AECOM
1601 Prospect Parkway
Fort Collins, Colorado 80525

970-493-8878 tel
970-493-0213 fax

December 24, 2013

Bridget Psarianos
Planning and Environmental Specialist
BLM - Alaska State Office
bpsarianos@blm.gov
(907) 271-4208

Subject: Revisions to the Air Quality Impact Analysis for Greater Mooses Tooth 1 Alternative A

Dear Bridget:

For the following reasons, AECOM has revised the ambient air quality impact analysis (AQIA) supporting the Greater Mooses Tooth 1 (GMT1) Alternative A[1] (GMT1 Alternative A AQIA) which was submitted on October 18, 2013, and are submitting revised impact summary tables:

- Dispersion modeling technical approaches were revised based on comments received from cooperating agencies participating in the project Air Quality Working Group. Among these, the most significant changes resulted from:
    - using background concentrations developed solely from the Nuiqsut ambient air quality monitoring station,
    - switching GMT1 project sources in the far-field modeling from a single volume source approach to a refined point and volume source approach consistent with the near-field modeling, and
    - updating the adjustment factors used in air toxics long-term cancer risk analysis to better represent the fact that many Nuiqsut residents will live and work in or near the community for the duration of the project.
- Minor errors were identified in the post-processing of near-field AERMOD results and far-field CALPUFF results.
- Refinements were made specifically to the construction equipment NO_2 emissions for the Pad Construction scenario and to the 24-hour PM_{10}/$PM_{2.5}$ fugitive dust modeling for the three scenarios with activities on or near the wellsite to reduce the conservatism leading to significant over predictions that were presented in the GMT1 Alternative A AQIA.
- Reported model-predicted PM_{10} impacts were switched from a conservative highest-second-high value to the true design value, which is based on not exceeding the standard more than once per year on average over 3 years, or in this case, not to be exceeded more than once per year on average over 5 years (equivalent to the highest-sixth-high value).

---

[1] AECOM Environment (AECOM). 2013. Greater Mooses Tooth 1 Air Quality Impact Analysis. Submitted to: ConocoPhillips Company, Anchorage, Alaska. Submitted by: AECOM Environment, Fort Collins, Colorado. October 2013.

- Reported model-predicted short-term $PM_{2.5}$ impacts were switched from a conservative highest-first-high value averaged over 5 years to the true design value which is based on the multi-year average of the 98th percentile of the annual distribution of 24-hour average values.

With these corrections and refinements, project impacts presented for both the near-field and far-field analysis demonstrate compliance with all applicable standards and are below acceptable thresholds without mitigation.

The resulting revised model-predicted impacts are shown in the tables included in Attachment A. Note that the tables now include background values from the Nuiqsut monitoring station, as requested through comments received on the GMT1 Alternative A AQIA.

Near Field Modeling – Description of Minor Corrections

For 24-hour particulate results that relied on post-processing to account for time-varying emissions, the duration of activities with emissions "turned on" was set up to be too short. In some cases, this increased the model-predicted impacts presented in Tables 5-1 through 5-7 of the GMT1 Alternative A AQIA. However, this error did not alter the compliance situation or any conclusions.

For the 1-hour NO_2 modeling supporting the Access Road and Pad Construction scenario, a typographical error was found in the input file to the hourly emissions post-processor that erroneously excluded the processing of several receptors. Following the adjustment, model-predicted 1-hour NO_2 impacts increased slightly for this scenario as compared to those presented in Table 5-3 of the GMT1 Alternative A AQIA. Regardless, this error did not alter the compliance situation or any conclusions.

In both of these case, the errors were found in an input file to the hourly emissions post-processor and did not affect the AERMOD modeling that fed the post-processor. These errors were discovered while comparing impacts predicted using the AECOM post-processor to those predicted using AERMOD with an hourly emissions input file.

