# AQIA MODELING REPORT

# Northwestern Energy
# Meriwether Compressor Station

### Federal Tribal Minor New Source Review Program

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Project Number: NWE221729
Report Issued: August 19, 2022

BISON
ENGINEERING, INC.

# NorthWestern Energy - Meriwether
# Air Impact Modeling Analyses Report

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## 1.0 SUMMARY

NorthWestern Energy (NWE) has applied for an air quality permit for modification of the Meriwether Compressor Station located on the Blackfeet Indian Reservation. This permit will be issued under Federal Tribal Minor New Source Review (TMNSR) Program in Indian Country. The EPA permitting authority is the Air Permitting and Monitoring Branch, Air and Radiation Division, U.S. EPA Region 8.

Bison Engineering, Inc. (Bison) is submitting this Air Quality Impact Analysis (AQIA) report on behalf of NWE. The purpose of the dispersion modeling is to demonstrate that the changes proposed in the TMNSR application will not cause or contribute to a violation of any National Ambient Air Quality Standard (NAAQS). Bison and NWE have worked with EPA Region 8 to develop a modeling protocol for this project. The final version of the modeling protocol is included as **Attachment 1** to this modeling report.

The current permitting action is for the proposed addition of a 2500 horsepower (hp) engine to the Meriwether facility. The dispersion modeling determines predicted ambient impacts due to the operation of the Meriwether facility with the proposed changes. The modeling is based on the Potential to Emit (PTE) of proposed and existing emission sources, calculated using applicable emission factors and methodologies as provided in the TMNSR permit application. The proposed facility is not PSD major - the current permitting action is not PSD Major Application. A detailed emissions inventory spreadsheet was included in TMNSR permit application.

Additional modeling has been performed to demonstrate the proposed project will not cause or contribute to a violation of the NAAQS with the proposed and existing compressor engines operating at 50% load as well as 100% load. The NAAQS compliance demonstration is based on the worst-case impacts from the facility under the two different operating scenarios.

# 2.0 PROJECT DESCRIPTION AND BACKGROUND

## 2.1 General Facility/Project Description

The Meriwether facility currently includes three natural gas fired compressor engines. Existing equipment at the facility will not be impacted by the proposed project. The facility was originally registered with a single 1,340-hp natural gas compressor engine and modified in 2018 to add two 1,380-hp natural gas compressor engines. The facility also includes an 85 hp gas-fired emergency generator engine. Maps showing the general site location are included in the Modeling Protocol in **Attachment 1**.

The scope of the project is the addition one new 2,500-hp natural gas compressor engine. The emission rates used in the modeling are the same as provided in the emissions inventory in the TMNSR permit application.

## 2.2 Location of Project

The NWE Meriwether facility is located 23 miles northwest of Cut Bank, Montana, 2.5 miles south of Buffalo Lake, Montana, and approximately 12.5 miles south of Canada. The facility is located in the NE¼, SE¼ of Section 3, Township 35 North, Range 9 West, in Glacier County. UTM coordinates for the proposed engine on the site are UTM Zone 12, Easting 370,986 meters, and Northing 5,408,634 meters. The proposed facility elevation is 4226 feet above sea level. The Big Sky Hutterite Colony is located 1.5 miles north of the project site.

The air quality classification for the project area is "Unclassifiable or Better than National Standards" (40 CFR 81.327) for the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants.

## 2.3 Applicable Standards

Criteria pollutant NAAQS are listed in **Table 1**, along with the applicable significant impact levels (SILs) for each pollutant and averaging period. SILs are used in the modeling analysis as described in Section 3.3.

## Table 1. Applicable Regulatory Limits

| Pollutant | Averaging Period | Significant Impact Levels[a] ($\mu g/m^3$)[b] | NAAQS[c] ($\mu g/m^3$) | Modeled Design Value Used[d] |
|---|---|---|---|---|
| $PM_{10}$[e] | 24-hour | 5.0 | 150[f] | Maximum 6th highest[g] |
| $PM_{2.5}$[h] | 24-hour | 1.2 | 35[i] | Mean of maximum 8th highest[j] |
| | Annual | 0.2 | 12[k] | Mean of maximum 1st highest[k] |
| Carbon monoxide (CO) | 1-hour | 2,000 | 40,000[l] | Maximum 2nd highest[m] |
| | 8-hour | 500 | 10,000[l] | Maximum 2nd highest[m] |
| Sulfur Dioxide ($SO_2$) | 1-hour | 3 ppb[n] (7.8 $\mu g/m^3$) | 75 ppb[o] (196 $\mu g/m^3$) | Mean of maximum 4th highest[q] |
| | 3-hour | 25 | 1,300 ppb[l,p] | Maximum 2nd highest[m] |
| Nitrogen Dioxide ($NO_2$) | 1-hour | 4 ppb (7.5 $\mu g/m^3$) | 100 ppb[s] (188 $\mu g/m^3$) | Mean of maximum 8th highest[t] |
| | Annual | 1.0 | 100[r] | Maximum 1st highest[n] |
| Lead (Pb) | 3-month[u] | NA | 0.15[r] | Maximum 1st highest[n] |
| | Quarterly | NA | 1.5[r] | Maximum 1st highest[n] |
| Ozone ($O_3$) | 8-hour | 40 TPY VOC[v] | 70 ppb[w] | Not typically modeled |

a. Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, April 17, 2018, www.epa.gov.
b. Micrograms/cubic meter.
c. National Ambient Air Quality Standard (NAAQS), www.epa.gov.
d. The maximum 1st highest modeled value is always used for the SIL analysis unless indicated otherwise. Modeled design values are calculated for each ambient air receptor.
e. Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.
f. Not to be exceeded more than once per year on average over 3 years (or the 5-year modeling period).
g. Concentration at any modeled receptor when using five years of meteorological data.
h. Particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.
i. 3-year mean of the upper 98th percentile of the annual distribution of 24-hour concentrations.
j. 5-year mean of the 8th highest modeled 24-hour concentrations at the modeled receptor for each year of meteorological data modeled. For the SIL analysis, the 5-year mean of the 1st highest modeled 24-hour impacts at each receptor for each year.
k. 3-year mean of annual concentration (or the 5-year modeling period) at the modeled receptor.
l. Not to be exceeded more than once per year.
m. Concentration at any modeled receptor.
n. Interim SIL established by EPA policy memorandum.
o. 3-year mean of the upper 99th percentile of the annual distribution of maximum daily 1-hour concentrations.
p. Secondary NAAQS - not modeled.
q. 5-year mean of the 4th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled. For the significant impact analysis, the 5-year mean of 1st highest modeled 1-hour impacts for each year is used.
r. Not to be exceeded in any calendar year.
s. 3-year mean of the upper 98th percentile of the annual distribution of maximum daily 1-hour concentrations.
t. 5-year mean of the 8th highest daily 1-hour maximum modeled concentrations for each year of meteorological data modeled. For the significant impact analysis, the 5-year mean of maximum modeled 1-hour impacts for each year is used.
u. 3-month rolling average.
v. An annual emissions rate of 40 ton/year of VOCs is considered significant for $O_3$.
w. Annual 4th highest daily maximum 8-hour concentration averaged over three years.

