Final

MOJAVE MICRO MILL PROJECT

Prevention of Significant Deterioration – Air Dispersion Modeling Analysis

Prepared for
PSGM3, LLC

May 2024

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Prepared for
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G Air Dispersion Modeling Figures
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List of Abbreviations

Abbreviation	Term/Phrase/Name
µg/m^3	micrograms per cubic meter
ADM	Air Dispersion Modeling
AERMIC	American Meteorological Society/U.S. Environmental Protection Agency Regulatory Model Improvement Committee
AERMOD	American Meteorological Society/U.S. Environmental Protection Agency Regulatory Model
BPIPPRIM	Building Profile Input Program
CFR	Code of Federal Regulations
CO	carbon monoxide
EAF	electric arc furnace
EID	Emission Source Identification
EKAPCD	Eastern Kern Air Pollution Control District
FLAG	Federal Land Managers' Air Quality Related Values Work Group
FLM	Federal Land Managers
GHG	greenhouse gas
H1H	Highest 1st High
H_2SO_4	sulfuric acid
hr	hour
km	kilometers
m	meters
NAAQS	national ambient air quality standards
NED	National Elevation Dataset
NO_2	nitrogen dioxide
NO_X	nitrogen oxides
NWS	National Weather Station
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
project	Mojave Micro Mill
PSD	Prevention of Significant Deterioration
PSGM3	PSGM3, LLC
SCAQMD	South Coast Air Quality Management District
SER	Significant emission rate

Abbreviation	Term/Phrase/Name
SIL	Significant Impact Levels
SO_2	sulfur dioxide
SO_X	sulfur oxides
tpy	tons per year
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
UTM	Universal Transverse Mercator

PSD APPLICATION

PSGM3, LLC (PSGM3), a subsidiary of Pacific Steel Group, submitted the Prevention of Significant Deterioration (PSD) construction permit application for the proposed construction of the Mojave Micro Mill (referred to herein as "project"), a new all-electric steel micro mill facility, to the Eastern Kern Air Pollution Control District (EKAPCD) on May 21, 2024. The following **Chapter 6 Air Dispersion Modeling** completes the application.

All other chapters of the PSD application were submitted earlier in May 2024.

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CHAPTER 6
Air Dispersion Modeling

This chapter describes the Air Dispersion Modeling (ADM) conducted for the proposed PSGM3 project to demonstrate compliance with National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments.

As demonstrated in Chapter 3 of the PSD application (May 2024), the following pollutants triggered PSD because of facility-wide potential emissions exceeding the major source threshold or exceeding the PSD Significant Emission Rate (SER):

- Carbon Monoxide (CO)
- Particulate Matter less than 2.5 microns in diameter ($PM_{2.5}$)
- Greenhouse Gas (GHG)

USEPA has not established a NAAQS or increment for GHG. Therefore, the air dispersion modeling is limited to CO and $PM_{2.5}$ only.

6.1 Model Selection and Inputs

Air dispersion modeling was conducted following the Air Dispersion Modeling Protocol (Protocol) submitted to EKAPCD, United States Environmental Protection Agency (USEPA) Region 9, and Federal Land Managers (FLM) in February 2023 and included in **Appendix F**. There have been changes in several design elements of the PSGM3 project, since submittal of the Protocol, which resulted in changes in emission units, site layout, building/structure information, and operational hours, and these are captured in the Air Dispersion Modeling Protocol - Revisions, also included in Appendix F.

The modeling methodology generally followed the procedures outlined in the following guidelines:

- Guideline on Air Quality Models 40 CFR 51 Appendix W; and
- South Coast Air Quality Management District (SCAQMD) Modeling Guidance for AERMOD.

6.1.1 Model Used

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) modeling program (AERMOD, version 23132) was used to predict off-site impacts. AERMOD is currently the preferred dispersion model recommended by the USEPA for complex source configurations and emission units subject to downwash.

The following preprocessors were used in the modeling:

- Building Profile Input Program (BPIPPRIM) version 04274
- AERMAP version 18081

6.1.2 Regulatory Options

All default options in AERMOD were used in this ADM. These include:

- Use the elevated terrain algorithms requiring input of terrain height data;
- Use stack-tip downwash (except for building downwash cases);
- Use the calms processing routines; and
- Use the missing data processing routines.

6.1.3 Selection of Dispersion Options

The AERMOD rural dispersion option was used in the ADM. As shown in Appendix C of the Modeling Protocol, the area within 3 kilometer (km) radius from the site is greater than 85% rural and therefore justifies this dispersion option.

6.1.4 Averaging Periods

The following averaging periods were used in the modeling:

- CO: 1-hour average and 8-hour average
- $PM_{2.5}$: 24-hour average and annual average

6.1.5 Building Wake Effects (Downwash)

The USEPA's Building Profile Input Program downwash algorithms were used to determine the parameters for accounting aerodynamic downwash from buildings and structures on modeled emission sources. Based on a review of the site plot plan and a visual survey of the project site, there were several buildings/structures which could potentially cause aerodynamic downwash to the modeled emission sources and these buildings/structures were be included in the ADM. Current information on the downwash structures included in the modeling, including height, size, and Universal Transverse Mercator (UTM) location information, are listed in **Appendix F (**AERMOD Modeling Protocol with Revisions**)**. These emission sources are also shown in the attached Plot Plan in **Appendix G** (Air Dispersion Modeling Figures) of this submittal.

6.1.6 Emission Sources and Source Terms

Table 6-1 lists the CO emission sources from the PSGM3 project and the source type used in the modeling. **Table 6-2** lists the same information for sources of emissions of $PM_{2.5}$. The source parameters for these emission sources used in the modeling are included in Appendix F. The revised source terms are based on Chapter 3 of the PSD application (Emission Rates) and PSGM3 design data.

TABLE 6-1
CO MODELED EMISSION SOURCES AND SOURCE TYPES

EID Number	Source Description	Source Type
EID-06	Melt Shop Baghouse	Point
EID-07	Caster Spray Vent Stack	Point
EID-16	Emergency Fire Water Pump	Point
EID-17	Emergency Cooling Water Pump	Point
EID-18	Emergency Generator	Point

NOTE: EID = Emission Source Identification
SOURCE: Data compiled by Environmental Science Associates in 2024

TABLE 6-2
$PM_{2.5}$ MODELED EMISSION SOURCES AND SOURCE TYPES

EID Number	Source Description	Source Type
EID-01	Scrap Material Storage and Handling—Indoor (Scrap Bay Door)	Volume
EID-01	Scrap Material Storage and Handling—Indoor (Scrap Bay Ridge Vent)	Buoyant Line
EID-02	Scrap Material Storage and Handling—Outdoor	Area
EID-03	Scrap Pile—Wind Erosion	Area
EID-04	Alloy Material Storage and Handling—Outdoor	Area
EID-05	Alloy Storage Pile—Wind Erosion	Area
EID-06	Melt Shop Baghouse	Point
EID-07	Caster Spray Vent Stack	Point
EID-08	Roll Mill Vent	Buoyant Line
EID-09	Slag Material Storage and Handling—Outdoor	Area
EID-10	Slag Pile Wind Erosion	Area
EID-11	Slag Screening and Crushing	Area
EID-12	Cooling Tower 1	Point
EID-13	Cooling Tower 2	Point
EID-14	Cooling Tower 3	Point
EID-15	Cooling Tower 4	Point
EID-16	Emergency Fire Water Pump	Point
EID-17	Emergency Cooling Water Pump	Point
EID-18	Emergency Generator	Point
EID-23	Paved Facility Roads	Line Volume
EID-24	Unpaved Facility Roads	Line Volume

NOTE: EID = Emission Source Identification
SOURCE: Data compiled by Environmental Science Associates in 2024

These modeled emission sources are shown in **Figure 6-1** in Appendix G.

6.1.7 Receptor Grid

Considering the location of the project, North American Datum 1983 UTM Zone 11S was used. The modeled Cartesian receptor grids used for this analysis included:

- Receptors placed along the fenceline with 25 meter spacing;
- Receptors placed at the fenceline out to a distance of 500 meters with 50 meter spacing;
- Receptors placed 500 meters from the fenceline to a distance of 1 km with 100 meter spacing;
- Receptors placed 1 km from the fenceline to a distance of 5 km with 250 meter spacing;
- Receptors placed 5 km from the fenceline to a distance of 10 km with 500 meter spacing; and
- Receptors placed 10 km from the fenceline to a distance of 50 km with 1 km spacing.

The receptor grid is shown in **Figure 6-2** included in Appendix G.

6.1.8 Meteorological Data

Representative meteorological data sets from the nearest National Weather Station (NWS), General William J. Fox Airfield Airport (Station ID: KWJF 723816) for the 2017-2021 calendar years was used in the modeling. This meteorological station is nearest to the project site with the latest five years of complete surface meteorological data. The meteorological station is located within the Mojave Desert Air Basin, approximately 14 miles south of the proposed project, and with surface characteristics representative of the project site. The location of the station is shown in Appendix F. The dataset has been processed by the California Air Resource Board (CARB) for AERMOD model.

Upper air station data from the Vandenberg Air Force base (Station ID No. 93214) was used in the modeling for 2017-2021 per CARB recommendation for the proposed project site.

6.1.9 Terrain Data

United States Geological Survey (USGS) national elevation dataset (NED) GeoTIFF terrain data was used for all modeling. As of March 19, 2009, USGS NED GeoTIFF is the terrain data that is recommended by the USEPA for use in the United States for regulatory purposes. The terrain data was processed with the most recent version of AERMAP (v18081).

6.2 Modeling Methodology

This section discusses the Class II air quality dispersion modeling methodologies that were followed to demonstrate compliance with the applicable NAAQS and Class II PSD Increments.

Class II air quality dispersion analyses are organized into two major sub-sections based on USEPA modeling guidance: the Preliminary Impact Analysis and the Full Impact Analysis. Each analysis is discussed below.

In the preliminary impact analysis, the emissions from the project are evaluated to determine whether there will be potential for a significant impact upon the area surrounding the facility. The AERMOD predicted maximum short-term and annual average concentrations are compared with the corresponding Significant Impact Levels (SILs).

If the AERMOD predicted maximum concentration from project emissions are less than the corresponding SIL value for all pollutants and averaging times and at all receptors, no further analysis is required and compliance with NAAQS as well as increment is demonstrated. If the AERMOD predicted maximum concentration exceeds the corresponding SIL value for any pollutant and averaging period, then further evaluation is required to compare the project's impacts to the Class II PSD Increment and the NAAQS for the specific pollutant and averaging period (full impact analysis).

6.2.1 Preliminary Impact Analysis for CO

AERMOD model was used to estimate the highest impact for CO for both averaging times modeled over 5 years of meteorological data and considering sitewide emissions for the pollutant. **Table 6-3** shows the results of the analysis, which are compared with the respective SILs. The AERMOD input/output modeling files are included in **Appendix H**.

TABLE 6-3
PSGM3 PROJECT IMPACTS OF CO

Pollutant – Averaging Time [a]	Project Impacts	Significant Impact Level	Project Impact Below SIL?
	µg/m^3	µg/m^3	Yes/No
CO – 1 hour	97.8	2000	Yes
CO – 8 hour	18.5	500	Yes

NOTE: CO = Carbon Monoxide; SIL = significant impact levels; µg/m^3 = microgram per cubic meter.

a. High 1st High (H1H) 1-hour and 8-hour impacts over 5 years of meteorological data at any receptor within the receptor network.

SOURCE: Data compiled by Environmental Science Associates in 2024

Figure 6-3 and **Figure 6-4** show the contour plot of the 1-hour and 8-hour CO impacts surrounding the facility, respectively.

6.2.2 Preliminary Impact Analysis for $PM_{2.5}$

For $PM_{2.5}$, both the primary and secondary impacts are to be added for comparison with the SIL. Primary $PM_{2.5}$ impact is from the direct emission of $PM_{2.5}$ from the emission sources. Secondary $PM_{2.5}$ is generated in the atmosphere due to complex reactions with the precursors of $PM_{2.5}$, which are nitrogen oxides (NO_X), sulfur dioxide (SO_2), and ammonia. PSGM3 facility will not have emission of ammonia; therefore, the only precursors for secondary $PM_{2.5}$ will be NO_X and SO_2.

The secondary $PM_{2.5}$ impacts for 24-hour averaging and annual averaging times were estimated following recent USEPA memorandum dated April 30, 2024, from Tyler Fox, Group Leader to Regional Office Modeling Contacts, a copy of which is included in Attachment F. The NO_X and SO_2 emissions were mainly from the EAF stack (EID-06), which is 165 feet (50 m) tall. Therefore, the average of the USEPA

impact data for 10 m and 90 m tall stack were considered to represent the EAF stack. **Table 6-4** shows the calculation of secondary $PM_{2.5}$ impact for the PSGM3 project.