Model predicted impacts for the Nuiqsut man camps have been updated to reflect the use of a 400 kW generator, instead of a 379 kW generator. This change was made to correct an oversight. Since the dispersion modeling for this scenario was conducted with a unit (1 g/sec) emission rate, the AERMOD model did not need to be executed again. The results simply needed to be multiplied by the new emission rate to capture the update. This is reflected in Attachment A Table A-5 and Table A-6, which shows little change in the predicted impacts, and no change to the compliance situation.

Near Field Modeling – Description of Refinements

Short-term particulate and NO_2 emissions from the construction equipment modeled as part of the Access Road and Pad Construction scenario were refined to reflect a more realistic number of off-highway tractors with bottom dump trailers that would be on the GMT1 pad at a given time. It was originally assumed that all 14 of these units would be operating on the GMT1 pad or within 500 meters of it on the access road. In reality, the 14 tractors will be operating between the GMT1 pad and the Clover material source. Therefore, this inventory of equipment was split between the GMT1 pad and the Clover material source. This is still conservative given that a fraction of the inventory will be traveling between the two locations. As a result of this refinement, 1-hour NO_2 and 24-hour PM_{10}/$PM_{2.5}$ model runs were updated. Emissions of SO_2 and CO, as well as all annual emissions, were not updated as modeled impacts submitted with the GMT1 Alternative A AQIA indicated a large margin of compliance even with the more conservative assumption which placed all tractors on or near the GMT1 pad.

The revised 1-hour NO_2 modeling also included the use of a seasonally-varying hourly background value in AERMOD, in lieu of adding a single background value from the Nuiqsut monitoring station to the modeled impacts. The seasonally varying hourly NO_2 background values were developed from data

collected at the Nuiqsut Air Quality Monitoring Station for calendar years 2010, 2011, and 2012. The background values were determined as follows:

1. Assign seasons to each month of data, where:
    - Season 1 = January, February, and December
    - Season 2 = March – May
    - Season 3 = June – August
    - Season 4 = September – November
2. Count the number of valid observations for each hour of the day, for each season.
3. Determine the 98th percentile value for each hour of the day, by season, based on the number of valid observations.
4. Determine the 3-year average (2010-2012) 98th percentile value for each hour of the day, by season.

Table 1 provides a count of valid hourly NO_2 observations by hour of day and season. **Table 2** provides the 98th percentile values calculated for each hour of the day, by season as well as the 3-year average 98th percentile values that were input to AERMOD.

An additional refinement was made to emissions of fugitive dust associated with windblown and vehicular disturbance of dirt on the drilling pad and access road that were included in the modeling of the Infill Drilling, Well Intervention, and Access Road and Pad Construction scenarios. The emissions were assumed to only occur from June to September of each year as freezing conditions in the region prevent fugitive dust emissions for the remainder of the year. Note that this refinement was not applied to annual $PM_{2.5}$ as modeled impacts included in the GMT1 Alternative A AQIA indicated a large margin of compliance even with the more conservative assumption that emissions occur throughout the year.

The air toxics long-term cancer risk analysis was revised to better represent the fact that many Nuiqsut residents will live and work in or near the community for the duration of the project. Based on this assumption, the most likely exposure (MLE) was set equal to the maximally exposed individual (MEI) and both were based on a 70 year exposure to the project which is expected to last 30 years. Even with this more conservative approach to the MLE, the cancer risk remained below 1 in a million in the community of Nuiqsut. A long-term cancer risk analysis was not conducted for individuals located at the GMT1 pad edge since individuals will not live and work at this location.

<u>Far Field Modeling – Description of Minor Corrections</u>

Due to two erroneous hours of WRF data included in the archive supplied by the UAF (one hour in 2007 and one hour in 2009), the CALPUFF long-range modeling had to be split into two periods for the years 2007 and 2009. As the archive was being compiled for transmittal to the BLM, it was noticed that the CALPOST runs for the latter periods of 2007 and 2009 had non-standard block averaging times. Upon review, it was found that this occurred because CALPOST was run to process the entire period contained within the CALPUFF data files, which typically begins on the first hour of the first day of the year. In the case of the latter portions of the split years, the CALPUFF simulation began the hour after the erroneous period, not the beginning of the first full day. As a result, the block averages in CALPOST were shifted several hours from what would have been obtained using blocks starting midnight according to standard protocol.