# 3.0 MODELING ANALYSES APPLICABILITY AND PROTOCOL

## 3.1 Modeling Protocol

NWE submitted the original AQIA modeling protocol on May 19, 2022. EPA reviewed the initial protocol submittal and returned comments. On June 23, 2022, the NWE team provided a protocol addendum including response to the additional items. NWE, Bison, and EPA had a conference call on June 28, 2022, in which EPA went over previous data requests and identified additional items. All EPA comments have been addressed in the final protocol, which is included as **Attachment 1**.

## 3.2 Criteria Pollutant Modeling Applicability

The Meriwether Compressor Station will have the potential to emit nitrogen oxides ($NO_x$), carbon monoxide (CO), and volatile organic compounds (VOC) in amounts exceeding the Minor NSR threshold for attainment areas listed in Table 1 to Section 49.153 – Minor NSR Thresholds. The proposed new engine by itself also has the potential to emit $NO_x$, CO and VOC in amounts exceeding the minor NSR thresholds. Emissions of sulfur dioxide ($SO_2$) and particulate matter ($PM_{10}$ and $PM_{2.5}$) from the entire facility are below the Minor NSR thresholds. In the modeling protocol review, EPA has requested that $SO_2$, $PM_{10}$, and $PM_{2.5}$ also be modeled for the SIL analysis.

## 3.3 SIL Modeling Parameters

The first step in the AQIA is to perform a single-source impact analysis to determine if the emissions from the new engine will exceed the applicable SILs. If the impacts exceed the applicable SILs, all the engines as the site will be modeled to determine compliance with the NAAQS. SIL analysis was performed using the EPA AERSCREEN model. Short-term and annual allowable emissions from the proposed engine were modeled to determine if ambient impacts exceeded the applicable SILs. **Table 2** contains a listing of the SIL values, averaging periods, and modeling approach.

**Table 2. SIL Compliance Demonstration Values**

| Pollutant | Averaging Period | Significant Impact Level (μg/m³) | Regulatory Modeled Value | AERSCREEN Modeled Value |
|---|---|---|---|---|
| $PM_{10}$ | 24-hour | 5.0 | High 1st high of 5 met years | Max 1-hr impact * 0.6 |
| $PM_{2.5}$ | 24-hour | 1.2 | Average of 24-hr H1H averaged over 5 years | Max 1-hr impact * 0.6 |
| | Annual | 0.2 | Average of annual high values over 5 years | Max 1-hr impact * 0.1 |
| $NO_2$ | 1-hour | 4 ppb (7.5 μg/m³) | Average of 1-hr H1H values over 5 years | Max 1-hour impact |
| | Annual | 1.0 | Highest annual average over 5 years | Max 1-hr impact * 0.1 |

| Pollutant | Averaging Period | Significant Impact Level (μg/m³) | Regulatory Modeled Value | AERSCREEN Modeled Value |
|---|---|---|---|---|
| $SO_2$ | 1-hour | 3 ppb (7.8 μg/m³) | Average of 1-hr H1H values over 5 years | Max 1-hr impact * 0.1 |
| CO | 1-hour | 2,000 | High 1st high of 5 met years | Max 1-hr impact |
| | 8-hour | 500 | High 1st high of 5 met years | Max 1-hr impact * 0.9 |

SIL modeling was performed using the AERSCREEN modeling program as described in the Modeling Protocol in Attachment 1. The use of AERSCREEN precludes the development of a radius of impact (ROI) from each pollutant/averaging period. SIL modeling results for each pollutant and averaging period are included in **Table 12** of this report.

## 3.4 NAAQS Modeling Parameters

The SIL modeling showed that the SIL impacts triggered NAAQS modeling for 1-hour $NO_2$, Annual $NO_2$, 24-hour $PM_{2.5}$ and Annual $PM_{2.5}$. The proposed full PTE emissions for these pollutants and averaging periods were modeled to determine total facility impact. The total modeled impacts were added to a background ambient concentration to determine compliance with the NAAQS. The background values are listed in Section 5 of this report.

The engine modeling for NAAQS compliance was performed using the three existing engines and one proposed engine running at 100% load and at 50% load. **Table 3** lists the sources and compliance demonstration values that were used in the NAAQS compliance demonstration.

**Table 3. NAAQS Compliance Demonstration Values**

| Pollutant | Averaging Period | Modeled Sources | Modeled Value | Met Data Set |
|---|---|---|---|---|
| $PM_{10}$ | 24-hour | Not Modeled | High 6th high of 5 met years | 5 year combined met data set |
| $PM_{2.5}$ | 24-hour | EU1, EU2, EU3, EU8 | H8H of max daily values averaged over 5 years | 5 year combined met data set |
| | Annual | EU1, EU2, EU3, EU8 | Average of annual high values over 5 years | 5 year combined met data set |
| CO | 1-hour | Not Modeled | High 2nd high of 5 met years | Individual met year files |
| | 8-hour | Not Modeled | | |
| $NO_2$ | 1-hour | EU1, EU2, EU3, EU8. | H8H of max daily values averaged over 5 years | 5 year combined met data set |
| | Annual | EU1, EU2, EU3, EU8 | Highest annual result of the 5 years modeled | Individual met year files |
| $SO_2$ | 1-hour | Not Modeled | H4H of max daily values averaged over 5 years | 5 year combined met data set |

## 4.0 MODELED EMISSION SOURCES

Emissions from the facility have been as calculated as detailed in the TMNSR application.

### 4.1 Criteria Pollutants

The modeled criteria pollutant emissions rates for the NWE sources relisted in **Table 4**.

**Table 4. Modeled Emission Rates**

| Emissions Unit | $PM_{2.5}$ | $PM_{2.5}$ | $NO_x$ | $NO_x$ | CO | CO |
|---|---|---|---|---|---|---|
| | lb/hr | tpy | lb/hr | tpy | lb/hr | tpy |
| EU1 – 1340 hp engine – 100% load<br>EU1 – 1340 hp engine – 50% load | 0.110<br>0.055 | 0.482<br>0.241 | 2.95<br>1.48 | 12.9<br>6.49 | 5.91<br>2.96 | 25.88<br>12.94 |
| EU2 – 1380 hp engine – 100% load<br>EU2 – 1380 hp engine – 50% load | 0.114<br>0.057 | 0.498<br>0.249 | 3.04<br>1.52 | 13.3<br>6.66 | 6.08<br>3.04 | 26.65<br>13.33 |
| EU3 – 1380 hp engine – 100% load<br>EU3 – 1380 hp engine – 50% load | 0.114<br>0.057 | 0.498<br>0.249 | 3.04<br>1.52 | 13.3<br>6.66 | 6.08<br>3.04 | 26.65<br>13.33 |
| EU8 –2500 hp engine – 100% load<br>EU8 –2500 hp engine – 50% load | 0.187<br>0.094 | 0.820<br>0.410 | 5.51<br>2.76 | 24.1<br>12.1 | 11.02<br>5.51 | 48.28<br>24.14 |

**Table 4 (Continued). Modeled Emission Rates**

| Emissions Unit | $SO_2$ | $SO_2$ | $PM_{10}$ | $PM_{10}$ |
|---|---|---|---|---|
| | lb/hr | tpy | lb/hr | tpy |
| EU1 – 1340 hp engine – 100% load<br>EU1 – 1340 hp engine – 50% load | 0.01 | 0.03 | 0.110<br>0.055 | 0.482<br>0.241 |
| EU2 – 1380 hp engine – 100% load<br>EU2 – 1380 hp engine – 50% load | 0.01 | 0.03 | 0.114<br>0.057 | 0.498<br>0.249 |
| EU3 – 1380 hp engine – 100% load<br>EU3 – 1380 hp engine – 50% load | 0.01 | 0.03 | 0.114<br>0.057 | 0.498<br>0.249 |
| EU8 –2500 hp engine – 100% load<br>EU8 –2500 hp engine – 50% load | 0.01 | 0.05 | 0.187<br>0.094 | 0.820<br>0.410 |

NAAQS modeling has been performed with the engines operating at 100% capacity and 50% capacity as described in **Section 6**. The impacts from operating at 100% capacity were consistently higher.