TABLE 6-4
SECONDARY $PM_{2.5}$ IMPACT FOR PSGM3 PROJECT

Averaging Time / Category	Pollutant	Value	Unit of Measure
24-Hour			
24-hr $PM_{2.5}$ Impact [a]	NO_X	0.1726	µg/m^3
24-hr $PM_{2.5}$ Impact [a]	SO_2	0.1948	µg/m^3
PSGM3 Project Emissions [b]	NO_X	22.79	tpy
PSGM3 Project Emissions [b]	SO_2	23.12	tpy
PSGM3 Project Impact [c]	NO_X	0.0079	µg/m^3
PSGM3 Project Impact [c]	SO_2	0.0090	µg/m^3
PSGM3 Project Impact [d]	NO_X + SO_2	0.0169	µg/m^3
Annual			
Annual $PM_{2.5}$ Impact [a]	NO_X	0.0156	µg/m^3
Annual $PM_{2.5}$ Impact [a]	SO_2	0.0090	µg/m^3
PSGM3 Project Emissions [b]	NO_X	22.79	tpy
PSGM3 Project Emissions [b]	SO_2	23.12	tpy
PSGM3 Project Impact [c]	NO_X	0.0007	µg/m^3
PSGM3 Project Impact [c]	SO_2	0.0004	µg/m^3
PSGM3 Project Impact [d]	NO_X + SO_2	0.0011	µg/m^3

NOTE: hr = hour; NO_X = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_2 = sulfur dioxide; tpy = tons per year; µg/m^3 = microgram per cubic meter.

a. Average hypothetical source impacts for tall (90 meter) and short (10 meter) stacks. NO_X/SO_2 emissions stack in PSGM3 (EID-06) is 165 feet (50 meter). Ref: USEPA MERPs View Qlik - https://www.epa.gov/scram/merps-view-qlik/k.
b. From project emission estimate - Chapter 3 of PSD Application May 2024.
c. Project Impact = [Project emissions/Hypothetical source emissions (=500 tpy)]* Hypothetical source $PM_{2.5}$ impact
d. PSGM3 Project Total Impact = Project Impact for NO_X + Project Impact for SO_2

SOURCE: Data compiled by Environmental Science Associates in 2024

AERMOD model was used to estimate the highest impact for primary $PM_{2.5}$ for both averaging times modeled over 5 years of meteorological data and considering sitewide emissions for the pollutant. The primary and secondary $PM_{2.5}$ impacts were added together and compared with the SILs for respective averaging times. **Table 6-5** shows the results of the analysis. The AERMOD input/output modeling files for the primary $PM_{2.5}$ impacts are included in Appendix H.

TABLE 6-5
PSGM3 PROJECT IMPACTS OF $PM_{2.5}$

Pollutant – Averaging Time [a]	Project Primary Impact	Project Secondary Impact	Project Total Impact	Significant Impact Levels	Project Impact Below SIL
	µg/m³	µg/m³	µg/m³	µg/m³	Yes/No
$PM_{2.5}$ – 24-hour	0.498	0.017	0.515	1.2	Yes
$PM_{2.5}$ – Annual	0.0827	0.0011	0.0838	0.13	Yes

NOTES: $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SIL = significant impact levels; µg/m³ = microgram per cubic meter.
a. High 1st High (H1H) 1-hour and 8-hour impacts over 5 years of meteorological data at any receptor within the receptor network.
SOURCE: Data compiled by Environmental Science Associates in 2024

Figure 6-5 and **Figure 6-6** show the contour plots of the 24-hour and annual primary $PM_{2.5}$ impacts surrounding the facility, respectively.

6.3 Conclusions

For both CO and $PM_{2.5}$, the PSGM3 project impacts were below the SILs for all averaging times. This demonstrates compliance with NAAQS a PSD increments for these criteria pollutants and no further analysis is required.

6.4 Class I Area Air Impact Analysis

6.4.1 Air Quality Related Value (AQRV) Analysis

Class I areas are protected more stringently under the PSD program than under the NAAQS. Class I areas include national parks, wilderness areas, and other areas of special national and cultural significance. Five Class I areas are within 200 kilometers of the project site (**Table 6-6**).

TABLE 6-6
CLASS I AREAS WITHIN 200 KILOMETERS OF THE PROJECT SITE

Class I Area	State	Distance from Project Site (km)
San Gabriel Wilderness	California	67
Domeland Wilderness	California	85
Cucamonga Wilderness	California	88
Sequoia National Forest	California	150
Joshua Tree National Park	California	180

NOTE: km = kilometers
SOURCE: Data compiled by Environmental Science Associates in 2024

Following the most recent Federal Land Managers' Air Quality Related Values Work Group (FLAG) Workshop procedures (USFS et al. 2010), the screening procedure (ratio of initial cumulative annual emissions divided by distance to Class I area, referred to as "Q/D") was used to determine whether the

project could opt (screen) out of an air quality–related value assessment for visibility and deposition with the CALPUFF modeling system. Following the FLAG screening procedures and using annualized emissions based on the maximum 24-hour emission rates, emissions of NO_X, SO_2, $PM_{10}/PM_{2.5}$, and sulfuric acid (H_2SO_4) mist were summed and divided by the distance to the respective Class I area. The annualized emissions rates calculated in this manner are only for the Q/D analysis and are not indicative of proposed annual sitewide emission rates listed in Section 3.0. **Table 6-7** summarizes the screening analysis for each Class I area located within 200 kilometers of the project site.

TABLE 6-7
CLASS I AREA IMPACT Q/D ANALYSIS

Class I Area	Q [1]	D (km)	Q/D
San Gabriel Wilderness	158.59	67	2.37
Domeland Wilderness	158.59	85	1.87
Cucamonga Wilderness	158.59	88	1.80
Sequoia National Forest	158.59	150	1.06
Joshua Tree National Park	158.59	180	0.88

NOTES: D = distance; km = kilometers; Q = emission rate.

[1] Sum of nitrogen oxides, sulfur dioxide, particulate matter less than 10 microns and less than 2.5 microns in diameter, and sulfuric acid mist (NO_X, SO_2, $PM_{10/2.5}$, and H_2SO_4 mist, respectively), based on maximum 24-hour average emissions annualized to tons per year.

SOURCE: Data compiled by Environmental Science Associates in 2024

In accordance with the FLAG guidance, if the Q/D ratio is less than 10, no air quality–related value analysis is required. Based on the ratio of Q/D, the Class I areas listed in Table 6-7, the PSGM3 project emissions do not require further analysis of air quality–related value.

6.4.2 Class I Area PSD Increment Analysis

CO does not have any PSD Class I increment, however there is a PSD Class I increment for $PM_{2.5}$. The SIL for Class I area for 24-hour average and annual average $PM_{2.5}$ are 0.07 and 0.06 $\mu g/m^3$. The nearest Class I area from the PSGM3 project is 67 km, which is beyond the allowable distance for AERMOD, which is 50 km. Therefore, the PSGM3 project impacts were estimated using the guidance in the recent USEPA memorandum dated April 30, 2024, from Tyler Fox, Group Leader to Regional Office Modeling Contacts, a copy of which is included in Attachment F.

The NO_X and SO_2 emissions were mainly from the electric arc furnace (EAF) stack (EID-06), which is 165 feet (50 m) tall. Therefore, the average of the USEPA impact data for 10 m and 90 m tall stack were considered to represent the EAF stack. Also, the nearest Class I area from the PSGM3 site is 67 km. As a conservative estimate, USEPA impact data at 60 km distance was used for the impact determination.

Table 6-8 shows the results of this analysis.

TABLE 6-8
PSD CLASS I AREA IMPACT ANALYSIS FOR $PM_{2.5}$

Averaging Time / Category	Pollutant	Value	Unit of Measure
24-Hour			
24-hr $PM_{2.5}$ Impact [a]	NO_X	0.0820	$\mu g/m^3$
24-hr $PM_{2.5}$ Impact [a]	SO_2	0.0703	$\mu g/m^3$
PSGM3 Project Emissions [b]	NO_X	22.79	tpy
PSGM3 Project Emissions [b]	SO_2	23.12	tpy
PSGM3 Project Impact [c]	NO_X	0.0037	$\mu g/m^3$
PSGM3 Project Impact [c]	SO_2	0.0033	$\mu g/m^3$
PSGM3 Project Impact [d]	$NO_X + SO_2$	0.0070	$\mu g/m^3$
PSD Class I SIL		0.07	$\mu g/m^3$
Project Impact as % of SIL		9.98	%
Annual			
Annual $PM_{2.5}$ Impact [a]	NO_X	0.0066	$\mu g/m^3$
Annual $PM_{2.5}$ Impact [a]	SO_2	0.0049	$\mu g/m^3$
PSGM3 Project Emissions [b]	NO_X	22.79	tpy
PSGM3 Project Emissions [b]	SO_2	23.12	tpy
PSGM3 Project Impact [c]	NO_X	0.0003	$\mu g/m^3$
PSGM3 Project Impact [c]	SO_2	0.0002	$\mu g/m^3$
PSGM3 Project Impact [d]	$NO_X + SO_2$	0.0005	$\mu g/m^3$
PSD Class I SIL		0.06	$\mu g/m^3$
Project Impact as % of SIL		0.88	%

NOTE: hr = hour; NO_X = nitrogen oxides; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PSD = Prevention of Signfiicant Deterioration; SIL = Significant Impact Levels; SO_2 = sulfur dioxide; tpy = tons per year; $\mu g/m^3$ = microgram per cubic meter.

a. Average hypothetical source impacts for tall (90 meter) and short (10 meter) stacks. NOx/SO_2 emissions stack in PSGM3 (EID-06) is 165 feet (50 meter). Ref: USEPA MERPs View Qlik - https://www.epa.gov/scram/merps-view-qlik/k.
b. From project emission estimate - Chapter 3 of PSD Application May 2024.
c. Project Impact = [Project emissions/Hypothetical source emissions (=500 tpy)]* Hypothetical source $PM_{2.5}$ impact
d. PSGM3 Project Total Impact = Project Impact for NO_X + Project Impact for SO_2

SOURCE: Data compiled by Environmental Science Associates in 2024

6.4.3 Conclusions

The analysis shows that the PSGM3 project will not adversely impact any Class I areas.

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CHAPTER 8
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Appendix F

AERMOD Modeling Protocol with Revisions

F-1 Air Dispersion Modeling Protocol - February 2023

Air Dispersion Modeling Protocol

Mojave Micro Mill Project
Mojave, Kern County, California

Prepared for

ESA

PSG PACIFIC STEEL GROUP

February 2023

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1.0 INTRODUCTION

Pacific Steel Group (PSG) plans to construct and operate a micro steel mill in Eastern Kern County, CA and will submit a major source construction air permit application to the Eastern Kern Air Pollution Control District (EKAPCD).

The facility is expected to have emissions of at least one criteria pollutant in excess of a major source threshold as well as criteria pollutant emission rates above the corresponding significant emission rate (SER) threshold for all Nation Ambient Air Quality Standard (NAAQS) pollutants; therefore, the requirements of Title 40 Code of Federal Regulations (40 CFR) 52.21 Prevention of Significant Deterioration (PSD) would to be triggered for these NAAQS pollutants. An Air Quality Impact Analysis (AQIA) will be required for the project to demonstrate compliance with all ambient air quality thresholds.

This Air Dispersion Modeling Protocol (Protocol) describes the methodology to be used to demonstrate compliance with all air quality standards in support of the following permit application.

Applicant:	**Pacific Steel Group**
Facility:	**Mojave Micro Mill**
Nearest City and County:	**Mojave, Kern County**
Applicant's Modeler:	**Sarah Patterson** **Environmental Science Associates** **SPatterson@esassoc.com** **(510) 463-6758**

1.1 Project Overview

The micro mill will produce rebar from scrap metal (e.g., shredded automobiles, appliances, structural and sheet metal, and other pre-processed steel bundles) through various recycling processes. The project will include air emissions sources for the manufacture of steel products from scrap steel.

The following processes and emission units are preliminary proposed for the project:

- Scrap and other material storage and handling
- Electric Arc Furnace (EAF) melting and refining operations
- Ladle Metallurgy Station (LMS) refining operations
- Ladle/Tundish preheating and ladle repair/rebuilding
- Casting and Rolling operations
- Finishing process
- Carbon, Flux, and Alloy storage and handling
- Slag handling and crushing
- Cooling towers
- Emergency-use combustion engines
- Haul roads
- Aboveground fuel storage tanks
- On-site mobile equipment (e.g. front-end loaders, etc.)

The micro mill facility (project site) would be developed on two parcels totaling approximately 174 acres located at 860 Sopp Road, Mojave, CA, along Sierra Highway in Kern County. The location of the

project site is shown in Figure A-1 in Appendix A. The project Site is bordered by SR-74 to the north with residences beyond, residential neighborhood to the south and southeast, and vacant land to the west. SR-79 is planned to pass through the southern end of the project site. The project site is currently vacant land and therefore has no current air quality or greenhouse gas (GHG) emission or energy consumption.

1.2 Type of Permit Review

The Mojave Micro Mill is located in Mojave, Kern County, California. Eastern Kern County, where the project will be located, is currently designated as Severe Nonattainment for Ozone 8-hour standard. Kern County is designated as attainment for all other criteria pollutants. The project is a listed source and potential emissions indicate that the project will be a major source; as a result, the project will be subject to a PSD construction permit review. A PSD permit requires an assessment of ambient impacts for those pollutants subject to PSD review.

This air dispersion modeling protocol has been drafted in accordance with the United States Environmental Protection Agency's (USEPA) most recent version of the "Guideline on Air Quality Models".[1] Submittal of this protocol will allow the EKAPCD to review and comment on the methodology to be employed in the modeling analyses.