Since the time shift was small and the changes in the results are due entirely to how the block averages were calculated, the changes are expectedly small and resulted in inconsequential changes to the far

field modeling results, as shown in the attached tables. Note that this error did not affect 1-hour and period averages since they do not rely on short-term block average calculation.

Since this post-processing error was detected and corrected prior to transmitting the far-field archive, the modeling files in the far field archive previously transmitted to the BLM are correct and only the results tables required revision.

Far-Field Modeling – Description of Refinements

For the GMT1 Alternative A AQIA the GMT1 Project sources were simulated in the far-field modeling as a single volume source. At the request of several cooperating agencies participating in the project air quality working group, this approach was refined. The refined approach involved simulated the project sources as individual point sources and volume sources as they were for the near-field analysis.

With these corrections and refinements, both the near-field and far-field model-predicted impacts demonstrate compliance with all applicable standards and all impacts are below acceptable thresholds without mitigation. The revised model-predicted impacts are shown in the tables included in Attachment A. As a result of the changes, the near-field modeling digital archive will be transmitted again.

Sincerely,

Thomas Damiana
Air Quality Engineer/Meteorologist
Tel. (970) 530-3465
thomas.damiana@aecom.com

Amanda MacNutt
Air Quality Meteorologist
Tel. (978) 905-2297
Amanda.Macnutt@aecom.com

cc: Lynn DeGeorge (ConocoPhillips Alaska, Inc.)
Brad Thomas (ConocoPhillips Alaska, Inc.)
Alan Peck (BLM Alaska)
Jessica Stark (SLR International)

Attachment: Revised Air Quality Impact Analysis Summary for ConocoPhillips Alaska, Inc. Greater Mooses Tooth – Alternative A

Table 1 Count of Valid Hourly NO_2 Observations by Hour of Day and Season

2010	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Season 1	79	78	53	79	79	79	77	77	78	78	77	79	79	78	77	77	76	75	76	77	78	78	78	79
Season 2	92	92	61	92	92	92	92	91	91	91	90	90	89	91	89	89	89	92	92	92	92	92	91	91
Season 3	91	91	61	91	91	90	90	90	88	89	88	87	88	90	90	90	91	91	91	91	91	91	90	91
Season 4	78	77	53	78	78	77	77	77	76	77	76	77	77	77	78	78	77	77	77	77	76	76	76	77
2011	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Season 1	90	90	90	64	65	90	90	90	90	90	89	89	90	90	89	90	89	88	90	90	90	90	90	90
Season 2	91	91	91	92	74	92	92	92	92	90	89	90	90	90	89	87	89	88	88	89	89	91	90	91
Season 3	90	90	90	90	77	90	90	90	87	87	87	87	90	87	85	84	86	87	89	88	90	90	91	91
Season 4	91	91	91	78	78	90	90	91	91	91	88	88	88	89	87	89	88	87	88	89	91	91	91	91
2012	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
Season 1	74	74	69	59	74	73	73	71	73	70	70	71	69	70	68	69	69	73	74	73	73	73	75	76
Season 2	89	89	89	72	89	89	89	89	89	87	87	89	89	88	88	86	87	89	88	88	89	88	88	89
Season 3	92	92	91	78	92	91	92	92	92	92	92	92	92	92	91	91	92	92	92	91	91	92	92	92
Season 4	84	84	84	72	84	84	84	84	83	82	82	83	82	82	81	81	81	83	84	84	84	84	84	84

Table 2 98th Percentile Hourly NO_2 Values by Hour of Day and Season ($\mu g/m^3$)