### 4.2 $NO_2/NO_x$ Ratio for $NO_x$ Chemistry Modeling

The estimated emissions of $NO_x$ from natural gas combustion are a mixture of primarily nitric oxide (NO) and $NO_2$. $NO_2$ is a regulated criteria air pollutant, while NO is not. It is valuable to know the concentrations of NO and $NO_2$ in the $NO_x$ emissions, and the rate at which the NO converts to $NO_2$.

Section 4.2.3.4.b of the EPA's Guideline on Air Quality Models, Appendix W to 40 CFR Part 51 (Jan. 17, 2017), contains the following description of $NO_2$ modeling.

> b. Due to the complexity of $NO_2$ modeling, a multi-tiered screening approach is required to obtain hourly and annual average estimates of $NO_2$. The tiers of $NO_2$ modeling include:
>
> i. A first tier (most conservative) "full" conversion approach;
>
> ii. A second-tier approach that assumes ambient equilibrium between NO and $NO_2$; and
>
> iii. For Tier 1, use an appropriate refined model (Section 4.2.2) to estimate $NO_X$ concentrations and assume a total conversion of NO to $NO_2$.

$NO_x$ modeling for SIL and NAAQS compliance was completed using the Tier I approach. No additional $NO_x$ analyses were necessary for this project.

## 4.3 AERSCREEN Emissions Release Parameters

The SIL modeling was performed using EPA's AERSCREEN screening model. AERSCREEN is a Gaussian plume model which provides maximum ground-level concentrations for point, area, flare, and volume sources that does not require the use of site-specific meteorological data. AERSCREEN was used for the SIL modeling to represent the proposed engine, EU8.

The proposed engine will be located at a distance of 133' (40.5 m) from the nearest point of public access at the site, which is the fence line. The model was run with receptors from 0 meters to 5000 meters. The highest impact was at a location of 51 m from the stack, which falls outside the fence line.

Building downwash was calculated in AERSCREEN, using the generator engine housing as the building. For purposes of this model exercise, a modeled emission rate of 1.0 pound per hour (lb/hr) was used to provide unit-based results. The AERSCREEN model input parameters are summarized below in **Table 5**.

**Table 5. AERSCREEN Modeling Parameters**

| | |
|---|---|
| Source Modeled | EU8 |
| Source Type | Point |
| Modeled Emission Rate (pound/hour) | 1.000 |
| Stack Height (ft) | 31 |
| Stack Inside Diameter (in) | 36 |
| Stack Exit Velocity (ft/s) | 37.7 |
| Stack Gas Exit Temp (°F) | 853 |
| Minimum Ambient Air Temp (°F) | -36 |
| Maximum Ambient Air Temp (°F) | 103 |
| Urban/Rural Option | Rural |

| | |
|---|---|
| Source Modeled | EU8 |
| Distance to the Ambient Air Boundary (ft) | 0 used |
| Building Height (ft) | 12 |
| Min. Horiz. Building Dimension (ft) | 23 |
| Max. Horiz. Building Dimension (ft) | 38 |

## 4.4 AERMOD Emissions Release Parameters

The NAAQS compliance modeling was performed for engine operations at 100% and 50% load. The modeled source emissions and stack parameters were based on all engines operating at the same load percentage. Details of modeled source parameters are contained in **Table 6**.

**Table 6. AERMOD Modeled Sources**

| Release Point | Description | UTM Coordinates[a] | | Stack Height (ft) | Stack Gas Temp. (°F)[b] | Stack Gas Velocity (ft/sec)[c] | Modeled Stack Diameter (ft) | Orient. of Release[d] |
|---|---|---|---|---|---|---|---|---|
| | | Easting (m) | Northing (m) | | | | | |
| EU1 | Existing 1340 hp Engine | 371008 | 5408667 | 26 | 992<br>1006 | 48.4<br>26.7 | 2 | v |
| EU2 | Existing 1380 hp Engine | 370986 | 5408667 | 26 | 980<br>986 | 45.9<br>24.8 | 2 | v |
| EU2 | Existing 1380 hp Engine | 370964 | 5408667 | 26 | 980<br>986 | 45.9<br>24.8 | 2 | v |
| EU4 | Existing 85 hp emergency generator | Not modeled – emergency unit | | | | | | |
| EU5 & 6 | Existing Building Heaters | Not modeled – insignificant sources | | | | | | |
| EU7 | Process Valves | Not modeled – fugitive non-combustion source | | | | | | |
| EU8 | Proposed 2500 hp Engine | 371045 | 5408701 | 31 | 853<br>956 | 37.7<br>21.1 | 3 | v |

a UTM Zone 12
b Temperatures at 100% and 50% engine load
c Velocities at 100% and 50% engine load.
d Orientation of Stack Release: v – vertical, h – horizontal, c - capped

## 5.0 MODELING METHODOLOGY

This section of the Modeling Report describes the specific methods and data used in the air impact analyses. **Table 7** summarizes the key modeling parameters used in the impact analyses.

**Table 7. AERMOD Modeling Parameters**

| Parameter | Description/Values | Documentation/Addition Description |
|---|---|---|
| General Facility Location | Attainment | The facility area is attainment or unclassified for all criteria pollutants. |
| Model | AERMOD | AERMOD with the PRIME downwash algorithm, version 21112. |
| Meteorological Data | KJER, Surface, Great Falls, Montana upper air | The modeling has been performed for the period 2016-2018, 2020-2021 using AERMET data processed as described in **Attachment 2**. |
| Terrain | Considered | 3-dimensional receptor coordinates were obtained from USGS National Elevation Dataset (NED) files and were used to establish elevation of ground level receptors. AERMAP was used to determine each receptor elevation and hill height scale. |
| Building Downwash | Considered | Plume downwash was considered for the structures associated with the facility. BPIP-PRIME was used to evaluate building dimensions for consideration of downwash effects in AERMOD. |
| NOx Chemistry | None | Tier I analysis used for SIL and NAAQS modeling. |
| Receptor Grid | Fenceline | 25-meter spacing along the ambient air boundary |
| | Fenceline to 1 km | 50-meter spacing |
| | 1 km to 3 km | 250-meter spacing |
| | 3 km to 10 km | 500-meter spacing |
| | Hot Spot Receptors | 10-meter spacing, around the peak modeled impact point |
| | NAAQS analysis used full 10 km grid | |

## 5.1 Model Selection

EPA's AERSCREEN model has been used for the SIL modeling and AERMOD has been used for the NAAQS and MERPS modeling. The modeling was implemented using the Providence Engineering and Environmental Group, LLC BEEST and AerScreen for Windows programs. **Table 8** lists the versions of all the modeling files that were used.

