The emission factors are in the units of kilogram of hydrocarbon/hr/count. The numbers of each type of

pipeline component was based on a representative component counts for similar service from "Methane Emissions for the Natural Gas Industry: Volume 8: Equipment Leaks", GRI-94/0257.25 (EPA-600/R-96-080). The pipelines are in light oil service in addition to natural gas. Therefore, mole fractions (and subsequently weight fractions) of various constituents were developed using flash gas and flash oil analyses via a ProMax 3.2 simulation for both natural gas and light oil. The hourly emissions (lb/hr) were used to calculate the monthly emissions (tons/month) based on 730 hours/month.

Fugitive emissions of particulate matter result primarily from gravel sourcing from the Clover Material site, general disturbed areas during construction of wellsite, vehicle travel on unpaved (gravel) roads during wellsite construction, developmental drilling and wellsite routine operations and maintenance. It is assumed that the conditions from October through May are considered winter and are characterized by significant snow cover and/or frozen ground. Therefore, little, if any, fugitive dust would be generated during this time. Moreover, vehicles will travel on ice roads during these months and use of gravel roads will be minimal.

Emissions of $PM_{10}$ and $PM_{2.5}$ generated by the process of gravel extraction consist of:

- Particulates generated by overburden and gravel extraction and stockpiling – Emission factor for overburden extraction and stockpiling was taken from Equation 1 of AP-42 Section 13.2.4. The emissions factor takes into account wind speed and material's moisture content to calculate total suspended particulate (TSP) emission factor which can be converted to $PM_{2.5}$ and $PM_{10}$ emission factors by applying the appropriate particle size multiplier. Since the moisture of overburden and gravel is expected to be high due to the ground being snow covered most part of the year, the high end of the range of moisture contents (4.8%) that justifies the validity of the emission factor was used.
- Particulates generated by gravel crushing – $PM_{10}$ and $PM_{2.5}$ emission factors for the gravel crushing operation were taken from AP-42 Table 11.19.2-2 (Controlled tertiary crushing). It should be noted that while primary crushing will likely be sufficient for the purposes of developing gravel for roads, tertiary crushing factors were used because there are no data available for primary and secondary crushing in AP-42.

Emissions of $PM_{10}$ and $PM_{2.5}$ generated by vehicle travel on the gravel roads were calculated based on the method presented in Equation 1a of AP-42 Section 13.2.2. The emission factor (lb/vehicle mile traveled) was multiplied by the total miles traveled by the vehicle per hour (20 miles per hour) to obtain a maximum hourly emission rate. The total miles travelled per day per vehicle were calculated based on the number of trips per day and total roundtrip miles per trip (26.2 miles). The total number of each vehicle type per month provided by CPAI was divided by 30 to obtain the average number of vehicles (or trips) per day.

In addition to vehicle travel on unpaved roads and gravel extraction, there are general disturbed areas created during the life of the wellsite construction. In particular, construction of the gravel roads, construction of the wellsite and installation of the pipeline, power line and communications line will result in disturbed areas. Emissions of TSP, $PM_{10}$ and $PM_{2.5}$ from these areas were calculated based on the emission factor available in AP-42 Section 13.2.3.3 (1.2 ton/acre/month) and the particle size multipliers from AP-42 Section 13.2.5.3. The area of disturbance was provided by CPAI. Since the disturbed areas will be watered periodically to mitigate fugitive dust emissions, a control factor of 75% was applied to the particulate emissions.

### 2.1.5 Infill Drilling Project Emissions Inventory

Similar to developmental drilling, infill drilling emissions consist of emissions associated with the main Doyon 19 drill rig and several mobile and stationary units in a supporting role. The Doyon 19 emission units consist of three (3) heaters, two (2) boilers, and three (3) engines as deployed in drilling operations for this project. Of the engines, 2 are cement pumps which rarely operate and the remaining engine is a primary power generation engine which operates in spinning reserve incase highline power becomes

temporarily unavailable. The stationary support equipment consists of six (6) boilers and fifteen (15) engines. Mobile support equipment consists of eight (8) vacuum trucks, four (4) heavy duty diesel trucks and eight (8) light pickup trucks. For detailed discussion of the emission estimation methodology, see Section 2.1.2.

## 2.2 GMT1 Project Modeled Emissions Inventory Summary

The near-field ambient air quality impact analysis was conducted to quantify maximum pollutant impacts within and nearby the GMT1 Project as a result of GMT1 Project-related construction and operational emissions. Impacts from criteria pollutant emissions of $PM_{10}$, $PM_{2.5}$, $NO_x$, $SO_2$, and CO, and emissions of air toxics (benzene, toluene, ethyl benzene, xylene, n-hexane, and formaldehyde) were evaluated as part of the study.

Several factors were considered when developing modeling scenarios to demonstrate compliance with the ambient air quality standards. These factors include the GMT1 Project's construction and operation schedule (and any overlapping therein); the location of GMT1 Project-related emissions and their proximity to ambient air or sensitive receptors; and the relative magnitude and type of emissions for each activity.

With consideration of the above factors, the five scenarios that were selected for the nearfield analysis were:

1) Access Road and Pad Construction;
2) Mining the Clover Material Source;
3) Infill Drilling;
4) Operation of the Nuiqsut man camps, and
5) Well Intervention.

These scenarios are expected to cover the range of GMT1 Project-related, worst-case emission scenarios for the various pollutants (e.g., maximum $PM_{10}$ and $PM_{2.5}$ emissions from construction; maximum 1-hour $NO_2$ emissions for drilling and blasting, and maximum air toxics from well intervention). These scenarios also consider GMT1 Project-related sources that are outside of the GMT1 site and may be within a closer proximity to the town of Nuiqsut, e.g., the man camp scenario and the blasting scenario. The cross-section of various activities analyzed provides a thorough and comprehensive assessment of Project-related emissions and their impacts on nearby ambient air and sensitive receptors.

### 2.2.1 Blasting Construction Modeled Emissions Inventory

Information regarding the modeled emissions inventory for blasting construction is in **Table 2-1**. Short term and annual emission rates for modeled criteria pollutants are in **Table 2-2**. Stack parameters for the blasting construction activities can be found in **Chapter 3**.

**Table 2-1 Blasting Construction Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| TAILPIPE | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad construction project emissions inventory and fractioned according to blasting usage information provided by CPAI. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. Hourly and annual emission rates represent the maximum emissions for the entire construction period. |
| TAILPIPE | Nonroad construction equipment | Emissions were pulled directly from the nonroad construction project emissions inventory and fractioned according to blasting usage information provided by CPAI. Hourly and annual emission rates represent the maximum emissions for the entire construction period. |
| BLAST_ST, BLAST_AN | Emissions directly related to the blasting source | Emissions were pulled explicitly from the project emissions inventory. |
| DISTURB | Disturbed area fugitive emissions | Material mining will be complete by May and when the ground thaws. At that point, the area will be filled with water. Therefore, the disturbed area will not be a source of dust emissions. |

**Table 2-2 Blasting Construction Modeled Emission Rates**

| | | $NO_x$ | | $PM_{10}$ | | $PM_{2.5}$ | | $SO_2$ | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour | Annual | 24-hr | Annual | 24-hr | Annual | 1-hour | 24-hour | Annual | 1-hour / 8-hour |
| Model ID | Source Description | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) |
| TAILPIPE | Onroad construction equipment | 3.57E-04 | 1.39E-04 | 1.90E-05 | 7.41E-06 | 1.84E-05 | 7.19E-06 | 9.38E-07 | 9.38E-07 | 3.78E-07 | 1.99E-04 |
| TAILPIPE | Nonroad construction equipment | 2.49E+00 | 8.88E-01 | 2.14E-01 | 7.83E-02 | 2.08E-01 | 7.61E-02 | 5.00E-03 | 5.00E-03 | 1.79E-03 | 1.77E+00 |
| DISTURB | Disturbed area fugitive emissions | N/A | N/A | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | N/A | N/A | N/A | N/A |
| BLAST_ST | Blasting source | 5.35E+01 | | 2.26E-01 | | 1.30E-02 | | 6.30E+00 | 2.62E-01 | | 2.11E+02 |
| BLAST_AN | Blasting source | | 3.67E-01 | | 3.71E-02 | | 2.14E-03 | | | 4.31E-02 | |

### 2.2.2 Well Interventions Modeled Emissions Inventory

Information regarding the modeled emissions inventory for well interventions is in **Table 2-3**. Short term and annual emission rates for modeled criteria pollutants are in **Table 2-4**. Stack parameters for well intervention activities can be found in **Chapter 3**.

**Table 2-3 Well Interventions Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| RD_TAIL | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad drilling project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| RD_FUG | Fugitive dust emissions from access road travel | Emissions were pulled from the fugitive dust project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| NONMOB | Stationary drilling support equipment | Emissions were pulled explicitly from the project emissions inventory. |
| PAD_DIST | Disturbed area fugitive emissions from wellsite | Emissions were pulled explicitly from the project emissions inventory. Though Well Interventions activities will be one month in duration, fugitive emissions will last four months. |
| WELLINT1, WELLINT2 | Well Interventions heaters and engines | Emissions from the coil tubing unit, rather than the well frac unit, were modeled. The coil tubing unit is what is most likely to be used, so it more accurately represents emissions from well interventions. |
| PROD_HTR | Gas Fired Production Heater | Emissions were pulled explicitly from the project emissions inventory. |

**Table 2-4 Well Interventions Modeled Emission Rates**

| | | $NO_x$ | | $PM_{10}$ | | $PM_{2.5}$ | | $SO_2$ | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour | Annual | 24-hr | Annual | 24-hr | Annual | 1-hour | 24-hour | Annual | 1-hour / 8-hour |
| **Model ID** | **Source Description** | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) |
| RD_TAIL | Onroad construction equipment | 1.60E-03 | 7.68E-05 | 6.71E-05 | 3.38E-06 | 6.51E-05 | 3.28E-06 | 6.54E-06 | 6.54E-06 | 2.66E-07 | 7.60E-04 |
| RD_FUG | Fugitive dust emissions | N/A | N/A | 1.35E-01 | 1.10E-02 | 1.35E-02 | 1.12E-03 | N/A | N/A | N/A | N/A |
| NONMOB | Stationary support equipment | 1.16E+00 | 9.69E-02 | 7.36E-02 | 6.13E-03 | 7.30E-02 | 6.08E-03 | 1.59E-03 | 1.59E-03 | 1.32E-04 | 6.17E-01 |
| PAD_DIST | Disturbed area fugitive emissions | N/A | N/A | 6.19E-01 | 2.04E-01 | 9.29E-02 | 3.06E-02 | N/A | N/A | N/A | N/A |
| WELLINT1 | Heaters and engines, split in half | 1.20E+00 | 9.90E-02 | 3.01E-02 | 2.48E-03 | 3.01E-02 | 2.48E-03 | 1.46E-03 | 1.46E-03 | 1.20E-04 | 2.76E-01 |
| WELLINT2 | Heaters and engines, split in half | 1.20E+00 | 9.90E-02 | 3.01E-02 | 2.48E-03 | 3.01E-02 | 2.48E-03 | 1.46E-03 | 1.46E-03 | 1.20E-04 | 2.76E-01 |
| PROD_HTR | Production Heater | 3.58E-01 | 3.58E-01 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 1.77E-02 | 1.77E-02 | 1.77E-02 | 3.01E-01 |

### 2.2.3 Nuiqsut Man Camps Modeled Emissions Inventory

Information regarding the modeled emissions inventory for the Nuiqsut man camps is in **Table 2-5**. Short term and annual emission rates for modeled criteria pollutants are in **Table 2-6**. Stack parameters for Nuiqsut man camp activities can be found in **Chapter 3**.

**Table 2-5 Nuiqsut Man Camps Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| RD_TAIL | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad drilling project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| RD_FUG | Fugitive dust emissions from access road travel | Emissions were pulled from the fugitive dust project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| NONMOB | Stationary drilling support equipment | Emissions were pulled explicitly from the project emissions inventory. |
| PAD_DIST | Disturbed area fugitive emissions from wellsite | Emissions were pulled explicitly from the project emissions inventory. Fugitive emissions will last four months. |
| D19_PWR | Primary Power | Emissions were pulled explicitly from the project emissions inventory. |
| D19_BOIL1 | Boiler 1 | |
| D19_BOIL2 | Boiler 2 | |
| D19_CEM1 | Cement Pump 1 | |
| D19_CEM2 | Cement Pump 2 | |
| D19_HTR1 | Air Heater 1 | |
| D19_HTR2A, D19_HTR2B | Air Heater 2 | |
| PROD_HTR | Gas fired production heater | |
| CAMP_ENG | Rig Camp Engine | |

**Table 2-6 Nuiqsut Man Camps Modeled Emission Rates**

| Model ID | Source Description | $NO_x$ | | $PM_{10}$ | | $PM_{2.5}$ | | $SO_2$ | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour | Annual | 24-hr | Annual | 24-hr | Annual | 1-hour | 24-hour | Annual | 1-hour / 8-hour |
| | | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) |
| RD_TAIL | Onroad construction equipment | 1.60E-03 | 9.21E-04 | 6.71E-05 | 4.06E-05 | 6.51E-05 | 3.94E-05 | 6.54E-06 | 6.54E-06 | 3.19E-06 | 7.60E-04 |
| RD_FUG | Fugitive dust emissions | N/A | N/A | 1.35E-01 | 1.32E-01 | 1.35E-02 | 1.35E-02 | N/A | N/A | N/A | N/A |
| NONMOB | Stationary support equipment | 1.16E+00 | 1.16E+00 | 7.36E-02 | 7.36E-02 | 7.30E-02 | 7.30E-02 | 1.59E-03 | 1.59E-03 | 1.59E-03 | 6.17E-01 |
| PAD_DIST | Disturbed area fugitive emissions | N/A | N/A | 6.19E-01 | 2.04E-01 | 9.29E-02 | 3.06E-02 | N/A | N/A | N/A | N/A |
| D19_PWR | Primary Power | 3.65E-01 | 3.65E-01 | 1.51E-02 | 1.51E-02 | 1.51E-02 | 1.51E-02 | 5.39E-04 | 5.39E-04 | 5.39E-04 | 1.07E-01 |
| D19_BOIL1 | Boiler 1 | 8.74E-02 | 8.74E-02 | 1.04E-02 | 1.04E-02 | 9.31E-03 | 9.31E-03 | 8.74E-04 | 8.74E-04 | 8.74E-04 | 2.19E-02 |
| D19_BOIL2 | Boiler 2 | 8.74E-02 | 8.74E-02 | 1.04E-02 | 1.04E-02 | 9.31E-03 | 9.31E-03 | 8.74E-04 | 8.74E-04 | 8.74E-04 | 2.19E-02 |
| D19_CEM1 | Cement Pump 1 | 2.29E-02 | 2.29E-02 | 2.41E-02 | 1.38E-03 | 2.41E-02 | 1.38E-03 | 1.87E-05 | 8.21E-05 | 1.87E-05 | 5.02E-01 |
| D19_CEM2 | Cement Pump 2 | 2.29E-02 | 2.29E-02 | 2.41E-02 | 1.38E-03 | 2.41E-02 | 1.38E-03 | 1.87E-05 | 8.21E-05 | 1.87E-05 | 5.02E-01 |
| D19_HTR1 | Air Heater 1 | 7.79E-02 | 7.79E-02 | 9.27E-03 | 9.27E-03 | 8.29E-03 | 8.29E-03 | 7.79E-04 | 7.79E-04 | 7.79E-04 | 1.95E-02 |
| D19_HTR2A | Air Heater 2, split in half | 1.94E-02 | 1.94E-02 | 2.31E-03 | 2.31E-03 | 2.07E-03 | 2.07E-03 | 1.94E-04 | 1.94E-04 | 1.94E-04 | 4.85E-03 |
| D19_HTR2B | Air Heater 2, split in half | 1.94E-02 | 1.94E-02 | 2.31E-03 | 2.31E-03 | 2.07E-03 | 2.07E-03 | 1.94E-04 | 1.94E-04 | 1.94E-04 | 4.85E-03 |
| PROD_HTR | Production Heater | 3.58E-01 | 3.58E-01 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 1.77E-02 | 1.77E-02 | 1.77E-02 | 3.01E-01 |
| CAMP_ENG | Rig Camp Engine | 4.21E-01 | 4.21E-01 | 2.11E-02 | 2.11E-02 | 2.11E-02 | 2.11E-02 | 6.91E-04 | 6.91E-04 | 6.91E-04 | 3.68E-01 |

### 2.2.4 Infill Drilling Modeled Emissions Inventory

Information regarding the modeled emissions inventory for infill drilling is in **Table 2-7**. Short term and annual emission rates for modeled criteria pollutants are in **Table 2-8**. Stack parameters for infilling drilling activities can be found in **Chapter 3**.

**Table 2-7 Infill Drilling Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| RD_TAIL | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad drilling project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| RD_FUG | Fugitive dust emissions from access road travel | Emissions were pulled from the fugitive dust project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| NONMOB | Stationary drilling support equipment | Emissions were pulled explicitly from the project emissions inventory. |
| PAD_DIST | Disturbed area fugitive emissions from wellsite | Emissions were pulled explicitly from the project emissions inventory. Fugitive emissions will last four months. |
| D19_PWR | Primary Power | Emissions were pulled explicitly from the project emissions inventory. |
| D19_BOIL1 | Boiler 1 | Emissions were pulled explicitly from the project emissions inventory. |
| D19_BOIL2 | Boiler 2 | Emissions were pulled explicitly from the project emissions inventory. |
| D19_CEM1 | Cement Pump 1 | Since the cement pumps typically operate for less than 12 hours per well according to an unpredictable schedule they are considered intermittent emission units. Emissions were pulled explicitly from the project emissions inventory; however, short term $NO_2$ emissions were annualized according to USEPA guidance for intermittent emission units. |
| D19_CEM2 | Cement Pump 2 | |
| D19_HTR1 | Air Heater 1 | Emissions were pulled explicitly from the project emissions inventory. |
| D19_HTR2A, D19_HTR2B | Air Heater 2 | Emissions were pulled explicitly from the project emissions inventory. |
| PROD_HTR | Gas fired production heater | Emissions were pulled explicitly from the project emissions inventory. |
| CAMP_ENG | Rig Camp Engine | This engine will not be used for the duration of infill drilling activities because power will be available onsite. |

**Table 2-8 Infill Drilling Modeled Emission Rates**

| Model ID | Source Description | $NO_x$ | | $PM_{10}$ | | $PM_{2.5}$ | | $SO_2$ | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour | Annual | 24-hr | Annual | 24-hr | Annual | 1-hour | 24-hour | Annual | 1-hour / 8-hour |
| | | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) |
| RD_TAIL | Onroad construction equipment | 1.60E-03 | 9.21E-04 | 6.71E-05 | 4.06E-05 | 6.51E-05 | 3.94E-05 | 6.54E-06 | 6.54E-06 | 3.19E-06 | 7.60E-04 |
| RD_FUG | Fugitive dust emissions | N/A | N/A | 1.35E-01 | 1.32E-01 | 1.35E-02 | 1.35E-02 | N/A | N/A | N/A | N/A |
| NONMOB | Stationary support equipment | 1.16E+00 | 1.16E+00 | 7.36E-02 | 7.36E-02 | 7.30E-02 | 7.30E-02 | 1.59E-03 | 1.59E-03 | 1.59E-03 | 6.17E-01 |
| PAD_DIST | Disturbed area fugitive emissions | N/A | N/A | 6.19E-01 | 2.04E-01 | 9.29E-02 | 3.06E-02 | N/A | N/A | N/A | N/A |
| D19_PWR | Primary Power | 3.65E-01 | 3.65E-01 | 1.51E-02 | 1.51E-02 | 1.51E-02 | 1.51E-02 | 5.39E-04 | 5.39E-04 | 5.39E-04 | 1.07E-01 |
| D19_BOIL1 | Boiler 1 | 8.74E-02 | 8.74E-02 | 1.04E-02 | 1.04E-02 | 9.31E-03 | 9.31E-03 | 8.74E-04 | 8.74E-04 | 8.74E-04 | 2.19E-02 |
| D19_BOIL2 | Boiler 2 | 8.74E-02 | 8.74E-02 | 1.04E-02 | 1.04E-02 | 9.31E-03 | 9.31E-03 | 8.74E-04 | 8.74E-04 | 8.74E-04 | 2.19E-02 |
| D19_CEM1 | Cement Pump 1 | 2.29E-02 | 2.29E-02 | 2.41E-02 | 1.38E-03 | 2.41E-02 | 1.38E-03 | 1.87E-05 | 8.21E-05 | 1.87E-05 | 5.02E-01 |
| D19_CEM2 | Cement Pump 2 | 2.29E-02 | 2.29E-02 | 2.41E-02 | 1.38E-03 | 2.41E-02 | 1.38E-03 | 1.87E-05 | 8.21E-05 | 1.87E-05 | 5.02E-01 |
| D19_HTR1 | Air Heater 1 | 7.79E-02 | 7.79E-02 | 9.27E-03 | 9.27E-03 | 8.29E-03 | 8.29E-03 | 7.79E-04 | 7.79E-04 | 7.79E-04 | 1.95E-02 |
| D19_HTR2A | Air Heater 2, split in half | 1.94E-02 | 1.94E-02 | 2.31E-03 | 2.31E-03 | 2.07E-03 | 2.07E-03 | 1.94E-04 | 1.94E-04 | 1.94E-04 | 4.85E-03 |
| D19_HTR2B | Air Heater 2, split in half | 1.94E-02 | 1.94E-02 | 2.31E-03 | 2.31E-03 | 2.07E-03 | 2.07E-03 | 1.94E-04 | 1.94E-04 | 1.94E-04 | 4.85E-03 |
| PROD_HTR | Production Heater | 3.58E-01 | 3.58E-01 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 2.72E-02 | 1.77E-02 | 1.77E-02 | 1.77E-02 | 3.01E-01 |
| CAMP_ENG | Rig Camp Engine | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

### 2.2.5 Wellsite Construction Modeled Emissions Inventory

Information regarding the modeled emissions inventory for the wellsite construction is in **Table 2-9**. Short term and annual emission rates for modeled criteria pollutants are in **Table 2-10**. Stack parameters for wellsite construction activities can be found in **Chapter 3**.

**Table 2-9 Wellsite Construction Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| RD_TAIL | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad construction project emissions inventory and fractioned according to wellsite construction usage information provided by CPAI. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. Hourly and annual emission rates represent the maximum emissions for the entire construction period. |
| RD_FUG | Access road fugitive dust emissions | Wellsite and road construction will occur during the winter months (October-May). Therefore, travel on the access road will not be a source of fugitive dust emissions. |
| PAD_CONST | Nonroad construction equipment | Emissions were pulled directly from the nonroad construction project emissions inventory and fractioned according to wellsite construction usage information provided by CPAI. Hourly and annual emission rates represent the maximum emissions for the entire construction period. |
| PAD_DIST | Disturbed area fugitive emissions | Emissions were pulled explicitly from the project emissions inventory. Fugitive emissions will only occur from June to September. |

**Table 2-10 Wellsite Construction Modeled Emission Rates**

| | | $NO_x$ | | $PM_{10}$ | | $PM_{2.5}$ | | $SO_2$ | | | CO |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour | Annual | 24-hr | Annual | 24-hr | Annual | 1-hour | 24-hour | Annual | 1-hour / 8-hour |
| Model ID | Source Description | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) | (g/sec) |
| RD_TAIL | Onroad construction equipment | 1.73E-04 | 7.02E-05 | 7.29E-06 | 2.94E-06 | 7.07E-06 | 2.85E-06 | 6.90E-07 | 6.90E-07 | 2.86E-07 | 8.25E-05 |
| RD_FUG | Access road fugitive dust | N/A | N/A | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | N/A | N/A | N/A | N/A |
| PAD_CONST | Nonroad construction equipment | 2.53E+00 | 9.41E-01 | 2.37E-01 | 8.88E-02 | 2.30E-01 | 8.62E-02 | 5.16E-03 | 5.16E-03 | 1.90E-03 | 1.90E+00 |
| PAD_DIST | Disturbed area fugitives | N/A | N/A | 6.19E-01 | 2.04E-01 | 9.29E-02 | 3.06E-02 | N/A | N/A | N/A | N/A |

### 2.2.6 Air Toxics Modeled Emissions Inventory

Information regarding the modeled emissions inventory for infill drilling is in **Table 2-11**. Short term and annual emission rates for modeled air toxic pollutants are in **Table 2-12**. Stack parameters for infilling drilling activities can be found in **Chapter 3**.

**Table 2-11 Air Toxics Modeled Emissions Inventory Information**

| Model ID | Description | Comments |
|---|---|---|
| RD_TAIL | Onroad construction equipment traveling on access road | Emissions were pulled from the onroad drilling project emissions inventory. Emissions from the project emissions inventory were scaled to represent emissions from one round trip travel per day on the 0.31 mile (0.5 kilometer) access road. |
| RD_FUG | Fugitive dust emissions from access road travel | There are no air toxic emissions associated with this activity. |
| NONMOB | Stationary drilling support equipment | Emissions were pulled explicitly from the project emissions inventory. |
| PAD_DIST | Disturbed area fugitive emissions from wellsite | Emissions were pulled explicitly from the project emissions inventory. Fugitive emissions will last four months. |
| D19_PWR | Primary Power | Emissions were pulled explicitly from the project emissions inventory. |
| D19_BOIL1 | Boiler 1 | |
| D19_BOIL2 | Boiler 2 | |
| D19_CEM1 | Cement Pump 1 | |
| D19_CEM2 | Cement Pump 2 | |
| D19_HTR1 | Air Heater 1 | |
| D19_HTR2A, D19_HTR2B | Air Heater 2 | |
| PROD_HTR | Gas fired production heater | Emissions were pulled explicitly from the project emissions inventory. |
| CAMP_ENG | Rig Camp Engine | This engine will not be used for the duration of infill drilling activities because power will be available onsite. |
| WELL | Well flowback | Emissions were pulled explicitly from the project emissions inventory. Hourly emissions represent the worst case between pre-production and post-production. Annual emissions are based on 8 months of pre-production activities and 4 months of post-production activities. |

## Table 2-12 Air Toxics Modeled Emission Rates

| Model ID | Source Description | Benzene | | Ethylbenzene | | Formaldehyde | | n-Hexane | | Toluene | | Xylene | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1-hour (g/sec) | Annual (g/sec) | 1-hour (g/sec) | Annual (g/sec) | 1-hour (g/sec) | Annual (g/sec) | 1-hour (g/sec) | Annual (g/sec) | 1-hour (g/sec) | Annual (g/sec) | 1-hour (g/sec) | Annual (g/sec) |
| RD_TAIL | Onroad equipment | 1.23E-06 | 7.41E-07 | 4.55E-07 | 2.68E-07 | 1.43E-05 | 8.37E-06 | 3.54E-07 | 2.07E-07 | 1.19E-06 | 6.51E-07 | 1.31E-06 | 6.97E-07 |
| RD_FUG | Fugitive emissions | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| NONMOB | Stationary support equipment | 5.47E-04 | 5.47E-04 | 1.46.E-07 | 1.46E-07 | 2.59E-04 | 2.59E-04 | 0.00E+00 | 0.00E+00 | 2.21E-04 | 2.21E-04 | 1.42E-04 | 1.42E-04 |
| PAD_DIST | Disturbed area fugitives | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| D19_PWR | Primary Power | 6.42E-04 | 6.42E-04 | 0.00E+00 | 0.00E+00 | 6.53E-05 | 6.53E-05 | 0.00E+00 | 0.00E+00 | 2.33E-04 | 2.33E-04 | 1.60E-04 | 1.60E-04 |
| D19_BOIL1 | Boiler 1 | 9.36E-07 | 9.36E-07 | 2.78E-07 | 2.78E-07 | 1.44E-04 | 1.44E-04 | 0.00E+00 | 0.00E+00 | 2.71E-05 | 2.71E-05 | 4.77E-07 | 4.77E-07 |
| D19_BOIL2 | Boiler 2 | 9.36E-07 | 9.36E-07 | 2.78E-07 | 2.78E-07 | 1.44E-04 | 1.44E-04 | 0.00E+00 | 0.00E+00 | 2.71E-05 | 2.71E-05 | 4.77E-07 | 4.77E-07 |
| D19_CEM1 | Cement Pump 1 | 1.99E-04 | 1.13E-05 | 0.00E+00 | 0.00E+00 | 2.51E-04 | 1.43E-05 | 0.00E+00 | 0.00E+00 | 8.71E-05 | 4.97E-06 | 6.07E-05 | 3.46E-06 |
| D19_CEM2 | Cement Pump 2 | 1.99E-04 | 1.13E-05 | 0.00E+00 | 0.00E+00 | 2.51E-04 | 1.43E-05 | 0.00E+00 | 0.00E+00 | 8.71E-05 | 4.97E-06 | 6.07E-05 | 3.46E-06 |
| D19_HTR1 | Air Heater 1 | 8.33E-07 | 8.33E-07 | 2.48E-07 | 2.48E-07 | 1.28E-04 | 1.28E-04 | 0.00E+00 | 0.00E+00 | 2.41E-05 | 2.41E-05 | 4.24E-07 | 4.24E-07 |
| D19_HTR2A | Air Heater 2, split in half | 2.08E-07 | 2.08E-07 | 6.17E-08 | 6.17E-08 | 3.20E-05 | 3.20E-05 | 0.00E+00 | 0.00E+00 | 6.02E-06 | 6.02E-06 | 1.06E-07 | 1.06E-07 |
| D19_HTR2B | Air Heater 2, split in half | 2.08E-07 | 2.08E-07 | 6.17E-08 | 6.17E-08 | 3.20E-05 | 3.20E-05 | 0.00E+00 | 0.00E+00 | 6.02E-06 | 6.02E-06 | 1.06E-07 | 1.06E-07 |
| PROD_HTR | Production Heater | 7.52E-06 | 7.52E-06 | 0.00E+00 | 0.00E+00 | 2.69E-04 | 2.69E-04 | 6.45E-03 | 6.45E-03 | 1.22E-05 | 1.22E-05 | 0.00E+00 | 0.00E+00 |
| CAMP_ENG | Rig Camp Engine | 4.18E-04 | 4.18E-04 | 0.00E+00 | 0.00E+00 | 5.29E-04 | 5.29E-04 | 0.00E+00 | 0.00E+00 | 1.83E-04 | 1.83E-04 | 1.28E-04 | 1.28E-04 |
| WELL | Well flowback | 1.92E-03 | 1.16E-04 | 6.06E-04 | 3.57E-05 | 0.00E+00 | 0.00E+00 | 7.51E-02 | 4.50E-03 | 2.18E-03 | 1.30E-04 | 7.34E-04 | 4.31E-05 |

# 3.0 Key Near-field Dispersion Modeling Assumptions

## 3.1 Modeling Methodology

The near field ambient air quality impact analysis was conducted to quantify maximum pollutant impacts within the GMT1 Project area due to project related construction and operational emissions. Concentrations of the following air contaminants were predicted as part of this study:

- Criteria pollutant emissions of:
  - Particulate matter less than 10 micrometers aerodynamic diameter ($PM_{10}$),
  - Particulate matter less than 2.5 micrometers aerodynamic diameter ($PM_{2.5}$),
  - Nitrogen Dioxide ($NO_2$),
  - Sulfur Dioxide ($SO_2$), and
  - Carbon Monoxide (CO);
- Air toxics emissions of:
  - benzene,
  - toluene,
  - ethyl benzene,
  - xylene,
  - n-hexane, and
  - formaldehyde

The USEPA's Guideline (USEPA 2005) model, AERMOD (Version 12345), was used to assess near field impacts. Regulatory model settings were utilized, with the exception of the non-regulatory Ozone Limiting Method (OLM) option, which was used for modeling nitrogen dioxide ($NO_2$) concentration estimates. Modeling analyses for $NO_2$ concentration estimates also utilized hourly ozone concentration data collected at the Nuiqsut monitoring station from 2008 through 2012.