1.3 NAAQS Pollutants Evaluated in AQIA

The modeling analyses will evaluate off-site impacts of NAAQS pollutants listed in Table 1-1 resulting from the emission sources authorized by the permit application.

Table 1-1: NAAQS Pollutants Evaluated in AQIA

Pollutant	Averaging Time	Class II SIL	SMC	Primary NAAQS	Secondary NAAQS	Class II Increment	Class I SIL	Class I Increment
		Micrograms per cubic meter (µg/m³)						
Carbon Monoxide (CO)	1-Hour	2,000	-	40,000	-	-	-	-
	8-Hour	500	575	10,000	-	-	-	-
Lead	Rolling 3-month average	-	0.1	0.15	-	-	-	-
Nitrogen Dioxide (NO_2)	1-Hour	7.5	-	188	-	-	7.5	-
	Annual	1	14	100	100	25	0.1	2.5
Particulate Matter (PM_{10})	24-Hour	5	10	150	150	30	0.2	8
	Annual	1	-	-	-	17	0.32	4
Particulate Matter ($PM_{2.5}$)	24-Hour	1.2	-	35	35	9		2
	Annual	0.2	-	12	15	4		1
Sulfur Dioxide (SO_2)	1-Hour	7.8	-	196	-	-	7.8	-
	3-Hour	25	-	-	1,300	512	1.0	25
	24-Hour	5	13	-	-	91	0.2	5
	Annual	1	-	-	-	20	0.08	2

Notes: SIL = Significant Impact Level; SMC = Significant Monitoring Concentration

[1] United States Environmental Protection Agency. 2017. *Guideline to Air Quality Models*. May. https://www.epa.gov/sites/production/files/2020-09/documents/appw_17.pdf,accessed December 2022.

2.0 PLOT PLAN AND AREA MAP

The project site is located in Mojave, Kern County, California. The Area Map illustrating the location of the project site and Plot Plan indicating the property boundary, fenceline, and buildings are provided in Appendix A. Class I areas located within 100 kilometers (km) of the project site are also included in the Area Map Figure A-1. The finalized emission sources and locations will be added to the Plot Plan as part of the modeling report submitted along with the permit application.

3.0 AIR QUALITY MONITORING DATA

A cumulative impact analysis will be conducted for all NAAQS pollutants and averaging periods, if project level impacts exceed the respective significant impact levels (SIL). The cumulative analysis will include project emissions and other nearby off-site emissions, as appropriate. Ambient background monitoring data will be used in the NAAQS compliance demonstration to estimate the contribution of off-site emission sources that are not explicitly included in the modeling. The sum of modeled impacts and background monitoring concentrations will be compared with respective NAAQS to demonstrate compliance.

The monitoring data discussed below was obtained from the USEPA's Air Quality System (AQS) Data Mart system.[2]

During preliminary discussions regarding the project, EKAPCD suggested the use of data from ambient air monitors within the same air basin as the project (Mojave Desert Air Basin) to account for representative background concentrations. The background monitors have been selected per this suggestion and are listed in Table 3-1. A single monitoring site (ID: 06-037-9033) will be used for CO, NO_2, PM_{10}, and $PM_{2.5}$ background concentration. SO_2 is not being monitored at this monitoring station; therefore, a different monitor (ID: 06-071-0306) will be used for SO_2. Both these monitors (ID: 06-037-9033 and ID:06-071-0306) are within the Mojave Desert Air Basin and closest to the project site, with the most recent available data at the time this protocol was developed.

Table 3-1: Background Monitors

Pollutant	AQS Monitor ID	Address	Latitude	Longitude
NO_2	06-037-9033	43301 Division Street, Lancaster, CA	34.669739	-118.130511
PM_{10}	06-037-9033	43301 Division Street, Lancaster, CA	34.669739	-118.130511
$PM_{2.5}$	06-037-9033	43301 Division Street, Lancaster, CA	34.669739	-118.130511
CO	06-037-9033	43301 Division Street, Lancaster, CA	34.669739	-118.130511
SO_2	06-071-0306	14306 Park Avenue, Victorville, CA	34.510961	-117.325540

Complete data for background concentration of lead is not available within the Mojave Desert Air Basin. There are no significant lead emission sources in the vicinity of the project site. Therefore, a regional background concentration will be considered if NAAQS modeling is required for lead. Historical information on lead emitting sources in the vicinity will be reviewed if required to develop the background concentration.

Appendix B shows the locations of the proposed monitors in relation to the project site. The monitoring data to be used as background concentration for this project is summarized in Table 3-2. If the background concentration data show significant variations in monthly or seasonal values, "Seasonal" and or "Monthly" background concentration options may be used in a refined analysis.

[2] United States Environmental Protection Agency. 2022. *EPA Air Quality System (AQS) Data Mart*. October. https://www.epa.gov/outdoor-air-quality-data,accessed December 2022.

Table 3-2: Background Monitor Data Summary

Compound	AQS Monitor ID	Year	Averaging Period	Value Rank	Monitored Concentration		Short-term Average Background Concentration	Annual Average Background Concentration
					Parts per Billion (ppb)	µg/m³	µg/m³	µg/m³
Carbon Monoxide (CO)	06-037-9033	2021	1-hr	Second Max	1.4	1.60	1.60	--
		2021	8-hr	Second Max	1	1.15	1.15	--
Lead (Pb) [1]	--	--	Rolling 3-month	Maximum 3 Month Avg	--	--	--	--
Nitrogen Dioxide (NO_2)	06-037-9033	2019	1-hr	98% Max Daily	40	75.26	76.51	--
		2020			40	75.26		
		2021			42	79.02		
		2021	Annual	Mean	8.26	15.54	--	15.54
Particulate Matter 10 (PM_{10})	06-037-9033	2019	24-hr	Second Max	--	159	126.33	--
		2020			--	121		--
		2021			--	99		--
Particulate Matter 2.5 ($PM_{2.5}$)	06-037-9033	2019	24-hr	98% Max Daily	--	12	24.33	--
		2020			--	40		--
		2021			--	21		--
		2019	Annual	Mean	--	6.1	--	7.83
		2020			--	9.3	--	
		2021			--	8.1	--	
Sulfur Dioxide (SO_2)	06-071-0306	2019	1-hr	99% Max Daily	4	10.47	8.73	--
		2020			3	7.85		
		2021			3	7.85		
		2021	3-hr	Second Max	2.7	7.07	7.07	--

[1] Regional background monitoring concentration will be used for the latest year available.

4.0 MODELING EMISSIONS INVENTORY

4.1 Source Parameter Justification

The sources being evaluated as part of this modeling project will be represented as various point sources, area sources, and volume sources. The source parameters are subject to change based on permitting review and will be finalized in the final modeling report. Source parameters for the emission sources will be based on facility operations and design and will be included in the modeling report with justification.

4.2 Off-Property Sources

Based on discussions with the EKAPCD on October 20, 2022, the only off-site sources that will be evaluated in the AQIA would be from the following facilities:

+ Golden Queen Mining;
+ Edwards Air Force Base;
+ CalPortland Cement;
+ Lehigh Cement;
+ US Borax; and
+ National Cement

EKAPCD concurred that all other off-site sources would be covered by the background monitor values described in Section 3.0.

4.3 Scaling Factors

Because the fugitive particulate emissions (PM_{10}/$PM_{2.5}$) from outdoor storage piles vary with wind speed, the AERMOD keywords "EMISFACT" and "WSPEED" may be used for considering variable emissions from based on wind speed from these sources. Intermittent Emissions

The project will include several emergency engines and fire pumps, which will be operated intermittently. For these emission sources, USEPA's memorandum dated March 11, 2011, will be used for both NO_2 and SO_2.[3] Justification will be provided in the modeling report for considering these sources as intermittent sources.

No other scaling factors will be evaluated in the AQIA for this project.

[3] United States Environmental Protection Agency. 2011. *Memorandum: Additional Clarification Regarding Application of Appendix W Modeling Guidance for 1-hour NO_2 National Ambient Air Quality Standard*. March. https://www.epa.gov/sites/default/files/2015-07/documents/appwno2_2.pdf,accessed December 2022.

4.4 Operating Scenarios

It is not expected that all of the emission sources at the project site will be operating simultaneously. Therefore, if necessary, separate operating scenarios will be developed for these operating conditions and will be reviewed to identify the maximum emission rates for each of the modeled NAAQS pollutants. Justification of the modeled operating scenarios will be included in the modeling report.

5.0 MODEL SELECTIONS AND MODELING TECHNIQUES

The modeling methodology will follow the procedures outlined in the following guidelines:

- Guideline on Air Quality Models 40 CFR 51 Appendix W [4]; and
- South Coast Air Quality Management District (SCAQMD) Modeling Guidance for AERMOD.[5]

Site-specific and project-specific revisions to these methodologies will be made when appropriate and justified in the AQIA report.

5.1 Dispersion Model Selection

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) modeling program (AERMOD, version 22112) will be used to predict off-site impacts for the AQIA. AERMOD is currently the preferred dispersion model recommended by the USEPA for complex source configurations and emission units subject to downwash. EDGE will use the LAKES software package for model inputs and performance of model runs.

The following preprocessors will be used in the modeling:

- Building Profile Input Program (BPIPPRIM) version 04274
- AERMAP version 18081

5.2 Modeling Procedures

5.2.1 Regulatory Options

All default options in AERMOD will be used in this AQIA. These include:

- Use the elevated terrain algorithms requiring input of terrain height data;
- Use stack-tip downwash (except for building downwash cases);
- Use the calms processing routines; and
- Use the missing data processing routines.

In addition, the dry plume dispersion option may be used for low release height emission sources of PM_{10}/$PM_{2.5}$ (e.g. haul roads, storage piles, raw material storage vents, cooling towers) to estimate more reasonable off-site impacts for these pollutants.

AERMOD will be applied to calculate concentrations using the regulatory defaults in addition to the options and data discussed in this section.

5.2.2 Selection of Dispersion Option

The AERMOD rural dispersion option will be used in the AQIA. Appendix C shows the land-use of the area within 3 km radius from the site is greater than 85% rural and therefore justifies this dispersion option.

5.2.3 Averaging Periods

Pollutant concentrations predicted by AERMOD will be averaged over short term (1-hr, 3-hr, 8-hr, 24-hr) and annual averaging periods as required by the applicable ambient air quality standard averaging period(s) for each modeled pollutant. The pollutants and averaging times to be reviewed as part of this AQIA are listed in Table 1-1 in Section 1.0 of this modeling protocol.

5.2.4 NO to NO_2 Conversion

Per 40 CFR 51, Appendix W, Section 4.2.3.4, a multi-tiered screening approach can be used to obtain account for atmospheric conversion of nitric oxides to nitrogen dioxide in the atmosphere, for estimating both hourly and annual average impacts of NO_2. The modeling will initially use Tier 1 and based on the results of this screening of conservative assumptions, Tier 2 or Tier 3 may be applied.

Tier 1: Assume a total conversion of NO to NO_2.

Tier 2: Multiply the Tier 1 results by the ambient ratio method 2 (ARM2), which provides estimates of representative equilibrium ratios of NO_2/NO_X value based ambient levels of NO_2 and NO_X derived from national data from the USEPA's AQS. The national default for ARM2 includes a minimum ambient NO_2/NO_X ratio of 0.5 and a maximum ambient ratio of 0.9. If necessary, alternative default minimum NO_2/NO_X values may be established based on the source's in-stack emissions ratio, with alternative minimum values reflecting the source's in-stack NO_2/NO_X ratios. If such alternative in-stack ratios are used, justification will be provided in the modeling report.

Tier 3: Estimate NO_X concentrations and then estimate the conversion of primary NO emission to NO_2 based on the ambient levels of ozone and the plume characteristics using either the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) option. Both the OLM/PVMRM options account for NO_2 formation based on the ambient levels of ozone. Any of the following two alternative options may be used in the OLM/PVMRM for the ambient ozone concentration: (i) hourly ozone concentration for the same period as the meteorological data; or (ii) average ozone concentration by season and hour of day from a set of latest available 5-yr period of ambient ozone data. The hourly background ozone concentration will be obtained from the nearest monitoring station to the project site. Any missing hourly data will be filled in using appropriate USEPA procedures.

5.2.5 Secondary $PM_{2.5}$ Impact Determination

Determination of impact of secondary $PM_{2.5}$ formation in the atmosphere from precursors (NO_X and SO_2) is required for Class I increments analysis and Class II SIL, NAAQS, and increment analysis. The impacts will be estimated using USEPA's Guidance on the Development Modeled Emission Rates as Precursors (MERP) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program.[4] Total NO_X and SO_2 emissions from the project will be used in the analysis and impacts will be determined using the MERP values for hypothetical sources modeled by USEPA. Source No. 26 in

[4] United States Environmental Protection Agency. 2019. *Memorandum: Guidance on the Development of Modeled Emission Rates for Precursors (MERP) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program*. April. https://www.epa.gov/sites/default/files/2019-05/documents/merps2019.pdf, accessed December 2022.

USEPA's list is in Kern County and is considered to be representative of the project site at this time. The secondary $PM_{2.5}$ impact will be added to the primary $PM_{2.5}$ impact to determine the total $PM_{2.5}$ impact for the project emissions.