**Table 8. Air Dispersion Modeling Programs**

| Model/Program Name | Version |
|---|---|
| AERSCREEN | 21112 |
| MAKEMET | 16216 |
| AerScreen for Windows | 4.02 |
| AERMOD | 21112 |
| AERMET | 21112 |
| AERMINUTE | 15272 |
| AERSURFACE | 20060 |

| Model/Program Name | Version |
|---|---|
| AERMAP | 18081 |
| BPIPPRM | 04274 |
| BEEST | 12.06 |

## 5.2 Meteorological Data

Met data for AERSCREEN was generated using the MAKEMET program. A figure showing the proposed MAKEMET meteorology parameters is shown below.

```
-----------------------------------------------------------------------------
**********************  MAKEMET METEOROLOGY PARAMETERS  *********************
-----------------------------------------------------------------------------

MIN/MAX TEMPERATURE:    235.4 / 312.6 (K)

MINIMUM WIND SPEED:       0.5 m/s

ANEMOMETER HEIGHT:     10.000 meters

SURFACE CHARACTERISTICS INPUT: AERMET SEASONAL TABLES

DOMINANT SURFACE PROFILE: Desert Shrubland
DOMINANT CLIMATE TYPE:    Dry Conditions
DOMINANT SEASON:          Spring

ALBEDO:                  0.30
BOWEN RATIO:             5.00
ROUGHNESS LENGTH:       0.300 (meters)

SURFACE FRICTION VELOCITY (U*) ADJUSTED
```

The AERMOD modeling used an AERMET dataset processed with the most recent five years of surface meteorological data from Cut Bank, Montana that meet the minimum data availability requirements. During met data processing, it was noted that the data from 2019 was less than 90% complete, so that year was replaced with 2016. The modeled met years are 2016, 2017, 2018, 2020 and 2021. The identification numbers for the Cut Bank airport are KCTB and WBAN 24137.

The 1-minute Automated Surface Observing System (ASOS) data from Cut Bank was processed using the AERMINUTE preprocessor. Upper air data from Great Falls International Airport was used. The identification numbers for the Great Falls airport are KGTF and WBAN 24143. A summary of the meteorological data processing is provided as **Attachment 2** to this modeling report.

## 5.3 Effects of Terrain

The terrain inclusion feature was used in AERSCREEN, which incorporates AERMAP. AERMAP was also used to establish receptor elevations and hill heights for use in AERMOD. Three-dimensional digital elevation data was obtained from USGS National Elevation Dataset (NED) and AERMAP was used to determine each receptor elevation and hill height scale.

## 5.4 Facility Layout

The modeling was based on the final facility plot plan shown in **Figure 1** of this AQIA report, which is the final site plan provided by NWE. The building and source locations were entered into AERMOD using the BEEST interface. BEEST was then used to overlay the modeled buildings and sources on a Google Earth satellite photo to confirm the locations of the ambient air boundary.

## 5.5 Receptor Network

For the AERSCREEN SIL modeling, receptors were placed from the EU8 location extending outward using the AERSCREEN recommended spacing. AERSCREEN automated receptor spacing of 25-meters was used from the source to a distance of 5,000 meters (16,404’). AERSCREEN interpolates the modeled results to identify the point of highest impact.

The facility fence line is the ambient air quality boundary (AAB) for modeling purposes. AERMOD receptor spacing used is as follows:

- 25 – meter spacing along the AAB
- 100 – meter spacing from the AAB to 1 km
- 250 – meter spacing from 1 km to 3 km
- 500 – meter from 3 km to 10 km

The full grid, along with the fence line receptors, includes a total of 3,115 receptors as shown on **Figure 2**. The fence line and nearby receptors are shown on **Figure 3**. The NAAQS modeling results were used to determine the receptor of highest impact within the modeling grid. Hotspot receptors were then placed at spacing of 10 meters surrounding the peak modeling point. All the peak impacts from each pollutant and averaging period were closely grouped, so only one hotspot receptor grid was needed. The hotspot grid is shown on **Figure 4**.

## 5.6 Effects of Building Downwash

The building downwash function within AERSCREEN only allows a single building per source. The compressor engine housing units are 23’ x 28’ and 12’ high. The proposed engine was modeled in AERSCREEN using its own housing for downwash, with the stack at the center, height of 12’, max dimension of 28’ and minimum dimension of 23’.

Detailed building downwash was used for each of the sources included in the refined AERMOD modeling. AERMOD uses the BPIPPRM program to calculate building downwash parameters. AERMOD allows input of multiple buildings and sources. The compressor engine housings were used as downwash structures at the dimensions listed above. The auxiliary building was also included in the modeling with dimensions of 12' x 20' and height of 12'. The other site buildings are far enough away to be excluded from the downwash calculations because the stacks are farther than the distance of 5L as described in the BPIP User's Manual. Each structure type produces an area of wake effect influence that extends out to a distance of five times L directly downwind from the trailing edge of the structure, where L is the lesser of the building height (BH) or the projected building width (PBW).[1]

## 5.7 $NO_x$ Chemistry

The estimated $NO_x$ emissions from the natural gas-fired engines are a mixture of primarily nitric oxide (NO) and $NO_2$. $NO_2$ is a regulated criteria air pollutant, and NO is not a regulated pollutant. Once emitted, NO converts to $NO_2$ in the ambient air. Section 4.2.3.4 of Appendix W to 40 CFR Part 51 (Jan. 17, 2017), contains a tiered approach for $NO_2$ modeling. For Tier I, all $NO_x$ is assumed to be $NO_2$ when emitted from the stack. The SIL modeling must be conducted using only the Tier 1 approach, to provide the widest reasonable pattern of significant impact receptors.

The NAAQS 1-hour compliance modeling began with an analysis using the Tier 1 methodology. If model did not show NAAQS compliance, additional modeling would have been performed using the Tier 2 ARM2 option to simulate the conversion of NO to $NO_2$ in the ambient air. The ARM2 option requires a minimum and maximum $NO_2$/NOx ratio to predict ambient concentrations of $NO_2$. The Tier II modeling EPA regulatory default maximum ratio is 0.9 and the default minimum ratio is 0.5. The project passed with Tier I modeling and Tier 2 modeling was not required for this application.

## 5.8 Background Concentrations

Ambient concentrations of the criteria pollutants provide background values for the NAAQS compliance demonstration. The modeling compliance demonstration used background concentrations obtained from the EPA air monitoring data website[2]. The EPA website includes an interactive map of air quality monitors which shows active pollutant monitors throughout the US. $PM_{10}$ and $PM_{2.5}$ monitors are located at Lewistown as well sites west of the Continental Divide in Northwest Montana. The Northwest sites represent air quality in mountain valleys with stagnant air patterns. The NWE Meriwether site is located east of the Rocky Mountains in an area of open plains, which is better represented by the Lewistown data. The NCORE site is located in the mountains just north of Helena, Montana. Data from Lewistown has been selected for NOx, $PM_{10}$, and $PM_{2.5}$ background values. $SO_2$ and CO NAAQS

[1] BPIP User Manual. gaftp.epa.gov/Air/aqmg/SCRAM/models/related/bpip/bpipd.pdf

[2] https://www.epa.gov/outdoor-air-quality-data/interactive-map-air-quality-monitors

modeling was not required; however, the appropriate background values were identified from the NCORE site. The selected background concentrations are listed in **Table 9**.