GMT1 Project impacts to ambient ozone and secondary $PM_{2.5}$ were not predicted using dispersion modeling for this air quality impact analysis; rather a qualitative assessment of the potential contribution to regional ozone and secondary $PM_{2.5}$ formation has been conducted.

## 3.2 Meteorological Input Data and Processing

Meteorological data collected at the Nuiqsut ambient air quality and meteorological monitoring station has been used for the near field dispersion modeling. Monitoring at Nuiqsut station began in 1998 and is ongoing. The onsite data include 10 meter level measurements of wind speed, standard deviation of horizontal wind speed, wind direction, standard deviation of wind direction (sigma theta),solar radiation, vertical wind speed, standard deviation of vertical wind speed, temperature (10-meter and 2-meter), and temperature difference (10-2 meters).

The Nuiqsut monitoring station is approximately 11.5 miles (18.5 kilometers) to the east-southeast of the GMT1 Project area. The monitoring site has a geophysical and topographical setting similar to the GMT1 Project area and is considered representative of the meteorological conditions in the GMT1 Project impact area. The most recent 5 years of data (2008 – 2012) were used for the near field analysis. The meteorological processing and data filling procedure is provided in Appendix B. The location of the Nuiqsut site is shown in **Figure 3-1**. A wind rose for the Nuiqsut location is presented in **Figure 3-2**.

**Figure 3-1 Nuiqsut Meteorological Tower Location in Relation to Project Area**

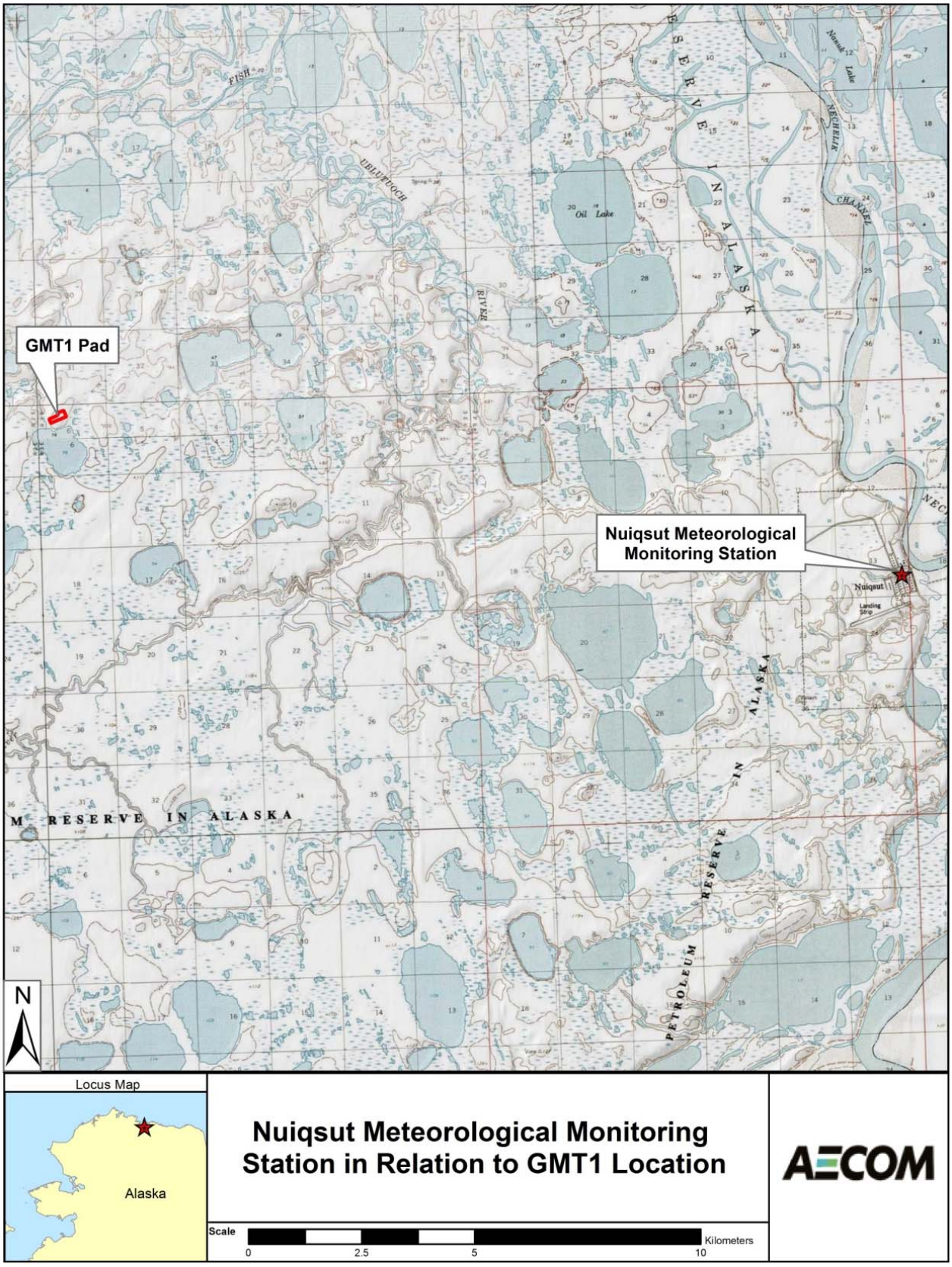
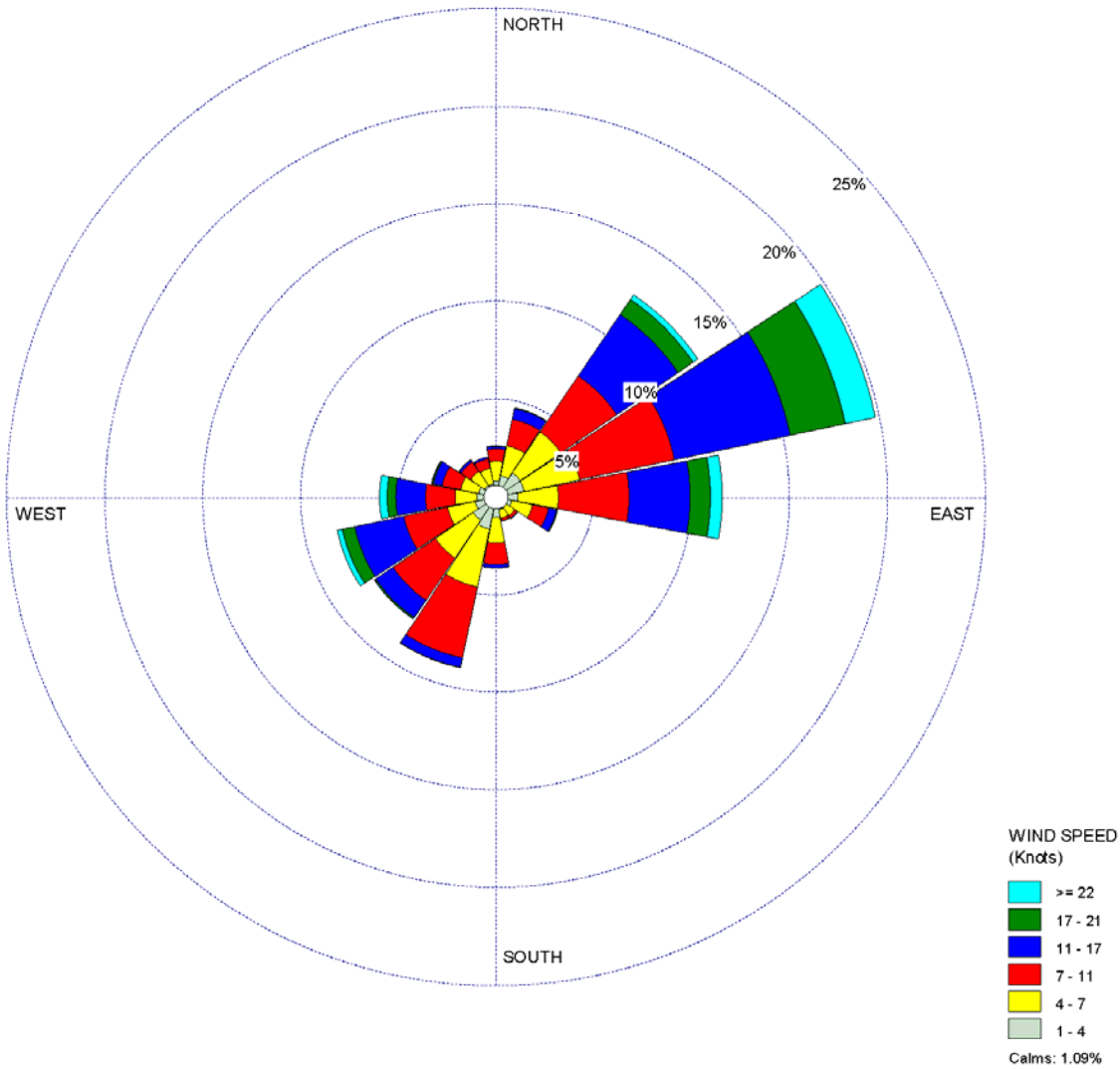


**Figure 3-2 Nuiqsut Meteorological Data Wind Rose**

WIND ROSE PLOT:
**Nuiqsut Meteorological Monitoring Station**
**Wind Rose for 2008 - 2012**

DISPLAY:
**Wind Speed**
**Direction (blowing from)**




| COMMENTS: | DATA PERIOD: | COMPANY NAME: | |
|---|---|---|---|
| | **Start Date: 1/1/2008 - 00:00**<br>**End Date: 12/31/2012 - 15:00** | MODELER: | |
| | CALM WINDS:<br>**1.09%** | TOTAL COUNT:<br>**43054 hrs.** | |
| | AVG. WIND SPEED:<br>**9.02 Knots** | DATE:<br>**9/17/2013** | PROJECT NO.: |

The Nuiqsut meteorological measurements were processed into datasets (surface data and profile data) compatible with the AERMOD dispersion model using the AERMET (Version 12345) meteorological processor. Since temperature difference and solar radiation data are included in the onsite measurements, AERMET was applied following the Bulk Richardson method switch settings.

## 3.3 Upper Air Data

The nearest NWS upper air data station to the GMT1 Project area is located at Barrow, Alaska, which is located approximately 150 miles (240 kilometers) northwest of the GMT1 Project area. Concurrent upper air data from this station were obtained from the National Oceanic and Atmospheric Administration Earth System Research Laboratory (NOAA/ESRL) Radiosonde Database and provided as input to AERMET.

## 3.4 Surface Characteristics

A summary of the surface characteristics used as input to AERMET is provided in **Table 3-1**. These values were applied seasonally over one sector surrounding the monitoring site. Values used for processing the Nuiqsut meteorological data were previously approved by Alaska Department of Environmental Conservation (ADEC) in their review of the BP Exploration (Alaska), Inc. (BPXA) WRDx Gas Partial Processing Project Modeling Protocol (ADEC 2007). As recommended by ADEC, these values were applied on a seasonal basis with summer defined as June through September and winter defined as October through May. These values are representative of locations classified as Coastal Wet Tundra. These conditions are specific to the North Slope coastal plain at low elevations near the coast, which are classified as wet sedge tundra and for tundra dominated by thaw lakes, ice-wedge polygons, frost boils, water tracks, and bogs.

**Table 3-1 ADEC Approved Surface Characteristics for the North Slope Coastal Plain**

| Surface Parameter | Winter Value (October through May) | Summer Value (June through September) |
|---|---|---|
| Albedo | 0.8 | 0.18 |
| Bowen Ratio | 1.5 | 0.80 |
| Surface Roughness Length (meters) | 0.004 | 0.02 |

## 3.5 Background Data

Background pollutant concentrations are used as an indicator of existing regional conditions, and are assumed to include impacts from emissions from existing stationary emission sources from mobile, urban, biogenic, other non-industrial emission sources, and from transport into the region. These background concentrations were added to the model predicted GMT1 Project impacts to estimate cumulative ambient air quality impacts. **Table 3-2** presents the background values used for this study. Except for $NO_2$, $PM_{2.5}$ and $SO_2$, these values were determined by USEPA to be appropriate background values for the Nuiqsut area (USEPA Region 10 2011) and have been used for this assessment. Though USEPA also determined $NO_2$ and $PM_{2.5}$ values, those values were reevaluated in light of more recent data and information suggesting the A-Pad and Deadhorse measurements of $NO_2$ and $PM_{2.5}$ are not representative of the GMT1 Project impact area.

**Table 3-2 Background Ambient Air Quality Concentrations in the Nuiqsut Area**

| Pollutant | Averaging Period | Measured Background Concentration | |
|---|---|---|---|
| | | (ppb) | ($\mu g/m^3$) |
| CO | 1-hour | 200 [3] | 2,291 |
| | 8-hour | 100 [3] | 1,146 |
| $NO_2$ | 1-hour | 19 [4] | 35.8 |
| | Annual | 2 [4] | 3.8 |
| $PM_{10}$ | 24-hour | - | 53 [1] |
| $PM_{2.5}$ | 24-hour | - | 3 [4] |
| | Annual | - | 3 [4] |
| $SO_2$ | 1-hour | 9 [2] | 23.6 |
| | 3-hour | 15 [2] | 39.3 |
| | 24-hour | 13 [2] | 34.0 |
| | Annual | 1 [2] | 2.6 |

[1] From measurements collected at the BPXA Central Compression Plant (CCP) ambient air quality monitoring station.

[2] From measurements collected at the A Pad ambient air quality and meteorological monitoring station during calendar years 2006 through 2010.

[3] From measurements collected at the BPXA Endicott Satellite Drilling Island (SDI).

[4] From measurements collected at the Nuiqsut ambient air quality monitoring station during calendar years 2010 through 2012.

The $NO_2$ values developed by USEPA are not considered representative of the GMT1 Project area because ambient measurements at the A-Pad location are known to be routinely influenced by near field mobile and portable source activity biasing 1-hour measurements high. Similarly, the $PM_{2.5}$ values proposed by USEPA are not considered representative of the GMT1 Project area because they were collected in Deadhorse, Alaska near a roadway and in the middle of light industrial development. Therefore, representative $NO_2$ and $PM_{2.5}$ values were developed from the most recent 3 years of measurements collected at the Nuiqsut Ambient Air Quality and Meteorological Monitoring station (calendar years 2010 through 2012). This station is not only close to the project area, it is also impacted by nearfield sources to a much lesser degree than those collected at A-Pad and Deadhorse. Given that the Nuiqsut Station is downwind from and nearer to major Alaskan North Slope stationary sources that the GMT1 project area, these measurements are conservatively representative of background concentrations in the GMT1 Project impact area.

Unlike the other pollutants, USEPA did not previously address ambient Alaskan North Slope $SO_2$ background concentrations. Therefore, values used were determined from the A-Pad monitoring station and used to support major stationary source permitting within the Greater Prudhoe Bay Unit. Concentrations measured at A-Pad have been used historically to represent background locations downwind of Alaskan North Slope oil production.

As mentioned in Section 3.1, simulating the $NO_x$ to $NO_2$ chemical transformation in modeled plumes has been conducted using the OLM methodology with the AERMOD model. To implement this technique, hourly background ozone concentrations required as input to the $NO_2$ modeling were developed from

data collected at the Nuiqsut monitoring station for 2008 through 2012. These data are concurrent with the Nuiqsut meteorological data that was used for the analysis.

### 3.6 Selection of Source In-Stack Ratios for Refined $NO_2$ Modeling

As mentioned in Section 3.1, simulating the $NO_x$ to $NO_2$ chemical transformation in modeled plumes has been conducted using the OLM methodology with the AERMOD model. Implementing this technique required estimates of source in-stack $NO_2$ to $NO_x$ ratios. For this analysis, with the exception of explosives detonation, estimates of in-stack ratios were developed for each source group based on a review of available literature. That review and the ratios developed is presented in Appendix A and summarized as follows:

- Small Diesel-Fired Heaters/Boilers: 0.05
- Large Natural Gas-Fired Heaters/Boilers: 0.3
- Diesel-Fired Internal Combustion Engines Associated with Power Generation: 0.2
- Diesel-Fired Nonroad Engines Associated with Construction Equipment: 0.2
- Onroad Mobile Sources: 0.15
- Explosives Detonation: 0.50

For explosives detonation, no literature could be found to support a source-specific in-stack ratio; therefore, the USEPA-approved screening value of 0.5 was used.

### 3.7 Facility Simulation Used for Criteria Pollutant Modeling

As discussed in Chapter 2, five scenarios were developed from comprehensive GMT1 Project emissions inventory that either represented those scenarios that were expected to produce the worst-case ambient air quality impacts or scenarios that are relevant to comprehensively characterizing GMT1 project impacts. A description of how these scenarios were characterized in the modeling is included in this section.

The proposed GMT1 Project site layout during Pad and Access Road Construction is provided in **Figure 3-3**. Modeled emission rates are presented in Chapter 2. Modeled source parameters are provided in **Table 3-3**. Modeling for the following pollutants/averaging periods included use of hourly varying emissions to more appropriately account for the short duration of some activities over the 5-year period that was modeled:

- 1-hour $NO_2$;
- 24-hour $PM_{2.5}$, unmitigated fugitive dust case;
- 24-hour $PM_{10}$, unmitigated fugitive dust case; and
- 24-hour $PM_{2.5}$, mitigated fugitive dust case.

It was assumed that pad construction activities occurred for 12 months, infill drilling activities for 14 months, and permanent operations for 34 months.

The proposed GMT1 Project Clover Material Source site layout during construction is provided in **Figure 3-4**. Modeled emission rates are presented in Chapter 2. Modeled source parameters are provided in **Table 3-4**. Modeling for the following pollutants/averaging periods included use of hourly varying emissions to more appropriately account for the short duration of some activities over the 5-year period that was modeled:

- 1-hour $NO_2$;
- 24-hour $PM_{2.5}$; and

- 24-hour $PM_{10}$.

It was assumed that blasting activity of the Clover material source occurred for 12 months, infill drilling activities for 14 months, and permanent operations for 34 months.

The proposed GMT1 Project modeled Nuiqsut Camp layout during construction is provided in **Figure 3-5**. Modeled emission rates are presented in Chapter 2. Modeled source parameters are provided in **Table 3-5**.

The proposed GMT1 Project site layout during Infill Drilling is provided in **Figure 3-6**. Modeled emission rates are presented in Chapter 2. Modeled source parameters are provided in **Table 3-6**. Modeling for the following pollutants/averaging periods included use of hourly varying emissions to more appropriately account for the short duration of some activities over the 5-year period that was modeled:

- 1-hour $NO_2$;
- 24-hour $PM_{2.5}$, unmitigated fugitive dust case; and
- 24-hour $PM_{10}$, unmitigated fugitive dust case.

It was assumed that infill drilling activity occurred for 14 months and permanent operations occurred for 46 months.

The proposed GMT1 Project site layout during Well Intervention is provided in **Figure 3-7**. Modeled emission rates are presented in Chapter 2. Modeled source parameters are provided in **Table 3-7**. Modeling for the following pollutants/averaging periods included use of hourly varying emissions to more appropriately account for the short duration of some activities over the 5-year period that was modeled:

- 1-hour $NO_2$;
- 24-hour $PM_{2.5}$, unmitigated fugitive dust case; and
- 24-hour $PM_{10}$, unmitigated fugitive dust case.

It was assumed that well intervention activities occurred for 1 month and permanent operations occurred for 11 months of each of the 5 years.

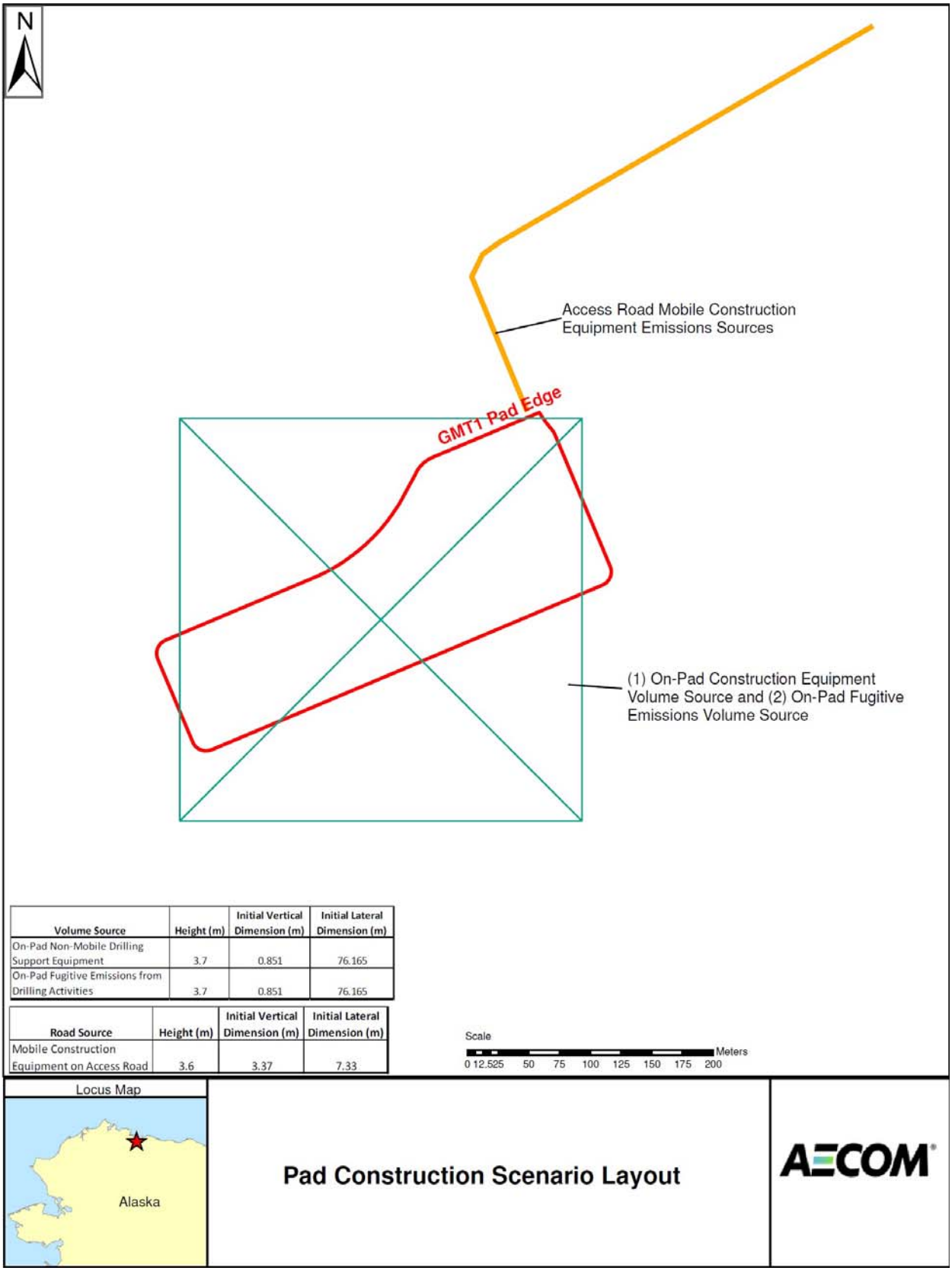
Point sources were used for modeling emissions from the drill rig, rig camp, well intervention source, and stationary line heater. The most recent PRIME version of the Building Profile Input Program (BPIP-PRIME version 04274) was used to determine appropriate direction-specific building dimension downwash parameters for each affected source.

## 3.8 Air Toxics Modeling

Near field air toxics were also predicted with AERMOD for both a short-term (acute) exposure assessment and for calculation of long-term risk in the GMT1 Project area. Air toxics will be emitted predominantly during well venting associated during the early stages of developmental drilling; therefore, only air toxics emissions from this activity were analyzed. A maximum emissions case was developed for each air toxic. The modeling methodology for the short-term and long-term air toxics impact assessments is nearly identical to the methodology outlined in Section 3.1. Emissions from well venting combined with those sources involved in drilling (i.e., drill rig, portable support equipment inventory, mobile sources inventory and production heater) were combined and the total was modeled as a single volume source similar to that modeled for the on-pad non-mobile drilling support equipment emissions for the Infill Drilling Scenario. The volume source was centered on the wellsite and modeled with the following parameters:

- Release Height – 3.66 meters (typical height of a 1-story structure)

**Figure 3-3 Modeled Layout – Access Road and Pad Construction**




| Volume Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| On-Pad Non-Mobile Drilling Support Equipment | 3.7 | 0.851 | 76.165 |
| On-Pad Fugitive Emissions from Drilling Activities | 3.7 | 0.851 | 76.165 |

| Road Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| Mobile Construction Equipment on Access Road | 3.6 | 3.37 | 7.33 |

**Table 3-3 Modeled Source Parameters - Access Road and Pad Construction**

| Model ID | Source Description | Source Type | Source Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height (m) | Plume Height (m) | Plume Width (m) | Initial Lat. Dimen. (m) | Initial Vert. Dimen. (m) | Vehicle Height[2] (m) | $NO_2/NO_X$ Ratios |
| RD_TAIL | Construction equip - on Access Road , tailpipe emissions | Line Source [1] (32 volumes) | 3.63 | 7.25 | 15.75 | 7.33 | 3.37 | 4.27 | 0.15 |

| Model ID | Source Description | Source Type | Release Height[3] (m) | | Length of Side[4] (m) | Initial Lat. Dimen.[5] (m) | Initial Vert. Dimen.[5] (m) | | $NO_2/NO_X$ Ratios |
|---|---|---|---|---|---|---|---|---|---|
| PAD_CONST | Construction equip - on Pad, tailpipe emissions | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | 0.20 |
| PAD_DIST | Pad Disturbed Area during construction, fugitive particulates | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | na |

[1] Source Parameters Based on Haul Road Workgroup Guidance (USEPA 2012a):

- Top of Plume Height – 1.7 x Vehicle Height.
- Volume Source Release Height – 0.5 x Top of Plume height.
- Width of Plume – Road Width + 6m for two lane roadways. Road width assumed to be 32 feet, based on sheet 22 in "GMT1 Permit Package 7-12-13.pdf" provided by CPAI.
- Initial Sigma Vertical Dimension – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).
- Initial Sigma Lateral Dimension – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).