5.2.6 Building Wake Effects (Downwash)

The USEPA's Building Profile Input Program downwash algorithms will be used to determine the parameters for accounting aerodynamic downwash from buildings and structures on modeled emission sources. Based on a review of the site plot plan and a visual survey of the project site, there are several buildings/structures which could potentially cause aerodynamic downwash to the modeled emission sources and these buildings/structures will be included in the AQIA. Current information on the downwash structures to be included, including height, size, and Universal Transverse Mercator (UTM) location information, are listed Table 5-1. They are also represented in the attached Plot Plan in Appendix A of this submittal. Any changes in the building/structure data will be incorporated in the final air dispersion modeling.

Table 5-1: Buildings and Structure Downwash Information (UTM Coordinates)

Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1A	22.86					395441	3866164	395442	3866197	395511	3866197	395511	3866164
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1BC	33.53					395447	3866313	395446	3866294	395446	3866259	395442	3866259
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395442	3866250	395442	3866211	395442	3866197	395442	3866164
							X9	Y9	X10	Y10	X11	Y11	X12	Y12
							395441	3866153	395417	3866154	395417	3866164	395417	3866210
							X13	Y13						
							395420	3866313						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1D	11.58					395417	3866164	395399	3866164	395399	3866188	395409	3866188
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395410	3866202	395406	3866202	395406	3866210	395417	3866210
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1E	11.58					395442	3866211	395442	3866250	395463	3866249	395463	3866211
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1FG	15.24					395447	3866383	395420	3866384	395420	3866387	395406	3866388
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395407	3866471	395448	3866471	395448	3866418	395448	3866405
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1H	12.19					395447	3866313	395420	3866313	395411	3866313	395412	3866379

							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395420	3866379	395420	3866384	395447	3866383	395447	3866379
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1I	15.24					395448	3866471	395407	3866471	395295	3866472	395296	3866510
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395317	3866510	395549	3866508	395569	3866508	395568	3866470
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1J	10.67					395446	3866294	395447	3866379	395468	3866379	395467	3866294
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_1K	6.71		5.71	13.17	359.43	395447	3866405						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1L	15.24					395549	3866508	395317	3866510	395317	3866547	395549	3866545
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1M	13.72					395549	3866545	395317	3866547	395318	3866584	395549	3866582
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_2	7.62					395505	3866355	395531	3866355	395529	3866252	395504	3866253
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_3	6.40					395244	3866649	395266	3866649	395266	3866638	395257	3866638
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395257	3866616	395266	3866616	395265	3866605	395244	3866606
							X9	Y9	X10	Y10	X11	Y11	X12	Y12

							395244	3866605	395238	3866605	395238	3866611	395239	3866611
							X13	Y13	X14	Y14	X15	Y15	X16	Y16
							395239	3866623	395232	3866623	395232	3866627	395234	3866627
							X17	Y17	X18	Y18	X19	Y19	X20	Y20
							395234	3866634	395244	3866634	395244	3866638	395243	3866638
							X21	Y21	X22	Y22				
							395243	3866646	395244	3866646				
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_4	5.49					395243	3866591	395264	3866591	395264	3866589	395266	3866589
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395266	3866578	395264	3866578	395264	3866572	395243	3866573
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_5	5.49					395336	3866126	395366	3866125	395365	3866053	395335	3866053
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_7	5.49		13.49	6.48	179.43	395741	3866291						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	WTPLANT	6.10					395381	3866354	395380	3866265	395375	3866265	395374	3866229
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395376	3866229	395376	3866218	395362	3866218	395362	3866247
							X9	Y9	X10	Y10	X11	Y11	X12	Y12
							395352	3866247	395352	3866272	395357	3866272	395357	3866342
							X13	Y13	X14	Y14				
							395355	3866342	395355	3866354				
							X1	Y1	X2	Y2	X3	Y3	X4	Y4

Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	FTPLT1	6.10					395575	3866209	395602	3866208	395602	3866191	395574	3866191
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	FTPLT2	6.10					395604	3866178	395612	3866178	395612	3866165	395604	3866166
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	FTPLT3	6.10					395565	3866194	395572	3866194	395572	3866181	395565	3866181
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_6A	5.49					395408	3866313	395399	3866313	395399	3866328	395399	3866333
							X5	**Y5**	**X6**	**Y6**				
							395408	3866333	395408	3866328				
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_6B	5.49					395408	3866341	395399	3866341	395399	3866345	395399	3866361
							X5	**Y5**	**X6**	**Y6**				
							395408	3866361	395408	3866345				
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**						
							[m]	**[m]**						
Tank	TANK1	6.10	25.33				395327	3866342						

5.2.7 Receptor Grid

Cartesian Receptor Grid

Considering the location of the project, North American Datum 1983 UTM Zone 11S will be used. The modeled Cartesian receptor grids to be used for this analysis will include:

- Receptors placed along the fenceline with 25 meter spacing;
- Receptors placed at the fenceline out to a distance of 500 meters with 50 meter spacing;
- Receptors placed 500 meters from the fenceline to a distance of 1 km with 100 meter spacing;
- Receptors placed 1 km from the fenceline to a distance of 5 km with 250 meter spacing;
- Receptors placed 5 km from the fenceline to a distance of 10 km with 500 meter spacing; and
- Receptors placed 10 km from the fenceline to a distance of 50 km with 1 km spacing.

5.2.8 Meteorological Data

Representative meteorological data sets from the nearest National Weather Station (NWS), General William J. Fox Airfield Airport (Station ID: KWJF 723816) for the 2017-2021 calendar years will be used in the AQIA. This meteorological station is nearest to the project site with latest five years of complete surface meteorological data. The meteorological station is located within the Mojave Desert Air Basin, approximately 14 miles south of the proposed project, and with surface characteristics representative of the project site. Location of the station is shown in Figure A-1 in Appendix A. The dataset has been processed by the California Air Resource Board (CARB) for AERMOD model.

Upper air station data from the Vandenberg Air Force base (Station ID No. 93214) will be used in the modeling for 2017-2021 per CARB recommendation for the proposed project site.

5.2.9 Terrain Data

United States Geological Survey (USGS) national elevation dataset (NED) GeoTIFF terrain data will be used for all modeling. As of March 19, 2009, USGS NED GeoTIFF is the terrain data that is recommended by the USEPA for use in the United States for regulatory purposes. It will be processed and run through the most recent version of AERMAP.

6.0 MODELING METHODOLOGY

6.1 Class II Air Quality Analysis

This section discusses the Class II air quality dispersion modeling methodologies that will be followed to demonstrate compliance with the applicable NAAQS and Class II PSD Increments.

Class II air quality dispersion analyses are organized into two major sub-sections based on USEPA modeling guidance: the Preliminary Impact Analysis and the Full Impact Analysis.[5] Each analysis that will be conducted is discussed in detail below.

6.1.1 Preliminary Impact Analysis

In the preliminary impact analysis, the emissions from the project will be evaluated to determine whether there will be potential for a significant impact upon the area surrounding the facility. The AERMOD predicted maximum short-term and annual average concentrations will be compared with the corresponding SIL listed in Table 1-1 in Section 1.0.

If the AERMOD predicted maximum concentration from project emissions are less than the corresponding SIL value for all pollutants and averaging times and at all receptors, no further analysis is required. If the AERMOD predicted maximum concentration exceeds the corresponding SIL value for any pollutant and averaging period, then further evaluation is required to compare the project's impacts to the Class II PSD Increment and the NAAQS for the specific pollutant and averaging period.

6.1.2 Area of Impact (AOI) Determination

If modeling results exceed any SIL at any receptor, the AOI will be determined for that pollutant and averaging period. The AOI is a circular area around the source with a radius equal to the distance to the furthest receptor with a concentration equal to or greater than the SIL. The AOI will not exceed 50 km due to constraints of the AERMOD dispersion model. As a conservative approach, all receptors within the AOI will be used for further analysis, including the receptors at which the project's impact is below the respective SILs.

6.1.3 Preconstruction Monitoring Analysis

Pre-construction ambient monitoring may be required for any regulated pollutant that triggers PSD review to develop the design background concentration. If the maximum concentration for the project exceeds a monitoring de minimis concentration, ambient monitoring may be required unless existing ambient monitoring data are deemed representative of local conditions. The applicable monitoring de minimis concentration values are presented in Table 1-1 in Section 1.0.

[5] United States Environmental Protection Agency. 2017. Guideline to Air Quality Models. May. https://www.epa.gov/sites/production/files/2020-09/documents/appw_17.pdf, accessed December 2022.

Representative ambient monitoring data are available for this project and are discussed in Section 3.0. Therefore, pre-construction monitoring is not required for this project.

6.1.4 Compliance Demonstration with PSD Class II Increment

For any pollutant and averaging period with a modeled concentration equal or greater than the corresponding SIL, a Class II Increment consumption analysis will be performed if an increment has been established for that pollutant and averaging period. All receptors inside the AOI equal to or exceeding the SIL (AOI receptors) in the preliminary impact analysis will be included in the increment analysis.

Any specific off-site sources to be included in the analysis will be obtained from EKAPCD. If required, increment consumption and expansion will be considered using the appropriate major source baseline date, trigger date, and minor source baseline date for the modeled pollutant and actual emissions changes from the baseline date for the off-site emission sources.

Project sources will be modeled at their proposed emission rate. Off-site emissions sources will be modeled at actual emission rates for the latest year of data available. Per USEPA guidance, the project's intermittent sources will be included in the annual average NO_2 increment analysis and 3-hour, 24-hour, and annual SO_2 increment analysis. The sum of the impact from the project emissions and the increment consuming off-site emission sources will be compared with respective increments listed in Table 1-1 in Section 1.0 to demonstrate compliance. If hours of operation per year data are not available, 8,760 hours of operation per year will be used. Justification will be provided for the emission rates used in the modeling.

6.1.5 Compliance Demonstration with NAAQS

A NAAQS assessment will be based on modeling of the project emissions and nearby off-site sources as instructed by EKAPCD. The list of off-site sources to be considered in the cumulative modeling for NAAQS compliance demonstration has been provided by EKAPCD and listed in Section 4.2. From this list, only the sources with significant concentration gradient in the proposed project's AOI receptors will be included explicitly in the cumulative modeling.

For determining whether an off-site source could have significance concentration gradient or not, each of these sources will be modeled with receptors located at the source boundary and extending to the proposed project's location, at increments of 500 m. To reduce computational time, the receptor grid will be arranged in a 30-45 degree arc from the candidate source to the proposed project with the proposed project at the center of the arc and covering the entire AOI. The modeling will be conducted for each NAAQS pollutant and averaging time with the emissions data and source parameters for the off-site source, received from EKAPCD. Per USEPA guidelines, emission from all sources will be based on allowable emissions or maximum potential to emit estimates except in cases where guidance allows other considerations, such as intermittent sources.

In order to reduce computational time, all emissions for a specific pollutant will be represented as a single source at the center of the facility. The release height will be based on an emission-weighted average height. Other source parameters for this hypothetical single source will be based on the source

parameters for the emission point with highest emissions. Meteorological data as described in Section 5.2.8 will be used in the modeling.

Modeled results within the receptor grid will be analyzed to determine the concentration gradient of the off-site source, both laterally and longitudinally, within the AOI of the proposed project. If the concentration gradients are significantly small (i.e., a flattened line when concentration is plotted with distance), the off-site source will be considered not to have significant concentration gradient near the proposed project. These off-site sources with insignificant concentration gradient with the AOI of the proposed project will not be included explicitly in the cumulative modeling and instead, will be considered part of the background concentration. Detailed justification for excluding these off-site sources from cumulative modeling will be provided in the modeling report.

All other off-site sources not listed by EKAPCD (Section 4.2) will be considered represented by the background monitor data.

Per USEPA guidelines, off-site intermittent sources will not be included in the NAAQS compliance demonstration for 1-hour NO_2 and 1-hour SO_2. The intermittent sources will be included for all other averaging times.

If a full NAAQS compliance demonstration is required, applicable background ambient concentrations will be included from a representative monitoring station. Representative background concentrations are available for the project as described in Section 3.0. A detailed justification of representative (or conservative) background monitoring station and analysis of the background concentration values is included in Section 3.0 and Appendix B.

The sum of the impacts from the project's net emissions, off-site emission sources, and representative background concentration will be compared with relevant NAAQS listed in Table 1-1 in Section 1.0 to demonstrate compliance.

If the impacts at any of the modeled AOI receptors exceed any of the short-term NAAQS (1-hour SO_2, 1-hour NO_2, 24-hour PM_{10}, and 24-hour $PM_{2.5}$), the contribution of the project's emission sources to these exceedances will be initially determined from the highest project impacts (i.e. unpaired in time) as determined from the preliminary modeling. If needed, in a subsequent step, the project's impact may be also determined, paired in time and space, using the AERMOD output keyword "MAXDCONT". If the project's impact (either the highest or paired in time and space) at all of these NAAQS-exceeding AOI receptors is less than the respective SIL for the pollutant and averaging time, then the project will be determined not to "cause or contribute" to the exceedance and NAAQS compliance will be deemed to have been demonstrated for the project.

In addition to NAAQS, the California Ambient Air Quality Standards (CAAQS) will be also evaluated, if required by EKAPCD.

6.1.6 Ozone NAAQS Compliance Demonstration

Eastern Kern County is designated as "Severe" Non-attainment for the 2008 Ozone Standard and "Serious" Non-attainment for 2015 Ozone Standard. Therefore, PSD AQIA for ozone is not applicable and ozone impact analysis will not be conducted for this project.