**Table 9. Background Concentrations for Modeling**

| Pollutant | Averaging Period | Background Concentration (μg/m³) | Data Source |
|---|---|---|---|
| $PM_{2.5}$ | 24-hour | 24.6 | EPA, Lewistown, MT, 3-year average DV |
| | Annual | 5.0 | EPA, Lewistown, MT, 3-year average DV |
| $PM_{10}$ | 24-hour | 70.7 | EPA, Lewistown, MT, 3-year average DV |
| $NO_2$ | 1-hour | 20.1 | EPA, Lewistown, MT, 3-year average DV |
| | Annual | 1.2 | |
| $SO_2$ | 1-hour | 4.4 | EPA, NCORE Site. 3-year average DV |
| CO | 1-hour | 908 | EPA, NCORE Site. 3-year average DV |
| | 8-hour | 687 | |
| Ozone | 8-hour | 0.063 ppm | EPA, Lewistown, MT. 3-year average DV |

# 6.0 RESULTS AND DISCUSSION

## 6.1 SIL Modeling Results

The AERSCREEN modeling was performed with a modeled emission rate of 1 lb/hr. Therefore, the results are provided in units of micrograms per cubic meter per pound per hour [(μg/m$^3$)/(lb/hr)] as shown in **Table 10**. The AERSCREEN output files and results are included in **Attachment 3**.

**Table 10. AERSCREEN Model Results**

| | **EU8** |
|---|---|
| Maximum 1-hr Conc. (μ/m$^3$)/(lb/hr) | 10.39 |
| Scaled 3-hr Conc. (μ/m$^3$)/(lb/hr) | 10.39 |
| Scaled 8-hr Conc. (μ/m$^3$)/(lb/hr) | 9.351 |
| Scaled 24-hr Conc. (μ/m$^3$)/(lb/hr) | 6.234 |
| Scaled Annual Conc. (μ/m$^3$)/(lb/hr) | 1.039 |
| Distance to Maximum Impact (m) | 51 |

The modeled emission rates for the engine running at 100% load for each of the pollutants are converted to ambient impact results using the AERSCREEN model results. The pollutant specific AERSCREEN model results are calculated as shown in the following example calculation:

- EU8 NOx Emissions = 5.51 lb/hr
- EU8 Unit-based Result = 10.39 (μg/m$^3$)/(lb/hr)
- NOx Impact: 5.51 lb/hr * 10.39 (μg/m$^3$)/(lb/hr) = 57.25 μg/m$^3$

The modeled impacts from the EU8 running at 100% load are shown in Table 11. The 100% load was selected over the 50% due to create a "worst case" scenario of the engine's operating conditions. The 100% load also creates a scenario where the compressor engine is at full capacity. The 100% load is typically routine for operating these compressor engines. A partial load for SILs analysis also seemed uncommon since the objective of the SIL modeling is to determine the extent of the significant impacts; therefore, modeling the scenario that generates the farthest impacts and not the highest impacts.

## Table 11. EU8 AERSCREEN Results

| Pollutants | Modeled Emission Rate (lb/hr) | Modeled Impact (µg/m³) |
|---|---|---|
| NOx 1-hr | 5.51 | 57.25 |
| NOx Annual | 5.51 | 5.72 |
| CO 1-hr | 5.51 | 57.25 |
| CO 8-hr | 5.51 | 51.52 |
| SO2 1-hr | 0.011 | 0.11 |
| $PM_{10}$ 24-hr | 0.187 | 1.17 |
| $PM_{2.5}$ 24-hr | 0.187 | 1.17 |
| $PM_{2.5}$ Annual | 0.187 | 0.19 |

The maximum total modeled impacts are compared to the applicable SIL values for each pollutant and averaging period. **Table 12** contains SIL analyses results comparing modeled results to applicable SILs.

## Table 12. Results for the Significant Impact Level Analysis

| Pollutant | Averaging Period | Modeled Emission Rate (lb/hr) | AERSCREEN Maximum Concentration (µg/m³) | Significant Impact Level (µg/m³) | Impact Percentage of SIL | Cumulative NAAQS Analysis Provided |
|---|---|---|---|---|---|---|
| $NO_2$ | 1-hour | 5.51 | 57.25 | 7.5 | 763% | Yes |
| | Annual | 5.51 | 5.72 | 1.0 | 572% | Yes |
| $PM_{2.5}$ | 24-hour | 0.187 | 1.17 | 1.2 | 97.5% | Yes |
| | Annual | 0.187 | 0.19 | 0.2 | 95.0% | Yes |
| $PM_{10}$ | 24-hour | 0.187 | 1.17 | 5.0 | 23.4% | No |
| CO | 1-hour | 5.51 | 57.25 | 2,000 | 2.86% | No |
| | 8-hour | 5.51 | 51.52 | 500 | 10.3% | No |
| $SO_2$ | 1-hour | 0.011 | 0.11 | 7.8 | 1.41% | No |

The AERSCREEN modeling results exceeded the applicable SILs for 1-hour $NO_2$ and annual $NO_2$, requiring that NAAQS modeling be provided. The results were close to the applicable SILs for 24-hour $PM_{2.5}$ and annual $PM_{2.5}$. NAAQS modeling is provided for $PM_{2.5}$ as well as $NO_2$.

## 6.2 Cumulative NAAQS Impact Analyses

The NAAQS modeling was performed with the engines at the facility operating at 50% and 100% load. Typically, the stack dispersion characteristics are less favorable at lower combustion rates, resulting in higher modeled impacts for the same emission rate. However, the pollutant emission rates are also reduced, so the outcome can only be assessed by modeling. As stated above, the modeling included a set of hot-spot receptors surrounding the peak modeled impact points from the 100% modeling case. Results from the various modeling cases are presented in **Table 13**.

## Table 13. Comparison of Modeled Impacts

| Pollutants | 100% Modeled Impact, Main Receptors (μg/m³) | 50% Modeled Impact, Main Receptors (μg/m³) | 100% Modeled Impact, Hot Spot Receptors (μg/m³) |
|---|---|---|---|
| $NO_2$ 1-hr | 91.30 | 59.19 | 92.44 |
| $NO_2$ Annual (2020) | 15.97 | 11.68 | 16.10 |
| $PM_{2.5}$ 24-hr | 2.05 | 1.43 | 2.73 |
| $PM_{2.5}$ Annual | 0.518 | 0.381 | 0.522 |

As shown in **Table 13**, the highest modeled impacts for all four modeled pollutant and averaging period combinations fell within the hot spot receptor grid when modeling the 100% operational load case. The modeling for $NO_2$ 1-hr and for $PM_{2.5}$ 24-hour and annual cases was performed using the concatenated met data set for all five modeled years. The annual $NO_2$ modeling was done separately for each modeled year, and the highest impacts resulted from the 2020 met data set.

**Table 14** provides results of Cumulative NAAQS Impact analyses for the project design configuration with the existing and proposed engines operating simultaneously. The NAAQS compliance demonstration has been performed with all of the proposed equipment modeled at 100% of capacity. No exceedances of NAAQS standards were modeled.