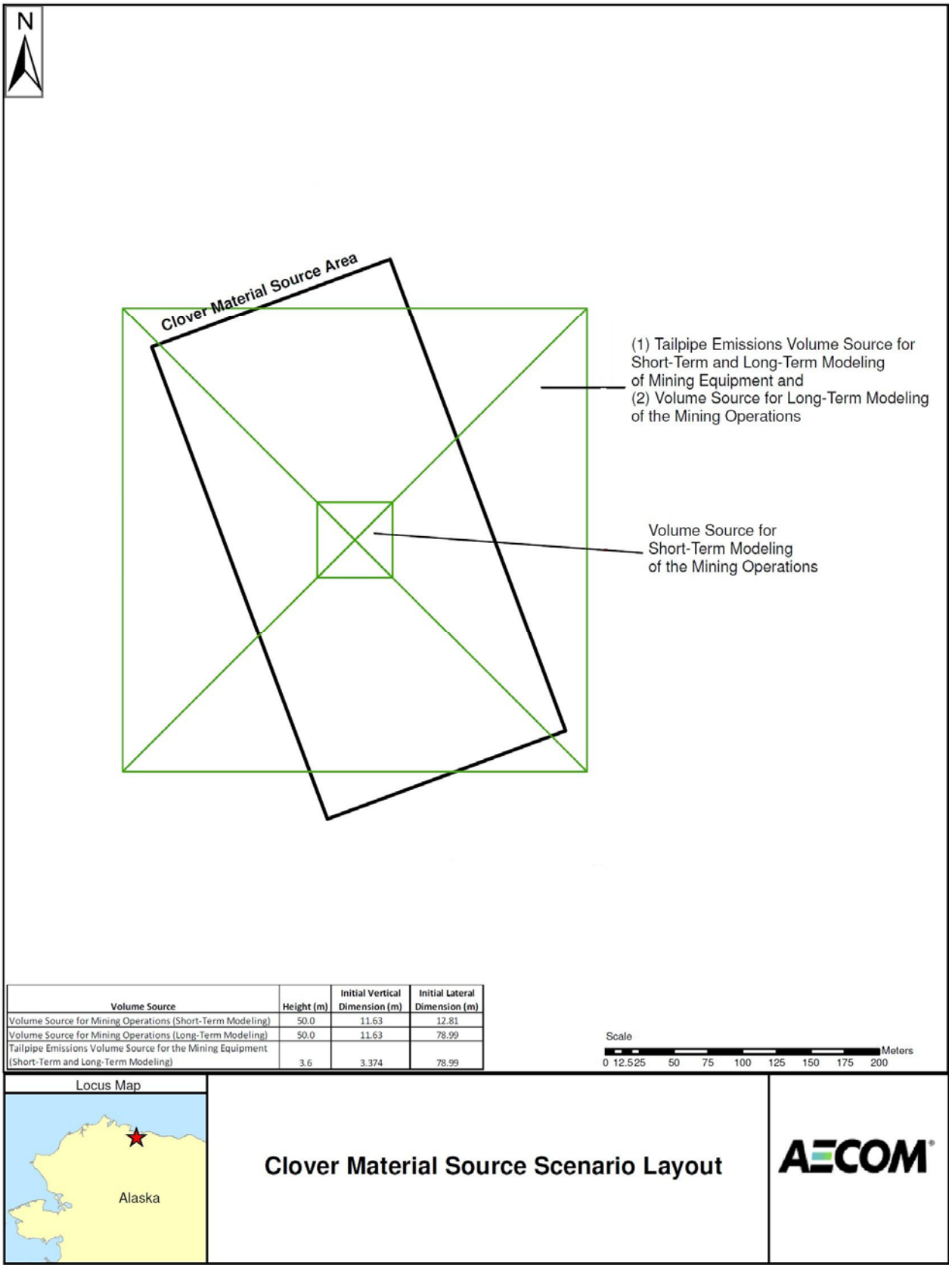
[2] Typical truck height.

[3] Typical height of a 1-story structure.

[4] Approximate length of area where most wellsite activity will take place.

[5] AERMOD User's Guide, Table 3-1 (USEPA 2004).

**Figure 3-4 Modeled Layout – Clover Material Source**




| Volume Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| Volume Source for Mining Operations (Short-Term Modeling) | 50.0 | 11.63 | 12.81 |
| Volume Source for Mining Operations (Long-Term Modeling) | 50.0 | 11.63 | 78.99 |
| Tailpipe Emissions Volume Source for the Mining Equipment (Short-Term and Long-Term Modeling) | 3.6 | 3.374 | 78.99 |

**Table 3-4 Modeled Source Parameters – Clover Material Source**

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height (m) | Plume Height (m) | Plume Width (m) | Initial Lat. Dimen. (m) | Initial Vert. Dimen. (m) | Vehicle Height[2] (m) | $NO_2/NO_X$ Ratios |
| TAILPIPE | Blasting Activity at Clover Material Source, tailpipe emissions | Volume[1] | 3.63 | 7.25 | 339.65 | 78.99 | 3.374 | 4.27 | 0.15 |

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height[3] (m) | | Length of Side[4] (m) | Initial Lat. Dimen.[5] (m) | Initial Vert. Dimen.[5] (m) | | $NO_2/NO_X$ Ratios |
| BLAST_ST | Blasting Activity at Clover Material Source, short-term averaging periods | Volume | 50.00 | | 55.09 | 12.81 | 11.63 | | 0.50 |
| BLAST_AN | Blasting Activity at Clover Material Source, long-term averaging periods | Volume | 50.00 | | 339.65 | 78.99 | 11.63 | | 0.50 |

[1] Source Parameters Based on Haul Road Workgroup Guidance (USEPA 2012a):

- Top of Plume Height – 1.7 x Vehicle Height.
- Volume Source Release Height – 0.5 x Top of Plume height.
- Width of Plume – Road Width + 6m for two lane roadways. Road width assumed to be 32 feet, based on sheet 22 in "GMT1 Permit Package 7-12-13.pdf" provided by CPAI.
- Initial Sigma Vertical Dimension – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).
- Initial Sigma Lateral Dimension – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).

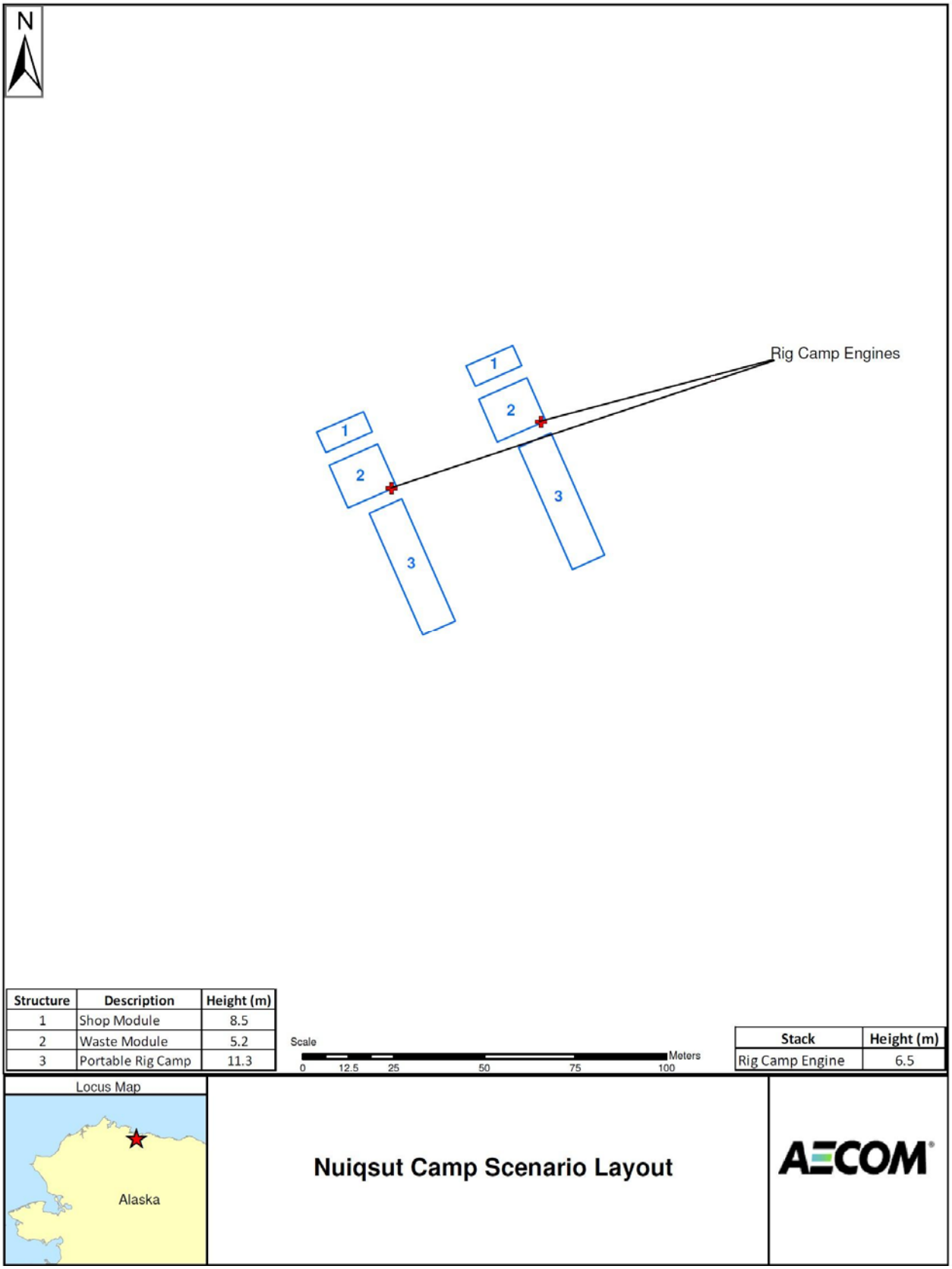
[2] Typical truck height.

[3] Typical height of a 1-story structure.

[4] Approximate length of area where most wellsite activity will take place.

[5] AERMOD User's Guide, Table 3-1 (USEPA 2004).

**Figure 3-5 Modeled Layout – Nuiqsut Camps**




| Structure | Description | Height (m) |
|---|---|---|
| 1 | Shop Module | 8.5 |
| 2 | Waste Module | 5.2 |
| 3 | Portable Rig Camp | 11.3 |

| Stack | Height (m) |
|---|---|
| Rig Camp Engine | 6.5 |

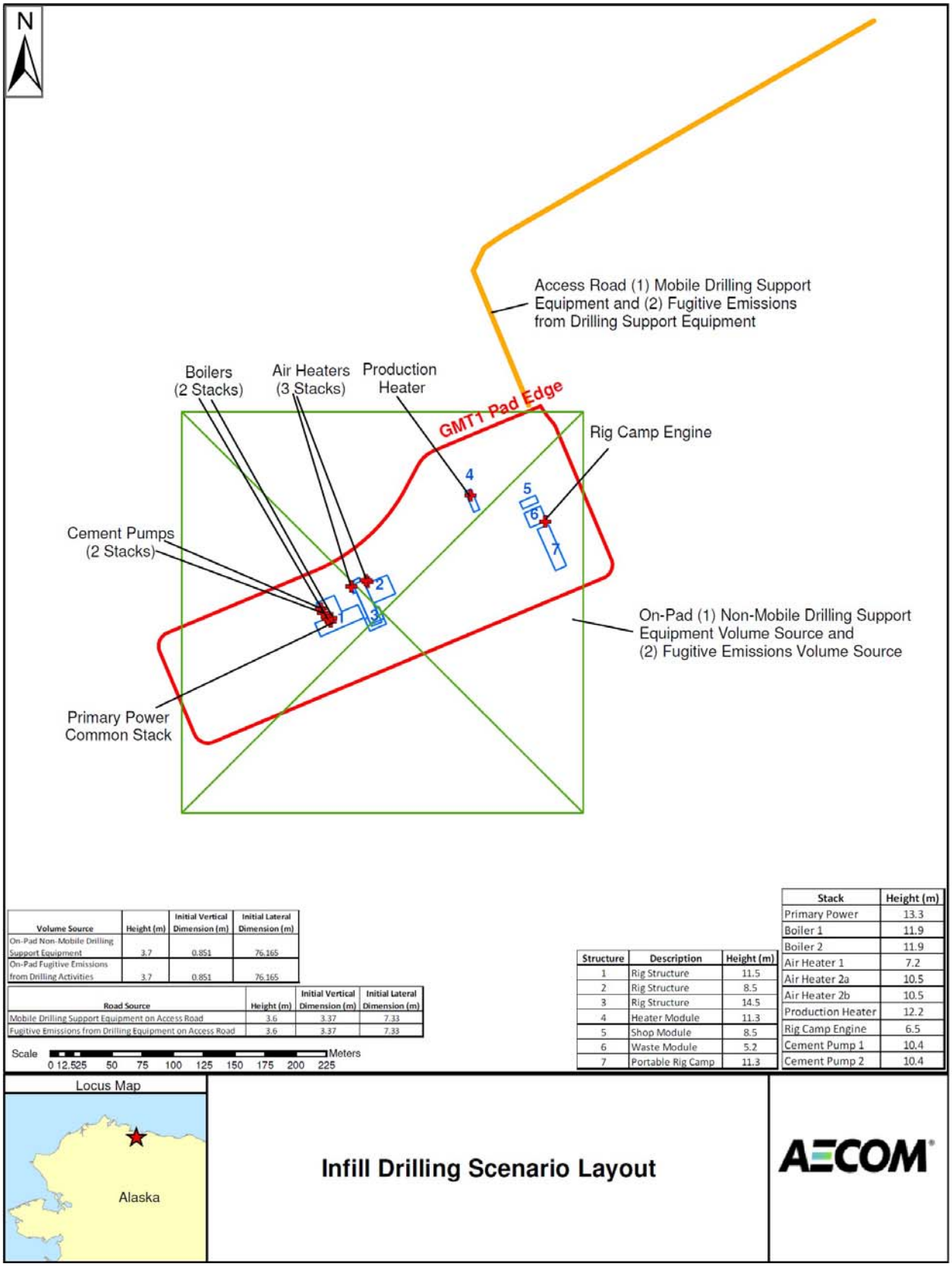
**Table 3-5 Modeled Source Parameters – Nuiqsut Camps**

| Model ID | Source Description | Stack Parameters[2] | | | | |
|---|---|---|---|---|---|---|
| | | Stack Height (m) | Stack Temp (deg K) | Stack Velocity (m/sec) | Stack Diameter (m) | $NO_2/NO_X$ Ratios |
| CAMP_ENG [1] | Rig Camp Engine 1 [1] | 6.5 | 761 | 47.0 | 0.200 | 0.20 |
| CAMPENG2 | Rig Camp Engine 2 | 6.5 | 761 | 47.0 | 0.200 | 0.20 |

[1] Engine included here for completeness, however it was assumed to be electrified and therefore was modeled with zero emissions.

[2] Stack parameters based on CD5 Minor Permit Application (SECOR 2005).

**Figure 3-6 Modeled Layout – Infill Drilling**




| Volume Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| On-Pad Non-Mobile Drilling Support Equipment | 3.7 | 0.851 | 76.165 |
| On-Pad Fugitive Emissions from Drilling Activities | 3.7 | 0.851 | 76.165 |

| Road Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| Mobile Drilling Support Equipment on Access Road | 3.6 | 3.37 | 7.33 |
| Fugitive Emissions from Drilling Equipment on Access Road | 3.6 | 3.37 | 7.33 |

| Structure | Description | Height (m) |
|---|---|---|
| 1 | Rig Structure | 11.5 |
| 2 | Rig Structure | 8.5 |
| 3 | Rig Structure | 14.5 |
| 4 | Heater Module | 11.3 |
| 5 | Shop Module | 8.5 |
| 6 | Waste Module | 5.2 |
| 7 | Portable Rig Camp | 11.3 |

| Stack | Height (m) |
|---|---|
| Primary Power | 13.3 |
| Boiler 1 | 11.9 |
| Boiler 2 | 11.9 |
| Air Heater 1 | 7.2 |
| Air Heater 2a | 10.5 |
| Air Heater 2b | 10.5 |
| Production Heater | 12.2 |
| Rig Camp Engine | 6.5 |
| Cement Pump 1 | 10.4 |
| Cement Pump 2 | 10.4 |

**Table 3-6 Modeled Source Parameters – Infill Drilling**

| Model ID | Source Description | Source Type | Stack Parameters | | | | |
|---|---|---|---|---|---|---|---|
| | | | Stack Height (m) | Stack Temp (deg K) | Stack Vel (m/sec) | Stack Diam (m) | $NO_2/NO_X$ Ratios |
| D19_PWR | Primary Power Common Stack[1] | Point | 13.3 | 614 | 10.5 | 0.400 | 0.20 |
| D19_BOIL1 | Boiler 1 - Superior[2] | Point | 11.9 | 450 | 11.7 | 0.279 | 0.05 |
| D19_BOIL2 | Boiler 2 - Superior[2] | Point | 11.9 | 450 | 11.7 | 0.279 | 0.05 |
| D19_CEM1 | Cement Pump 1[2] | Point | 10.4 | 750 | 43.5 | 0.130 | 0.20 |
| D19_CEM2 | Cement Pump 2[2] | Point | 10.4 | 750 | 43.5 | 0.130 | 0.20 |
| D19_HTR1 | Air Heater 1 - Dick's[2] | Point | 7.2 | 533 | 10.8 | 0.300 | 0.05 |
| D19_HTR2A | Air Heater 2 - Dick's, split into 2 stacks[2] | Point | 10.5 | 533 | 3.2 | 0.300 | 0.05 |
| D19_HTR2B | Air Heater 2 - Dick's, split into 2 stacks[2] | Point | 10.5 | 533 | 3.2 | 0.300 | 0.05 |
| PROD_HTR | Gas fired production heater[2] | Point | 12.2 | 529 | 5.7 | 0.940 | 0.30 |

[1] Stack parameters based on vendor data.

[2] Stack parameters based on DOYON 19 drill rig and CD5 Minor Permit Application (SECOR 2005).

**Table 3-6 Modeled Source Parameters – Infill Drilling Cont.**

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height (m) | Plume Height (m) | Plume Width (m) | Initial Lat. Dimen. (m) | Initial Vert. Dimen. (m) | Vehicle Height[2] (m) | $NO_2/NO_X$ Ratios |
| RD_TAIL | Mobile Drilling Support Equip on Access Road, tailpipe emissions | Line Source [1] (32 volumes) | 3.63 | 7.25 | 15.75 | 7.33 | 3.37 | 4.27 | 0.15 |
| RD_FUG | Mobile Drilling Support Equip on Access Road, fugitive particulates | Line Source [1] (32 volumes) | 3.63 | 7.25 | 15.75 | 7.33 | 3.37 | 4.27 | na |

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height[3] (m) | | Length of Side[4] (m) | Initial Lat. Dimen.[5] (m) | Initial Vert. Dimen.[5] (m) | | $NO_2/NO_X$ Ratios |
| NONMOB | Non-Mobile Drilling Support Equip on Pad | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | 0.20 |
| PAD_DIST | Pad Disturbed Area, fugitive particulates | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | na |

[1] Source Parameters Based on Haul Road Workgroup Guidance (USEPA 2012a):

- Top of Plume Height – 1.7 x Vehicle Height.
- Volume Source Release Height – 0.5 x Top of Plume height.
- Width of Plume – Road Width + 6m for two lane roadways. Road width assumed to be 32 feet, based on sheet 22 in "GMT1 Permit Package 7-12-13.pdf" provided by CPAI.
- Initial Sigma Vertical Dimension – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).
- Initial Sigma Lateral Dimension – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).

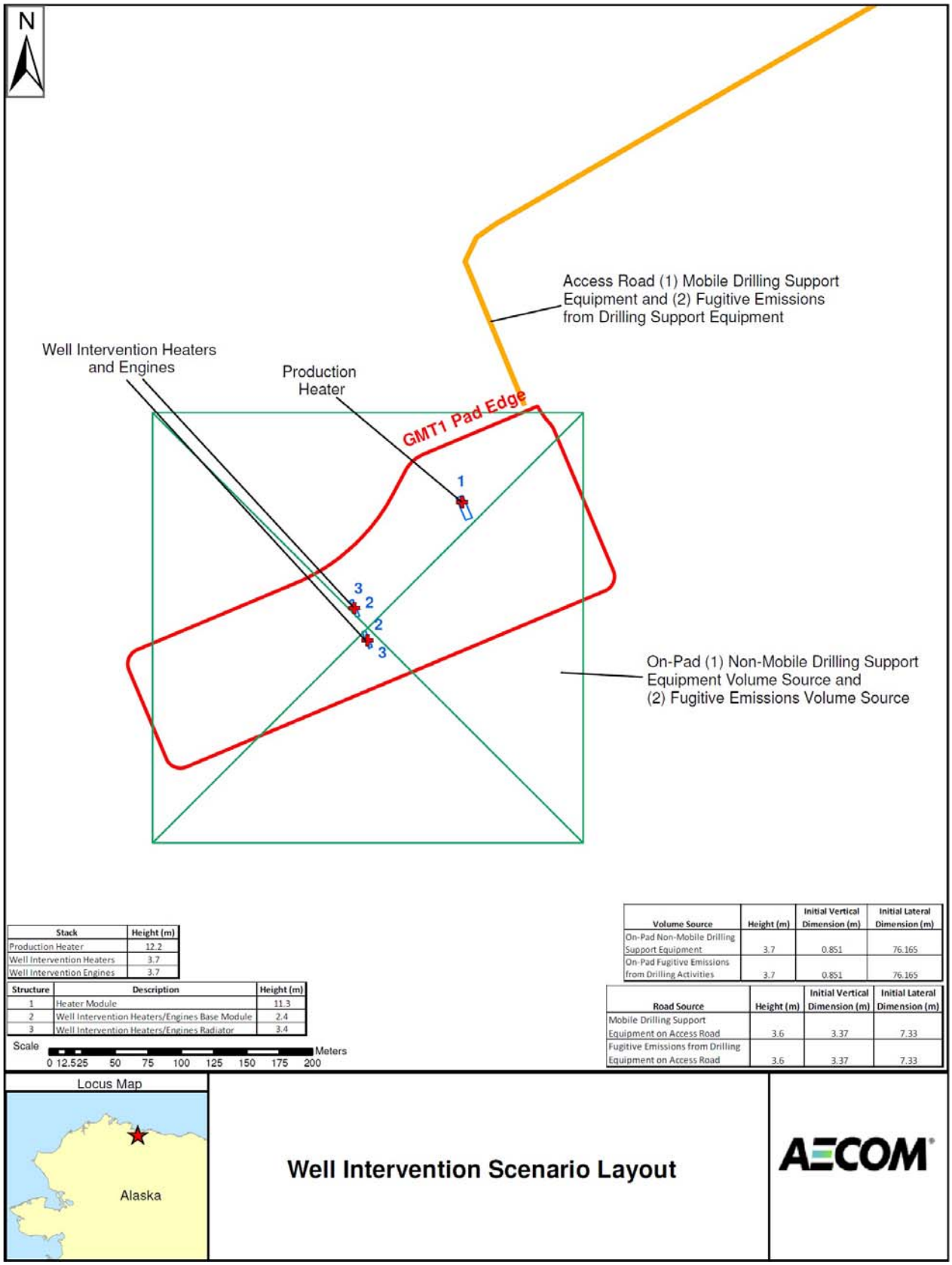
[2] Typical truck height.

[3] Typical height of a 1-story structure.

[4] Approximate length of area where most wellsite activity will take place.

[5] AERMOD User's Guide, Table 3-1 (USEPA 2004).

**Figure 3-7 Modeled Layout – Well Intervention**




| Stack | Height (m) |
|---|---|
| Production Heater | 12.2 |
| Well Intervention Heaters | 3.7 |
| Well Intervention Engines | 3.7 |

| Structure | Description | Height (m) |
|---|---|---|
| 1 | Heater Module | 11.3 |
| 2 | Well Intervention Heaters/Engines Base Module | 2.4 |
| 3 | Well Intervention Heaters/Engines Radiator | 3.4 |

| Volume Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| On-Pad Non-Mobile Drilling Support Equipment | 3.7 | 0.851 | 76.165 |
| On-Pad Fugitive Emissions from Drilling Activities | 3.7 | 0.851 | 76.165 |

| Road Source | Height (m) | Initial Vertical Dimension (m) | Initial Lateral Dimension (m) |
|---|---|---|---|
| Mobile Drilling Support Equipment on Access Road | 3.6 | 3.37 | 7.33 |
| Fugitive Emissions from Drilling Equipment on Access Road | 3.6 | 3.37 | 7.33 |

**Table 3-7 Modeled Source Parameters – Well Intervention**

| Model ID | Source Description | Source Type | Stack Parameters | | | | |
|---|---|---|---|---|---|---|---|
| | | | Stack Height (m) | Stack Temp (deg K) | Stack Vel (m/sec) | Stack Diam (m) | $NO_2/NO_X$ Ratios |
| PROD_HTR | Gas fired production heater[1] | Point | 12.2 | 529 | 5.74 | 0.940 | 0.30 |
| WELLINT1 | Well Intervention Heaters and Engines were combined, with emissions then divided between two sources[2]. Fuel consumption by this source is dominated by engines; therefore, the instack ratio is consistent with that. | Point | 3.70 | 644 | 41.60 | 0.356 | 0.20 |
| WELLINT2 | | Point | 3.70 | 644 | 41.60 | 0.356 | 0.20 |

[1] Stack parameters based on CD5 Minor Permit Application (SECOR 2005).

[2] Stack parameters based on professional judgment following a comparison to similar equipment operating on the North Slope.

**Table3-7 Modeled Source Parameters – Well Intervention (Cont.)**

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height (m) | Plume Height (m) | Plume Width (m) | Initial Lat. Dimen. (m) | Initial Vert. Dimen. (m) | Vehicle Height[2] (m) | $NO_2/NO_X$ Ratios |
| RD_TAIL | Mobile Drilling Support Equip on Access Road, tailpipe emissions | Line Source [1] (32 volumes) | 3.63 | 7.25 | 15.75 | 7.33 | 3.37 | 4.27 | 0.15 |
| RD_FUG | Mobile Drilling Support Equip on Access Road, fugitive particulates | Line Source [1] (32 volumes) | 3.63 | 7.25 | 15.75 | 7.33 | 3.37 | 4.27 | na |

| Model ID | Source Description | Source Type | Stack Parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Release Height[3] (m) | | Length of Side[4] (m) | Initial Lat. Dimen.[5] (m) | Initial Vert. Dimen.[5] (m) | | $NO_2/NO_X$ Ratios |
| NONMOB | Non-Mobile Drilling Support Equip on Pad | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | 0.20 |
| PAD_DIST | Pad Disturbed Area, fugitive particulates | Volume | 3.66 | | 327.51 | 76.165 | 0.851 | | na |

[1] Source Parameters Based on Haul Road Workgroup Guidance (USEPA 2012a):

- Top of Plume Height – 1.7 x Vehicle Height.
- Volume Source Release Height – 0.5 x Top of Plume height.
- Width of Plume – Road Width + 6m for two lane roadways. Road width assumed to be 32 feet, based on sheet 22 in "GMT1 Permit Package 7-12-13.pdf" provided by CPAI.
- Initial Sigma Vertical Dimension – Top of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).
- Initial Sigma Lateral Dimension – Width of Plume / 2.15 (AERMOD User's Guide, Table 3-1, USEPA 2004).

[2] Typical truck height.

[3] Typical height of a 1-story structure.

[4] Approximate length of area where most wellsite activity will take place.

[5] AERMOD User's Guide, Table 3-1 (USEPA 2004).

- Length of Side – 327.51 meters (Approximate length of area where most wellsite activity will take place)
- Initial Lateral Dimension – 76.17 meters (AERMOD User's Guide, Table 3-1)
- Initial Vertical Dimension – 0.851 meter (AERMOD User's Guide, Table 3-1)

AERMOD was executed with a unitized (1g/sec) emission rate. The resulting concentration was then multiplied by the pollutant emissions to determine the AERMOD concentrations for each individual pollutant.

## 3.9 Receptors

Discrete modeling receptor sets were used for each modeling scenario. The receptor grids consisted of receptors placed at 25-meter intervals along the ambient boundary which was defined at the perimeter of the wellsite gravel pad, the extent of the Clover Material Source and at the edge of the active area surrounding the Nuiqsut camps, with remaining receptors placed at:

- 25-meter resolution extending from the ambient boundary outward at least 100 meters;
- 100-meter resolution extending from the 25 meter density receptors outward to 1 kilometers in each cardinal direction, and
- 250-meter resolution extending from the 100 meter density receptors outward to 2 kilometers in each cardinal direction.

Flat terrain receptors were used for all near field modeling analyses based on a review of the terrain in the GMT1 Project area. An illustration of the receptor grid for each of the modeled scenarios is provided in **Figure 3-8** through **Figure 3-10**.

**Figure 3-10,** which shows the receptors for the Nuiqsut camps, also shows a set of receptors spaced 10 degrees apart along an arc at a distance of 250 meters from the center of the area defined by the ambient air boundary. These receptors represent the distance to the nearest Nuiqsut resident.

Dispersion modeling for all scenarios was also conducted for a single receptor representing the Nuiqsut Community. The receptor was located at 70.217° N, 150.995° W (NAD 83) and assigned an elevation of 15.24 meters (50 feet), based on the approximate location of the community on Google Earth aerial photography.

## 3.10 Offsite Sources

As mentioned above, background pollutant concentrations are assumed to include impacts from emissions from existing emission sources in the region. Background concentrations calculated for this project were based on monitoring data collected through 2012. Thus, any significant offsite sources would be reflected in the background concentrations. There are no other reasonably foreseeable development sources that would be large enough to create a significant concentration gradient in the impact area. Therefore, no offsite source inventory was included in the near field dispersion modeling analysis.