2010	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Season 1	20.7	28.2	15.0	15.0	13.2	13.2	22.6	13.2	18.8	15.0	13.2	13.2	22.6	20.7	16.9	24.4	18.8	18.8	16.9	20.7	24.4	15.0	16.9	22.6
Season 2	20.7	18.8	15.0	15.0	15.0	11.3	11.3	9.4	5.6	11.3	7.5	9.4	7.5	7.5	7.5	9.4	9.4	11.3	9.4	20.7	22.6	15.0	18.8	18.8
Season 3	13.2	15.0	15.0	9.4	9.4	9.4	9.4	11.3	9.4	11.3	7.5	5.6	5.6	7.5	5.6	5.6	5.6	7.5	9.4	11.3	9.4	13.2	11.3	13.2
Season 4	7.5	7.5	9.4	9.4	7.5	5.6	7.5	9.4	7.5	5.6	7.5	7.5	5.6	7.5	7.5	9.4	7.5	9.4	15.0	15.0	9.4	13.2	9.4	7.5
2011	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Season 1	16.9	19.0	15.0	20.7	11.3	15.0	20.7	20.7	18.8	20.7	20.7	27.3	20.7	18.8	20.5	22.6	20.9	20.1	35.9	45.1	22.6	25.0	26.3	20.1
Season 2	19.6	22.2	15.0	17.7	16.4	16.0	16.0	16.9	13.2	11.3	16.9	13.7	9.4	7.5	5.6	6.2	7.5	9.2	11.3	11.3	13.2	15.0	19.2	18.8
Season 3	15.8	14.1	15.2	11.8	11.1	12.0	10.7	9.4	9.0	8.1	7.5	7.9	8.1	6.6	6.8	7.3	10.0	11.3	11.1	11.3	14.9	18.8	14.5	19.0
Season 4	9.8	10.3	6.8	5.1	4.7	7.0	11.8	20.5	9.2	5.6	5.3	12.0	8.3	10.5	12.0	12.8	10.9	14.5	13.0	18.1	9.8	9.0	8.8	8.8
2012	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Season 1	25.8	24.3	23.7	16.9	18.6	21.1	21.2	16.0	18.2	27.5	18.1	21.6	27.3	18.2	20.1	25.0	17.7	16.2	26.3	17.9	24.3	20.5	17.5	15.4
Season 2	13.5	16.2	21.1	25.6	23.3	19.6	14.5	12.2	9.8	5.3	7.0	6.0	4.9	7.5	8.7	6.0	6.4	10.0	9.0	12.0	10.5	13.7	17.7	15.8
Season 3	17.3	15.0	16.9	8.3	7.9	8.5	6.8	10.0	9.2	7.0	8.3	7.5	8.3	9.4	9.0	7.7	8.1	7.3	7.0	6.6	6.8	10.2	15.8	14.9
Season 4	6.2	6.4	5.8	5.3	4.9	4.5	4.7	10.2	10.3	7.7	7.3	8.3	10.0	7.1	8.3	7.0	12.6	12.6	12.4	11.8	9.4	16.0	6.4	6.4
3-Yr Avg.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Season 1	21.1	23.8	17.9	17.6	14.4	16.4	21.5	16.6	18.6	21.1	17.3	20.7	23.5	19.2	19.2	24.0	19.1	18.4	26.4	27.9	23.8	20.2	20.2	19.4
Season 2	17.9	19.1	17.1	19.4	18.2	15.6	13.9	12.9	9.5	9.3	10.5	9.7	7.3	7.5	7.3	7.2	7.8	10.2	9.9	14.7	15.4	14.6	18.6	17.8
Season 3	15.4	14.7	15.7	9.8	9.5	10.0	9.0	10.2	9.2	8.8	7.8	7.0	7.3	7.8	7.1	6.9	7.9	8.7	9.2	9.7	10.3	14.0	13.9	15.7
Season 4	7.8	8.1	7.3	6.6	5.7	5.7	8.0	13.4	9.0	6.3	6.7	9.3	8.0	8.4	9.3	9.7	10.3	12.2	13.5	15.0	9.5	12.7	8.2	7.6