6.1.7 Lead NAAQS Compliance Demonstration

The NAAQS for lead is 0.15 µg/m^3 as a rolling three-month average. This differs from other NAAQS in that it uses a rolling period, so a new three-month period is calculated with each successive month (e.g., January-March, February-April, etc.).

Currently, the AERMOD model does not perform rolling average calculations. Therefore, the monthly average output from AERMOD will be processed with USEPA's LEADPOST post-processing utility to estimate the maximum 3-month rolling average over the modeled meteorological period and compared with the NAAQS.

6.2 Class I Area Impact Analysis

There are three (3) Class I areas within 100 km of the project site. These Class I areas and approximate distance from the site are shown in Table 6-1. A Class I area impact analysis will be conducted for this project at all three identified Class I areas. All other Class I areas within USEPA Region 9 (California, Nevada, and Arizona) are at a distance greater than 100 km from the project site and therefore will not be included in the analysis for this project. Figure A-1 shows the Class 1 areas within 100 km of the project site.

Table 6-1: Class I Areas

Class I Area	State	Distance from Project Site (km)
San Gabriel Wilderness	California	67
Domeland Wilderness	California	85
Cucamonga Wilderness	California	88

The objective of a Class I area analysis is to determine if the area could potentially be affected by the emissions from project operations. In order to make this determination, the following analyses will be conducted.

6.2.1 Class I Area SIL Analysis

All criteria pollutants with NAAQS (NAAQS pollutant) will be evaluated in this analysis. The maximum ground-level impact from emissions from all sources from the project site for each of these regulated pollutants will be modeled and compared with the corresponding Class I area SIL. The relevant NAAQS pollutants for this project and corresponding SILs are shown in Table 1-1 in Section 1.0.

For the Class I area SIL analysis, a first step screening methodology using USEPA's AERMOD model will be used. In this step, a ring of receptors will be located at a distance of 50 km from the site (the

maximum distance of impact covered by AERMOD model) in the direction of each of the three Class I areas. The receptor ring will be spaced at 1 km and will cover the full arc of potential plume transport from the site to these Class I areas. Figure A-1 shows the location of these ring receptors. The modeling methodology to determine impacts at these receptors will be similar to the Class II modeling analysis described in Section 6.1.

The impacts at the Class I areas further downwind are expected to be lower due to additional dispersion than the impacts at these receptors. Therefore, if the impacts of all of the NAAQS pollutants at all of these receptors are lower than the corresponding Class I area SILs, it can be assumed that the impacts at the Class 1 areas further downwind will be also lower than the SILs and no further analysis will be necessary.

If the impacts of any NAAQS pollutant at any of the receptors is above the corresponding SIL, a second step screening analysis with USEPA's California Puff model (CALPUFF) will be conducted. This step will use receptors at the Class 1 areas listed in Table 6-1, obtained from the Federal Land Managers (FLM). USEPA's guidance and defaults for screening modeling with CALPUFF will be followed. If the second screening analysis still shows impact above any of the Class I area SILs, a refined analysis using CALPUFF model will be used. A modeling protocol will be submitted to EKCAPCD prior to undertaking the CALPUFF modeling.

6.2.2 Class I Area Increment Analysis

For any NAAQS pollutant for which the maximum modeled impact is shown to be at or above SIL, a Class I area increment analysis will be conducted. The Class I PSD increments for NAAQS pollutants relevant to this project are shown in Table 1-1 above.

The analysis will be similar to the Class I area SIL analysis described in Section 6.2.1. The screening steps will be first with AERMOD model at the 50 km receptor rings followed by CALPUFF model at the Class I area receptors. The refined analysis will use CALPUFF model at the Class I area receptors. A modeling protocol will be submitted to EKCAPCD prior to undertaking the CALPUFF modeling.

6.2.3 Air Quality Related Values (AQRV) Analysis

The AQRVs are those attributes of a Class I area that deterioration of air quality may adversely impact. These are Flora and Fauna, Water, Visibility, Cultural-Archeological, and Odor. The FLMs have established criteria for determining what constitutes an "adverse impact" in the Federal Land Managers' Air Quality Related Value Work Group (FLAG) Phase I Report- Revised.[6] The guidance included in this report will be followed in the AQRV analysis for the project.

Based on this guideline, a screening approach will be used to determine if a refined approach is required. In this approach, all visibility-related emissions (SO_2, NO_X, PM_{10}, and sulfuric acid mist) from

[6] U.S. Forest Service, National Park Service, and U.S. Fish and Wildlife Service. 2010. *Federal Land Managers' Air Quality Related Value Work Group (FLAG) Phase I Report – Revised (2010)*. October. https://www.fws.gov/guidance/sites/guidance/files/documents/FLAG%20Air%20Quality%20Phase%201%20report.pdf, accessed December 2022.

the project based on 24-hour maximum allowable emissions prorated to annual emissions in units of tons per year will be summed (Q). This sum will be divided by the distance in km (D) from the site to the nearest receptor for each Class I area. If the ratio (Q/D) is less than 10, the project will be presumed to have negligible impact on Class I AQRVs and no further analysis will be required.

The analysis will be submitted to the respective FLMs for approval and the approval will be submitted to EKCAPCD as part of the air dispersion modeling analysis. If the Q/D is equal or greater than 10 or if suggested by the FLM, a refined analysis with CALPUFF model will be conducted. A modeling protocol will be submitted to the FLM for the refined AQRV analysis prior to undertaking the CALPUFF modeling.

6.2.4 Class I Area Visibility Impairment Analysis

A Class I area visibility impairment analysis is intended to determine If emissions from the project has the potential to adversely impair visibility in the Class I area. The FLAG guidance will be followed for this analysis.

All three Class I areas for analysis in this project are beyond 50 km from the project site. Therefore, FLAG guidance for Distant/Multi-source analysis will be used. This analysis is similar to the AQRV analysis described in Section 6.2.3 above and will use the Q/D analysis to determine if a refined analysis with CALPUFF model is necessary. If a refined visibility impairment assessment is required, a separate modeling protocol will be submitted to FLM prior to undertaking the analysis.

6.3 Additional Impact Analysis

6.3.1 Growth Analysis

An in-depth growth analysis is only required if the project would result in a significant shift in population and associated activity into the area (i.e., a population increase in the order of thousands of people). The project will not result in a large population shift and therefore, growth analysis is not required for the project.

6.3.2 Visibility Impairment Analysis

The project will comply with the visibility and opacity requirements in EKAPCD regulations. Therefore, a visibility impairment analysis is not required for the project.

6.3.3 Soil and Vegetation Analysis

The area surrounding the project is not known for any sensitive soil or vegetation. For most types of soils and vegetation, ambient concentrations of criteria pollutants below the secondary NAAQS do not result in harmful effects. Therefore, the analysis will be limited to a demonstration of compliance with the applicable secondary NAAQS.

7.0 MODELING REPORT

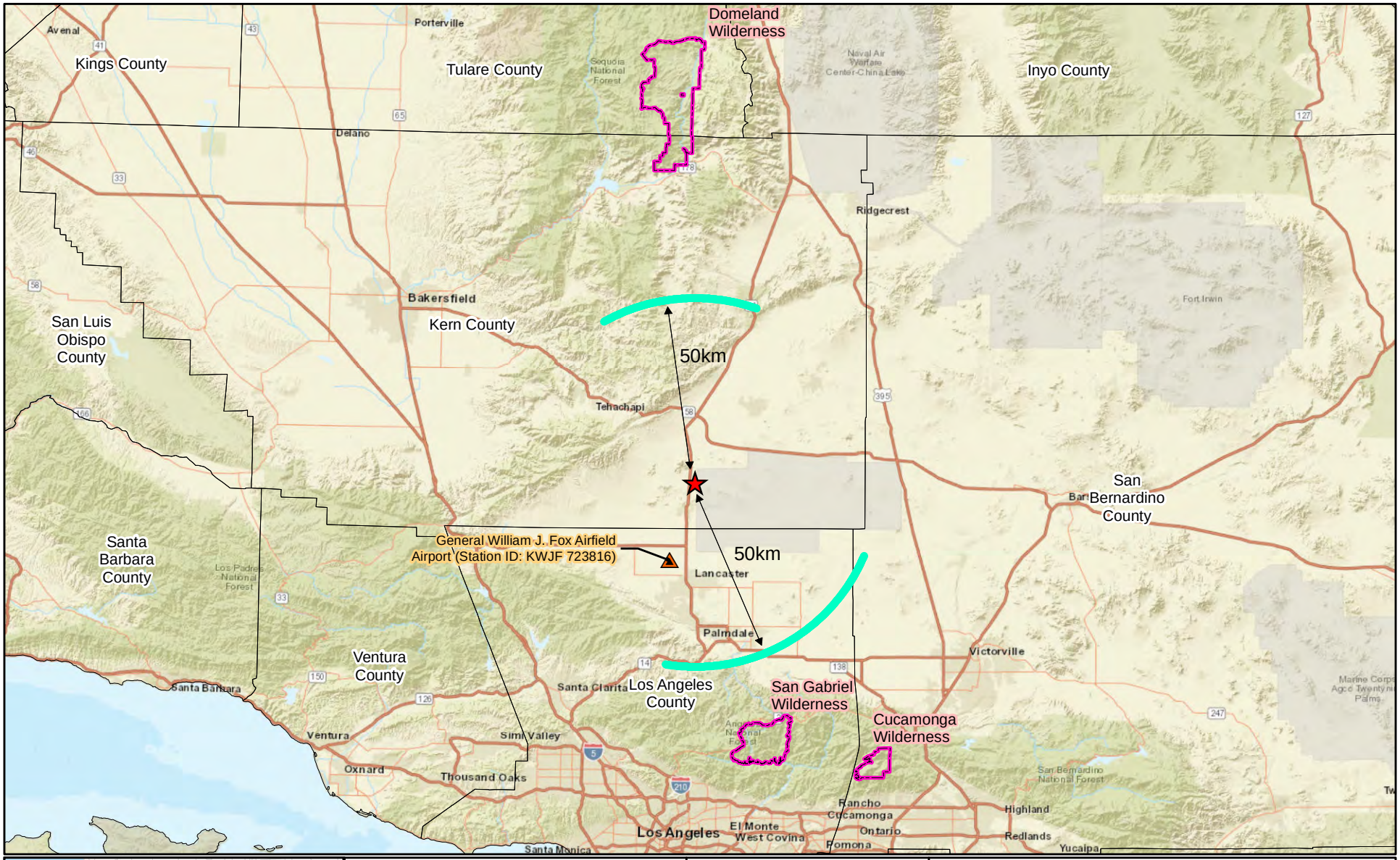
On completion of AQIA, a report will be prepared and submitted to demonstrate compliance with all applicable air quality impact requirements for the project. The report will include the details identified below.

- Brief overview of project;
- Facility plot plan indicating sources, property line, clear scale, and true north;
- Emission rate summary for all project sources, with units consistent with modeling;
- Stack parameter summary for all project sources, with units consistent with modeling;
- Any calculations for stack parameters (e.g., combined stacks, flares, etc.);
- Source parameters for volume and area sources with justifications;
- Approved modeling protocol;
- Technical basis for any non-standard procedure with documentation of prior approval;
- Summary of all model inputs (e.g., model used, met data, rural or urban dispersion coefficients, etc.);
- Comparison of all modeling results to the applicable standards; and

  Electronic copies of all modeling files, including model input files, output files, meteorological data with appropriate documentation if processing performed, and building downwash files. Electronic copies of the modeling report, plot plan, and maps will also be provided.