**Figure 3-8 Receptor Grid – Scenarios for Activities on or Near the GMT1 Project Wellsite**

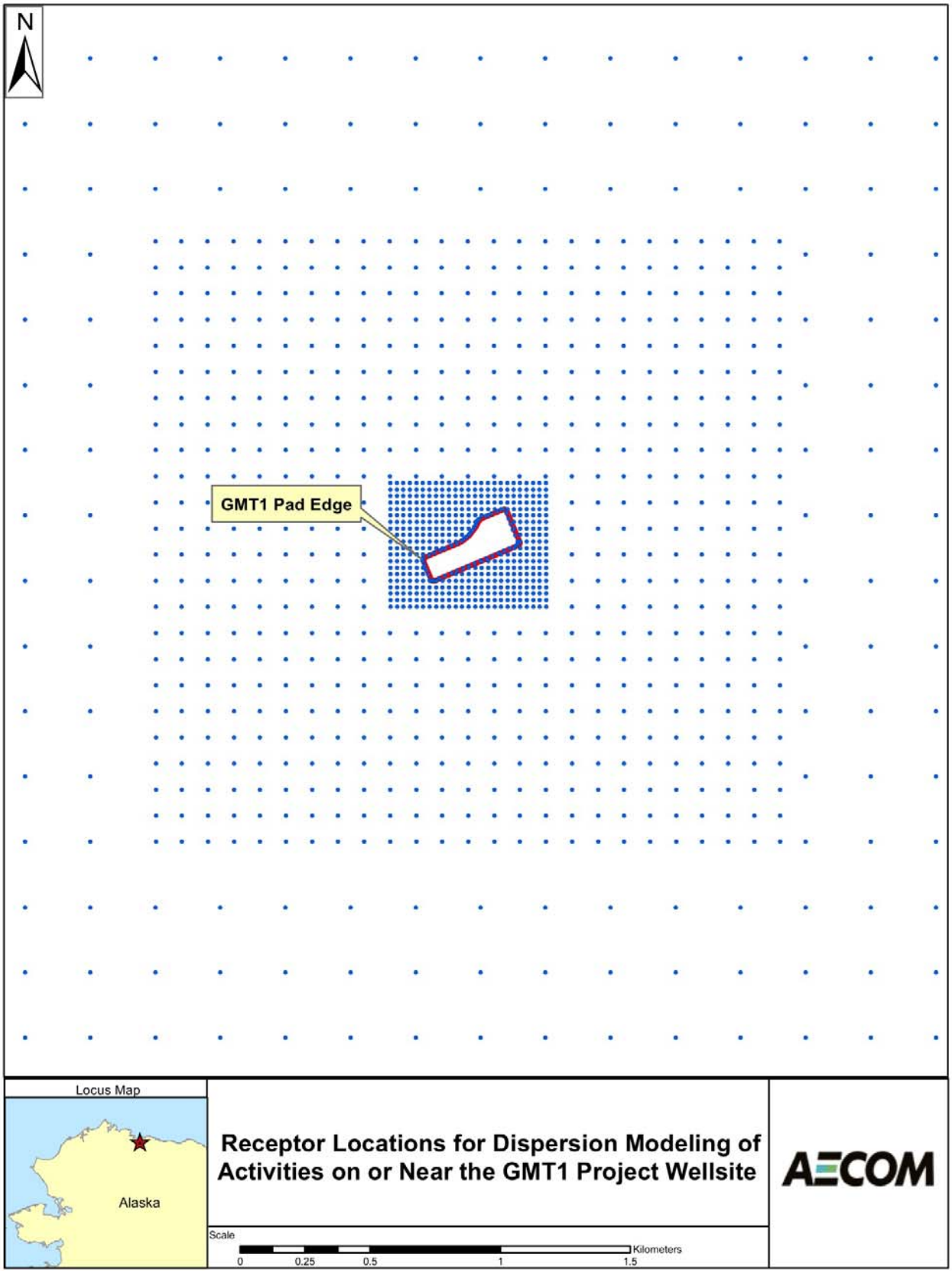


**Figure 3-9 Receptor Grid – Clover Material Source**

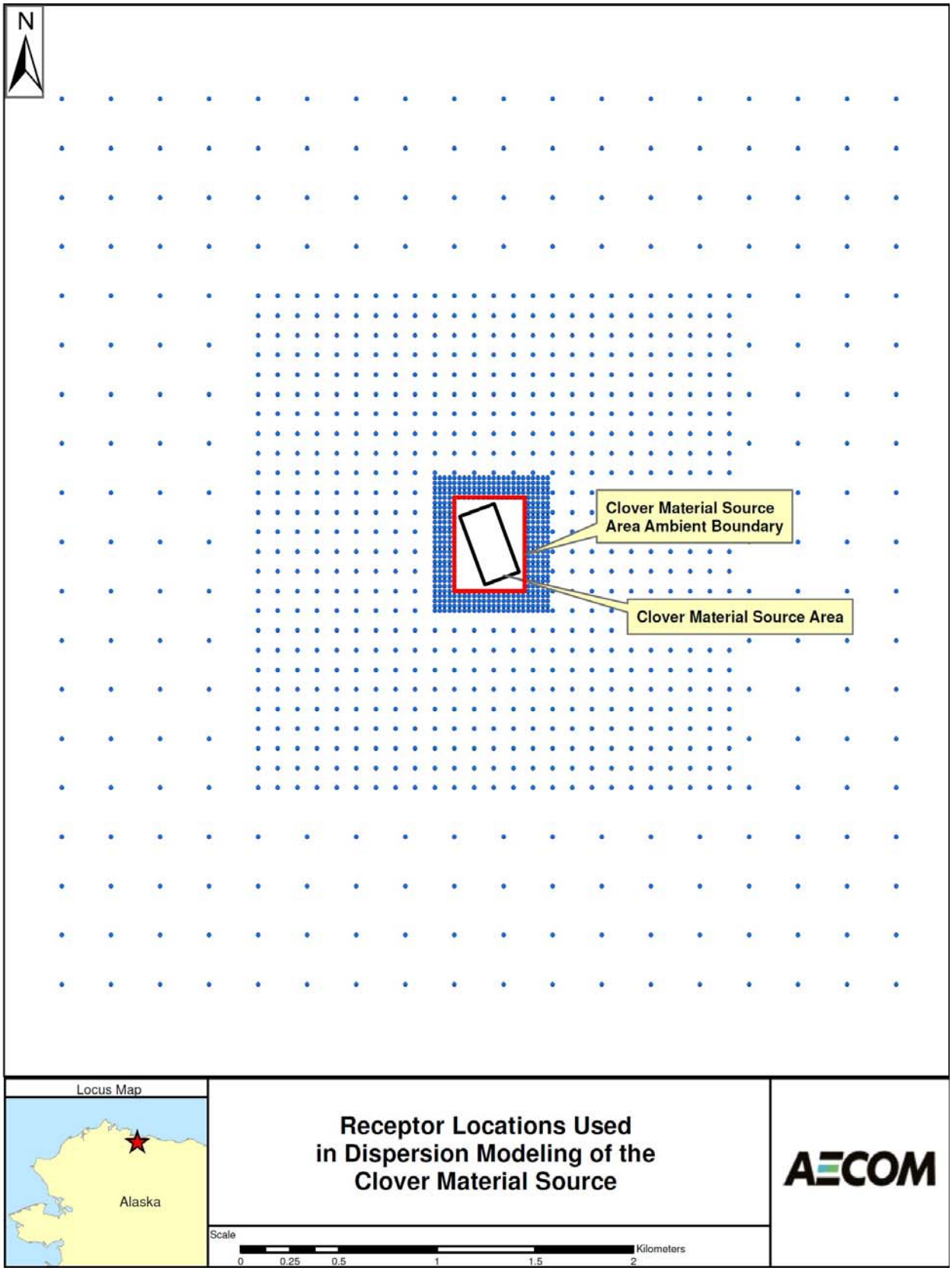
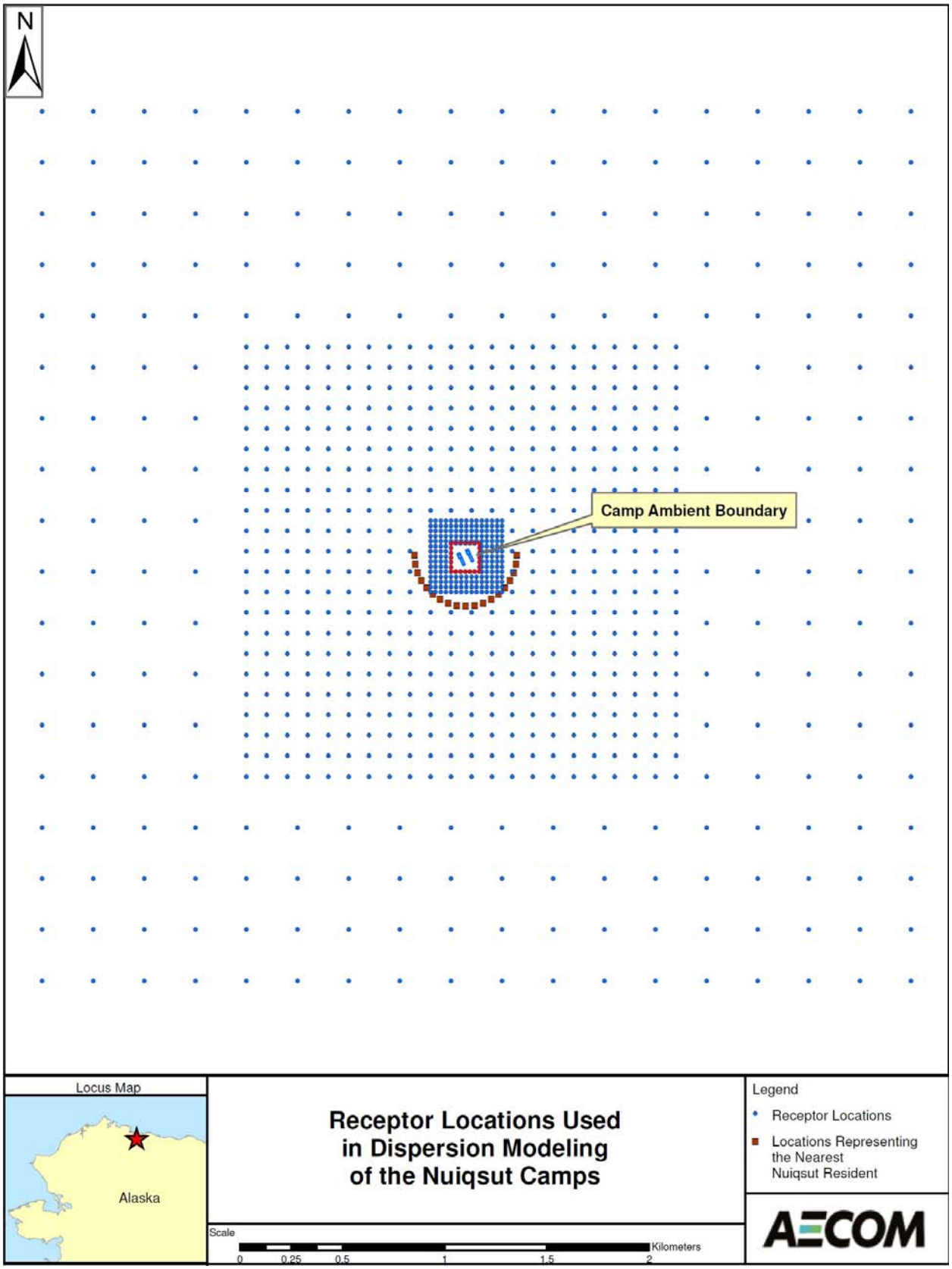


**Figure 3-10 Receptor Grid – Nuiqsut Camps**



# 4.0 Key Far-field Dispersion Modeling Assumptions

## 4.1 Modeling Methodology

The purpose of the far field analysis was to quantify potential far-field air quality impacts to both ambient air concentrations and Air Quality Related Values (AQRVs) from air pollutant emissions of $NO_x$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ that result from the drilling and operation of the GMT1 Project as detailed in Chapter 2. Nearby Reasonably Foreseeable Development (RFD) sources, not yet built and therefore, not included in the background ambient air quality data, were also explicitly modeled to quantify potential cumulative air quality and AQRV impacts. Ambient air quality impacts of $NO_2$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ and AQRVs were analyzed at the U.S. Fish and Wildlife Service (USFWS)-identified sensitive Class II receptors within 185 miles (300 kilometers) of the GMT1 Project. Cumulative air quality impacts of $NO_2$, $SO_2$, $PM_{10}$, and $PM_{2.5}$ were also analyzed at the community of Nuiqsut.

The analyses was performed using the USEPA-approved version of the CALPUFF modeling system (Version 5.8) that was subsequently modified by the USFWS to account for Polar Stereographic coordinate system (BLM 2012). The meteorological data for the analysis were processed with the latest version of Mesoscale Model Interface Program (MMIF), currently version 2.3p1, (ENVIRON 2012) to develop a meteorological wind field. All CALPUFF model options conform to the 2009 USEPA guidance (USEPA 2009) as applicable and all CALPOST model options and inputs will utilize FLAG 2010 guidance and inputs (FLAG 2010).

The community of Nuiqsut and sensitive Class II areas located within 185 miles (300 kilometer) of the GMT1 Project are listed in **Table 4-1** and shown on **Figure 4-1**. **Table 4-1** also lists the agency responsible for managing the area, and the PSD classification.

Using the Project and RFD sources, the CALPUFF-predicted impacts will be compared with ambient air quality standards and post-processed to compute: 1) air quality impacts 2) AQRV impacts due to light extinction change for comparison to visibility impact thresholds; and 3) AQRV impacts due to deposition rates for comparison to sulfur (S) and nitrogen (N) deposition thresholds.

## 4.2 GMT1 Project Simulation

The scenario modeled in CALPUFF to assess far-field GMT1 Project impacts was the Infill Drilling scenario described in Chapter 2. This scenario's emission inventory consists of a drill rig, a production heater, drill rig portable support equipment and attendant fugitive and tailpipe emissions from mobile equipment. This scenario is expected to provide the worst-case emissions with fuel combustion sources that will provide worst-case air quality and AQRV impacts. For conservatism with respect to the visibility, it was assumed that all filterable particulate matter, including that from non-combustion sources, was treated as elemental carbon and all condensable particulate matter was treated as secondary organic aerosols. The particulate speciation was based on data from AP-42 for representative engines and the MOVES model for mobile sources. The short-term modeled emission rate for the GMT1 Infill Drilling scenario is provided in **Table 4-2** below.

The GMT1 Project sources for the Infill Drilling scenario, as well as all RFD sources, were modeled as a single volume source with parameters provided in **Table 4-3** below. Based on the coarse grid cell resolution of WRF/CALPUFF, it is expected that collocating all sources into a single low-level source will provide robust and conservative source impacts.

**Figure 4-1 CALPUFF Domain and Sensitive Class II Receptors**

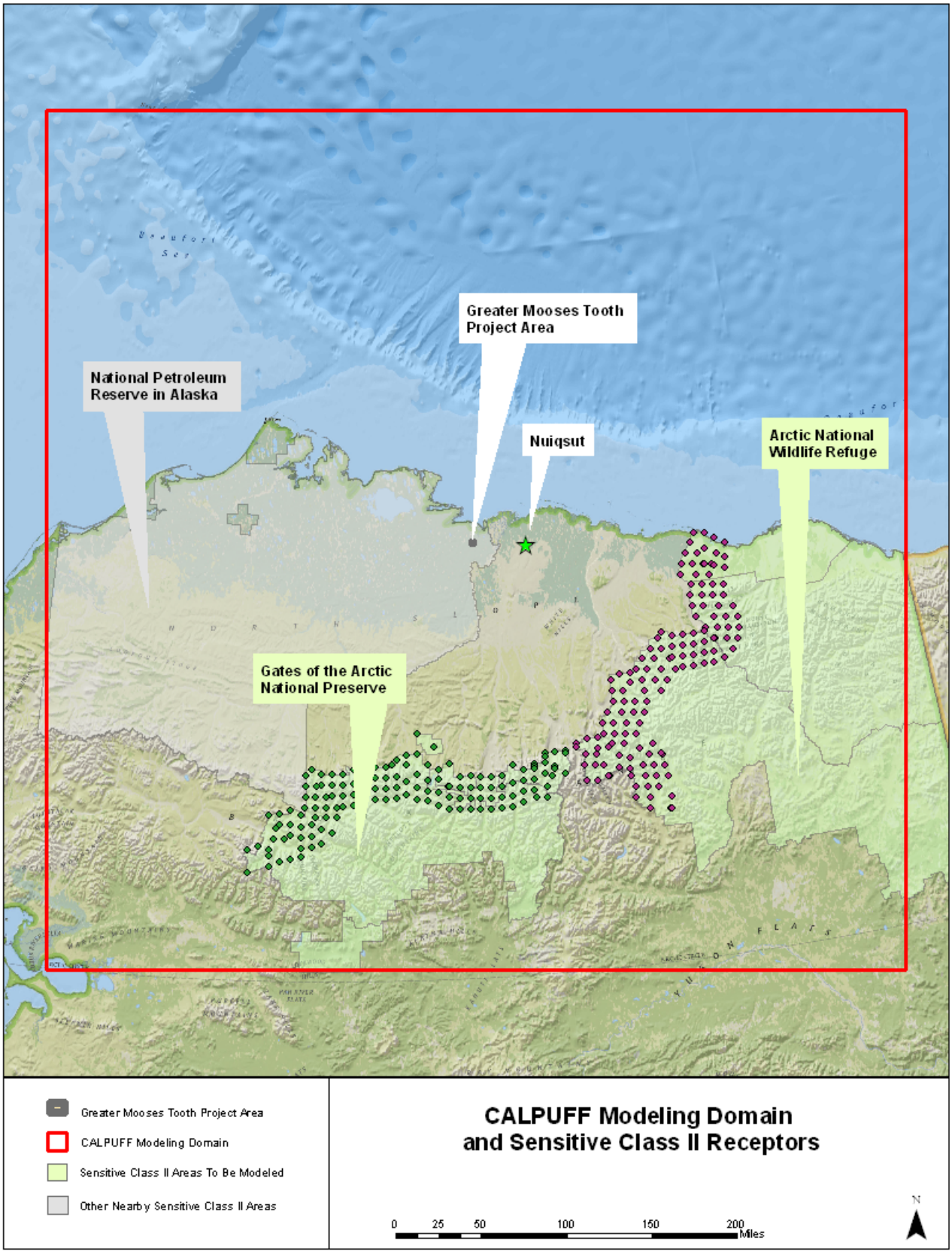


**Table 4-1 Sensitive Class II Areas**

| Area of Concern | Managing Agency | PSD Classification |
|---|---|---|
| Gates of the Arctic | National Park Service | II |
| Alaska National Wildlife Refuge | Fish and Wildlife Service | II |
| Nuiqsut | Alaska Department of Environmental Conservation | II |

**Table 4-2 GMT1 Speciated Emissions for the Infill Drilling Scenario**

| Facility | $SO_2$ (g/s) | $NO_x$ (g/s) | Elemental Carbon (g/s) | Secondary Organic Aerosol (g/s) |
|---|---|---|---|---|
| GMT1 | 0.27 | 9.69 | 1.88 | 0.23 |

**Table 4-3 GMT1 and RFD Far-field Source Parameters**

| Release Height (m) | Sigma-Y (m) | Sigma-Z (m) |
|---|---|---|
| 10 | 2.33 | 2.33 |

## 4.3 Receptors

The CALPUFF model receptors for the sensitive areas listed in **Table 4-1** are shown in **Figure 4-1**. The sensitive Class II receptors were obtained from the 2012 NPRA Integrated Activity Plan (IAP)/EIS (BLM 2012) CALPUFF modeling. A single receptor was also placed in the community of Nuiqsut to represent cumulative impacts at that location. The receptors located within the sensitive Class II areas have sufficient buffer for potential recirculation effects.

## 4.4 Meteorological Input Data and Processing

Three years (2007, 2008 and 2009) of the Weather Research and Forecasting (WRF) meteorological model output produced by the Bureau of Ocean and Energy Management (BOEM) (Zhang et al. 2013) was used as the meteorological dataset for input into the CALPUFF modeling.

The WRF data was extracted for the air quality modeling domain and processed into CALPUFF-ready format using the MMIF meteorological preprocessor. MMIF version 2.3 was updated version 2.3p1 by the USFS to include look-up tables for the Moderate Resolution Imaging Spectroradiometer (MODIS) land use categories that were used in the WRF analysis. During MMIF processing, two corrupt hours of WRF data were identified (October 23, 2007 hour 24 and March 5, 2009 hour 17) and after discussion with USEPA Region 10 and the USFS, removed from the MMIF processing. As a result, CALPUFF was run with the years 2007 and 2009 split into two separate periods. The location of the extracted CALPUFF domain is shown in **Figure 4-1**.

The WRF model output was processed with MMIF with the following options selected:

- Output for CALPUFF version 5.8;
- The WRF vertical layers will be interpolated to the FLM/USEPA-recommended vertical layers using the TOP option;
- The Pasquill- Gifford stability classes will be calculated with the Golder option; and
- Planetary boundary layer heights were recalculated.

CALPUFF was run in the same polar stereographic projection and 10-kilometer spatial resolution as the WRF data. The number and depth of vertical layers is consistent with USEPA specifications (USEPA 2009).

## 4.5 Ozone and Ammonia Data

Representative ozone and ammonia data is required for use in the chemical transformation of primary pollutant emissions. Ozone is used by CALPUFF to oxidize $NO_x$ and $SO_2$ emissions within the modeling domain to nitric acid and sulfuric acid, respectively. The predicted nitric acid and sulfuric acid are then partitioned in CALPUFF between the gaseous and particulate nitrate and sulfate phases based on the available ammonia, ambient temperature and relative humidity.

Hourly ozone data from the Nuiqsut station collected from 2008 through 2012 was processed into monthly averages for input into the CALPUFF model and provided in **Table 4-4** below. A value of 1.0 ppb for each month of the year was used as a conservative model input for ammonia. Based on a literature review for representative ammonia values in the area, provided in **Appendix C**, a 1.0 ppb value is highly conservative.

**Table 4-4 Monthly Average Ozone Data from Nuiqsut**

| | Jan. | Feb. | March | April | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ozone value (ppb)** | 31.8 | 31.7 | 25.5 | 17.0 | 21.2 | 21.2 | 16.2 | 16.4 | 20.9 | 27.6 | 27.9 | 30.4 |

## 4.6 Air Quality

The CALPOST processor was used to obtain the appropriate averaging period for each criteria pollutant. Years 2007 and 2009 were each modeled in two separate periods separated by the erroneous WRF file, therefore, the two ‘period’ averages was obtained to conservatively represent the annual average. All air quality impacts presented in Chapter 5 are the maximum impacts from each of the 3 years (or 5 total periods due to 2007 and 2009 each having 2 periods per year).

For both the $PM_{10}$ and $PM_{2.5}$ air quality impacts, the elemental carbon, secondary organic aerosol, secondary nitrates and secondary sulfates were combined to create a total Particulate Matter (PM) species that included both primary and secondary particulates.

## 4.7 Visibility

CALPUFF predicted 24-hour concentrations of nitrate, sulfate, $PM_{10}$, $PM_{2.5}$ and elemental carbon at each of the analyzed sensitive Class II receptors were processed using CALPOST following the procedures described in the FLAG 2010 document to estimate potential change in light extinction. This method uses seasonal natural background visibility conditions and monthly relative humidity factors provided in the FLAG 2010 report. Since natural background and relative humidity factors are only provided for Class I

PSD areas in FLAG, the values from the closest Class I area, Denali National Park, were used for both Class II sensitive areas.

## 4.8 Deposition

The POSTUTIL and CALPOST processor were used to determine annual deposition of total Sulfur and total Nitrogen from CALPUFF modeled deposition results at each sensitive Class II area. The results are expressed in kilograms per hectare per year (kg/ha/yr).

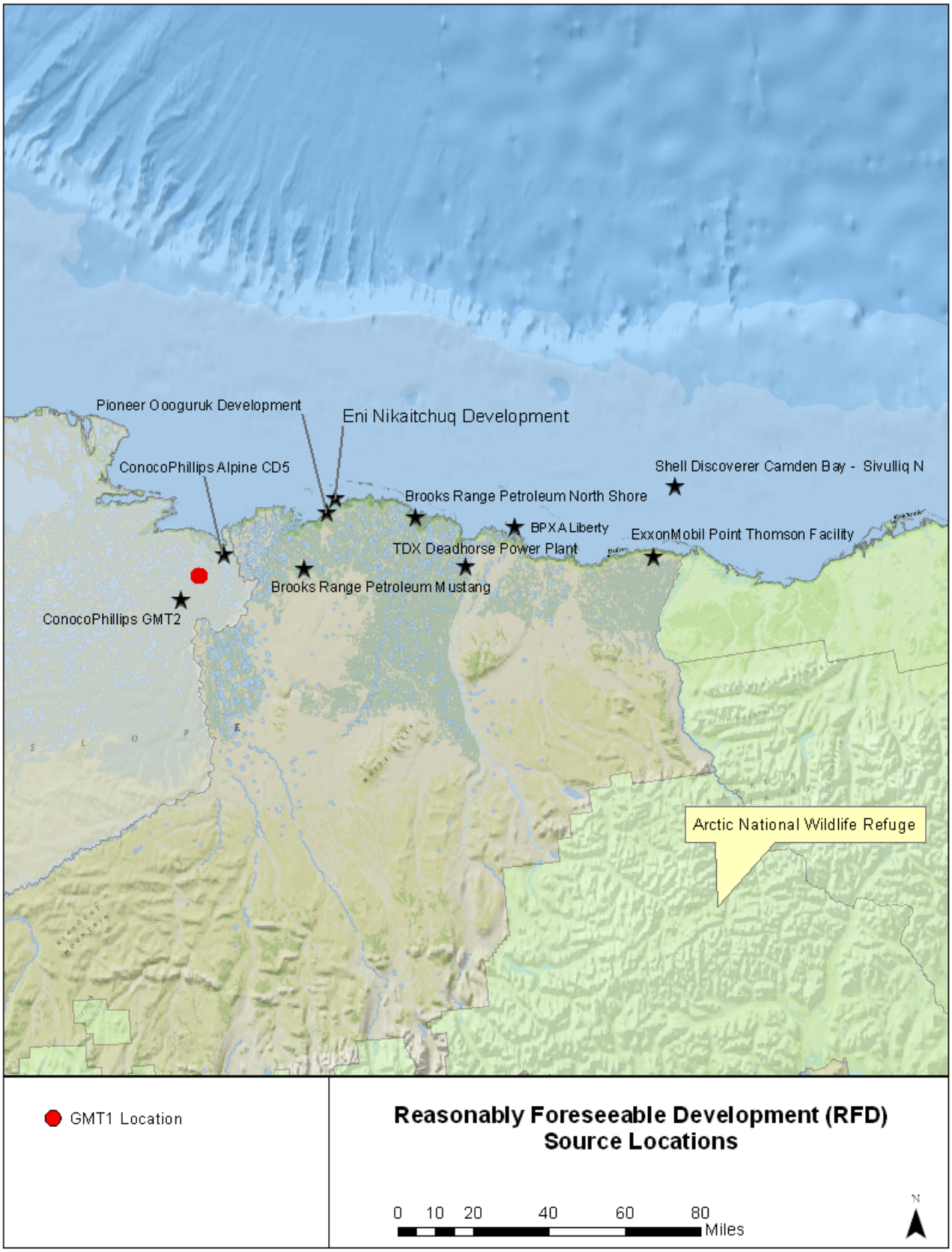
## 4.9 Reasonably Foreseeable Development Sources

As discussed in detail in Chapter 2, publicly available project information was reviewed to identify potential RFD sources. These sources were modeled using the same inputs and meteorology as the GMT1 Project sources. The predicted impacts from the GMT1 Project and RFD sources were combined so that a cumulative impact could be assessed. The RFD sources and their emissions are provided in **Table 4-5** below. The RFD sources were modeled with the same source parameters as the GMT1 sources provided in **Table 4-3**. Elevations for the RFD sources were obtained from the elevation of the WRF/CALPUFF grid cell in which they were located. The locations of the RFD sources are provided in **Figure 4-2**.

**Table 4-5 Reasonably Foreseeable Development Emissions**

| Facility | $SO_2$ (g/s) | $NO_x$ (g/s) | $PM_{10}$ (g/s) | $PM_{2.5}$ (g/s) |
|---|---|---|---|---|
| Shell Discoverer Camden Bay | 0.25 | 86.9 | 5.2 | 5.04 |
| Eni Nikaitchuq Development | 1.59 | 6.47 | 0.93 | 0.93 |
| TDX Deadhorse Power Plant | 0.49 | 11.03 | 0.43 | 0.43 |
| Pioneer Oooguruk Development | 2.12 | 6.96 | 1.01 | 1.04 |
| Brooks Range Petroleum North Shore | 0.24 | 2.55 | 0.07 | 0.07 |
| ConocoPhillips Alpine CD5 | 0.65 | 2.69 | 0.12 | 0.12 |
| ExxonMobil Point Thomson Facility | 0.88 | 4.61 | 0.58 | 0.58 |
| ConocoPhillips GMT2 | 0.26 | 5.30 | 0.19 | 0.19 |
| Brooks Range Petroleum Mustang | 0.11 | 1.03 | 0.10 | 0.10 |
| BPXA Liberty | 2.51 | 10.25 | 0.54 | 0.51 |

**Figure 4-2 Reasonably Foreseeable Development Source Locations**



# 5.0 Ambient Air Quality Impact Analysis Results

The results of the ambient air quality dispersion modeling analyses for the GMT1 Project are presented in this Chapter. Both nearfield and farfield analyses are discussed below. The analyses were conducted according to the technical approaches, source emission rates, and stack parameters presented in Chapters 2, 3, and 4.

## 5.1 Nearfield Dispersion Model Impacts

### 5.1.1 Criteria Pollutant Cumulative Impact Analysis

The results of the unmitigated GMT1 Project criteria pollutant cumulative impact analysis for scenarios with activities occurring on or near the wellsite are compared to the NAAQS/AAAQS in **Table 5-1** through **Table 5-3**. With the exception of short-term particulate emissions, the Infill Drilling and Well Intervention scenarios show compliance with the NAAQS/AAAQS. The 1-hour $NO_2$ impact for the Access Road and Pad Construction Scenario is 117 percent of the NAAQS/AAAQS.

Elevated 1-hour $NO_2$ impacts predicted during the Access Road and Pad Construction Scenario are dominated by construction equipment engaged in road and pad construction. Because of highly conservative assumptions required to represent this highly transient activity in the dispersion modeling, the elevated impacts are surely higher than what is expected in reality. The most conservative of the assumptions leading to significant over predictions include:

1) All potential construction equipment engaged in road and pad construction was assumed to be operating concurrent when in reality the equipment will be staged depending on what is being constructed (i.e., the access road construction will be completed prior to pad construction rather than concurrently as modeled) and which phase of construction is occurring (i.e., gravel placement and gravel compaction are unlikely to occur concurrently).
2) All potential construction equipment engaged in road and pad construction was assumed to operate every day of the entire construction phase.

As a first step in mitigating these impacts, the modeling should be refined to reduce the conservatism to understand if mitigation is even necessary.