Attachment A
Revised Air Quality Impact Analysis Summary for GMT1 Alternative A

Revised Air Quality Impact Analysis Summary for ConocoPhillips Alaska, Inc. Greater Mooses Tooth – Alternative A

Summary Air Quality Impacts

Summaries of nearfield, farfield ambient air quality impacts predicted for the Greater Mooses Tooth 1 (GMT1) Project Alternative A are presented in the tables below. These include an analysis of impacts compared to the National and Alaska Ambient Air Quality Standards (NAAQS/AAAQS), Prevention of Significant Deterioration (PSD) Class II Increments and applicable thresholds for evaluating impacts from air toxics.

The analysis summarized below was conducted according to the methodologies presented in the GMT1 Ambient Air Quality Impact Analysis submitted for Alternative A[2] revised in accordance with comments received from cooperating agencies.

Table A-1 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Infill Drilling – Alternative A

Pollutant	Averaging Period	Rank [1]	Maximum Model Predicted Concentration (µg/m^3)	Ambient Background (µg/m^3)	Total (µg/m^3)	NAAQS/ AAAQS (µg/m^3)	% of NAAQS/ AAAQS
CO	1-hour	H2H	915	1,488	2,403	40,000	6%
	8-hour	H2H	420	1,259	1,680	10,000	17%
SO_2	1-hour	99th	3.42	7.7	11	196	6%
	3-hour	H2H	3.40	18	21	1,300	2%
	24-hour	H2H	2.84	6.8	10	365	3%
	Annual	MAX	0.465	0.34	0.80	80	1%
NO_2	1-hour	98th	101	38	138	188	73%
	Annual	MAX	39.3	2.9	42	100	42%
PM_{10}	24-hour	H6H	66.4	48	115	150	76%
$PM_{2.5}$	24-hour	98th	21.6	7.1	29	35	82%
	Annual	MAX	5.83	2.2	8.0	12	67%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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.

[2] AECOM Environment (AECOM). 2013. Greater Mooses Tooth 1 Air Quality Impact Analysis. Submitted to: ConocoPhillips Company, Anchorage, Alaska. Submitted by: AECOM Environment, Fort Collins, Colorado. October 2013.

Table A-2 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Well Intervention – Alternative A

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	1,488	1,983	40,000	5%
	8-hour	H2H	328	1,259	1,587	10,000	16%
SO_2	1-hour	99th	3.42	7.7	11	196	6%
	3-hour	H2H	3.40	18	21	1,300	2%
	24-hour	H2H	2.84	6.8	10	365	3%
	Annual	MAX	0.416	0.34	0.76	80	1%
NO_2	1-hour	98th	127	38	164	188	87%
	Annual	MAX	7.43	2.9	10	100	10%
PM_{10}	24-hour	H6H	59.1	48	107	150	72%
$PM_{2.5}$	24-hour	98th	14.0	7.1	21	35	60%
	Annual	MAX	1.80	2.2	4.0	12	33%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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 A-3 GMT1 Cumulative Impacts Compared to Established Ambient Criteria for Pad and Access Road Construction – Alternative A

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	1,523	1,488	3,011	40,000	8%
	8-hour	H2H	1,009	1,259	2,268	10,000	23%
SO_2	1-hour	99th	3.34	7.7	11	196	6%
	3-hour	H2H	3.43	18	21	1,300	2%
	24-hour	H2H	1.78	6.8	8.5	365	2%
	Annual	MAX	0.0941	0.34	0.43	80	1%
NO_2	1-hour	98th	155	AERMOD[2]	155	188	82%
	Annual	MAX	31.3	2.9	34.2	100	34%
PM_{10}	24-hour	H6H	64.8	48	113	150	75%
$PM_{2.5}$	24-hour	98th	27.6	7.1	34.7	35	99%
	Annual	MAX	5.22	2.2	7.42	12	62%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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.

[2] Seasonally varying background was included as an input to the model run; therefore, a single ambient background concentration was not added in order to determine the cumulative impact.