## Table 14. Results for Cumulative NAAQS Impact Analysis

| Pollutant | Averaging Period | Modeled Design Concentration (μg/m³)[a] | Background Concentration (μg/m³) | Total Impact (μg/m³) | NAAQS (μg/m³) | % of NAAQS |
|---|---|---|---|---|---|---|
| $PM_{2.5}$ | 24-hour | 2.73[b] | 24.6 | 27.3 | 35 | 78% |
| | Annual | 0.522[c] | 5.0 | 5.52 | 12 | 46% |
| $NO_2$ | 1-hour | 92.44[b] | 20.1 | 113 | 188 | 60% |
| | Annual | 16.10 | 1.2 | 17.3 | 100 | 17% |

a. Micrograms/cubic meter
b. Maximum of 5-year means of 8th highest modeled concentrations for each year modeled.
c. 5-year mean of annual concentration.
d. Maximum annual impact of 5 years modeled.

The modeling analysis demonstrates that the NWE Meriwether facility will not cause or contribute to an exceedance of any NAAQS.

## 7.0 MODELED EMISSION RATES AS PRECURSORS (MERPS)

EPA has requested that NWE address the potential impacts of emissions on ozone and secondary particulate matter formation. The analysis is based on the 2019 EPA memorandum titled Guidance on the Development of Modeled Emission Rates for Precursors (MERPS) as a Tier I Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program[3].

The MERPS guidance explains how to estimate single-source ozone and secondary $PM_{2.5}$-formation pollutants under the Tier I approach put forth in EPA's Guideline on Air Quality Models (Appendix W to 40 CFR Part 51). For Tier 1 assessments, the analysis uses existing empirical relationships between precursors and secondary impacts (*e.g.*, $O_3$ and $PM_{2.5}$). EPA has generated empirical relationships between single sources and $O_3$ and $PM_{2.5}$ impacts for hundreds of hypothetical sources that vary in stack height, emission rate, and geographic location.

The MERPS analysis uses the methodology provided in the MERPS View Qlik website: www.epa.gov/scram/merps-view-qlik. The MERPS analysis requires selection of one of the embedded hypothetical sources as the basis of the analysis. The selected hypothetical source is located in Glacier County, near Cutbank, Montana. The 10-meter stack height was used, with 500 tpy of VOC and 1000 tpy of $NO_2$ and $SO_2$. **Table 15** lists the associated VOC and NOx MERP values for ozone and associated NOx and $SO_2$ MERP values for 24-hour and annual secondary $PM_{2.5}$.

### Table 15. MERPS-Related Values for Glacier County Source

| Pollutant | Precursor | MERP | MaxConc | Annual PTE(1) |
|---|---|---|---|---|
| 8-hour Ozone | VOC | 5400 | 0.0926 ppb | 44.9 tpy |
| | NOx | 407 | 2.455 ppb | 64.4 tpy |
| Secondary Daily $PM_{2.5}$ | 24-hour NOx | 8595 | 0.1396 μg/m$^3$ | 64.4 tpy |
| | 24-hour $SO_2$ | 1615 | 0.513 μg/m$^3$ | 0.138 tpy |
| Sec. Annual $PM_{2.5}$ | Annual NOx | 21,988 | 0.009096 μg/m$^3$ | 64.4 tpy |
| | Annual $SO_2$ | 9851 | 0.0203 μg/m$^3$ | 0.138 tpy |

(1) Facility-wide PTE.

**Equation 1**, along with the values in **Table 15**, is used to determine the ozone impacts resulting from the project for comparison to the Ozone SIL (1 ppb). **Equation 2** is used to determine the secondary $PM_{2.5}$ impacts resulting from the project for comparison to the 24-hour and annual $PM_{2.5}$ SILs (24-hour = 1.2 μg/m$^3$ and Annual = 0.2μg/m$^3$).

Equation 1: $[\frac{X\ tpy\ NOx\ from\ Source}{X\ tpy\ NOx\ 8\text{−}hr\ daily\ Maximum\ Ozone\ MERP} + \frac{X\ tpy\ VOC\ from\ Source}{X\ tpy\ VOC\ 8\text{−}hr\ daily\ Maximum\ Ozone\ MERP}] \times 100.0$

[3] www.epa.gov/sites/default/files/2019-05/documents/merps2019.pdf

**Equation 2**: $[\frac{AERMOD\ Primary\ PM2.5}{PM2.5\ SIL} + \frac{X\ tpy\ NOx\ from\ Source}{X\ tpy\ NOx\ PM2.5\ MERP} + \frac{X\ tpy\ SO2\ from\ Source}{X\ tpy\ SO2\ PM2.5\ MERP}] \times 100.0$

**Table 16** outlines the results of the MERPS analysis for ozone and secondary $PM_{2.5}$. Using **Equation 1** and the values outlined in **Table 15**, ozone is predicted to be about 17% of the SIL. This suggests that the NAAQS will not be exceeded as a result of the emissions from the project. Using **Equation 2**, the values in **Table 15**, and the AERMOD Primary $PM_{2.5}$ Concentrations, the combined primary and secondary $PM_{2.5}$ impacts are predicted to be above the 24-hour and annual $PM_{2.5}$ SILs.

## Table 16. Results of MERPS Analysis for $O_3$ and Secondary $PM_{2.5}$

| **Pollutant Impacts** | **NOx Contribution [ppb]** | **VOC Contribution [ppb]** | | | | **Total Impact [ppb]** | **Percent of SIL** |
|---|---|---|---|---|---|---|---|
| Ozone | 0.158 | 0.008 | | | | 0.166 | 17% |
| **Pollutant Impacts** | **NOx Contribution** | **$SO_2$ Contribution** | **Total Secondary Impact** | **Primary[1] $PM_{2.5}$ [µg/m³]** | | **Total Impact [µg/m³]** | **Percent of SIL** |
| 24-hour $PM_{2.5}$ | 0.0075 | 0.0001 | 0.0076 | 1.17 | | 1.18 | 98% |
| Annual $PM_{2.5}$ | 0.0029 | 0.000014 | 0.0029 | 0.19 | | 0.193 | 96% |
| **Pollutant Impacts** | **NOx Contribution** | **$SO_2$ Contribution** | **Total Secondary Impact** | **Primary[1] $PM_{2.5}$ [µg/m³]** | **Back-ground[2] [µg/m³]** | **Total Impact [µg/m³]** | **Percent of NAAQS** |
| 24-hour $PM_{2.5}$ | 0.0090 | 0.00002 | 0.0090 | 2.73 | 24.6 | 27.3 | 78.1% |
| Annual $PM_{2.5}$ | 0.0006 | 0.000003 | 0.0006 | 0.522 | 5.0 | 5.523 | 46.0% |

[1] See Table 12
[2] See Table 9

For the final cumulative impact analysis, the EPA's 2019 MERP guidance recommends using the existing relevant single-source modeled impacts and then adding the impacts to the appropriate background concentrations for comparison to the NAAQS. Instead of calculating a modeled emission rate based on a critical air quality threshold such as a SIL value (i.e., Equation 2), Equation 3 would be used to calculate a project-specific cumulative impact analysis relative to the NAAQS.