The high 24-hour $PM_{2.5}$ and 24-hour $PM_{10}$ impacts shown in the tables can be attributed to fugitive dust associated with windblown and vehicular disturbance of dirt on the drilling pad and access road. For the unmitigated case, 75 percent control of fugitive dust based on watering was assumed. For comparison, impacts were also predicted assuming that fugitive dust control would be more comprehensive and consistent with North Slope best practices which require watering at the first sign of dust. For this mitigated case, 100 percent control of fugitive dust sources was assumed and the dispersion modeling was conducted a second time for these scenarios. **Table 5-4** through **Table 5-6** provides the dispersion modeling results for the mitigated case which demonstrates compliance with 24-hour particulate NAAQS/AAAQS for each of the three scenarios.

**Table 5-7** provides model predicted criteria pollutant impacts for activities associated with the Clover Material Source. This table shows these activities demonstrate compliance with the NAAQS/AAQS for all criteria pollutants and averaging periods.

**Table 5-8** shows the criteria pollutant impact analysis for the GMT1 Project man camps located to the north of the community of Nuiqsut for receptors covering the local impact area outside the ambient air boundary. **Table 5-9** provides impacts specifically predicted on receptors located a distance away from the man camps equivalent to the distance of the camps to the nearest Nuiqsut resident. **Tables 5-8**

and **5-9** both demonstrate that impacts from this activity will be below the NAAQS/AAQS for all criteria pollutants and averaging periods.

For the three scenarios with activities on or near the GMT1 wellsite as well as the Clover Material Source activity, dispersion modeling was also conducted using a single receptor representing the community of Nuiqsut. **Table 5-10** provides the results, indicating compliance with the NAAQS/AAAQS for all scenarios, for all criteria pollutants and averaging periods.

### 5.1.2 Air Toxics Impact Analysis

As described in Chapter 3, AERMOD dispersion modeling was also used to assess short-term (acute) exposure as well as long-term risk from air toxics. Short-term (1-hour) air toxics concentrations were compared to acute Reference Exposure Levels (RELs), as shown in **Table 5-11**. RELs are defined as concentrations at or below which no adverse health effects are expected. No RELs are available for ethyl benzene and n-hexane; instead, the available Immediately Dangerous to Life or Health divided by 10 (IDLH/10) values were used. These IDLH values are determined by the National Institute for Occupational Safety and Health and were obtained from USEPA's Air Toxics Database (USEPA 2011). These values are approximately comparable to mild effects levels for 1-hour exposures. **Table 5-11** provides the acute exposure assessment. Maximum modeled 1-hour concentrations were below the criteria levels for each of the air toxics evaluated.

**Table 5-11** also provides the non-carcinogenic long-term exposure assessment, where annual modeled concentrations for each of the air toxics were compared directly to the Reference Concentrations for Chronic Inhalation (RfCs). An RfC is defined by USEPA as the continuous inhalation exposure concentration at which no long-term adverse health effects are expected. RfCs exist for both non-carcinogenic and carcinogenic effects on human health (USEPA 2012b). Annual modeled concentrations were below the RfCs for each of the air toxics evaluated.

Long-term cancer risk was analyzed by applying USEPA's unit risk factors (based on 70-year exposure) and an adjustment factor to the annual modeled concentrations. The adjustment factor represents the ratio of projected exposure time to 70 years. Two exposure scenarios were evaluated: a most likely exposure (MLE) scenario and one reflective of the maximally exposed individual (MEI).

The MLE exposure duration was assumed to be 9 years, which corresponds to the mean duration that a family remains at a residence (USEPA 1993). This duration corresponds to an adjustment factor of 9/70 = 0.13. The duration of exposure for the MEI is assumed to be 30 years (i.e., the Life of Project), corresponding to an adjustment factor of 30/70 = 0.43.

A second adjustment was made for time spent at home versus time spent elsewhere. For the MLE scenario, the at-home time fraction is 0.64 (USEPA 1993), and it was assumed that during the rest of the day the individual would remain in an area where annual air toxics concentrations would be one quarter as large as the maximum annual average concentration. Therefore, the MLE adjustment factor was (0.13) x [(0.64 x 1.0) + (0.36 x 0.25)] = 0.0949. The MEI scenario assumed that the individual is at home 100 percent of the time, for a final adjustment factor of (0.43 x 1.0) = 0.43.

After the unit risk factors and adjustment factors were applied to the annual modeled concentrations, the cancer risk for each constituent was summed to provide an estimate of the total inhalation cancer risk. **Table 5-12** shows that the total cancer risk for both the MLE and MEI scenarios are less than 1.0E-06 which represents a one-in-one-million cancer risk.

An air toxics impact analysis was also performed for the single receptor representing the Nuiqsut Community. **Table 5-13** shows that maximum modeled 1-hour and annual concentrations were below the criteria levels at the Nuiqsut Community receptor for each of the air toxics evaluated. **Table 5-14** shows a less than a one-in-one-million cancer risk at the Nuiqsut Community receptor for both the MLE and MEI exposure scenarios.

### 5.1.3 Ambient Ozone Cumulative Impact Analysis

Currently, there is no USEPA-recommended modeling approach for conducting an ozone ambient air quality impact analysis for this project. Therefore, to understand potential project impacts to existing ambient ozone concentrations several aspects of the ozone conditions on the Alaskan North Slope have been investigated and summarized. This includes a review of the recent emission trends of ozone precursors, a review of existing monitoring data, and a review of recent literature that details polar ozone trends and chemistry. From this analysis it is clear that regional ozone concentrations are low, well below the NAAQS/AAAQS, and not correlated to levels of anthropogenic precursor emissions. From this it is easy to conclude that the small increase in regional precursor emissions that occur as a result of the project will have negligible effect on existing background ozone concentrations; therefore, regional ozone levels will remain well below the NAAQS/AAAQS.

An analysis of recent ozone observations at locations on the Alaskan North Slope indicate that the maximum 1-hour concentration was 73 ppbv while the maximum 8-hour measurement was 50 ppbv. The hourly concentration represents 61 percent of the hourly NAAQS/AAAQS while the 8-hour concentration represents 67 percent of the 8-hour NAAQS/AAAQS (Shell 11/23/09 Supp. App.).

These ozone levels are typical of the long term trend which shows that regional ozone levels have remained low and essentially unchanged even in light of significant changes to regional precursor production leading to the conclusion that regional ozone levels are poorly correlated to regionally produced anthropogenic precursor emissions. Substantial oil production began at Prudhoe Bay in 1977 resulting in the start of a significant increase in ozone precursors from anthropogenic sources in North Slope Borough. Since that time the magnitude of these anthropogenic precursor emissions increased as oil production peaked and then decreased following trends in oil production. According to the 2008 National Emission Inventory (NEI), estimated emissions of ozone precursors from all sources in North Slope Borough were approximately 37,300 tons per year of $NO_x$ and 1,300 tons per year of VOC. These 2008 emissions represent a decrease of 11 percent and 28 percent from the 2002 NEI inventory values for $NO_x$ and VOCs, respectively. Even with these changes in regional precursor load, ozone trends have remained essentially unchanged. The National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory (ESRL) Global Monitoring Division (GMD) has been recording tropospheric ozone measurements since 1973 at Barrow. These observations provide a continuous and robust dataset that are useful to assess ozone trends, averages and other useful information for the North Slope area. The Barrow data was extensively analyzed by Helmig et. al. (2007) who found that over the long term, no statistically significant trend has been observed in the Barrow data although a slight increase of 0.05 (± 0.08) ppbv per year has been observed since monitoring began. This slight increase does not correlate to regional anthropogenic production of precursors which has increased and decreased over that time frame.

This lack of connection between anthropogenic precursor emissions and regional ozone levels is also demonstrated by examining diurnal ozone trends. The lack of a diurnal trend in measured ozone concentrations is an indicator that ozone production through photochemistry involving precursor emissions and sunlight is not a significant source of regional ozone. Ground level ozone is formed through many complex chemical reactions involving precursors ($NO_x$, VOC, and CO) and sunlight. A correlation of measured concentrations to sunlight (i.e., a diurnal trend) would be an indicator that ozone formation is the result of the presence of precursors; however, that correlation is not observed regionally on the North Slope. Again using the long-term ozone data measured at Barrow, Helmig et al., found that the ozone levels at Barrow are generally stable on an hourly, daily and a long-term average basis. On average, only 1.8 percent (± 3.1 percent) of the hourly data exceeds the 1.5 times the annual median ozone value, the criteria in the study to denote extreme high events. This lack of diurnal variation demonstrates that local formation of ozone from regional precursors is not prevalent on the North Slope.

Though it is theoretically possible for ozone production to occur regionally as a result of precursor emissions, it simply does not dominate measured ozone levels leading to the lack of sensitivity of ozone levels to regional precursor production. In terms of local ozone production, according to Helmig et al.

"…models show that a considerable amount of ozone can be photochemically formed near the surface during daytime hours over polar snow." However, an analysis of the diurnal ozone pattern at Barrow indicates a very small, ~1 ppbv, amplitude within the daily ozone cycle pointing to very little local ozone formation. It is expected that the complex snow chemistry, clean (low $NO_x$) maritime air, enhanced ozone deposition and halogen chemistry act as ozone sinks and negate any local production. In addition, monitored ozone data represent the net effects of atmospheric mixing and dynamics as opposed to an artificial surface layer in a photochemical model that cannot account for actual mixing and the known ozone sinks.

After an examination of long-term and short-term ozone trends and comparing those to trends in regional levels of anthropogenic precursors it is clear that regional ozone levels are not sensitive to changes in regional levels of anthropogenic precursor emissions. The evidence clearly indicates that small changes in regional precursor loading as a result of the GMT1 Project and RFD sources will have negligible effect on already low regional background ozone concentrations due to lack of sensitivity of regional ozone concentrations to regionally produced anthropogenic precursors.

### 5.1.4 Secondary $PM_{2.5}$ Formation

Secondary $PM_{2.5}$ formation is a complex photochemical reaction that requires a mix of precursor atmospheric pollutants in sufficient quantities for significant secondary formation to occur. The major precursor pollutants that result in the formation of secondary $PM_{2.5}$ are $SO_2$ and $NO_x$, although the GMT1 Project emits far more $NO_x$ than $SO_2$, eliminating the need to consider sulfate formation.

The AERMOD dispersion model does not have the capability to account for secondary particulate formation when predicting particulate impacts. Therefore, to account for secondary $PM_{2.5}$ formation in nearfield model predicted concentrations in this ambient air quality impact analysis, the 5-year average of the maximum (i.e., highest-first-high) 24-hour modeled concentration was used to compare to the 24-hour $PM_{2.5}$ NAAQS/AAAQS rather than the 98$^{th}$ percentile value. This screening level approach to predicting the design value accounts for secondary particulate formation according to the USEPA Office of Air Quality Planning and Standards (USEPA 2010). Since the CALPUFF model can account for secondary particulate formation, this screening level approach was not necessary in the far-field modeling analysis.

Even without relying on the screening level approach, an analysis conducted by USEPA Region 10 for a similar source shows that contributions to impacts from secondary $PM_{2.5}$ formation will be small. When discussing secondary particulate formation from diesel fuel fired combustion sources, USEPA Region 10 in the Supplemental Statement of Basis Permit Noble Discoverer Drillship – Beaufort and Chukchi Sea Exploration Drilling Program (USEPA Region 10 2011), indicated that secondary formation of $PM_{2.5}$ will generally be low near the emission release point, where modeled concentrations are highest, because there has not been enough time for the secondary chemical reactions to occur. Instead, secondary $PM_{2.5}$ impacts will generally occur farther from the emission source. Applying this to the GMT1 project combustion sources, it is therefore unlikely that maximum primary $PM_{2.5}$ impacts and maximum secondary $PM_{2.5}$ impacts from GMT1 Project combustion sources will occur at the same time (paired in time) or location (paired in space), providing assurance that emissions from secondary formation of $PM_{2.5}$ will not threaten compliance with the NAAQS/AAAQS in the nearfield.

Based on a review of existing monitoring data across the Alaskan North Slope, USEPA Region 10 determined that available $PM_{2.5}$ monitoring data from the onshore communities along the Beaufort and Chukchi Seas, and in potential transport areas where monitoring is performed, show low levels of $PM_{2.5}$, generally in the range of 2 $\mu g/m^3$ (USEPA Region 10 2011). USEPA Region 10 went on to say that the higher $PM_{2.5}$ values recorded on monitors in the North Slope generally occur on days where windblown dust or fires are believed to be contributing factors. Based on this information, USEPA Region 10 asserted that, there is no indication that secondary formation of $PM_{2.5}$ from existing sources in the North Slope is currently causing or contributing to a violation of the $PM_{2.5}$ NAAQS in the onshore communities.

To contrast this assessment of $PM_{2.5}$ concentrations in North Slope communities, USEPA Region 10 had the following to say about the large precursor loading from Prudhoe Bay stationary sources (USEPA Region 10 2011):

> "As a point of comparison, however, actual emissions of $NO_x$ from point sources in the North Slope oil and gas fields near Deadhorse are approximately 65,000 tpy, yet the total (not just the secondary) $PM_{2.5}$ concentrations in Deadhorse are quite low. Given the amount of $NO_x$ emissions to be authorized under these permits in comparison to $NO_x$ emissions in the North Slope area in general, it is unlikely that $NO_x$ emissions from the Discoverer and the Associated Fleet would be expected to cause or contribute to a violation of the $PM_{2.5}$ NAAQS given the generally low levels of $PM_{2.5}$ recorded at monitoring stations in the area."

Given that GMT1 project $NO_x$ emissions are on the order of 100 TPY during a typical production year and much less than those from the Shell Discoverer and the Associated Fleet which were permitted at 336 tpy, the statements made by USEPA Region10 with respect to the Discoverer are equally applicable to the GMT1 Project.

In summary, evidence compiled by USEPA Region 10 suggests that secondary $PM_{2.5}$ formed from precursor emissions on the Alaskan North Slope is low even in light of large precursor emissions. Therefore, precursor emissions from the relatively small GMT1 Project will not result in significant secondarily formed $PM_{2.5}$. Furthermore, excluding windblown fugitive dust contributions, the model predicted $PM_{2.5}$ impacts indicates that a significant margin of safety exists before the $PM_{2.5}$ NAAQS/AAAQS would be threatened even with the conservatism that has been built into the analysis. This conservatism includes: 1) assuming that maximum direct and secondary $PM_{2.5}$ impacts occur at the same location and time, and 2) comparing highest-first-high model predicted impacts to the NAAQS/AAAQS in accordance with the USEPA-recommended screening approach. Based on this assessment, it is clear that the $PM_{2.5}$ NAAQS/AAAQS will be protected when accounting for secondary precursors and that it is not appropriate or necessary to use a photochemical model to further evaluate secondary $PM_{2.5}$ formation in this near-field AERMOD modeling exercise.

### 5.1.5 Lead

The primary source of lead emissions from combustion sources results from lead additives contained in some fuels and subsequently emitted during combustion. Since lead is not an additive to any source fuels, lead will only be present at trace element levels as a result of engine lubricant constituents or as a result of engine wear and will be negligible. Currently, the only liquid fuel type containing a lead additive is leaded aviation gasoline used in piston-engine aircraft which are not part of the temporary source inventory.

Therefore, lead emissions from all GMT1 project emission units will be negligible, and source emissions will not cause or contribute to an exceedance of the lead NAAQS.

### 5.1.6 Nearfield Conclusions

The base case criteria pollutant impact analysis demonstrates compliance with all criteria pollutant NAAQS/AAAQS for all averaging periods with the following exceptions:

- Unmitigated fugitive dust case 24-hour particulate impacts exceed the NAAQS/AAAQS for the three scenarios with activities on or near the drilling pad (Infill Drilling, Well Intervention, and Access Road and Pad Construction). Fugitive dust sources are responsible for the high impacts. Mitigating these impacts by assuming best-practices control of fugitive dust emissions through a comprehensive watering program demonstrates compliance with the 24-hour $PM_{2.5}$ and 24-hour $PM_{10}$ NAAQS/AAAQS for all scenarios.
- 1-hour $NO_2$ impacts exceed the NAAQS/AAAQS for the Access Road and Pad Construction scenario. These high impacts can be attributed to highly conservative modeling assumptions

necessary to represent this highly transient activity. A more realistic modeled scenario could be built in which sources do not all operate contemporaneously would likely demonstrate compliance with the NAAQS/AAAQS.

**Table 5-1 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Infill Drilling – Unmitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum Model Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 915 | 2291 | 3206 | 40,000 | 8 |
| | 8-hour | H2H | 420 | 1146 | 1566 | 10,000 | 16 |
| $SO_2$ | 1-hour | 99th | 3.42 | 23.6 | 27.02 | 196 | 14 |
| | 3-hour | H2H | 3.40 | 39.3 | 42.70 | 1,300 | 3 |
| | 24-hour | H2H | 2.84 | 34 | 36.84 | 365 | 10 |
| | Annual | MAX | 0.46 | 2.60 | 3.06 | 80 | 4 |
| $NO_2$ | 1-hour | 98th | 109.5 | 35.8 | 145.3 | 188 | 77 |
| | Annual | MAX | 42.3 | 3.8 | 46.1 | 100 | 46 |
| $PM_{10}$ | 24-hour | H1H | 177.1 | 53 | 230.1 | 150 | **153** |
| $PM_{2.5}$ | 24-hour | H1H | 34.1 | 3 | 37.1 | 35 | **106** |
| | Annual | MAX | 5.83 | 3 | 8.83 | 12 | 74 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-2 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Well Intervention – Unmitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum Model Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 495 | 2300 | 2795 | 40,000 | 7 |
| | 8-hour | H2H | 328 | 1150 | 1478 | 10,000 | 15 |
| $SO_2$ | 1-hour | 99th | 3.42 | 23.6 | 27.02 | 196 | 14 |
| | 3-hour | H2H | 3.40 | 39.3 | 42.70 | 1,300 | 3 |
| | 24-hour | H2H | 2.84 | 34 | 36.84 | 365 | 10 |
| | Annual | MAX | 0.42 | 2.60 | 3.02 | 80 | 4 |
| $NO_2$ | 1-hour | 98th | 127.0 | 35.7 | 162.7 | 188 | 87 |
| | Annual | MAX | 7.4 | 3.8 | 11.2 | 100 | 11 |
| $PM_{10}$ | 24-hour | H1H | 213.6 | 53 | 266.6 | 150 | **178** |
| $PM_{2.5}$ | 24-hour | H1H | 32.1 | 3 | 35.1 | 35 | **100** |
| | Annual | MAX | 1.80 | 3 | 4.80 | 12 | 40 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-3 GMT1 Cumulative Impacts Compared to Established Ambient Criteria for Pad and Access Road Construction – Unmitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum Model Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 1523 | 2300 | 3823 | 40,000 | 10 |
| | 8-hour | H2H | 1009 | 1150 | 2159 | 10,000 | 22 |
| $SO_2$ | 1-hour | 99th | 3.34 | 23.6 | 26.94 | 196 | 14 |
| | 3-hour | H2H | 3.43 | 39.3 | 42.73 | 1,300 | 3 |
| | 24-hour | H2H | 1.78 | 34 | 35.78 | 365 | 10 |
| | Annual | MAX | 0.09 | 2.60 | 2.69 | 80 | 3 |
| $NO_2$ | 1-hour | 98th | 184.4 | 35.7 | 220.1 | 188 | **117** |
| | Annual | MAX | 31.25 | 3.76 | 35.01 | 100 | 35 |
| $PM_{10}$ | 24-hour | H1H | 213.6 | 53 | 266.6 | 150 | **178** |
| $PM_{2.5}$ | 24-hour | H1H | 40.1 | 3 | 43.1 | 35 | **123** |
| | Annual | MAX | 5.22 | 3 | 8.22 | 12 | 68 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-4 GMT1 Cumulative Impacts Compared to Established Ambient Criteria for Infill Drilling – Mitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration (µg/m$^3$) | Ambient Background (µg/m$^3$) | Total (µg/m$^3$) | NAAQS/ AAAQS (µg/m$^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hour | H2H | 36.1 | 53 | 89.1 | 150 | 59 |
| $PM_{2.5}$ | 24-hour | H1H | 15.6 | 3 | 18.6 | 35 | 53 |

[1] H1H: Highest value across all five modeled years.
H2H: Highest Second Highest value across all five modeled years.

**Table 5-5 GMT1 Cumulative Impacts Compared to Established Ambient Criteria for Well Intervention – Mitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration (µg/m$^3$) | Ambient Background (µg/m$^3$) | Total (µg/m$^3$) | NAAQS/ AAQS (µg/m$^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hour | H2H | 29.2 | 53 | 82.2 | 150 | 55 |
| $PM_{2.5}$ | 24-hour | H1H | 25.2 | 3 | 28.2 | 35 | 81 |

[1] H1H: Highest value across all five modeled years.
H2H: Highest Second Highest value across all five modeled years.

**Table 5-6 GMT1 Cumulative Impacts Compared to Established Ambient Criteria for Access Road and Pad Construction – Mitigated Fugitive Dust Case**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration (µg/m$^3$) | Ambient Background (µg/m$^3$) | Total (µg/m$^3$) | NAAQS/ AAAQS (µg/m$^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| $PM_{10}$ | 24-hour | H2H | 70.1 | 53 | 123.1 | 150 | 82 |
| $PM_{2.5}$ | 24-hour | H1H | 14.5 | 3 | 17.5 | 35 | 50 |

[1] H1H: Highest value across all five modeled years.
H2H: Highest Second Highest value across all five modeled years.

**Table 5-7 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Activities within the Clover Material Source**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 1939 | 2300 | 4239 | 40,000 | 11 |
| | 8-hour | H2H | 1121 | 1150 | 2271 | 10,000 | 23 |
| $SO_2$ | 1-hour | 99th | 16.22 | 23.6 | 39.82 | 196 | 20 |
| | 3-hour | H2H | 30.04 | 39.3 | 69.34 | 1,300 | 5 |
| | 24-hour | H2H | 6.44 | 34 | 40.44 | 365 | 11 |
| | Annual | Max | 0.11 | 2.60 | 2.71 | 80 | 3 |
| $NO_2$ | 1-hour | 98th | 130.6 | 35.7 | 166.3 | 188 | 88 |
| | Annual | Max | 36.87 | 3.76 | 40.63 | 100 | 41 |
| $PM_{10}$ | 24-hour | H1H | 11.4 | 53 | 64.4 | 150 | 43 |
| $PM_{2.5}$ | 24-hour | H1H | 11.1 | 3 | 14.1 | 35 | 40 |
| | Annual | Max | 3.74 | 3 | 6.74 | 12 | 56 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-8 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Man Camps Located Near Nuiqsut – Full Receptor Grid**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 421 | 2291 | 2712 | 40,000 | 7 |
| | 8-hour | H2H | 192 | 1146 | 1338 | 10,000 | 13 |
| $SO_2$ | 1-hour | 99th | 0.49 | 23.6 | 24.09 | 196 | 12 |
| | 3-hour | H2H | 0.46 | 39.3 | 39.76 | 1,300 | 3 |
| | 24-hour | H2H | 0.29 | 34 | 34.29 | 365 | 9 |
| | Annual | MAX | 0.067 | 2.60 | 2.667 | 80 | 3 |
| $NO_2$ | 1-hour | 98th | 106.89 | 35.75 | 142.64 | 188 | 76 |
| | Annual | MAX | 14.28 | 3.76 | 18.04 | 100 | 18 |
| $PM_{10}$ | 24-hour | H1H | 8.86 | 53 | 61.86 | 150 | 41 |
| $PM_{2.5}$ | 24-hour | H1H | 8.79 | 3 | 11.79 | 35 | 34 |
| | Annual | MAX | 1.75 | 3 | 4.75 | 12 | 40 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-9 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Man Camps Located Near Nuiqsut – Nearest Residence Receptor Grid**

| Pollutant | Averaging Period | Rank [1] | Maximum AERMOD Predicted Concentration ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total ($\mu g/m^3$) | NAAQS/ AAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|
| CO | 1-hour | H2H | 376 | 2291 | 2667 | 40,000 | 7 |
| | 8-hour | H2H | 139 | 1146 | 1285 | 10,000 | 13 |
| $SO_2$ | 1-hour | 99th | 0.42 | 23.6 | 24.02 | 196 | 12 |
| | 3-hour | H2H | 0.31 | 39.3 | 39.61 | 1,300 | 3 |
| | 24-hour | H2H | 0.15 | 34 | 34.15 | 365 | 9 |
| | Annual | MAX | 0.021 | 2.60 | 2.621 | 80 | 3 |
| $NO_2$ | 1-hour | 98th | 92.67 | 35.75 | 128.42 | 188 | 68 |
| | Annual | MAX | 5.62 | 3.76 | 9.38 | 100 | 9 |
| $PM_{10}$ | 24-hour | H1H | 4.45 | 53 | 57.45 | 150 | 38 |
| $PM_{2.5}$ | 24-hour | H1H | 3.97 | 3 | 6.97 | 35 | 20 |
| | Annual | MAX | 0.53 | 3 | 3.53 | 12 | 29 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99th percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-10 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria at the Community of Nuiqsut**

| Pollutant | Averaging Period | Rank | Maximum AERMOD Predicted Concentrations (µg/m$^3$) | | | | | Ambient Background (µg/m$^3$) | Total (µg/m$^3$) | NAAQS/ AAAQS (µg/m$^3$) | % of NAAQS/ AAAQS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Infill Drilling | Well Interv. | Pad & Access Road Constr. | Clover Material Source | Max | | | | |
| CO | 1-hour | H2H | 25.03 | 22.58 | 68.07 | 163.82 | 163.8 | 2291 | 2455 | 40,000 | 6 |
| | 8-hour | H2H | 3.20 | 2.88 | 8.69 | 24.53 | 24.5 | 1146 | 1170 | 10,000 | 12 |
| $SO_2$ | 1-hour | 99th | 0.052 | 0.044 | 0.045 | 1.40 | 1.4 | 23.6 | 25.0 | 196 | 13 |
| | 3-hour | H2H | 0.034 | 0.031 | 0.062 | 1.06 | 1.1 | 39.3 | 40.4 | 1,300 | 3 |
| | 24-hour | H2H | 0.006 | 0.005 | 0.010 | 0.19 | 0.2 | 34 | 34.2 | 365 | 9 |
| | Annual | MAX | 0.0003 | 0.0002 | 0.0001 | 0.0009 | 0.0009 | 2.60 | 2.6 | 80 | 3 |
| $NO_2$ | 1-hour | 98th | 6.42 | 8.24 | 9.93 | 39.30 | 39.3 | 35.8 | 75.0 | 188 | 40 |
| | Annual | MAX | 0.050 | 0.008 | 0.030 | 0.095 | 0.095 | 3.8 | 3.9 | 100 | 4 |
| $PM_{10}$ | 24-hour | H6H | 1.48 | 1.44 | 1.60 | 0.94 | 1.6 | 53 | 54.6 | 150 | 36 |
| $PM_{2.5}$ | 24-hour | H1H | 0.37 | 0.35 | 0.62 | 0.63 | 0.6 | 3 | 3.6 | 35 | 10 |
| | Annual | MAX | 0.004 | 0.001 | 0.003 | 0.005 | 0.005 | 3 | 3.0 | 12 | 25 |

[1] H1H: Highest value across all five modeled years.

H2H: Highest Second Highest value across all five modeled years.

98th: Average across all five modeled years of the 98$^{th}$ percentile of 1-hour daily maximum predicted concentrations.

99th: Average across all five modeled years of the 99$^{th}$ percentile of 1-hour daily maximum predicted concentrations.

MAX: Maximum period impact from among all individual modeled years.