Table A-4 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Activities within the Clover Material Source – Alternative A

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	1,939	1,488	3,427	40,000	9%
	8-hour	H2H	1,121	1,259	2,380	10,000	24%
SO_2	1-hour	99th	16.2	7.7	24	196	12%
	3-hour	H2H	30.0	18	48	1,300	4%
	24-hour	H2H	6.44	6.8	13	365	4%
	Annual	MAX	0.108	0.34	0.45	80	1%
NO_2	1-hour	98th	131	38	168	188	90%
	Annual	MAX	36.9	2.9	40	100	40%
PM_{10}	24-hour	H6H	26.6	48	75	150	50%
$PM_{2.5}$	24-hour	98th	25.8	7.1	33	35	94%
	Annual	MAX	3.74	2.2	5.9	12	50%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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

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	445	1,488	1,933	40,000	5%
	8-hour	H2H	203	1,259	1,462	10,000	15%
SO_2	1-hour	99th	0.494	7.7	8.2	196	4%
	3-hour	H2H	0.459	18	18	1,300	1%
	24-hour	H2H	0.292	6.8	7.1	365	2%
	Annual	MAX	0.0679	0.34	0.41	80	1%
NO_2	1-hour	98th	109	38	146	188	78%
	Annual	MAX	14.8	2.9	18	100	18%
PM_{10}	24-hour	H6H	10.9	48	59	150	39%
$PM_{2.5}$	24-hour	98th	10.8	7.1	18	35	51%
	Annual	MAX	2.15	2.2	4.4	12	36%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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 A-6 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria for Man Camps Located Near Nuiqsut – Nearest Residence Receptor Grid – Alternative A

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
CO	1-hour	H2H	397	1,488	1,885	40,000	5%
	8-hour	H2H	147	1,259	1,406	10,000	14%
SO_2	1-hour	99th	0.43	7.7	8.1	196	4%
	3-hour	H2H	0.32	18	18	1,300	1%
	24-hour	H2H	0.15	6.8	6.9	365	2%
	Annual	MAX	0.021	0.34	0.36	80	0.5%
NO_2	1-hour	98th	94.04	38	132	188	70%
	Annual	MAX	5.90	2.9	8.8	100	9%
PM_{10}	24-hour	H6H	5.45	48	54	150	36%
$PM_{2.5}$	24-hour	98th	4.87	7.1	12	35	34%
	Annual	MAX	0.65	2.2	2.9	12	24%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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 A-7 GMT1 Project Impacts Compared to the Class II PSD Increments for Infill Drilling –Alternative A

Pollutant	Averaging Period	Rank [1]	Maximum Model Predicted Concentration (µg/m^3)	Class II PSD Increments
SO_2	3-hour	H2H	3.40	512
	24-hour	H2H	2.84	91
	Annual	MAX	0.46	20
NO_2	Annual	MAX	39.3	25
PM_{10}	24-hour	H2H	71.2	30
	Annual	MAX	21.2	17
$PM_{2.5}$	24-hour	H2H	33.3	9
	Annual	MAX	5.83	4

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

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

Table A-8 GMT1 Project Cumulative Impacts Compared to Established Ambient Criteria at the Community of Nuiqsut – Alternative A

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	163.8	163.8	1,488	1,652	40,000	4%
	8-hour	H2H	3.20	2.88	8.69	24.5	24.5	1,259	1,284	10,000	13%
SO_2	1-hour	99th	0.05	0.04	0.05	1.4	1.4	7.7	9.1	196	5%
	3-hour	H2H	0.03	0.03	0.06	1.1	1.1	18	18.6	1,300	1%
	24-hour	H2H	0.01	0.01	0.01	0.2	0.2	6.8	7.0	365	2%
	Annual	MAX	0.00	0.00	0.00	0.001	0.001	0.34	0.34	80	0%
NO_2	1-hour	98th	6.42	8.24	9.93	39.3	39.3	38	77.0	188	41%
	Annual	MAX	0.05	0.01	0.03	0.10	0.1	2.9	3.0	100	3%
PM_{10}	24-hour	H6H	1.48	1.44	1.60	0.94	1.6	48	49.8	150	33%
$PM_{2.5}$	24-hour	98th	0.37	0.35	0.62	0.63	0.6	7.1	7.7	35	22%
	Annual	MAX	0.004	0.001	0.003	0.005	0.005	2.2	2.2	12	18%

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

H6H: Highest Sixth Highest value across five continuous modeled years.