Appendix A

AREA MAP AND PLOT PLANS



Legend

- Site Location
- Class I Receptors
- Class I areas within 100km

N

0 15 30

Miles

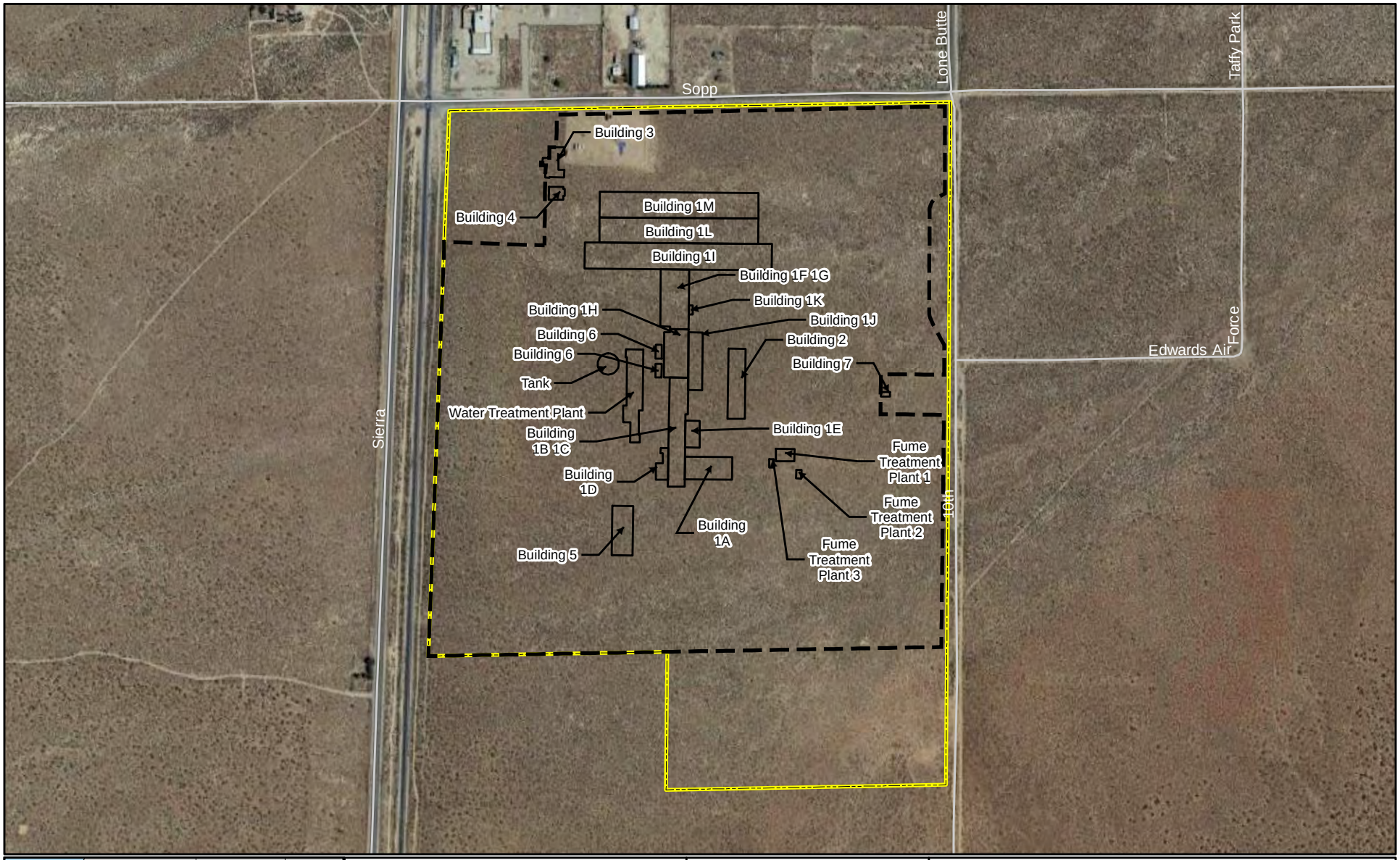
Scale: 1:1,500,000

EDGE ENGINEERING & SCIENCE

Appendix A-1
Area Map

Pacific Steel Group
Mojave Micro Mill
Mojave, Kern County, California

Z:\PROJECTS\Environmental Science Associates_ESA\ELA2022-0001 Mini Steel Mill\GIS\MXD\Appendix A-1 Area Map.mxd



Legend

Fence Line

Property Line

N

0 500 1,000

Feet

Scale: 1:8,000

EDGE ENGINEERING & SCIENCE

Appendix A-2
Plot Plan

Pacific Steel Group
Mojave Micro Mill
Mojave, Kern County, California

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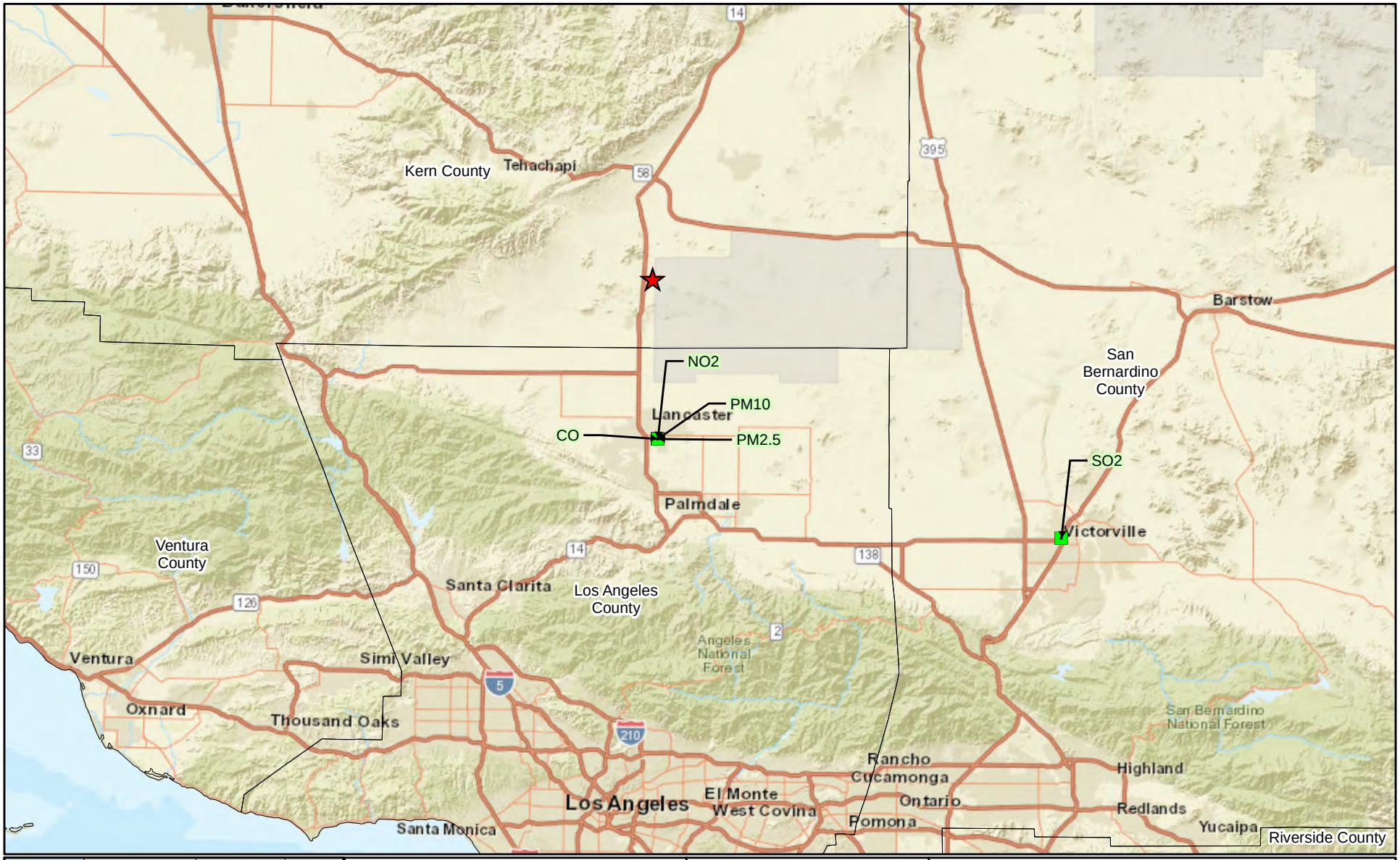
Appendix B

BACKGROUND MONITOR LOCATION FIGURES



Legend

- Background Monitoring Location
- Site Location

N

0 10 20

Miles

Scale: 1:1,000,000

EDGE ENGINEERING & SCIENCE

Appendix B
Background Monitor Locations

Pacific Steel Group
Mojave Micro Mill
Mojave, Kern County, California

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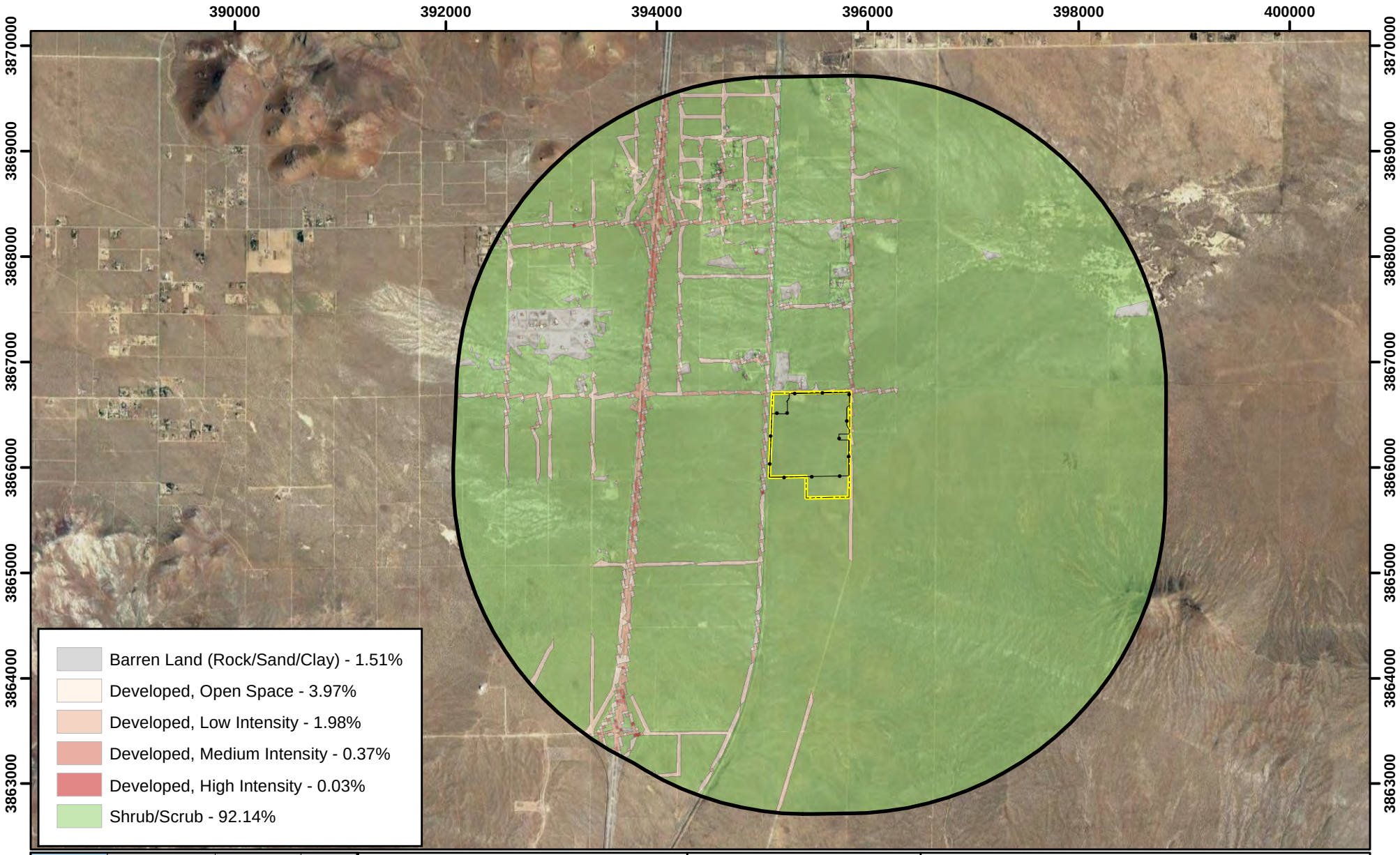
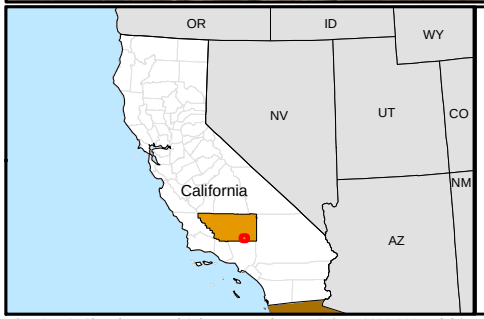
Appendix C

RURAL DISPERSION JUSTIFICATION





Legend

- Fence Line
- Property Line
- 3-km. Property Boundary Buffer

Datum: NAD_1983_UTM_Zone_11N

N

0 0.5 1

Miles

Scale: 1:50,000

EDGE ENGINEERING & SCIENCE

Appendix C
Land Use Analysis

Pacific Steel Group
Mojave Micro Mill
Mojave, Kern County, California

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F-2 Air Dispersion Modeling Protocol - Revisions

Air Dispersion Modeling Protocol – Revisions

Mojave Micro Mill Project
Mojave, Kern County, California

Prepared for

ESA

PSG PACIFIC STEEL GROUP

Revisions

May 2024

Prepared by:

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Unchanged for Protocol.

LIST OF ATTACHMENTS

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1.0 INTRODUCTION

Pacific Steel Group (PSG) plans to construct and operate a micro steel mill in Eastern Kern County, CA and will submit a major source construction air permit application to the Eastern Kern Air Pollution Control District (EKAPCD).

The proposed facility is expected to have emissions of at least one criteria pollutant in excess of a major source threshold as well as criteria pollutant emission rates above the corresponding significant emission rate (SER) threshold for all Nation Ambient Air Quality Standard (NAAQS) pollutants; therefore, the requirements of Title 40 Code of Federal Regulations (40 CFR) 52.21 Prevention of Significant Deterioration (PSD) would to be triggered for these NAAQS pollutants. An Air Quality Impact Analysis (AQIA) will be required for the project to demonstrate compliance with all ambient air quality thresholds.

This Air Dispersion Modeling Protocol (Protocol) describes the methodology to be used to demonstrate compliance with all air quality standards in support of the following permit application. The following information has been updated from the final Protocol of February 2023.

2.0 PLOT PLAN AND AREA MAP

Unchanged from the February 2023 Protocol.