**Table 5-11 Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment**

| Pollutant | REL (1-hour) (µg/m$^3$) | Maximum Modeled 1-hour Concentration (µg/m$^3$) | Non-carcinogenic RfC[3] (Annual) (µg/m$^3$) | Maximum Modeled Annual Concentration (µg/m$^3$) |
|---|---|---|---|---|
| Benzene | 1300 [1] | 3.3 | 30 | 0.060 |
| Ethyl benzene | 37000 [1] | 0.5 | 5,000 | 0.0017 |
| Formaldehyde | 350000 [2] | 1.8 | 1,000 | 0.050 |
| n-Hexane | 22000 [1] | 68.9 | 100 | 0.49 |
| Toluene | 390000 [2] | 2.6 | 700 | 0.031 |
| Xylene | 55 [1] | 1.1 | 10 | 0.016 |

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).
[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).
[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

**Table 5-12 Air Toxics Long-term Cancer Risk Analysis**

| Exposure Scenario[1] | Pollutant | Maximum Modeled Annual Concentration (µg/m$^3$) | Carcinogenic Unit Risk Factor[2] (1/µg/m$^3$) | Exposure Adjustment Factor | Cancer Risk |
|---|---|---|---|---|---|
| MLE | Benzene | 0.060 | 7.8E-06 | 0.0949 | 4.43E-08 |
| MLE | Ethyl benzene | 0.0017 | 2.5E-06 | 0.0949 | 3.92E-10 |
| MLE | Formaldehyde | 0.050 | 1.3E-05 | 0.0949 | 6.12E-08 |
| | | | | **Total Inhalation Cancer Risk** | **1.06E-07** |
| MEI | Benzene | 0.060 | 7.8E-06 | 0.43 | 2.01E-07 |
| MEI | Ethyl benzene | 0.0017 | 2.5E-06 | 0.43 | 1.78E-09 |
| MEI | Formaldehyde | 0.050 | 1.3E-05 | 0.43 | 2.77E-07 |
| | | | | **Total Inhalation Cancer Risk** | **4.80E-07** |

[1] MLE = most likely exposure; MEI = maximally exposed individual.
[2] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

**Table 5-13 Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment for Nuiqsut Community Receptor**

| Pollutant | REL (1-hour) (μg/m$^3$) | Maximum Modeled 1-hour Concentration (μg/m$^3$) | Non-carcinogenic RfC[3] (Annual) (μg/m$^3$) | Maximum Modeled Annual Concentration (μg/m$^3$) |
|---|---|---|---|---|
| Benzene | 1300 [1] | 0.19 | 30 | 3.80E-05 |
| Ethyl benzene | 37000 [1] | 0.029 | 5,000 | 1.05E-06 |
| Formaldehyde | 350000 [2] | 0.10 | 1,000 | 3.15E-05 |
| n-Hexane | 22000 [1] | 3.89 | 100 | 3.11E-04 |
| Toluene | 390000 [2] | 0.15 | 700 | 1.98E-05 |
| Xylene | 55 [1] | 0.061 | 10 | 1.01E-05 |

[1] USEPA Air Toxics Database, Table 2 (USEPA 2011).
[2] No REL available for these air toxics. Values shown are from (IDLH/10), USEPA Air Toxics Database, Table 2 (USEPA 2011).
[3] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

**Table 5-14 Air Toxics Long-term Cancer Risk Analysis for Nuiqsut Community Receptor**

| Exposure Scenario[1] | Pollutant | Maximum Modeled Annual Concentration (μg/m$^3$) | Carcinogenic Unit Risk Factor[2] (1/μg/m$^3$) | Exposure Adjustment Factor | Cancer Risk |
|---|---|---|---|---|---|
| MLE | Benzene | 3.80E-05 | 7.8E-06 | 0.0949 | 2.82E-11 |
| MLE | Ethyl benzene | 1.05E-06 | 2.5E-06 | 0.0949 | 2.49E-13 |
| MLE | Formaldehyde | 3.15E-05 | 1.3E-05 | 0.0949 | 3.89E-11 |
| | | | | **Total Inhalation Cancer Risk** | **6.73E-11** |
| MEI | Benzene | 3.80E-05 | 7.8E-06 | 0.43 | 1.28E-10 |
| MEI | Ethyl benzene | 1.05E-06 | 2.5E-06 | 0.43 | 1.13E-12 |
| MEI | Formaldehyde | 3.15E-05 | 1.3E-05 | 0.43 | 1.76E-10 |
| | | | | **Total Inhalation Cancer Risk** | **3.05E-10** |

[1] MLE = most likely exposure; MEI = maximally exposed individual.
[2] USEPA Air Toxics Database, Table 1 (USEPA 2012b).

### 5.1.7 Comparison of Near-field Model Predicted Impacts to Ambient Measurements

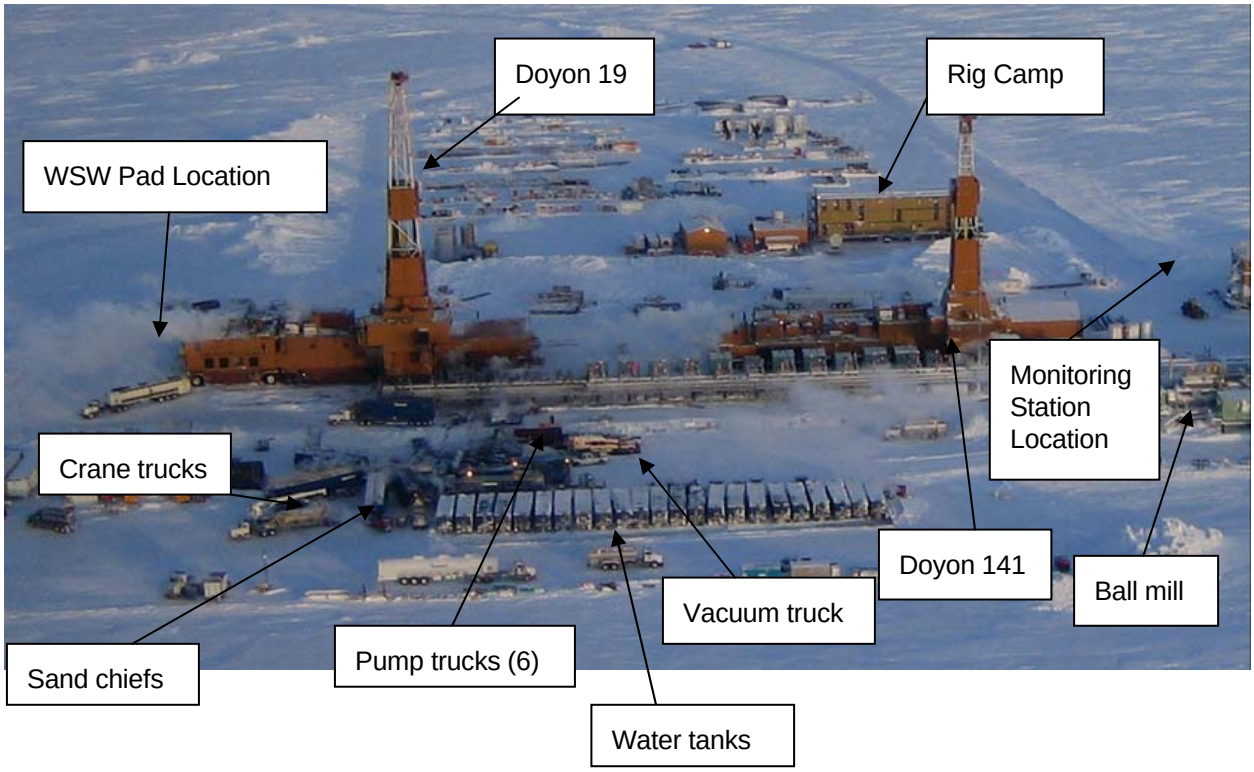
Given the results of several North Slope monitoring programs it is not surprising that the nearfield GMT1 Project model predicted impacts demonstrated compliance with the NAAQS/AAAQS since ambient data collected indicates that it should. Consistent with the modeling conducted, two of these monitoring programs, Alpine CD3 and Alpine CD1, were specifically design to characterize impacts from large drilling activities within the Alpine Development by collecting data downwind, and in the near-field, of large drilling activities and stationary sources.

**Alpine CD3 Ambient Monitoring Program**

The Alpine CD3 Ambient Monitoring Program was a PSD-quality ambient air monitoring project on the CD3 pad at Alpine in early spring of 2011. Ambient air monitoring for the purpose of measuring drilling activity emissions impacts for comparison with the AAAQS/NAAQS spanned an eight-week period from February 21 to April 16, 2011, in which the Doyon 19 drill rig, the Doyon 141 drill rig, a hydraulic fracturing operation, and a large inventory of portable support equipment were working simultaneously on the pad. Both the Doyon 19 and Doyon 141 drill rigs were connected to highline power but the slick-line units, the coil tubing unit, and the well fracturing operations were not. In these eight weeks, the Doyon 19 and Doyon 141 drill rigs drilled a combined five new wells, while the Halliburton Energy Services Slick Line Unit and Schlumberger Coil Tubing Unit did pre-fracturing work on seven different wells. Hydraulic fracturing also occurred at one well on CD3 from April 11 through April 13.

As shown in **Figure 5-1**, the location of the monitoring station was specifically chosen to be downwind of the drilling activities under prevailing southwesterly wind directions. Pad space limitations prevented placing the station downwind of dominant prevailing northeasterly wind directions. Additionally, the pollutant measurement inlet height was selected with the help of dispersion modeling to help assure that maximum impacts from the drill rigs would be measured. The project Quality Assurance Project Plan and data set were transmitted and reviewed by the Alaska Department of Environmental Conservation.

**Figure 5-1 Alpine CD3 Wellsite During the Monitoring Program**



During the Alpine CD3 monitoring program, all criteria pollutants were measured and no AAAQS/NAAQS exceedances were recorded. The standard for which drilling operations have difficulty demonstrating compliance via existing modeling protocols is the 1-hour $NO_2$ standard. The CD3 monitoring results for this pollutant is plotted in **Figure 5-2**. Based on the data collected, the highest one-hour $NO_2$ concentration measured during the monitoring program was 0.087ppm, or 87 percent of the standard. This peak occurred the evening of March 4. During this time, the winds were coming from the west-southwest (across the pad) around 3 miles per hour. Observations from the station's cameras indicate frequent vehicle traffic near the station and an idling truck downwind of the station inlet. Given that the drilling program consisted of two rigs and included well fracturing operations, it is safe to conclude that any ambient air quality impacts from this or any other CPAI drilling operations should not threaten compliance with the AAAQS/NAAQS.

**Alpine CD1 Ambient Monitoring Program**

The Alpine CD1 Monitoring Program is a PSD-quality ambient air monitoring program on the CD1 pad at Alpine which began collecting data in October 2012 and has been in continuous operation since that time. Similar to the CD3 Monitoring Program, this program was specifically designed to collect data in the nearfield of drill rigs; however, the CD1 pad also includes the Alpine Central Processing Facility which is a PSD major stationary source. Therefore, measurements collected by this monitoring program not only include impacts from drilling activities but also large onsite sources.

As shown in **Figure 5-3**, the CD1 monitoring station is located downwind, according to historical wind patterns, from the southern end of the CD1 well line (i.e., west-southwest by southwest of the southern end of the well line) and southwest from the Alpine Central Processing Facility. The program collects measurements for all criteria pollutants. This monitoring program is operated in accordance with a quality assurance project plan that was reviewed and approved by ADEC in September 2012.

From the point that the station was operational through the end of 2012, the Doyon 19 drill rig was operating on the southern end of the well line. Since installation, including that period when the Doyon 19 was present upwind of the monitoring station, no violations of the AAAQS/NAAQS have been recorded. All validated $NO_2$ data from the CD1 program collected to date is plotted in **Figure 5-4**. Based on the data collected, the highest one-hour $NO_2$ concentration measured during the monitoring program was 0.073 ppm, or 73 percent of the standard. The relatively low measured concentrations collected, not only in the nearfield of a drill rig, but also a major stationary source, reinforces what was concluded from the Alpine CD3 Monitoring Program, ambient air quality impacts from this or any other CPAI drilling operations should not threaten compliance with the AAAQS/NAAQS.

In addition to these targeted programs, data collected at the Kuparuk River Unit Drill Site 1F location and the 25-year+ data set collected at the Prudhoe Bay Unit A Pad both have reported measurements impacted by large drilling activities occurring near the monitoring location. Data collected and the drilling activities at these sites have been documented in the following correspondence with the State of Alaska as part of recent drill rig permitting activities:

- ConocoPhillips Alaska, Inc. Operating Permit Renewal Application - Kuparuk Transportable Drilling Rigs Permit No. AQ0909TVP01 submitted to the Alaska Department of Environment Conservation May 2012.
- Ambient Monitoring within the Alpine and Kuparuk fields in Support of Drill Rig Stationary Source Permitting. A letter from Brad Thomas (ConocoPhillips Alaska, Inc.) and Alejandra Castano (BP Exploration (Alaska) Inc.) to Jim Baumgartner (Alaska Department of Environmental Conservation) February 15, 2013.

**Figure 5-2 Alpine CD3 Monitoring Program Measured $NO_2$ Concentrations**

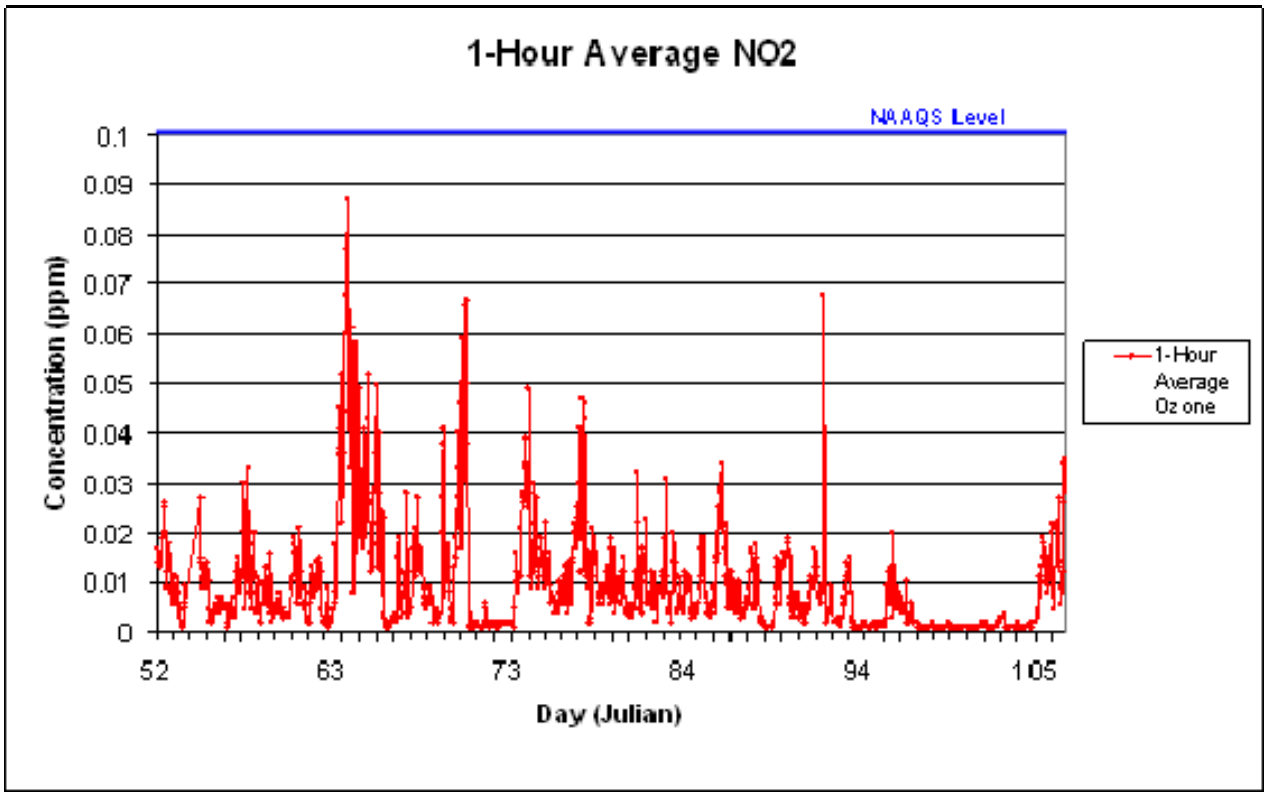


**Figure 5-3 Photo of the Alpine CD1 Facility with the Monitoring Station Identified**

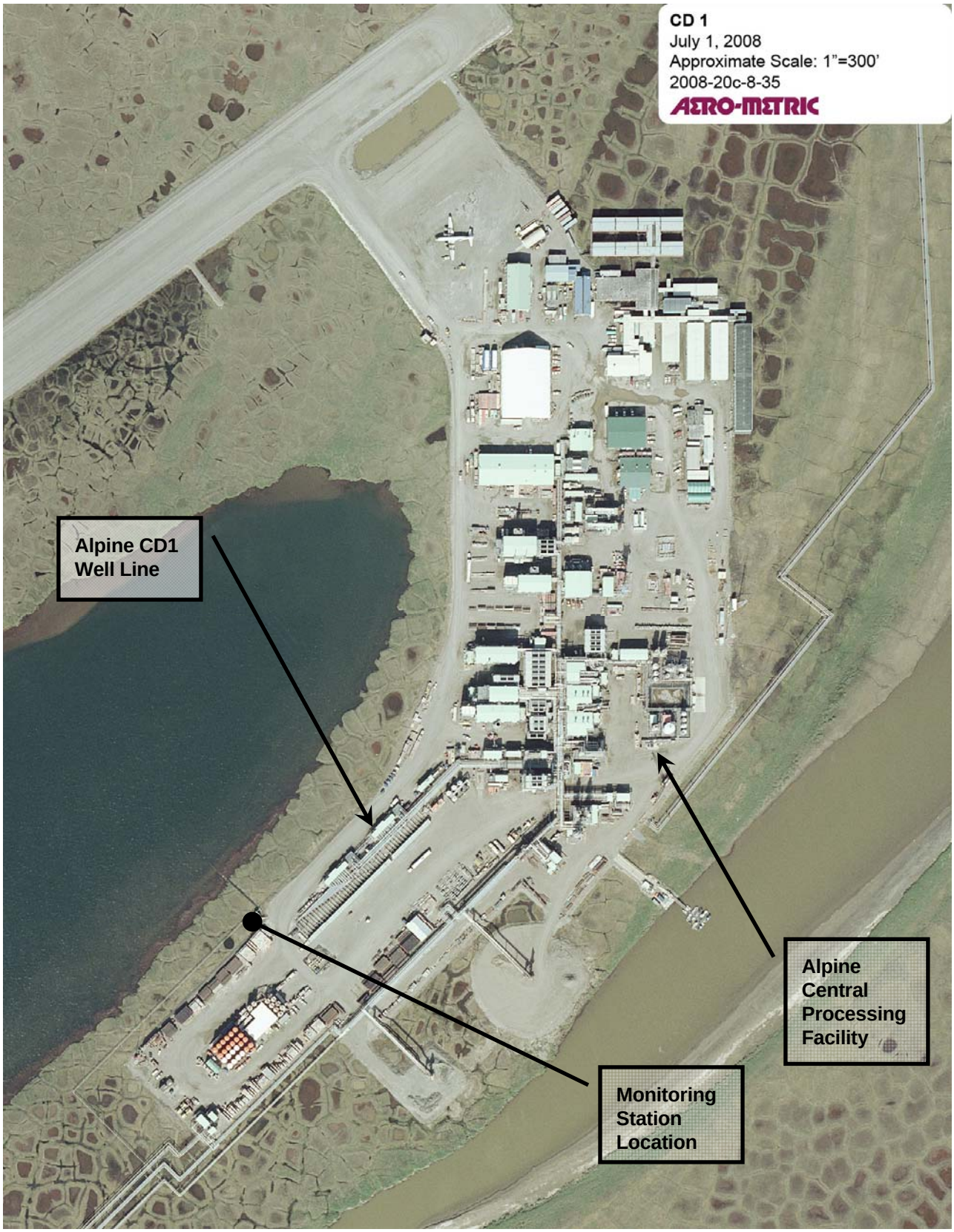
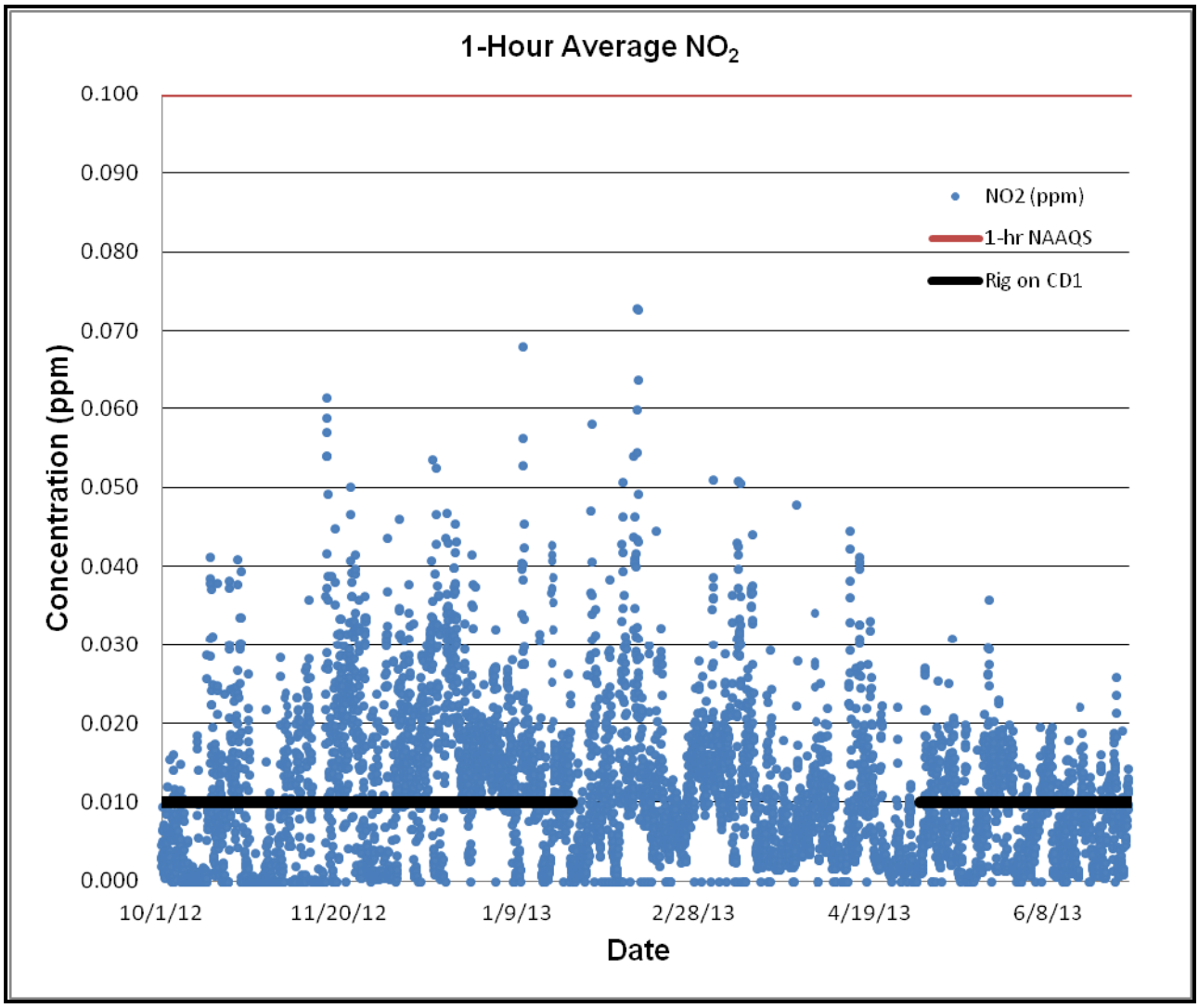


**Figure 5-4 Alpine CD1 Monitoring Program Measured $NO_2$ Concentrations**



In the case of both of the DS1F and A Pad monitoring programs, a drilling operation was present on the pad with the monitoring station on average once per year. Similar to the Alpine CD3 and CD1 data sets discussed above, neither of these datasets have ever reported a violation of the NAAQS/AAAQS.

All of these datasets were collected near much more intensive drilling activities than those proposed for the GMT1 Project without threatening compliance with the NAAAQS/AAAQS. Therefore, data from these projects provide clear evidence that no violations of the NAAQS/AAAQS will occur for the GMT1 Project even without conducting the dispersion modeling presented in this document given the projects smaller emissions footprint. Regardless, a high level comparison of the ambient monitoring data to the model predicted impacts for the GMT Project provides some measure of model performance. Since the model is generally predicting higher impacts for a smaller activity when compared to the monitoring data, it is concluded that the modeling satisfies the objective of predicting conservatively representative impacts from the GMT1 Project.

## 5.2 Far-field Dispersion Model Impacts

Using the modeling inputs, options and assumptions discussed in Chapters 2 and 4, the far-field modeling was executed and results are presented in the following sections. The results for both project-alone and cumulative impacts for air quality and AQRVs are provided in separate sections.

### 5.2.1 Project Impacts

The impacts from the GMT1 project are provided below and compared to the NAAQS/AAAQS, visibility and sulfur and nitrogen deposition at each of the sensitive Class II areas.

#### 5.2.1.1 Air Quality

As shown in **Table 5-15** and **Table 5-16** below, the maximum GMT1 Project air quality impacts, combined with representative background air quality data, at the areas of concern are well below the applicable ambient air quality standards.

#### 5.2.1.2 Visibility

As shown in **Table 5-17** through **Table 5-20** below, all GMT1 Project visibility impacts are well below both the 0.5 and 1.0 ddv threshold at both areas of concern.

#### 5.2.1.3 Deposition

As shown in **Table 5-21** below, all GMT1 Project deposition impacts are well below the DAT at both areas of concern.

### 5.2.2 Cumulative Impacts

Cumulative impacts were assessed by combining both GMT1 Project and RFD impacts for an assessment of total air quality impacts at the areas of concern.

#### 5.2.2.1 Air Quality

As shown in **Tables 5-22** through **Table 5-24** below, the maximum cumulative air quality impacts, combined with representative background air quality data, at both areas of concern and Nuiqsut are below the applicable ambient air quality standards.

#### 5.2.2.2 Visibility

As shown in **Table 5-25** through **Table 5-28** below, the cumulative visibility impacts exceed both the 0.5 and 1.0 ddv threshold at both areas of concern.

#### 5.2.2.3 Deposition

As shown in **Table 5-29** below, the cumulative deposition impacts exceed the DAT at ANWR for nitrogen, but are below the DAT for ANWR for sulfur and for both pollutants and Gates of the Arctic.

## 5.3 Far-Field Analysis Conclusions

The far-field, project-only impacts are negligible with all impacts below their applicable standards and thresholds at all areas of concern.

The cumulative impacts are below the ambient air quality standards at all areas, but exceed the visibility thresholds (0.5 and 1.0 ddv) at both Gates of Arctic and the Arctic National Wildlife Refuge. Nitrogen deposition at ANWR is above the DAT, but the remaining deposition impacts are below the DATs. It is likely that the cumulative impacts are controlled by the nearby offshore and onshore sources and their proximity to the Alaska National Wildlife Refuge as shown in **Figure 4-2**. It is expected that if additional model runs with refined source data were conducted, the impacts would be reduced.

**Table 5-15 GMT1 Air Quality Impacts at Alaska National Wildlife Refuge**

| Pollutant | Averaging Period | Maximum Predicted Impact ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS (%) |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [1] | 1.60E-01 | 35.80 | 35.96 | 188 | 19 |
| | Period [1, 2] | 1.23E-03 | 3.80 | 3.80 | 100 | 4 |
| $SO_2$ | 1-hour [1] | 5.62E-03 | 13.10 | 13.11 | 196 | 7 |
| | 3-hour [1] | 3.17E-03 | 43.00 | 43.00 | 700 | 6 |
| | 24-hour [1] | 1.32E-03 | 37.00 | 37.00 | 365 | 10 |
| | Period [1, 2] | 5.29E-05 | 4.10 | 4.10 | 60 | 7 |
| $PM_{10}$ | 24-hour [1] | 3.81E-02 | 53.00 | 53.04 | 150 | 35 |
| $PM_{2.5}$ | 24-hour [1] | 3.81E-02 | 3.00 | 3.04 | 35 | 9 |
| | Period [1, 2] | 1.81E-03 | 3.00 | 3.00 | 15 | 20 |

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

**Table 5-16 GMT1 Air Quality Impacts at Gates of the Arctic**

| Pollutant | Averaging Period | Maximum Predicted Impact ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS (%) |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [1] | 7.34E-02 | 35.8 | 35.87 | 188 | 19 |
| | Period [1, 2] | 2.84E-04 | 3.80 | 3.80 | 100 | 4 |
| $SO_2$ | 1-hour [1] | 4.18E-03 | 13.1 | 13.1 | 196 | 7 |
| | 3-hour [1] | 2.55E-03 | 43.0 | 43.0 | 1300 | 3 |
| | 24-hour [1] | 1.05E-03 | 37.0 | 37.0 | 365 | 10 |
| | Period [1, 2] | 1.98E-05 | 4.10 | 4.10 | 80 | 5 |
| $PM_{10}$ | 24-hour [1] | 3.75E-02 | 53.0 | 53.04 | 150 | 35 |
| $PM_{2.5}$ | 24-hour [1] | 3.75E-02 | 3.0 | 3.04 | 35 | 9 |
| | Period [1, 2] | 9.51E-04 | 3.0 | 3.00 | 12 | 25 |

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8760 hours and conservatively represent an annual average.

**Table 5-17 GMT1 Number of Days Greater Than 0.5 ddv**

| Area | Number of Days Greater Than 0.5 ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 0 | 0 | 0 |
| Gates of the Arctic | 0 | 0 | 0 |

**Table 5-18 GMT1 Number of Days Greater Than 1.0 ddv**

| Area | Number of Days Greater Than 1 ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 0 | 0 | 0 |
| Gates of the Arctic | 0 | 0 | 0 |

**Table 5-19 GMT1 Project Maximum ddv Impact**

| Area | Maximum ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 0.174 | 0.173 | 0.247 |
| Gates of the Arctic | 0.117 | 0.164 | 0.265 |

**Table 5-20 GMT1 Project 98th Percentile ddv Impact**

| Area | 98th Percentile ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 0.092 | 0.104 | 0.142 |
| Gates of the Arctic | 0.059 | 0.069 | 0.082 |

**Table 5-21 GMT1 Project Deposition Impacts**

| Area | Pollutant | Averaging Period | Maximum Impact (kg/ha/yr) | DAT (kg/ha/yr) | % of DAT (%) |
|---|---|---|---|---|---|
| Alaska National Wildlife Refuge | Nitrogen | Annual [1] | 3.71E-04 | 0.005 | 7 |
| Gates of the Arctic | Nitrogen | Annual [1] | 2.03E-04 | 0.005 | 4 |
| Alaska National Wildlife Refuge | Sulfur | Annual [1] | 2.46E-05 | 0.005 | 0.5 |
| Gates of the Arctic | Sulfur | Annual [1] | 1.57E-05 | 0.005 | 0.3 |

[1] All maximum GMT deposition impacts occur in year 2008, thus represent a true annual impact.

**Table 5-22 Cumulative Air Quality Impacts at Alaska National Wildlife Refuge**

| Pollutant | Averaging Period | Maximum Predicted Impact (µg/m$^3$) | Ambient Background (µg/m$^3$) | Total Impact (µg/m$^3$) | NAAQS/ AAAQS (µg/m$^3$) | % of NAAQS/ AAAQS (%) |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [1] | 41.47 | 35.80 | 77.27 | 188 | 41 |
| | Period [1, 2] | 0.20 | 3.80 | 4.00 | 100 | 4 |
| $SO_2$ | 1-hour [1] | 0.76 | 13.10 | 13.86 | 196 | 7 |
| | 3-hour [1] | 0.54 | 43.00 | 43.54 | 1300 | 6 |
| | 24-hour [1] | 0.18 | 37.00 | 37.18 | 365 | 10 |
| | Period [1,2] | 0.01 | 4.10 | 4.11 | 80 | 7 |
| $PM_{10}$ | 24-hour [1] | 1.64 | 53.00 | 54.64 | 150 | 36 |
| $PM_{2.5}$ | 24-hour [1] | 0.46 | 3.00 | 3.46 | 35 | 10 |
| | Period [1, 2] | 0.02 | 3.00 | 3.02 | 12 | 20 |

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8760 hours and conservatively represent an annual average.