Equation 3: $\left[X\ tpy\ of\ NOx\ from\ Source\ \times \frac{Modeled\ NOx\ Impact\ from\ Hypothetical\ Source\ [\frac{\mu g}{m^3}]}{X\ tpy\ NOx\ PM2.5\ MERP}\right] +$
$[X\ tpy\ of\ SO2\ from\ Source\ \times \frac{Modeled\ SO2\ Impact\ from\ Hypothetical\ Source\ [\frac{\mu g}{m^3}]}{X\ typ\ SO2\ PM2.5\ MERP}] + Monitor\ DV\ \left[\frac{\mu g}{m^3}\right] +$
$AERMOD\ Primary\ PM2.5$

The $O_3$ analysis does not include any modeled impacts of direct $O_3$ emissions. The predicted 8-hour impact from $O_3$ formation due to $NO_x$ and VOC emissions is 0.169 ppb ozone, which is below the applicable SIL value of 1 ppb. No additional $O_3$ analysis is required.

The $PM_{2.5}$ analysis includes modeled impacts of direct $PM_{2.5}$ emissions as well as impacts from secondary $PM_{2.5}$ formation due to $NO_x$ and $SO_2$ emissions. The modeled 24-hour and annual $PM_{2.5}$ SIL impacts have been used for the MERPS analysis, as shown in **Table 16**. The SIL modeled impacts represent the high-first-high 24-hour $PM_{2.5}$ impact and the average annual maximum impact.

Based on direct $PM_{2.5}$ alone, the modeled impacts exceed the 24-hour and annual $PM_{2.5}$ SIL values. The secondary $PM_{2.5}$ contributions are a small fraction of the total $PM_{2.5}$ impacts, so the modeled results will not change. The project will comply with applicable $PM_{2.5}$ NAAQS.


# FIGURE 1: SITE PLAN WITH AERIAL PHOTO

| Affix Stamp Here | Affix Stamp Here | Affix Stamp Here |
|---|---|---|
| | | |
| Signature/Date | Signature/Date | Signature/Date |
| Rev. No. _____ | Rev. No. _____ | Original |

| NO | DATE | DESCRIPTION | BY | CK | ENG | PE | APP |
|---|---|---|---|---|---|---|---|

| REFERENCE DRAWINGS, TITLE | DRWG.NO. |
|---|---|

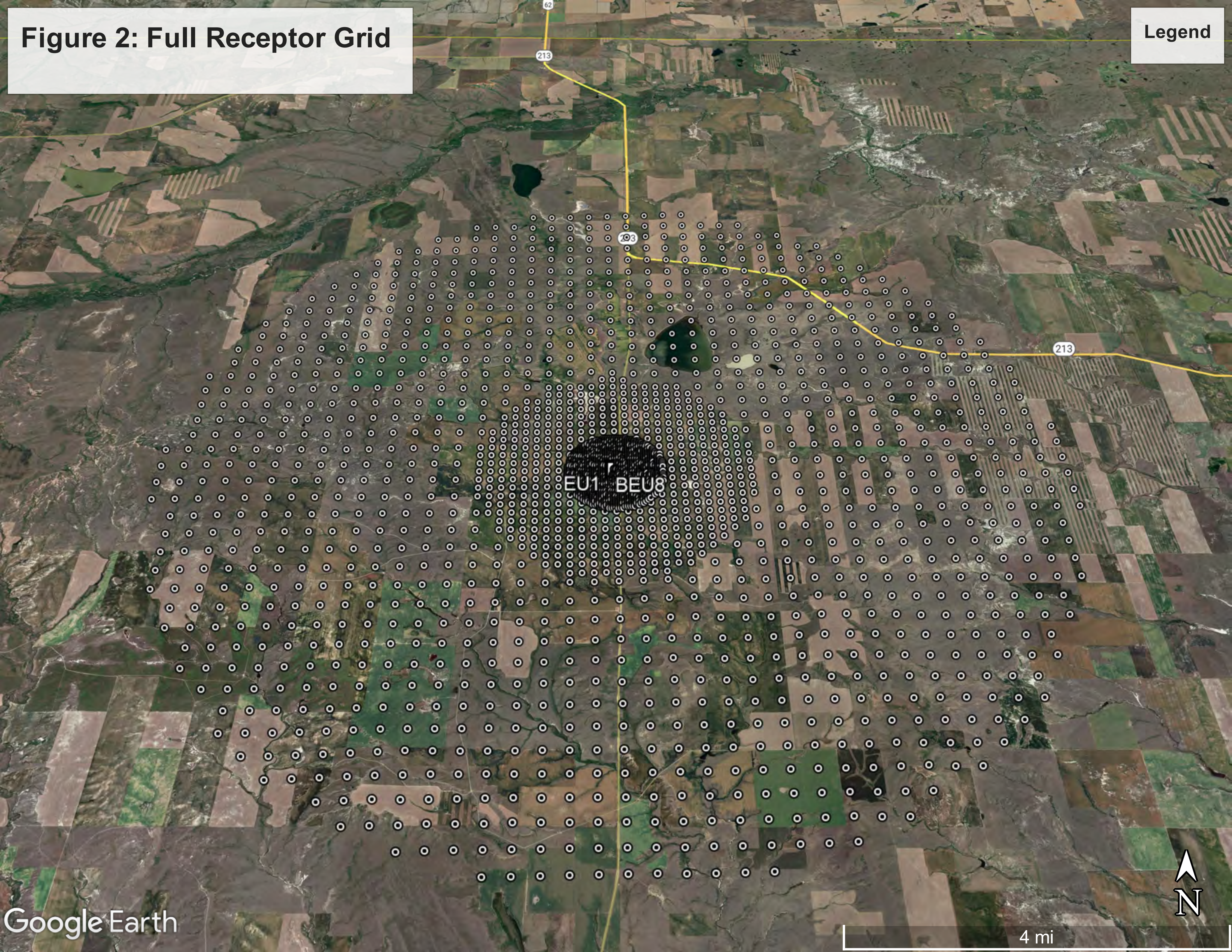
**MERIWETHER COMPRESSOR STATION
2022 NEW PIPING INSTALL
16" USM & REG LOOP AND ESD #4,
NEW COMP #4 & YP**