3.0 AIR QUALITY MONITORING DATA

The background monitor data from the February 2023 Protocol was for the years 2019 to 2021. More recent data is available, however, some of the background monitors selected in Protocol have since been categorized as "inactive". Specifically, for the monitoring site in Lancaster, CA (ID: 06-037-9033) became inactive and does not have data for 2023, however, a new Lancaster monitoring site (ID: 06-037-9035) was established and is located approximately 4 miles northeast of its predecessor inactive site. Both Lancaster sites will be used for NO_2, however, because the new Lancaster monitoring site (ID: 06-037-9035) does not collect for CO, a different monitor was selected (ID: 06-037-6012). For PM_{10} and $PM_{2.5}$, it was determined that the Mojave monitoring station would be a more representative station for the project site, therefore the Mojave Stations (ID: 06-029-0019 and ID: 06-029-0020) will be used for these pollutants. The Victorville monitor (ID: 06-071-0306), which was previously selected for SO_2, also became "inactive" and did not collect data for 2022 or 2023, therefore, a new site was selected (ID: 06-37-1103).

Table 3-1: Background Monitors

Pollutant	AQS Monitor ID	Address	Latitude	Longitude
NO_2	06-037-9033	43301 Division Street, Lancaster, CA	34.669739	-118.130511
	06-037-9035	2551 W Avenue H, Lancaster, CA	34.725389	-118.178601
PM_{10}	06-029-0019	1773 CA-58 BUS, Mojave, CA	35.04653	-118.16283
	06-029-0020	3200 Pat Avenue, Mojave, CA	35.04944	-118.18893
$PM_{2.5}$	06-029-0019	1773 CA-58 BUS, Mojave, CA	35.04653	-118.16283
	06-029-0020	3200 Pat Avenue, Mojave, CA	35.04944	-118.18893
CO	06-037-6012	22224 Placerita Canyon Rd, Santa Clarita, CA	34.38344	-118.5284
SO_2	06-037-1103	1630 N Main Street, Los Angeles, CA	34.06659	-118.22688

The latest years of monitoring data from these monitors will be used as background concentration for this project and are presented in Table 3-2.

Table 3-2: Background Monitor Data Summary

Compound	AQS Monitor ID	Year	Averaging Period	Value Rank	Monitored Concentration		Short-term Average Background Concentration	Annual Average Background Concentration
					Parts per Billion (ppb)	µg/m³	µg/m³	µg/m³
Carbon Monoxide (CO)	06-037-6012	2023	1-hr	Second Max	1,000	1,150	1,150	--
		2023	8-hr	Second Max	500	575	575	--
Lead (Pb) [1]	--	--	Rolling 3-month	Maximum 3 Month Avg.	--	--	--	--
Nitrogen Dioxide (NO_2)	06-037-9033	2021	1-hr	98% Max Daily	42.1	79.1	68.2	--
	06-037-9033	2022			38.7	72.8		
	06-037-9035	2023			28.1	52.8		
	06-037-9035	2023	Annual	Mean	3.03	5.70	--	5.70
Particulate Matter 10 (PM_{10})	06-029-0019	2021	24-hr	Second Max	--	112	80.0	--
	06-029-0019	2022			--	66		--
	06-029-0019 06-029-0020	2023			--	62		--
Particulate Matter 2.5 ($PM_{2.5}$)	06-029-0019	2021	24-hr	98% Max Daily	--	27.1	16.3	--
	06-029-0019	2022			--	10.2		--
	06-029-0019 06-029-0020	2023			--	11.6		--
	06-029-0019	2021	Annual	Mean	--	7.48	--	6.06
	06-029-0019	2022			--	5.19	--	
	06-029-0019 06-029-0020	2023			--	5.51	--	
Sulfur Dioxide (SO_2)	06-037-1103	2021	1-hr	99% Max Daily	2.00	5.24	5.50	--
		2022			2.30	6.03		
		2023			2.00	5.24		
		2023	3-hr	Second Max	5.50	14.4	14.4	--

[1] Regional background monitoring concentration will be used for the latest year available.

4.0 MODELING EMISSIONS INVENTORY

4.1 Source Parameter Justification

The sources being evaluated as part of this modeling project will be represented as various point sources, area sources, and volume sources.

4.2 Point Sources

All vertical stack exhausts will be represented as Point sources. **Table 4-1** below shows the Point sources and stack parameters proposed for the project modeling. Ladles and Tundishes will be preheated electrically at the facility and will not be a source of air emissions.

The stack parameters for these sources are based on process knowledge and design of the facility. These parameters are determined as follows:

Location Coordinates:
The location coordinates are based on the currently planned location of the stack at the site. X and Y represent the UTM East and UTM N coordinates, respectively.

Release Height:
Release heights are determined as the height of the stack exit from the ground level. The Scrap Material Storage and Handling Indoor emission source (ES01) is the vent from the scrap material storage building. The height of the point source is equivalent to the building height. All stacks are vertical exhausts with no rain caps.

Stack Exit Temperature:
The stack exit temperature for raw material storage silo bin vents will operate at ambient temperature. This parameter will be entered in AERMOD to allow processing each hour of the modeling at respective hourly ambient temperature.

For the Meltshop Baghouse and the Scrap Torch cutting, the stack exit temperature will be based on vendor data. For cooling towers, a reasonably conservative stack exit temperature of 95 Degree Fahrenheit (°F) is used considering the site location. For the Emergency Generator and the Emergency Fire Pump, the stack exit temperature will be based on typical vendor data for the rated capacity of these units.

Stack Diameter:
Stack diameters for all point sources are based on current design and vendor data.

Stack Gas Flowrate:
Stack gas flowrate for all point sources is based on current design and vendor data. Stack for all point sources except the scrap torch cutting stack and emergency engine stacks will be connected to a baghouse. The rated capacity of the baghouse from current design and vendor data will be the basis for the stack gas flowrate for these sources. The Meltshop baghouse can be operated at two operating modes: (i) a high flow condition; and (ii) a low flow condition. The tap-to-tap operating average is

presented in Table 4-1. The stack gas flowrate for the scrap torch cutting stack and emergency engines will be based on typical vendor data for the rated capacity of these units.

Stack Gas Velocity:
Stack gas velocity is calculated from the stack gas flowrate and the stack diameter for all point sources.

Intermittent Sources:
Emergency Generator, Emergency Cooling Water Pump, and Emergency Fire Pump will be operating maximum of 200 hours per year in non-emergency mode. These two sources will be considered as "Intermittent Sources."

Table 4-1: Point Source Parameters

Emission Source No.	Description	Modeling Source Type	X (UTM)	Y (UTM)	Release Height (ft)	Stack Exit Temperature (°F)	Stack Diameter (ft)	Stack Gas Flowrate (ft^3/min)	Gas Exit Velocity (ft/s)
EID-06	Meltshop Baghouse – Tap to Tap	Point	395648	3866203	164	181.4	18.0	979,600	63.9
EID-07	Caster Spray Stack	Point	395424	3866250	97	140	1.5	6,447	60.0
EID-12	Cooling Tower 1 Cell 1	Point	395367	3866317	30	95	12	3,398	0.50
	Cooling Tower 1 Cell 2	Point	395367	3866313	30	95	12	3,398	0.50
	Cooling Tower 1 Cell 3	Point	395367	3866309	30	95	12	3,398	0.50
	Cooling Tower 1 Cell 4	Point	395367	3866306	30	95	12	3,398	0.50
EID-13	Cooling Tower 2 Cell 1	Point	395367	3866329	30	95	12	1,585	0.23
	Cooling Tower 2 Cell 2	Point	395367	3866326	30	95	12	1,585	0.23
EID-14	Cooling Tower 3	Point	395600	3866264	30	95	8	4,850	1.61
EID-15	Cooling Tower 4	Point	395611	3866264	30	95	8	410	0.14
EID-16	Emergency Fire Water Pump	Point	395367	3866384	30	961	0.5	1,400	118.8
EID-17	Emergency Cooling Water Pump	Point	395382	3866309	30	961	0.5	1,400	118.8
EID-18	Emergency Generator	Point	395414	3866307	30	600	1.25	10,475	142.3

Table 4-2 presents emission sources will be vented to the Melt Shop Baghouse (EID-06) and therefore will not be modeled separately.

Table 4-2: Sources Captured by Melt Shop Baghouse (EID-06)

Emission Source No.	Description
EID-06	Meltshop Baghouse (MS BH)
EID-06_01	Electric Arc Furnace (EAF) DEC
EID-06_02	EAF Fugitives
EID-06_03	Ladle Metallurgical Furnace (LMF) DEC
EID-06_04	Casting Operation (fugitives)
EID-06_05	Slag dump
EID-06_06	Ladle and Tundish refractory repairs
EID-06_07	Ladle and Tundish dumping
EID-06_08	MS BH Dust Silo Bin Vent
EID-06_09	MS BH Dust Loadout
EID-06_10	Activated Carbon Injection Bin Vent
EID-06_11	Carbon Silo Bin and Hopper Vent
EID-06_12	Flux Silo 1 Bin and Hopper Vent - Lime
EID-06_13	Flux Silo 2 Bin and Hopper Vent - Dolomite
EID-06_14	Scrap Cutting Torches

4.3 Area Sources

Ground-level area sources at this facility will include storage and handling of outdoor scrap, alloy, and slag. All Mill Scales at this facility will be handled in wet form and therefore will not have any air emission.

The area sources for this facility and the source parameters proposed for use in the modeling are shown below in **Table 4-3**, **Table 4-4**, and **Table 4-5**. These parameters are determined as follows:

Location Coordinates:
The location coordinates are based on the currently planned location of the area source at the site. For rectangular area sources, X and Y represent the UTM East and UTM N coordinates, respectively of the south-west corner of the area sources. For circular area sources, X and Y represent the UTM East and UTM N coordinates, respectively of the center corner of the area sources. The X and Y for the polygonal area source represent each point in the parameter of the source's UTM East and UTM N coordinates, respectively.

Release Height:
Particulate emissions from the storage and handling operations are expected to be generated near the ground level and as a conservative estimate, a release height of 10 feet (ft) is considered for all these area sources.

Length of Sides:
The lengths of sides define the area from which the emissions are expected to be generated. For all area sources, these dimensions are estimated from the current site plan.

Angle from North:
This data represents the orientation of the area sources with respect to North as 0 Degree. This information for all area sources is estimated from the current site plan.

Table 4-3: Area Source Parameters

Emission Source No.	Description	Modeling Source Type	Slag Pile Wind Erosion – Processed Fine Slag Pile	Slag Pile Wind Erosion – Processed Fine Slag Pile	Slag Pile Wind Erosion – Processed Fine Slag Pile	Slag Pile Wind Erosion – Processed Fine Slag Pile	Length of Side Y (ft)	Angle from North (deg)
EID-02	Scrap Material Storage and Handling Outdoor - Pile 1	Area	395415	3866091	10	65	120	0
	Scrap Material Storage and Handling Outdoor - Pile 2		395462	3866085	10	65	140	0
	Scrap Material Storage and Handling Outdoor - Pile 3		395506	3866104	10	18	24	0
	Scrap Material Storage and Handling Outdoor - Pile 4		395606	3866085	10	65	140	0
	Scrap Material Storage and Handling Outdoor - Pile 5		395642	3866091	10	65	120	0
	Scrap Material Storage and Handling Outdoor - Pile 6		395642	3866023	10	65	100	0
	Scrap Material Storage and Handling Outdoor - Pile 7		395606	3866023	10	65	140	0
	Scrap Material Storage and Handling Outdoor - Pile 8		395499	3866023	10	65	140	0
	Scrap Material Storage and Handling Outdoor - Pile 9		395462	3866023	10	65	140	0
	Scrap Material Storage and Handling Outdoor - Pile 10		395415	3866023	10	65	100	0
EID-03	Scrap Pile Wind Erosion	Area	Emissions combined with EID02					
EID-04	Alloy Material Storage and Handling Outdoor	Area	395491	3866260	10	50	30	90
EID-05	Alloy Pile Wind Erosion	Area	395491	3866260	10	50	30	90

EID-09	Slag Material Storage and Handling Outdoor – Part 1	Area	395285	3866099	10	36	30	0
	Slag Material Storage and Handling Outdoor – Part 2	Area	395296	3866101	10	39	20	0
	Slag Material Storage and Handling Outdoor – Part 3	Area	395278	3866118	10	39	79	0
EID-10	Slag Pile Wind Erosion - Raw Slag Pile	Area	395312	3866140	10	100	40	0
	Slag Pile Wind Erosion – Processed Fine Slag Pile	Area	395307	3866187	10	80	40	0
EID-11	Slag Screening and Crushing	Area	395296	3866180	10	70	20	90

Table 4-4: Area Polygon Source Parameters

Emission Source No.	Description	Modeling Source Type	Release Height (ft)	Number of Coordinates	X1	Y1	X2	Y2
EID-09	Slag Material Storage and Handling Outdoor – Part 4	Area Poly	10	4	395280	3866065	395308	3866065
					X3	**Y3**	**X4**	**Y4**
					395294	3866088	395280	3866088

Table 4-5: Area Circle Source Parameters

Emission Source No.	Description	Modeling Source Type	X (center)	Y (center)	Release Height (ft)	Diameter (ft)
EID-10	Slag Pile Wind Erosion – Non-Magnetic Fine Slag Pile	Area Circle	395273	3866121	10	26

4.4 Volume Sources

Elevated-level volume sources at this facility will include indoor scrap handling, the Rolling Mill ridge vent, and paved and unpaved roads. The indoor scrap handling will have a loading dock area, modeled as a volume source, and a ridge vent modeled as a

The volume sources for this facility and the source parameters proposed for use in the modeling are shown below in **Table 4-6**, **Table 4-7**, and **Table 4-8**. These parameters are determined as follows:

Location Coordinates:
The location coordinates are based on the currently planned location of the volume sources at the site. Paved and unpaved roads following the on-site pathways scrap deliveries, other material deliveries, product load out, slag yard trucks will take. For singular volume source, X and Y represent the UTM East and UTM N coordinates, respectively of the center corner of the source. The X and Y, the UTM East and UTM N coordinates, respectively, for the buoyant line sources represent the two points at either end of ridge vent.