**Table 5-23 Cumulative Air Quality Impacts at Gates of the Arctic**

| Pollutant | Averaging Period | Maximum Predicted Impact (µg/m$^3$) | Ambient Background (µg/m$^3$) | Total Impact (µg/m$^3$) | NAAQS/ AAAQS (µg/m$^3$) | % of NAAQS/ AAAQS (%) |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [1] | 0.64 | 35.80 | 36.44 | 188 | 19 |
| | Period [1, 2] | 0.01 | 3.80 | 3.81 | 100 | 4 |
| $SO_2$ | 1-hour [1] | 0.05 | 13.10 | 13.15 | 196 | 7 |
| | 3-hour [1] | 0.04 | 43.00 | 43.04 | 1300 | 6 |
| | 24-hour [1] | 0.02 | 37.00 | 37.02 | 365 | 10 |
| | Period [1, 2] | 0.001 | 4.10 | 4.10 | 80 | 7 |
| $PM_{10}$ | 24-hour [1] | 0.25 | 53.00 | 53.25 | 150 | 35 |
| $PM_{2.5}$ | 24-hour [1] | 0.02 | 3.00 | 3.03 | 35 | 9 |
| | Period [1, 2] | 0.03 | 3.00 | 3.00 | 12 | 20 |

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

**Table 5-24 Cumulative Air Quality Impacts at the Community of Nuiqsut**

| Pollutant | Averaging Period | Maximum Predicted Impact ($\mu g/m^3$) | Ambient Background ($\mu g/m^3$) | Total Impact ($\mu g/m^3$) | NAAQS/ AAAQS ($\mu g/m^3$) | % of NAAQS/ AAAQS (%) |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour [1] | 5.45 | 35.80 | 41.25 | 188 | 22 |
| | Period [1,2] | 0.21 | 3.80 | 4.01 | 100 | 4 |
| $SO_2$ | 1-hour [1] | 0.72 | 13.10 | 13.82 | 196 | 7 |
| | 3-hour [1] | 0.62 | 43.00 | 43.62 | 1300 | 6 |
| | 24-hour [1] | 0.34 | 37.00 | 37.34 | 365 | 10 |
| | Period [1,2] | 0.02 | 4.10 | 4.12 | 80 | 7 |
| $PM_{10}$ | 24-hour [1] | 1.25 | 53.00 | 54.25 | 150 | 36 |
| $PM_{2.5}$ | 24-hour [1] | 0.09 | 3.00 | 3.11 | 35 | 9 |
| | Period [1,2] | 0.11 | 3.00 | 3.02 | 12 | 20 |

[1] The maximum impacts are reported for all averaging periods.

[2] Due to the two erroneous WRF files, both 2007 and 2009 had to be run in separate periods in CALPUFF. Therefore, the reported values may represent an annual average for only 2008, while 2007 and 2009 have periods much less than 8,760 hours and conservatively represent an annual average.

**Table 5-25 Cumulative Number of Days Greater Than 0.5 ddv**

| Area | Number of Days Greater Than 0.5 ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 74 | 82 | 81 |
| Gates of the Arctic | 6 | 12 | 17 |

**Table 5-26 Cumulative Number of Days Greater Than 1.0 ddv**

| Area | Number of Days Greater Than 1 ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 45 | 42 | 43 |
| Gates of the Arctic | 1 | 1 | 3 |

**Table 5-27 Cumulative Maximum ddv Impact**

| Area | Max ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| Alaska National Wildlife Refuge | 6.851 | 6.364 | 6.356 |
| Gates of the Arctic | 1.326 | 1.15 | 1.106 |

**Table 5-28 Cumulative 98th Percentile ddv Impact**

| Area | 98th percentile ddv | | |
|---|---|---|---|
| | 2007 | 2008 | 2009 |
| ANWR | 3.024 | 2.928 | 3.79 |
| GAAR | 0.47 | 0.567 | 0.791 |

**Table 5-29 Cumulative Deposition Impacts**

| Area | Pollutant | Averaging Period | Maximum Impact (kg/ha/yr) | DAT (kg/ha/yr) | % of DAT (%) |
|---|---|---|---|---|---|
| Alaska National Wildlife Refuge | Nitrogen | Annual [1] | 2.76E-02 | 0.005 | 552 |
| Gates of the Arctic | Nitrogen | Period [2] | 4.85E-03 | 0.005 | 97 |
| Alaska National Wildlife Refuge | Sulfur | Annual [1] | 3.92E-03 | 0.005 | 78 |
| Gates of the Arctic | Sulfur | Period [2] | 7.89E-04 | 0.005 | 16 |

[1] Maximum cumulative impacts occur in year 2008, thus represent a true annual impact.

[2] Maximum cumulative impacts occur in the second portion of year 2009 (7,230 hours), thus do not represent a true annual impact. The conversion from $g/m^2/s$ to kg/ha/yr assumes 8,784 hours, therefore; reported impacts are conservatively high.

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# Appendix A

# Survey of Typical Emission Unit In-Stack $NO_2$ to $NO_x$ Ratios

# Survey of Typical Emission Unit In-Stack $NO_2$ to $NO_x$ Ratios

## 1.0 Introduction

Representative emission unit exhaust in-stack $NO_2/NO_x$ Ratios selected for refined 1-hour $NO_2$ dispersion modeling were selected based on a survey of data available from the following:

- USEPA Technology Transfer Network (TTN) Support Center for Regulatory Atmospheric Modeling (SCRAM) database (http://www.epa.gov/ttn/scram/no2_isr_database.htm). The data used is contained in the spreadsheet named NO2_ISR_alpha_database.xlsx (herein referred to as "USEPA Database") and available on that web site. This data represents values collected by various Regional, State, and Local air permitting offices prior to the formal collection which has been initiated by the Office of Air Quality Planning and Standards (OAQPS) and represents the largest database available at this time.
- Alaska Department of Environmental Conservation (ADEC) Air Dispersion Modeling data base publically available at (http://dec.alaska.gov/air/ap/modeling.htm). This data represents values collected by ADEC from source tests conducted on emission units within the state. The following presents a review of available data and justification for the $NO_2/NO_x$ Ratios selected for modeling based on emission unit type.

For onroad mobile sources, the following peer-reviewed papers were used:

- P G Boulter, I S McCrae, and J Green, Transportation research Laboratory, "Primary $NO_2$ Emissions From Road Vehicles in the Hatfield and Bell Commons Tunnels", July 2007.
- X Yao, N T Lau, C K Chan, and M Fang, Atmospheric Chemistry and Physics Discussions, "The use of tunnel concentration profile data to determine the ratio of $NO_2/NO_x$ directly emitted from vehicles", December 2005.
- G A Bishop and D H Stedman, Air Pollution XVI 247, Department of Chemistry and Biochemistry, University of Denver, WIT Transactions on Ecology and the Environment, Vol 116, "Emissions of Nitrogen Dioxide from Modern Diesel Vehicles".

The following presents a review of available data and justification for the $NO_2/NO_x$ Ratios selected for modeling based on emission unit type.

### 1.1 Small Diesel-Fired Heaters/Boilers

Entries of exhaust $NO_2/NO_x$ ratio data from the USEPA database were summarized for diesel fired "small" heaters and boilers, i.e., units less than 10 MMBtu/hr heat input. Only units for which the heat input information was available were taken into consideration. The results are summarized in **Table 1-1** below. As shown in the table, only two data points were found for $NO_x$ and $NO_2$ emissions test data collected from small, diesel-fired, uncontrolled boilers. Both the boilers were tested at a 100% load only, and therefore, $NO_2/NO_x$ ratios across various load cases could not be determined.

**Table 1-1 $NO_2/NO_X$ Ratios for Uncontrolled Diesel Boilers from USEPA Database**

| Load | No. of Data Points | Average | Maximum | Minimum |
|---|---|---|---|---|
| 100% | 2 | 0.0409 | 0.0476 | 0.0341 |

Based on the above analysis, an $NO_2/NO_X$ Ratio of 0.05 is selected for the purposes of modeling small diesel fired boilers.

### 1.2 Large Natural Gas-Fired Heaters/Boilers

Exhaust $NO_2/NO_x$ ratio data were summarized for natural gas-fired "large" heaters and boilers, i.e., units equal to or greater than 30 MMBtu/hr heat input. There was no $NO_2$ or $NO_x$ emissions test information available in the USEPA database for natural gas fired boilers. Therefore, a similar database developed by the Alaska Department of Environmental Conservation (ADEC) was referenced. As stated previously, only units for which the heat input information was available were taken into consideration. The search returned one 30 MMBtu/hr Zeeco boiler (Model GLSFWB12) equipped with a low $NO_x$ burner installed at BP's Milne Point Unit (MPU) facility in Alaska. The results are summarized in **Table 2-2** below. As shown in the table, the boiler was tested at two load conditions, 40% load and 60% load.

**Table 1-2 $NO_2/NO_X$ Ratios for Large Natural Gas-Fired Boilers from the ADEC Database**

| Load | No. of data Points | Average | Maximum | Minimum |
|---|---|---|---|---|
| 60% | 1 | 0.05 | 0.05 | 0.05 |
| 40% | 1 | 0.34 | 0.34 | 0.34 |
| **Overall Maximum** | | | **0.34** | |

Based on the above analysis, a proposed $NO_2/NO_X$ Ratio of 0.30 for the purposes of modeling large natural gas-fired boilers operating above 50% load is conservative and justifiable as the proposed $NO_2/NO_X$ Ratio is well above the maximum expected $NO_2/NO_X$ Ratio for similar boilers.

### 1.3 Diesel-Fired Internal Combustion Engines Associated with Power Generation

Exhaust stack $NO_2/NO_x$ Ratio data were summarized for emissions test data for large (greater than 600 horsepower), diesel-fired reciprocating, internal-combustion engines (RICE) for which load information was available. Data for the one or more Caterpillar 3406B RICE associated with the City of LeMoore were eliminated from consideration due to lack of information concerning equipment size and load. Removal of these data resulted in the loss of 41 data points. Data from the AEL&P Lemon Creek facility appeared to contain emission results for three runs; therefore, data were reduced to one average value for each load category presented contributing three data points for the data analysis. This reduced the total number of available data points by six (6). Average $NO_2/NO_x$ Ratio values ranged between 0.06 and 0.10, ranging between 0.05 and 0.11 when taking into consideration information such as the standard deviation and number of data points (i.e. generating confidence intervals based on 95th percentile). These data are summarized in **Table 2-3** below.

**Table 1-3 Average $NO_2/NO_x$ Ratios by Load for Uncontrolled Diesel RICE Emission Test Results from USEPA Database**

| Load Class | No. of data Points | Upper Confidence Limit | Average | Lower Confidence Limit |
|---|---|---|---|---|
| 90-100% | 7 | 0.08 | 0.06 | 0.05 |
| 70-89% | 10 | 0.11 | 0.08 | 0.05 |
| 50-69% | 13 | 0.11 | 0.10 | 0.08 |
| Less than 50% | 8 | 0.11 | 0.10 | 0.08 |
| **All** | **38** | **0.09** | **0.09** | **0.08** |

An examination of the ADEC data did not reveal differences in the average $NO_2/NO_x$ Ratio by load class. The average ratio value was 0.04 across all load classes. The maximum and minimum values observed for the uncontrolled ADEC $NO_2/NO_x$ Ratio data were 0.05 and 0.03, respectively. The total number of data points within the subset of ADEC data in which emission controls were not installed was six (6).

In addition to generating average values, the maximum and minimum values observed by load class and for all data points combined were examined as well. Based on this analysis, the maximum $NO_2/NO_x$ Ratio observed was 0.19 and the minimum ratio value observed was 0.01 (See **Table 1-4**).

**Table 1-4 Range of $NO_2/NO_x$ Ratios by Load for Uncontrolled Diesel RICE Emission Test Results from USEPA Database**

| Load Class | No. of data Points | Maximum | Minimum |
|---|---|---|---|
| 90-100% | 7 | 0.10 | 0.02 |
| 70-89% | 10 | 0.15 | 0.01 |
| 50-69% | 13 | 0.19 | 0.06 |
| Less than 50% | 8 | 0.14 | 0.08 |
| **All** | **38** | **0.19** | **0.01** |

Based on the above analysis, an $NO_2/NO_x$ Ratio of 0.2 or above for the purposes of modeling diesel-fired RICE is both conservative and justifiable. This is particularly the case when the maximum and minimum observed values are taken into consideration. Clearly the maximum observed value across the 38 data points demonstrates that 0.20 is just above the range of values expected for the $NO_2/NO_x$ Ratio of diesel-fired RICE engines.

## 1.4 Diesel-Fired Nonroad Engines Associated with Construction Equipment

The USEPA database was researched to evaluate instances of diesel-fired RICE specifically used in construction service. Engines serving equipment such as cranes, bulldozers, excavators, front-end loaders, winches etc. would fall under this category. Two entries for nonroad construction engines were found in the USEPA database. Two 250 HP Caterpillar C7 diesel engine powered logging winches were each tested at 50% load and 80% load. A 365 HP Caterpillar D343 diesel engine powered crane was also tested at 60% load and 80% load. The test data are summarized in **Table 1-5** below.

**Table 1-5 Range of $NO_2/NO_x$ Ratios by Load for Uncontrolled Construction Equipment Diesel RICE Emission Test Results from USEPA Database**

| Load Class | No. of data Points | Average | Maximum | Minimum |
|---|---|---|---|---|
| 70-89% | 3 | 0.1354 | 0.1811 | 0.0965 |
| 50-69% | 3 | 0.1496 | 0.1669 | 0.1209 |
| **Overall Maximum** | | | **0.1811** | |

Based on the above analysis, a proposed $NO_2/NO_x$ Ratio of 0.20 or above for the purposes of modeling diesel fired engines used in construction service is conservative and justifiable as the maximum expected $NO_2/NO_x$ Ratio for such units is below the proposed ratio.

## 1.5 Onroad Mobile Sources

The USEPA and ADEC databases contained test information for stationary and nonroad sources only. Therefore, a web search was conducted to research $NO_2/NO_x$ Ratios for light/medium duty and heavy duty

diesel vehicles. The findings are presented in **Table 1-6**. The maximum $NO_2/NO_x$ Ratio for light and medium duty diesel and gasoline vehicles is 0.25; whereas, that for heavy duty diesel vehicles is 0.11. Based on **Table 1-6**, a proposed $NO_2/NO_x$ Ratio of 0.01 or more for heavy duty diesel vehicles and 0.20 or more for light and medium duty diesel vehicles for the purposes of modeling is conservative. For a mixed fleet, a value of 0.15 should be conservative assuming that most of the fuel consumed will be in the larger engines.

**Table 1-6 $NO_2/NO_x$ Ratios for Onroad Sources**

| Vehicle Class | Average | Maximum | Minimum |
|---|---|---|---|
| Light and Medium Duty Gasoline / Diesel Vehicles [1] | 0.18 | 0.25 | 0.16 |
| Heavy Duty Diesel Vehicles [1] | 0.085 | 0.11 | 0.06 |

[1] Ranges of $NO_2/NO_x$ ratios obtained from - P G Boulter, I S McCrae, and J Green, Transportation research Laboratory, “Primary NO2 Emissions From Road Vehicles in the Hatfield and Bell Commons Tunnels”, July 2007.

# Appendix B

# Surface Meteorological Data Filling Procedure

# Meteorological Processing and Data-Filling Procedure

In order to find 5 suitable years for near field modeling, quarterly data capture statistics for the Nuiqsut meteorological data were compiled in order to see if the variables needed for modeling meet a 90% data capture on a quarterly basis. The specific variables reviewed were wind speed, wind direction, solar radiation, temperature at 2 and 10-meters, and deltaT (the difference in temperature from 10 to 2 meters). To begin with, the latest 5 complete calendar years of data, 2008-2012 were reviewed. The quarterly joint data recovery for all variables needed to model is shown in **Table B-1** for 2008-2012. Most quarters meet or exceed 90% joint data recovery, with the exception of 2008 Q2 and Q3, 2009 Q4, 2010 Q2, 2011 Q1 and Q2, and 2012 Q4. A majority of these quarters that fell short of the 90% joint data recovery was due to missing temperature data. **Table B-2** shows the quarterly data capture on a variable by variable basis. As noted, **Table B-2** shows that with the exception of wind speed and direction data in 2009 Q4 and 2010 Q2, the joint data recovery being less than 90% is driven by the missing temperature data.

Given how close the Nuiqsut National Weather Service (NWS) Automated Surface Observing System (ASOS) site is to the project site (i.e., less than 1.2 kilometers), using the Nuiqsut NWS data to supplement the Nuiqsut onsite data is a suitable approach for this modeling analysis. Additional years of the Nuiqsut onsite data was reviewed going back to 1998, without finding 5 complete calendar years of data with joint quarterly data capture that exceeded 90%. Therefore, substituting for small periods was considered the preferred approach.

As such, the Nuiqsut onsite data was supplemented with the Nuiqsut NWS data only for those parameters and hours when onsite data were unavailable. The onsite date was supplemented using the following procedure:

1) Substitutions were only carried out for periods of excessive missing onsite data resulting in data recovery less than 90 percent per quarter.
2) Substitutions were only made to bring the quarterly data capture up to 100 percent.
3) Substitutions were made manually in an excel spreadsheet using two separate AERMET runs (1) using the Nuiqsut onsite data as the only source of surface observations without the SUBNWS AERMET Stage 3 keyword and (2) using the Nuiqsut onsite data as the primary source of surface observations along with the Nuiqsut NWS data and the SUBNWS AERMET Stage 3 keyword.

In reviewing the data, there were 5 distinct places in of the onsite dataset were either winds or temperature data were missing. These places do not account for all the missing data in the onsite record, but account for the largest blocks of missing data contributing to the quarters with less than 90% joint data recovery shown in **Table B-3**. The time periods are as follows:

- 2008 Q2/Q3:
    - The Nuiqsut temperature and deltaT data was missing for a 2,017 hour period starting 6/4 1300 ending 8/27 1300. This data will be block filled with a SUBNWS AERMET run.
- 2009 Q4:
    - The Nuiqsut wind speed and direction data was missing for a 232 hour period starting 12/11 1300 ending 12/21 0400. This data will be block filled with a SUBNWS AERMET run.
- 2010 Q1/Q2:
    - The Nuiqsut wind speed and direction data was missing for a 494 hour period starting 3/24 2100 ending 4/14 1100. This data will be block filled with a SUBNWS AERMET run.

- 2011 Q1/Q2:
  - The Nuiqsut wind speed and direction data was missing for a 55 hour period starting 2/25 0700 ending 2/27 1300. This data will be block filled with a SUBNWS AERMET run.
  - The Nuiqsut temperature and deltaT data was missing for a 2,262 hour period starting 2/27 1400 ending 6/1 1900. This data will be block filled with a SUBNWS AERMET run.
  - The Nuiqsut wind speed and direction data was missing for a 29 hour period starting 6/1 2000 ending 6/2 2400. This data will be block filled with a SUBNWS AERMET run.
- 2012 Q4:
  - The Nuiqsut wind speed and direction data was missing for a 193 hour period starting 12/23 2400 ending 12/31 2400. This data will be block filled with a SUBNWS AERMET run.

**Table B-3** shows the joint data recovery for 2008-2012 after the data substitution. As shown in **Table B-3**, the joint data recovery exceeds 90% on a quarterly basis.

**Table B-1 2008-2012 Nuiqsut Meteorological Joint Data Recovery Prior to Data Substitution**

| Quarter | Year | | | | |
|---|---|---|---|---|---|
| | **2008** | **2009** | **2010** | **2011** | **2012** |
| 1 | 98.6% | 95.7% | 90.6% | **71.7%** | 94.7% |
| 2 | **70.4%** | 99.2% | **84.0%** | **79.7%** | 98.9% |
| 3 | **36.7%** | 99.4% | 99.5% | 97.6% | 93.9% |
| 4 | 95.2% | **85.6%** | 97.1% | 92.4% | **89.2%** |

**Table B-2 Variable Specific 2008-2012 Nuiqsut Meteorological Data Recovery Prior to Data Substitution**

| Year | Quarter | Wind Speed (10-meters) | Wind Direction (10-meters) | Temperature (10-meters) | Temperature (2-meters) | 10-2 meters deltaT | Solar Radiation |
|---|---|---|---|---|---|---|---|
| 2008 | 1 | 99.2% | 99.2% | 99.5% | 99.5% | 99.5% | 99.5% |
| 2008 | 2 | 99.6% | 99.6% | **70.9%** | **70.9%** | **70.9%** | 99.5% |
| 2008 | 3 | 99.6% | 99.6% | **37.5%** | **37.8%** | **37.5%** | 99.6% |
| 2008 | 4 | 98.1% | 98.1% | 99.6% | 99.6% | 99.6% | 99.6% |
| 2009 | 1 | 97.8% | 97.8% | 99.6% | 99.6% | 99.6% | 99.6% |
| 2009 | 2 | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |
| 2009 | 3 | 99.5% | 99.5% | 99.5% | 99.5% | 99.5% | 99.5% |
| 2009 | 4 | **88.6%** | **88.6%** | 99.9% | 99.9% | 99.9% | 100.0% |
| 2010 | 1 | 91.4% | 91.4% | 99.5% | 99.5% | 99.5% | 99.9% |
| 2010 | 2 | **84.9%** | **84.9%** | 99.2% | 99.2% | 99.2% | 99.1% |
| 2010 | 3 | 99.5% | 99.5% | 99.5% | 99.5% | 99.5% | 100.0% |
| 2010 | 4 | 98.0% | 98.0% | 99.6% | 99.6% | 99.6% | 99.8% |
| 2011 | 1 | 90.2% | 90.2% | 99.3% | **63.8%** | **63.8%** | 97.6% |
| 2011 | 2 | 94.7% | 94.2% | 95.6% | **31.3%** | **31.3%** | 99.3% |
| 2011 | 3 | 97.6% | 97.6% | 97.8% | 97.8% | 97.8% | 97.3% |
| 2011 | 4 | 92.9% | 99.4% | 99.4% | 99.4% | 99.3% | 98.1% |
| 2012 | 1 | 96.1% | 94.9% | 99.5% | 99.5% | 99.5% | 99.8% |
| 2012 | 2 | 99.3% | 98.9% | 99.3% | 99.3% | 99.3% | 99.8% |
| 2012 | 3 | 94.0% | 93.9% | 94.0% | 94.0% | 94.0% | 94.6% |
| 2012 | 4 | 90.2% | 90.0% | 98.9% | 98.9% | 98.9% | 98.8% |

**Table B-3 2008-2012 Nuiqsut Meteorological Joint Data Recovery After Data Substitution**

| Quarter | Year | | | | |
|---|---|---|---|---|---|
| | 2008 | 2009 | 2010 | 2011 | 2012 |
| 1 | 98.6% | 95.7% | 96.6% | 95.7% | 94.7% |
| 2 | 96.4% | 99.2% | 96.7% | 98.8% | 98.9% |
| 3 | 98.9% | 99.4% | 99.5% | 97.6% | 93.9% |
| 4 | 95.2% | 95.6% | 97.1% | 92.4% | 96.0% |

# Appendix C

# Survey of Alaskan North Slope Background Ammonia Concentrations

# Summary of Findings for Representative North Slope Ammonia Values

## 1.0 Introduction

The purpose of this section is to document the findings of a literature review to identify a representative value of background ammonia ($NH_3$) mixing ratios in the North Slope of Alaska for input into the CALPUFF model. Although the complete ammonia life cycle is very complex and dependent on many factors, the CALPUFF model has very simple chemistry and currently only requires the input of monthly average $NH_3$ backgrounds. Due to the model's simplified chemistry, a representative $NH_3$ mixing ratio is a very important input to modeling accurate formation of ammonium ($NH_4^+$) aerosol and nitrogen deposition on the North Slope of Alaska using CALPUFF. Previously, CALPUFF studies used a conservative estimate of North Slope $NH_3$ mixing ratios of 1 ppb (0.001 ppt); however, this assumption may be an overestimate as detailed in this document. This document provides an overview of research and observations over the last several decades documenting, estimating, and studying $NH_3$ and $NH_4^+$ conditions on the North Slope of Alaska or related environments. Based on this information, a representative mixing ratio of $NH_3$ of less than 1 ppb may be considered valid for this area.

## 2.0 Ammonia Conditions on the North Slope of Alaska

### 2.1 Atmospheric Chemistry in the North Slope

The North Slope of Alaska is characterized by small mixing ratios and low emission levels of $NH_3$ and $NH_4^+$ compared to global estimates. The $NH_4^+$ aerosol is converted from gaseous $NH_3$ by chemical reactions in the atmosphere. The small $NH_3$ mixing ratios are mostly a result of natural $NH_3$ emission sources from microbial and bacterial processes in the ocean, soils, and wild animal excreta and limited anthropogenic sources in the region. Arctic $NH_4^+$ aerosol, on the other hand, are mostly transported from Northern Hemispheric anthropogenic $NH_3$ sources including European and Asian agricultural sources and biomass burning. A modeling study suggests that 60% to 80% of Arctic $NH_4^+$ aerosols originate from these anthropogenic $NH_3$ sources during the Arctic haze season. The Arctic haze season is the period of peak aerosol concentrations and typically occurs in the winter and spring months between January and May (Fisher et al. 2011).

In the atmosphere, the gas-to-particle conversion of $NH_3$ to $NH_4^+$ aerosol proceeds most often by the following five chemical reactions:

| | | | | |
|---|---|---|---|---|
| (1) | $NH_{3(gas)} + H_2O_{(liquid)}$ (water) | $\leftrightarrow$ | $NH_4^+{}_{(aqueous)} + OH^-{}_{(aqueous)}$ | (hydroxyl radical) |
| (2) | $NH_{3(gas)} + H_2SO_{4(liquid)}$ (sulfuric acid) | $\rightarrow$ | $NH_4HSO_{4(solid,\ liquid)}$ | (ammonium bisulfate) |
| (3) | $NH_{3(gas)} + NH_4HSO_{4(liquid)}$ | $\rightarrow$ | $(NH_4)_2SO_{4(solid,\ liquid)}$ | (ammonium sulfate) |
| (4) | $NH_{3(gas)} + NHO_{3(gas)}$ (nitric acid) | $\leftrightarrow$ | $NH_4NO_{3(solid)}$ | (ammonium nitrate) |
| (5) | $NH_{3(gas)} + HCl_{(gas)}$ (hydrochloric acid) | $\leftrightarrow$ | $NH_4Cl_{(solid)}$ | (ammonium chloride) |

The atmospheric lifetime of $NH_3$ generally ranges from 0.5 hours to 5 days while the lifetime of $NH_4^+$ typically ranges from 5 to 10 days. The lifetimes of $NH_3$ to $NH_4^+$ are strongly dependent on the ambient acid and water vapor concentrations for the aforementioned chemical reactions and the local conditions governing wet and

dry deposition such as plant properties and meteorological conditions. Gas-phase $NH_3$, however, is also removed by reaction with $OH^-$ (Walker et al. 2000).

### 2.2 Prior Approaches

While very limited observations of $NH_3$ and $NH_4^+$ exist, some modeling and observational studies have explored aspects of $NH_3$ and $NH_4^+$ conditions on or near the North Slope of Alaska. For instance, Adams et al. (1999), Dentener and Crutzen (1994), Fisher et al. (2011), Shephard et al. (2011), and Xu and Penner (2012) all present global modeling studies estimating $NH_3$ or $NH_4^+$ mixing ratios using both chemical transport models and general circulation models. Observations of $NH_4^+$ are cited in Fisher et al. (2011) and Quinn et al. (2009), and found in limited Clean Air Status and Trends Network (CASTNET) data near the North Slope. Due to the extremely sparse observations of $NH_3$, estimates of typical $NH_3$ mixing ratios on the North Slope must rely on modeling efforts.

### 2.3 Summary of Findings

Adams et al. (1999) models the global emissions, transport, and deposition of tropospheric sulfate, nitrate, and $NH_4^+$ aerosol using a general circulation model and input data representative of the 1990s conditions. In analyzing the aerosol, this modeling work predicts global mixing ratios of $NH_3$ throughout the atmosphere using the global $NH_3$ emissions inventory developed by Bouwman et al. (1997). Bouwman et al. (1997) estimates that $NH_3$ emissions from the North Slope are between 0.0 and 0.1 grams of nitrogen per meter squared per year (g $N/m^2/yr$). As shown in **Figure C-1**, Adams et al. (1999) suggests that $NH_3$ mixing ratios on the North Slope of Alaska are between 3 and 10 parts per trillion by volume (pptv) as shown in Adams et al. (1999) Plate 3(a). Ammonium modeled in Adams et al. (1999) Plate 3(b) suggests $NH_4^+$ mixing ratios between 100 and 300 pptv on the North Slope of Alaska.