NorthWestern Energy

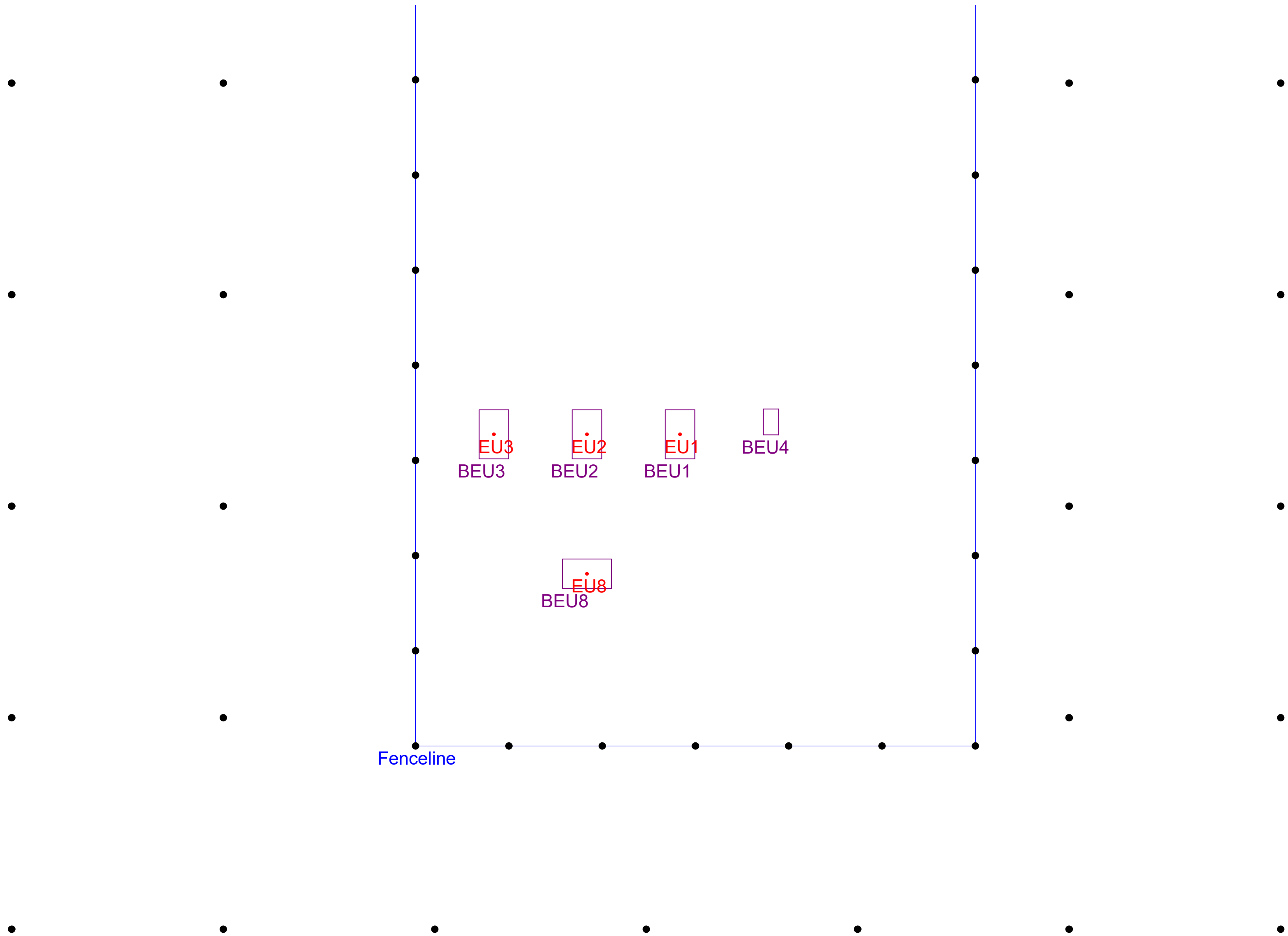
| | | | |
|---|---|---|---|
| DRAWN | S. CROSSMAN | SCALE | 1'-0" = 30'-0" |
| CHECKED | -- | DATE | 6/28/2022 |
| ENGINEERED | C. SMITH | DRAWING NUMBER | EXHIBIT A |
| APPROVED | | | 1 OF 1 |

W:\GAS TRANSMISSION\DRAFTING\GGAS-DFT_PROJECTS\MERIWEATHER\MODELS\MERIWEATHER.DWG 6/28/2022 12:17 PM 00081636

Figure 2: Full Receptor Grid



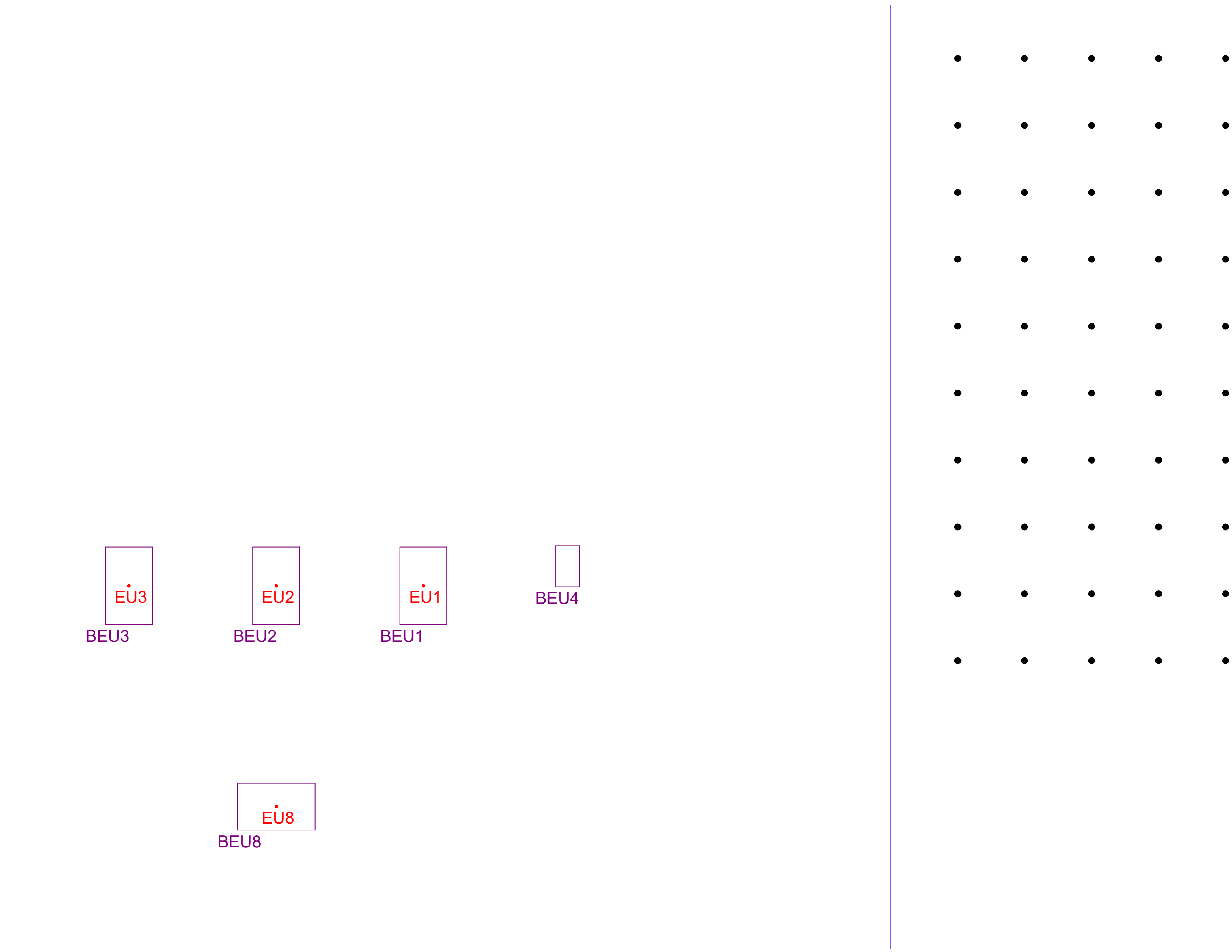
# Figure 3:  Fenceline and Sources




X:\Models\NWE221729  Meriwether\AERMOD\MW.BST

Scale: 1 inch = 37.4 Meters

# Figure 4:  Hot Spot Receptor




X:\Models\NWE221729  Meriwether\AERMOD\MW_HS.BST

Scale: 1 inch = 21.7 Meters