98th: Average across all five modeled years of the 98th percentile of 1-hour daily maximum predicted concentrations (1-hour NO_2) or of 24-hour concentrations (24-hour $PM_{2.5}$).

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 A-9 Air Toxics Acute Exposure Assessment and Long-term Non-carcinogenic Exposure Assessment Predicted at the GMT1 Pad Edge – Alternative A

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	1,300 [1]	3.3	30	0.060
Ethyl benzene	350,000 [2]	0.5	1,000	0.0017
Formaldehyde	55 [1]	1.8	9.8	0.050
n-Hexane	390,000 [2]	68.9	700	0.49
Toluene	37,000 [1]	2.6	5,000	0.031
Xylene	22,000 [1]	1.1	100	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 A-10 Air Toxics Long-Term Cancer Risk Analysis for Nuiqsut Community Receptor – Alternative A

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	0.43	1.28E-10
MLE	Ethyl benzene	1.05E-06	2.5E-06	0.43	1.13E-12
MLE	Formaldehyde	3.15E-05	1.3E-05	0.43	1.76E-10
				Total Inhalation Cancer Risk	**3.05E-10**
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).

Table A-11 GMT1 Air Quality Impacts at Alaska National Wildlife Refuge – Project Only – Alternative A

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]	2.42E-02	38	38	188	20%
	Period [1, 2]	2.04E-04	2.9	2.9	100	2.9%
SO_2	1-hour [1]	3.72E-04	7.7	7.7	196	3.9%
	3-hour [1]	2.46E-04	18	18	1300	1.3%
	24-hour [1]	1.09E-04	6.8	6.8	365	1.9%
	Period [1, 2]	4.29E-06	0.34	0.34	80	0.42%
PM_{10}	24-hour [1]	1.38E-02	48	48	150	32%
$PM_{2.5}$	24-hour [1]	1.38E-02	7.1	7.1	35	20%
	Period [1, 2]	6.84E-04	2.2	2.2	12	18%

[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 A-12 GMT1 Air Quality Impacts at Gates of the Arctic – Project Only – Alternative A

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]	1.23E-02	38	38	188	20
	Period [1, 2]	2.54E-05	2.9	2.9	100	2.9
SO_2	1-hour [1]	2.54E-04	7.7	7.7	196	3.9
	3-hour [1]	2.34E-04	18	18	1300	1.3
	24-hour [1]	9.04E-05	6.8	6.8	365	1.9
	Period [1, 2]	1.62E-06	0.34	0.34	80	0.42
PM_{10}	24-hour [1]	1.32E-02	48	48	150	32
$PM_{2.5}$	24-hour [1]	1.32E-02	7.1	7.1	35	20
	Period [1, 2]	3.39E-04	2.2	2.2	12	18

[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 A-13 GMT1 Number of Days Greater Than 0.5 ddv – Project Only – Alternative A

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 A-14 GMT1 Number of Days Greater Than 1.0 ddv – Project Only – Alternative A

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 A-15 GMT1 Project Maximum ddv Impact – Project Only – Alternative A

Area	Maximum ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.061	0.075	0.080
Gates of the Arctic	0.042	0.054	0.079

Table A-16 GMT1 Project 98th Percentile ddv Impact – Project Only – Alternative A

Area	98th Percentile ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	0.032	0.031	0.045
Gates of the Arctic	0.020	0.022	0.023