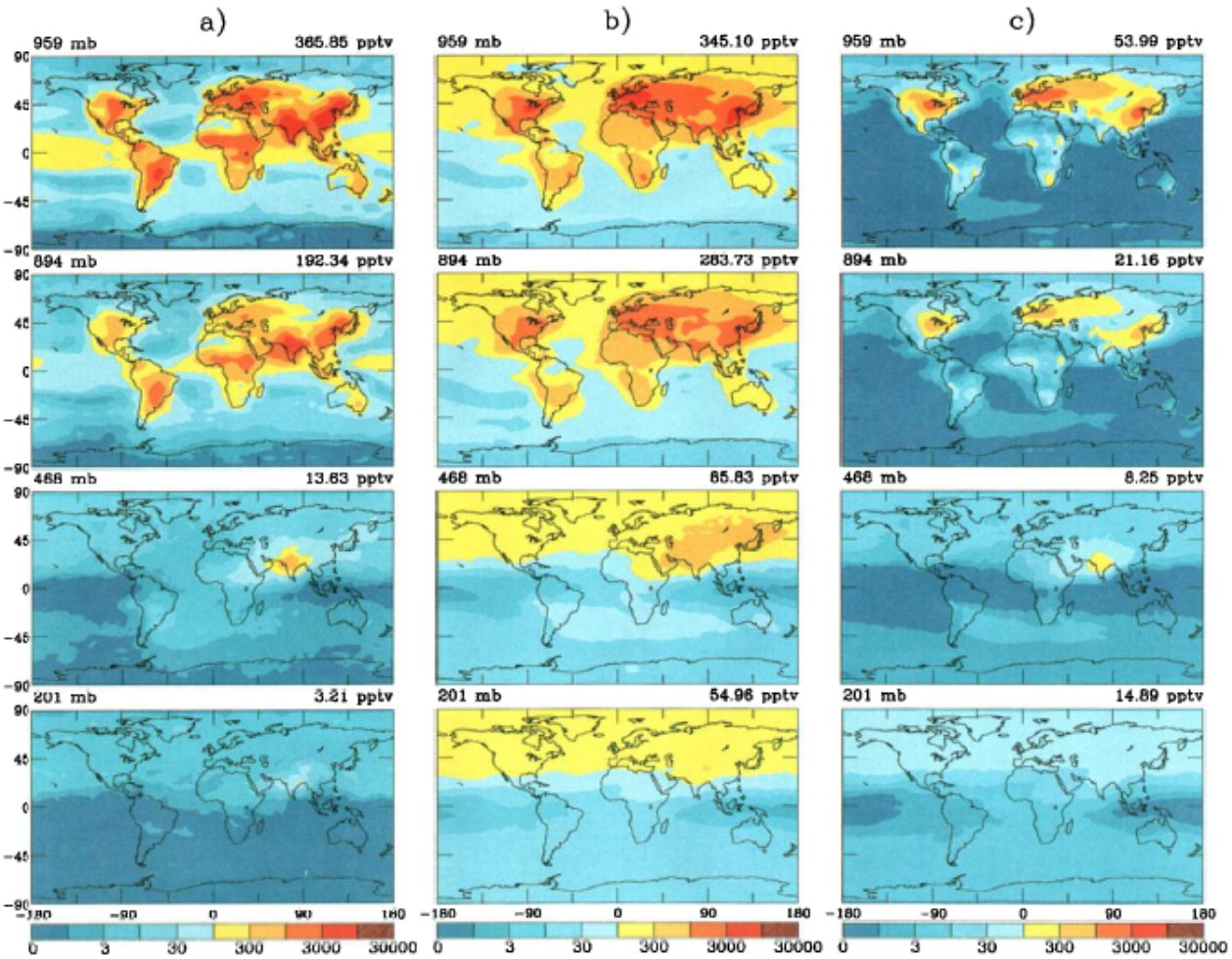


**Plate 3.** (a) Annual average ammonia mixing ratios. Note that 1 μg $m^{-3}$ $NH_3$ = 1457 pptv $NH_3$ at 298 K and 1 bar. (b) Annual average ammonium mixing ratios. Note that 1 μg $m^{-3}$ $NH_4^+$ = 1377 pptv $NH_4^+$ at 298 K and 1 bar. (c) Annual average nitrate mixing ratios. Note that 1 μg $m^{-3}$ $NO_3^-$ = 400 pptv $NO_3^-$ at 298 K and 1 bar. Above each plot, the pressure level of the corresponding model layer is indicated, as is the average mixing ratio in that layer. Contour lines are 1, 3, 10, 30, 100, 300, 1000, 3000, 10,000, and 30,000 pptv.

**Figure C-1: Figure taken from Adams et al. (1999) Plate 3**

Other evidence in Osada et al. (2011) suggests surface $NH_3$ concentrations in “remote” regions are generally less than 0.01 µmol/m$^3$ ( > 224 pptv as shown below) based on studies in Ayers and Gras (1980), Quinn et al. (1988), Johnson et al. (2008), and Norman and Leck (2005). The “remote” locations in these studies, however, are in isolated ocean environments and are largely representative of ocean-atmosphere $NH_3$ interactions with limited influence from significant anthropogenic sources. While other natural $NH_3$ sources also contribute to $NH_3$ on the North Slope, these studies corroborate the low concentrations of $NH_3$ in maritime environments without significant anthropogenic emission sources. The following calculation converts 0.01 µmol/m$^3$ to units of pptv:

$$\left(\frac{0.01\ \mu mol}{m^3}\ @STP\right)\left(\frac{1m^3}{1000\ L}\right)\left(\frac{1\ mol}{10^6\ \ \mu mol}\right)\left(\frac{22.4\ L}{1\ mol}\ @STP\right)\left(\frac{10^{12}\ pL}{1\ L}\right)\left(\frac{1\ ppt}{1\ pL/_{L}}\right) = \mathbf{224\ pptv\ NH_3}$$

Dentener and Crutzen (1994) model the global ammonia cycle using a three-dimensional transport model of the troposphere and emissions factors and estimates based on research in the 1980s and 1990s. Modeled ammonia mixing ratios are shown in **Figure C-2** from Dentener and Crutzen (1994) Fig. 2a and indicate $NH_3$ mixing ratios between 60 and 100 pptv on the North Slope. Modeled ammonium mixing ratios are shown in the following Dentener and Crutzen (1994) Fig. 3a and indicate $NH_4^+$ mixing ratios between 100 and 200 pptv on the North Slope.

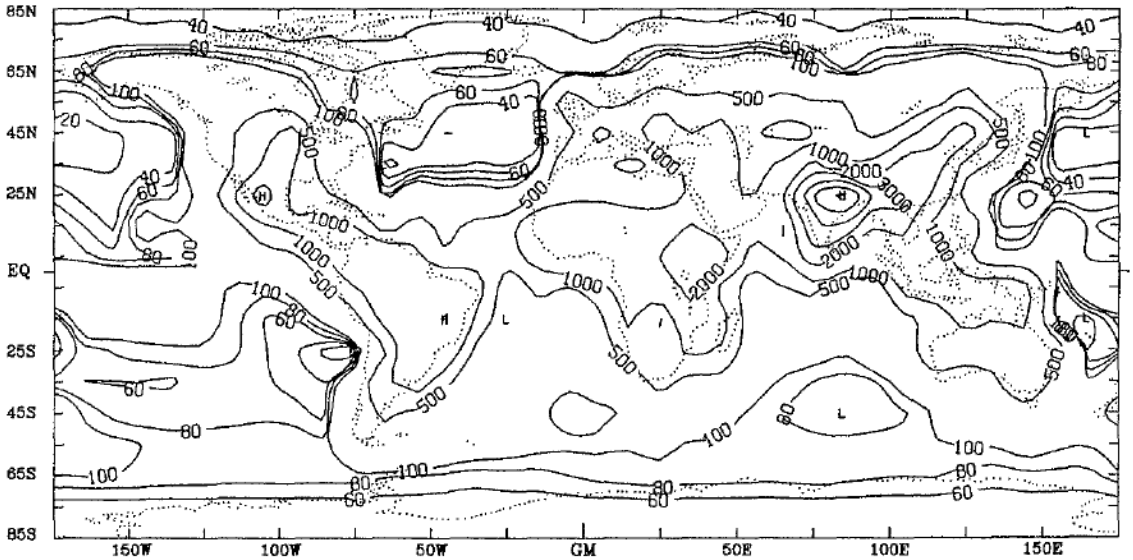


Fig. 2a.

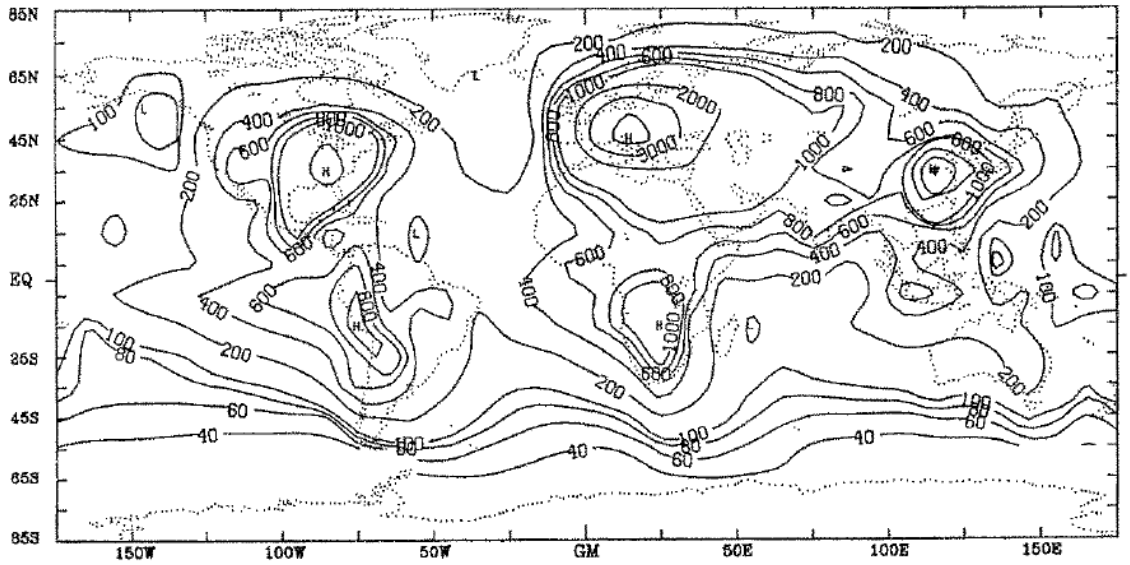


Fig. 3a.

**Figure C-2: Figures taken from Dentener and Crutzen (1994) Fig. 2a. and Fig. 3a.**

Fisher et al. (2011) models Arctic $NH_4^+$ concentrations for the 2008 Arctic haze season from January through May using a chemical transport model and observations for comparison. Modeled results for Barrow, Alaska are shown in **Figure C-3** for comparison to average monthly observed $NH_4^+$ concentrations, averaged over the years 2004 to 2008 in the extracted Figure 6 below. Using the minimum and maximum observed monthly average $NH_4^+$ concentrations in Barrow, Alaska from 2004 to 2008 in the following figure (thick black line), an estimated range of $NH_4^+$ mixing ratios on the North Slope is evaluated for the Arctic haze season. These observations suggest a range of 4 to 12 nanomoles per cubic meter (nmol/m$^3$) $NH_4^+$ (90 to 270 ppt, respectively) on the North Slope of Alaska.

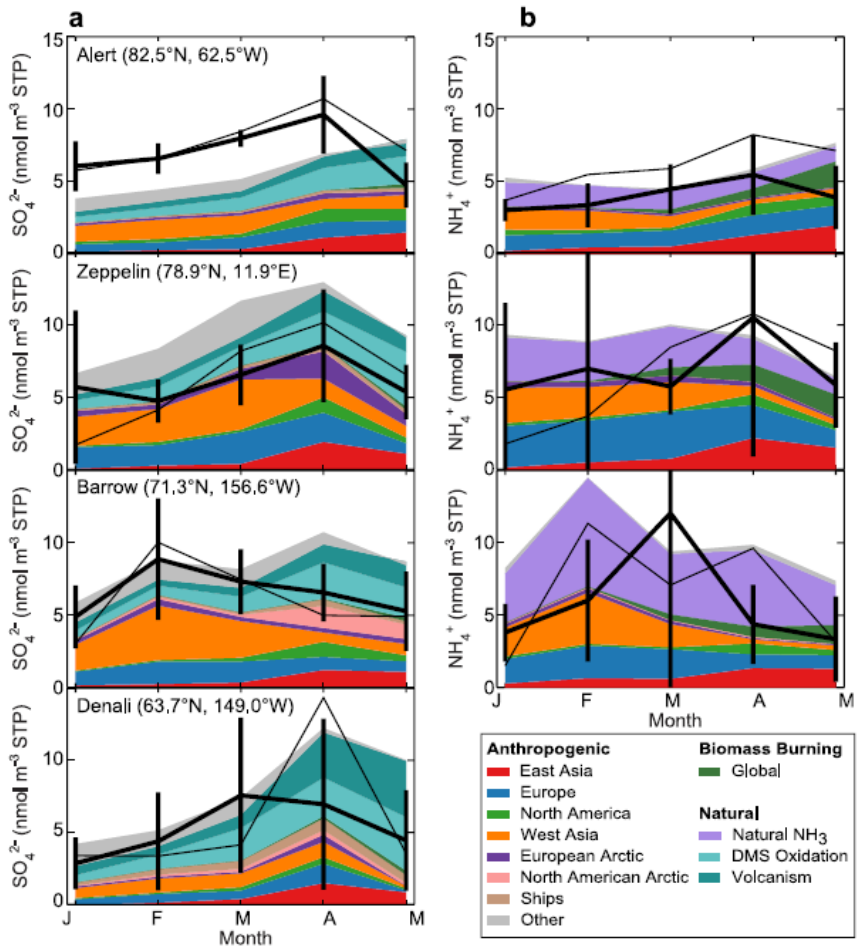


**Fig. 6.** January–May monthly mean (a) sulfate and (b) ammonium concentrations observed and modeled at Arctic surface sites. No ammonium data are available at Dena IMPROVE sites. The thick black lines show the observed 2004–2008 monthly means and interannual standard deviations; 2008 monthly means are shown as thin lines. concentrations are subdivided into contributions from individual sources as indicated in the legend. Biomass burning refers to open biomass burning; biofuel is inclu anthropogenic source. The "other" anthropogenic term also includes minor non-linear effects in source attribution (see text). Data sources are as follows: Alert – Env Canada (Gong et al., 2010); Zeppelin – EMEP (http://ebas.nilu.no); Barrow – the NOAA Pacific Marine Environmental Laboratory (http://saga.pmel.noaa.gov/data/); De IMPROVE network (Malm et al., 1994).

**Figure C-3: Taken from Fisher et al. (2011) Fig. 6**

$$\left(\frac{4\ nmol}{m^3}\ @STP\right)\left(\frac{1m^3}{1000\ L}\right)\left(\frac{22.4\ L}{1\ mol}\ @STP\right)\left(\frac{10^3\ pmol}{1\ nmol}\right)\left(\frac{1\ ppt}{1\ pmol/_{mol}}\right) = \mathbf{90\ ppt\ NH_4{}^+}$$

$$\left(\frac{12\ nmol}{m^3}\ @STP\right)\left(\frac{1m^3}{1000\ L}\right)\left(\frac{22.4\ L}{1\ mol}\ @STP\right)\left(\frac{10^3\ pmol}{1\ nmol}\right)\left(\frac{1\ ppt}{1\ pmol/_{mol}}\right) = \mathbf{270\ ppt\ NH_4{}^+}$$

Quinn et al. (2009) uses measurements of $NH_4^+$ at Barrow, Alaska from 1976 to 2008 to analyze concentrations, trends, and chemical composition of aerosol in the Arctic. At Barrow, Alaska over the decade prior to 2008, $NH_4^+$ concentrations during the haze season have been decreasing at a rate of 6% per year according to Quinn et al. (2009) as shown in **Figure C-4**, in contrast to global $NH_3$ mixing ratios which have been increasing (Fisher et al. 2008). Using the 2008 slope estimated $NH_4^+$ concentration in the following Quinn et al. (2009) Figure 4 (yellow dashed line), an estimate of $NH_4^+$ mixing ratios on the North Slope is evaluated as 1,680 ppt $NH_4^+$.

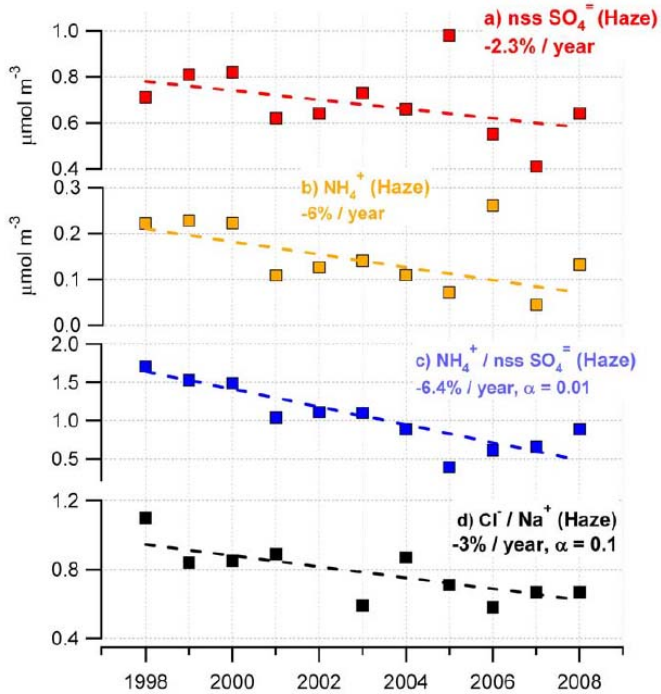


**Fig. 4.** Values of **(a)** nss $SO_4^=$, **(b)** $NH_4^+$, **(c)**, $NH_4^+$/nss $SO_4^=$ molar ratio and **(d)** $Cl^-/Na^+$ molar ratio averaged over the haze season (January–April) at Barrow. Lines indicate the Sen's slope estimates. $\alpha$ indicates the significance level of the trend.

**Figure C-4: Figure taken from Quinn et al. (2009) Fig. 4**

$$\left(\frac{0.075\ \mu mol}{m^3}\ @STP\right)\left(\frac{10^6\ pmol}{1\ \mu mol}\right)\left(\frac{1m^3}{1000\ L}\right)\left(\frac{22.4\ L}{1\ mol}\ @STP\right)\left(\frac{1\ ppt}{1\ pmol/_{mol}}\right) = \mathbf{1,680\ ppt\ NH_4{}^+}$$

Using the estimate trend of $NH_4^+$ concentrations in Figure 4 are decreasing at a rate of 6% per year, these 2008 estimates can be projected to 2013 in the following calculation.

$$(1{,}680\ ppt\ NH_4{}^+)(1-0.06)^5 = \mathbf{1,230\ ppt\ NH_4{}^+}$$

Shephard et al. (2011) conducts a study comparing global $NH_3$ satellite-based measurements to modeled $NH_3$ using a three-dimensional transport model. While satellite retrievals do not include latitudes north of 60

degrees North, modeled estimates do evaluate $NH_3$ in the Arctic. These estimates, while not as spatially resolved as other modeling studies presented here, indicate the potential for higher $NH_3$ mixing ratios during summer months in Alaska (up to 1,250 pptv) as indicated by the August monthly averaged mixing ratios in the following Shephard et al. (2011) Figure 2 shown below as **Figure C-5**.

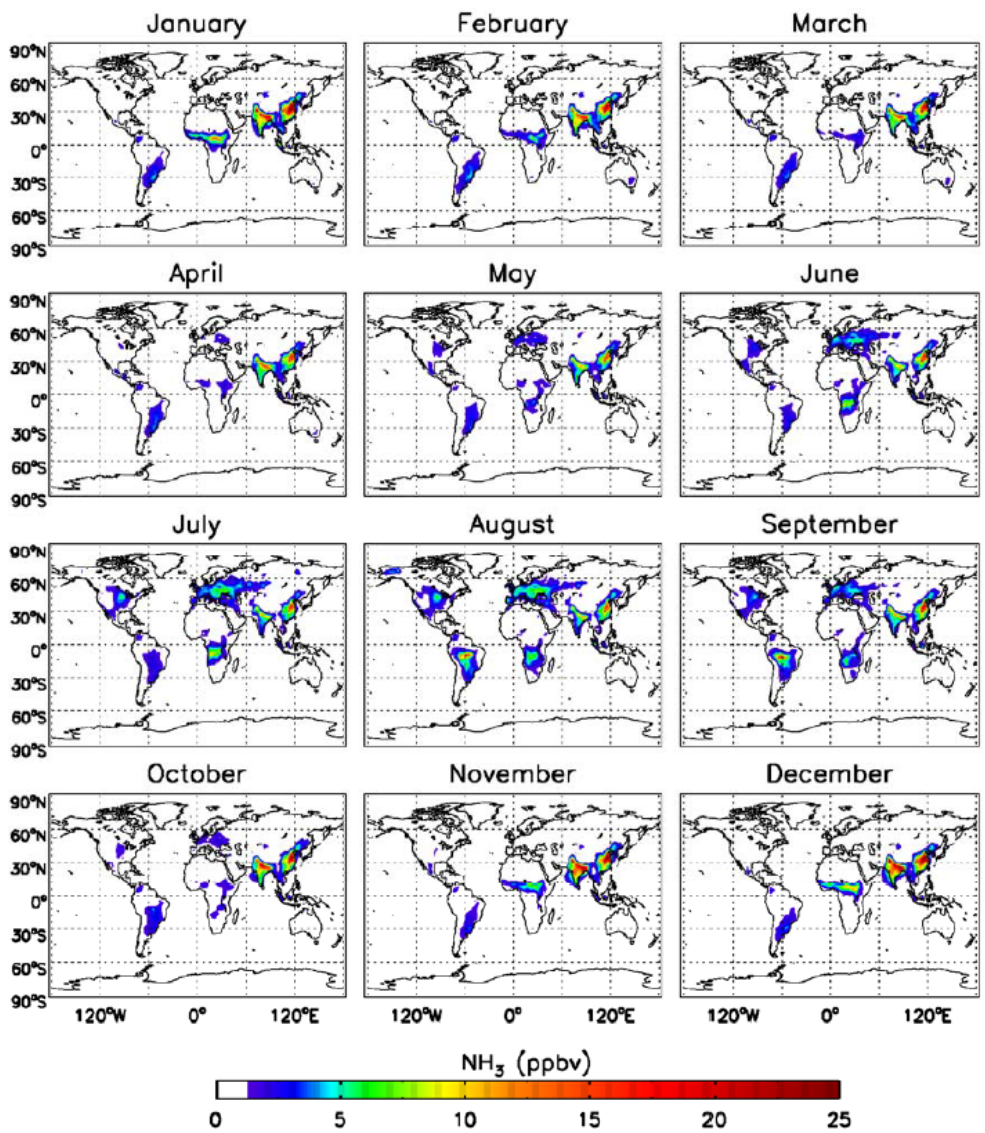


**Fig. 2.** GEOS-Chem monthly mean surface $NH_3$ mixing ratio amounts.

**Figure C-5: Taken from Shephard et al. (2011) Figure 2**

Seasonal variations in $NH_3$ and $NH_4^+$ on the North Slope may be present but are not well documented. Seasonal variations may result from nitrogen nutrient release in melting snow and ice (Tovar-Sánchez et al. 2010) and changes in microbial and bacterial activities in oceans and soils during warmer months. Ammonia fluxes from the ocean and soils, however, are dependent on temperature, ambient mixing ratios, and other environmental factors; therefore, the ocean and soils may act as a net source or sink of atmospheric $NH_3$ and $NH_4^+$ varying by conditions (Barsdate and Alexander 1975, Langford et al. 1992). Studies suggest that $NH_3$ fluxes are dominantly from the air to sea in at high latitudes greater than 55 degrees North (Johnson et al. 2008) and that $NH_3$ fluxes also are dominantly from air to soils in the Arctic tundra (Barsdate and Alexander 1975).

Xu and Penner (2012) conducted a global modeling study of nitrate and ammonium aerosols and associated radiative effects. They use the $NH_3$ emissions inventory from Bouwman et al. (1997) to model present day $NH_3$ mixing ratios in Xu and Penner (2012) Figure 2 shown as **Figure C-6** below. This modeling work indicates $NH_3$ mixing ratios to be between approximately 1 and 10 pptv on the North Slope of Alaska. Xu and Penner (2012) also model average mixing ratios of $NH_4^+$ in Xu and Penner (2012) Figure 5 as **Figure C-6** below. This suggests $NH_4^+$ on the North Slope to be between 100 and 300 pptv.

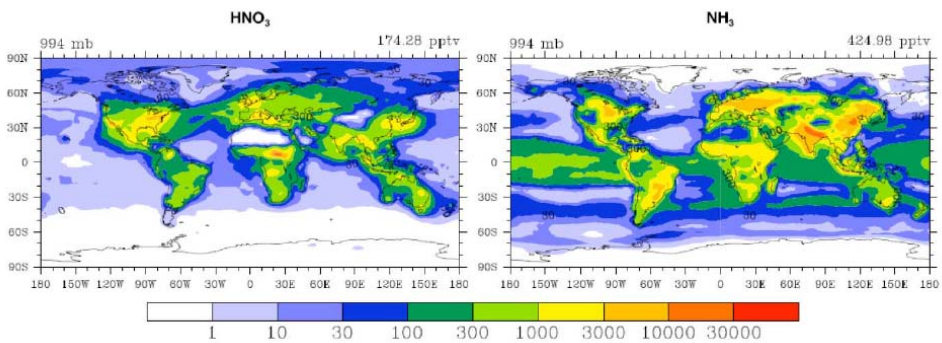


**Fig. 2.** Predicted annual average mixing ratios (pptv) of gaseous $HNO_3$ (left) and $NH_3$ (right) in the surface layer. The pressure level of the surface layer together with the average mixing ratio for that layer is indicated above each panel.

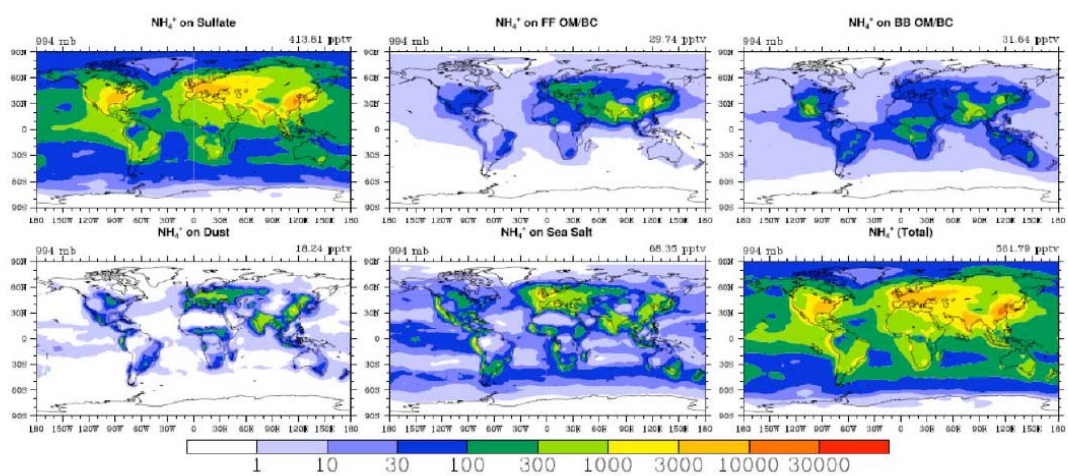


**Fig. 5.** Predicted annual average mixing ratios (pptv) of ammonium associated with each aerosol type and for the total ammonium aerosols (bottom right) in the surface layer. The pressure level of the surface layer together with the average mixing ratio for that layer is indicated at each panel.

**Figure C-6: Figures taken from Xu and Penner (2012) Figure 2 and Figure 5**

# 3.0 Conclusion

**Table C-1** below summarizes the findings and calculations made in the aforementioned assessments of the $NH_3$ and $NH_4^+$ conditions on the North Slope of Alaska. Although the results below represent many different assumptions (models, resolution, time frame, averaging period) they all indicate a generally low $NH_3$ background value in the North Slope of Alaska with concentrations consistently much lower than 1,000 ppt (1 ppb).

The findings also indicate that $NH_3$ mixing ratios are generally smaller than $NH_4^+$ mixing ratios in this region. This is consistent with the sensitivity studies by Fisher et al. (2011) that conclude that most of total $NH_X$ ($NH_3$ + $NH_4^+$) is in the form of $NH_4^+$ in the Arctic. These findings, in conjunction with an understanding of CALPUFF's inherent limitations and conservatisms regarding ammonia and in-transit chemistry, support the idea that use of 1 ppb of $NH_3$ for the entire year as input to CALPUFF for the area is likely much higher than observed values.

| Source of Estimate | $NH_3$ (pptv) | $NH_4^+$ (pptv) | Description | Location | Year(s) |
|---|---|---|---|---|---|
| Adams et al. (1999) Plate 3 | 3 – 10 | 100 – 300 | Modeled annual average | North Slope, Alaska | 1990s |
| Osada et al. (2011) | < 224 | – | Suggested conclusion from marine modeling studies | "Remote" Marine Regions | 2000s |
| Dentener and Crutzen (1994) Fig. 2a and Fig. 3a | 60 – 100 | 100 – 200 | Modeled annual average | North Slope, Alaska | 1980/1990s |
| Fisher et al. (2011) Fig. 6 | – | 90 – 270 | Observed and modeled monthly averages over haze season (Jan to May) | Barrow, Alaska | 2004-2008 |
| Quinn et al. (2009) Fig. 4 | – | 1,680 | Observed annual haze season average (Jan to Apr) | Barrow, Alaska | 2008 |
| Quinn et al. (2009) Fig. 4 (Projection to 2013) | – | 1,230 | Projected annual haze season average (Jan to Apr) | Barrow, Alaska | 2013 |
| Shepard et al. (2011) Fig. 2 | 0 – 1,250 | – | Modeled monthly average for most months | North Slope, Alaska | 2000s |
| Xu and Penner (2012) Fig. 2 and Fig. 5 | 1 – 10 | 100 – 300 | Modeled annual average | North Slope, Alaska | 1990/2000s |

**Table C-1: Summary of Findings**

# 4.0 References

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