Table A-17 GMT1 Project Deposition Impacts – Project Only – Alternative A

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	% of DAT (%)
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	6.18E-05	0.005	1
Gates of the Arctic	Nitrogen	Annual [1]	3.32E-05	0.005	1
Alaska National Wildlife Refuge	Sulfur	Annual [1]	2.13E-06	0.005	0.04
Gates of the Arctic	Sulfur	Annual [1]	1.33E-06	0.005	0.03

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

Table A-18 Cumulative Air Quality Impacts at Alaska National Wildlife Refuge – Alternative A

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]	40.79	38	78	188	42
	Period [1, 2]	0.14	2.9	3.1	100	3.1
SO_2	1-hour [1]	0.76	7.7	8.4	196	4.3
	3-hour [1]	0.54	18	18	1,300	1.4
	24-hour [1]	0.17	6.8	6.9	365	1.9
	Period [1, 2]	0.01	0.34	0.35	80	0.44
PM_{10}	24-hour [1]	2.68	48	51	150	34
$PM_{2.5}$	24-hour [1]	0.45	7.1	7.5	35	22
	Period [1, 2]	0.02	2.2	2.2	12	19

[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 A-19 Cumulative Air Quality Impacts at Gates of the Arctic – Alternative A

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]	0.44	38	38	188	20
	Period [1, 2]	0.002	2.9	2.9	100	2.9
SO_2	1-hour [1]	0.05	7.7	7.7	196	3.9
	3-hour [1]	0.04	18	18	1,300	1.4
	24-hour [1]	0.02	6.8	6.8	365	1.9
	Period [1, 2]	0.001	0.34	0.34	80	0.43
PM_{10}	24-hour [1]	0.33	48	49	150	32
$PM_{2.5}$	24-hour [1]	0.04	7.1	7.1	35	20
	Period [1, 2]	0.003	2.2	2.2	12	18

[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 A-20 Cumulative Air Quality Impacts at the Community of Nuiqsut – Alternative A

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]	2.71	38	40	188	21
	Period [1, 2]	0.15	2.9	3.1	100	3.1
SO_2	1-hour [1]	0.71	7.7	8.4	196	4.3
	3-hour [1]	0.60	18	18	1300	1.4
	24-hour [1]	0.31	6.8	7.1	365	1.9
	Period [1,2]	0.02	0.34	0.36	80	0.45
PM_{10}	24-hour [1]	1.35	48	50	150	33
$PM_{2.5}$	24-hour [1]	0.12	7.1	7.2	35	21
	Period [1, 2]	0.03	2.2	2.2	12	19

[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 A-21 Cumulative Number of Days Greater Than 0.5 ddv – Alternative A

Area	Number of Days Greater Than 0.5 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	80	103	91
Gates of the Arctic	8	11	18

Table A-22 Cumulative Number of Days Greater Than 1.0 ddv – Alternative A

Area	Number of Days Greater Than 1 ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	49	58	48
Gates of the Arctic	1	1	2

Table A-23 Cumulative Maximum ddv Impact – Alternative A

Area	Max ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	9.016	8.628	7.772
Gates of the Arctic	1.242	1.039	1.154

Table A-24 Cumulative 98th Percentile ddv Impact – Alternative A

Area	98th percentile ddv		
	2007	2008	2009
Alaska National Wildlife Refuge	3.614	4.267	4.502
Gates of the Arctic	0.521	0.558	0.684

Table A-25 Cumulative Deposition Impacts Alternative A

Area	Pollutant	Averaging Period	Maximum Impact (kg/ha/yr)	DAT (kg/ha/yr)	% of DAT (%)
Alaska National Wildlife Refuge	Nitrogen	Annual [1]	2.33E-02	0.005	467
Gates of the Arctic	Nitrogen	Period [2]	4.54E-03	0.005	91
Alaska National Wildlife Refuge	Sulfur	Annual [1]	3.90E-03	0.005	78
Gates of the Arctic	Sulfur	Period [2]	7.85E-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, thus reported impacts are conservative.