Release Height:
For the ridge vents of the Rolling Mill and the Indoor Scrap handling, the release height is based on their respective building heights. The volume source for the scrap bay loading dock is based on half the initial plume height, which is equal to the loading bay dock opening height. The paved and unpaved haul roads follow EPA's 2012 Haul Road Workgroup Final Report Submission and is based on an average truck height of 3 meters.[1]

Length of Sides:
The lengths of sides define the initial plume size for where the emissions are expected to be generated. For all area sources, these dimensions are estimated from the current site plan. For the Rolling Mill vent, the lengths of sides are based on the width of the (minimum dimension) and the layout of the exhaust vents (maximum side). The volume source for the scrap bay loading dock is based on the initial plume width, which is equal to the loading bay dock opening width. The paved and unpaved haul roads follow EPA's 2012 Haul Road Workgroup Final Report Submission and is based on an average truck width of 3 meters.[2]

[1] U.S. EPA, 2012. Haul Road Workgroup Final Report Submission to EPA-OAQPS. Available: https://www.epa.gov/sites/default/files/2020-10/documents/haul_road_workgroup-final_report_package-20120302.pdf

[2] U.S. EPA, 2012. Haul Road Workgroup Final Report Submission to EPA-OAQPS. Available: https://www.epa.gov/sites/default/files/2020-10/documents/haul_road_workgroup-final_report_package-20120302.pdf

Table 4-6: Volume Line Source Parameters

Emission Source No.	Description	Modeling Source Type	X	Y	Release Height (ft)	Plume Height (ft)	Plume Width (ft)
EID-23	Paved Facility Roads	Volume Line Source	Follows road segments		8.4	16.7	29.5
EID-24	Unpaved Facility Roads	Volume Line Source	Follows road segments		8.4	16.7	29.5

Table 4-7: Volume Source Parameters

Emission Source No.	Description	Modeling Source Type	X	Y	Release Height (ft)	Initial Lateral Dimension (ft)	Initial Vertical Dimension (ft)
EID-01_1	Scrap Material Storage and Handling-Indoor, loading dock	Volume	3954945	3866157	16.7	29.5	8.4

Table 4-8: Buoyant Line Source Parameters

Emission Source No.	Description	Modeling Source Type	X	Y	Release Height (ft)	Length of Side X (ft)	Average Buoyancy Parameter (m^4/s^3)
EID-01_2	Scrap Material Storage and Handling-Indoor, ridge vent	Buoyant Line	X1: 395449 X2: 395518	Y1: 3866174 Y2: 3866173	75	6.0	0.0
EID-08	Roll Mill Vent	Buoyant Line	X1: 395436 X2: 395436	Y1: 3866388 Y2: 3866472	50	6.0	0.0

4.5 Off-Property Sources

Off-site sources were not evaluated in the AQIA because project level impacts were found to be below their respective significant impact levels.

4.6 Scaling Factors

The AERMOD keywords "EMISFACT" and "WSPEED" will not be used for the fugitive particulate emissions (PM_{10}/$PM_{2.5}$) from outdoor storage piles vary. Intermittent emissions for modeling of NO_2 and SO2 from emergency engines us not required because NO_2 and SO_2 emissions are below the Federal NNSR threshold. [3]

The AERMOD keyword "HROFDY" was used for select sources to represent their average daily activity.

4.7 Operating Scenarios

It is not expected that all of the emission sources at the project site will be operating simultaneously. Therefore, if necessary, separate operating scenarios will be developed for these operating conditions and will be reviewed to identify the maximum emission rates for each of the modeled NAAQS pollutants. Justification of the modeled operating scenarios will be included in the modeling report.

[3] United States Environmental Protection Agency. 2011. *Memorandum: Additional Clarification Regarding Application of Appendix W Modeling Guidance for 1-hour NO_2 National Ambient Air Quality Standard*. March. https://www.epa.gov/sites/default/files/2015-07/documents/appwno2_2.pdf,accessed December 2022.

5.0 MODEL SELECTIONS AND MODELING TECHNIQUES

The modeling methodology will follow the procedures outlined in the following guidelines:

- Guideline on Air Quality Models 40 CFR 51 Appendix W [4]; and
- South Coast Air Quality Management District (SCAQMD) Modeling Guidance for AERMOD.[5]

Site-specific and project-specific revisions to these methodologies will be made when appropriate and justified in the AQIA report.

5.1 Dispersion Model Selection

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) modeling program (AERMOD) has been updated from version 22112, as listed in the Protocol, to version 23132. The newest version will be used to predict off-site impacts for the AQIA. Modeling Procedures

5.1.1 Regulatory Options

Unchanged from the Protocol.

5.1.2 Selection of Dispersion Option

Unchanged from the Protocol.

5.1.3 Averaging Periods

Unchanged from the Protocol.

5.1.4 NO to NO_2 Conversion

This is no longer required. NO_2 emissions are below the Federal Nonattainment New Source Review (NNSR) threshold.

5.1.5 Secondary $PM_{2.5}$ Impact Determination

Determination of impact of secondary $PM_{2.5}$ formation in the atmosphere from precursors (NO_X and SO_2) is required for Class I increments analysis and Class II SIL, NAAQS, and increment analysis. The impacts will be estimated using USEPA's Guidance on the Development Modeled Emission Rates as Precursors (MERP) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program.[4] Total NO_X and SO_2 emissions from the project will be used in the analysis and impacts will be determined using the MERP values for hypothetical sources modeled by USEPA. Source No. 26 in USEPA's list is in Kern County and is considered to be representative of the project site at this time.

[4] United States Environmental Protection Agency; April 30, 2024, Memorandum from Tyler Fox, Group Leader to Regional Office Modeling Contacts. "Clarification on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD Permitting Program".

The secondary $PM_{2.5}$ impact will be added to the primary $PM_{2.5}$ impact to determine the total $PM_{2.5}$ impact for the project emissions.

5.1.6 Building Wake Effects (Downwash)

The USEPA's Building Profile Input Program downwash algorithms will be used to determine the parameters for accounting aerodynamic downwash from buildings and structures on modeled emission sources. Based on a review of the site plot plan and a visual survey of the project site, there are several buildings/structures which could potentially cause aerodynamic downwash to the modeled emission sources and these buildings/structures will be included in the AQIA. Current information on the downwash structures to be included, including height, size, and Universal Transverse Mercator (UTM) location information, are listed **Table 5-1**. The buildings have been updated since the February 2023 Protocol.

Table 5-1: Buildings and Structure Downwash Information (UTM Coordinates)

Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1A	22.86					395449	3866157	395449	3866190	395518	3866189	395518	3866156
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1BC	33.53					395454	3866315	395454	3866297	395453	3866261	395450	3866261
							X5	**Y5**	**X6**	**Y6**	**X7**	**Y7**	**X8**	**Y8**
							395450	3866252	395449	3866213	395449	3866199	395449	3866166
							X9	**Y9**	**X10**	**Y10**	**X11**	**Y11**	**X12**	**Y12**
							395449	3866152	395424	3866152	395424	3866166	395425	3866212
							X13	**Y13**						
							395427	3866315						
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1D	11.58					395424	3866166	395402	3866166	395402	3866199	395417	3866198
							X5	**Y5**	**X6**	**Y6**	**X7**	**Y7**	**X8**	**Y8**
							395417	3866203	395407	3866203	395407	3866212	395425	3866212
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1E	11.58					395449	3866213	395450	3866252	395471	3866252	395470	3866213
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1FG	15.24					395455	3866386	395428	3866386	395428	3866390	395413	3866390
							X5	**Y5**	**X6**	**Y6**	**X7**	**Y7**	**X8**	**Y8**
							395414	3866473	395456	3866472	395455	3866421	395455	3866407
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1H	12.19					395454	3866315	395427	3866315	395418	3866315	395419	3866381

							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395427	3866381	395428	3866386	395455	3866386	395454	3866381
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_1I	15.24		37.25	267.85	269.6	395301	3866511						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_1J	10.67					395454	3866297	395454	3866381	395475	3866381	395474	3866296
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_1K	6.71		5.71	13.17	359.43	395455	3866407						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_1L	15.24		36.37	227.05	269.6	395322	3866547						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1						
							[m]	[m]						
Building	BLD_1M	13.72		36.37	227.05	269.6	395322	3866583						
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_2	7.62					395513	3866358	395538	3866357	395536	3866249	395512	3866249
Downwash Type	Modeled Building ID	Maximum Height (m)	Diameter (m)	X Length (m)	Y Length (m)	Rotation Angle (deg)	X1	Y1	X2	Y2	X3	Y3	X4	Y4
							[m]	[m]	[m]	[m]	[m]	[m]	[m]	[m]
Building	BLD_3	6.40					395256	3866637	395256	3866615	395265	3866615	395265	3866604
							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395243	3866604	395243	3866604	395237	3866604	395237	3866610
							X9	Y9	X10	Y10	X11	Y11	X12	Y12
							395238	3866610	395238	3866622	395231	3866622	395231	3866626
							X13	Y13	X14	Y14	X15	Y15	X16	Y16

							395233	3866626	395233	3866632	395243	3866632	395243	3866637
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_4	5.49					395242	3866590	395263	3866590	395263	3866587	395265	3866587
							X5	**Y5**	**X6**	**Y6**	**X7**	**Y7**	**X8**	**Y8**
							395265	3866577	395262	3866577	395262	3866571	395241	3866572
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_5	5.49					395342	3866133	395373	3866132	395373	3866062	395342	3866062
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_6A	5.49					395413	3866319	395398	3866319	395398	3866327	395398	3866329
							X5	**Y5**	**X6**	**Y6**				
							395413	3866329	395413	3866327				
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	BLD_6B	5.49					395412	3866368	395398	3866368	395398	3866370	395398	3866378
							X5	**Y5**	**X6**	**Y6**				
							395412	3866378	395412	3866370				
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**						
							[m]	**[m]**						
Building	BLD_7	5.49		13.49	6.48	179.43	395753	3866296						
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**						
							[m]	**[m]**						
Building	BLD_8	5.49		8.39	8.02	30	395798	3866394						
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	WTPLANT	6.10					395385	3866355	395386	3866265	395380	3866265	395380	3866230

							X5	Y5	X6	Y6	X7	Y7	X8	Y8
							395382	3866230	395382	3866220	395368	3866220	395367	3866249
							X9	Y9	X10	Y10	X11	Y11	X12	Y12
							395358	3866249	395357	3866273	395369	3866273	395370	3866343
							X13	Y13	X14	Y14				
							395360	3866343	395360	3866355				
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	FTPLT1	6.10					395582	3866212	395615	3866212	395615	3866196	395582	3866196
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	FTPLT2	6.10					395612	3866179	395620	3866179	395620	3866167	395612	3866167
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**	**X2**	**Y2**	**X3**	**Y3**	**X4**	**Y4**
							[m]	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**	**[m]**
Building	FTPLT3	6.10					395573	3866195	395580	3866195	395579	3866182	395573	3866183
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**						
							[m]	**[m]**						
Tank	TANK1	6.10	25.33				395372	3866381						
Downwash Type	**Modeled Building ID**	**Maximum Height (m)**	**Diameter (m)**	**X Length (m)**	**Y Length (m)**	**Rotation Angle (deg)**	**X1**	**Y1**						
							[m]	**[m]**						
Tank	TANK2	6.1	20.26				395341	3866267						

5.1.7 Receptor Grid

Unchanged from the Protocol.

5.1.8 Meteorological Data

Unchanged from the Protocol.

5.1.9 Terrain Data

Unchanged from the Protocol.

6.0 MODELING METHODOLOGY

Unchanged from the Protocol.

7.0 MODELING REPORT

7.1 Interim Submittal

This document quantifies as the Interim Submittal.

7.2 Final AQIA Report

On completion of AQIA, a report will be prepared and submitted to demonstrate compliance with all applicable air quality impact requirements for the project. The report will include the details identified below.

- Brief overview of project;
- Area Map and Facility Plot Plan indicating sources, property line, clear scale, and true north;
- Emission rate summary for all project sources, with units consistent with modeling;
- Stack parameter summary for all project sources, with units consistent with modeling;
- Any calculations for stack parameters (e.g., combined stacks, flares, etc.);
- Source parameters for volume and area sources with justifications;
- Approved modeling protocol;
- Technical basis for any non-standard procedure with documentation of prior approval;
- Summary of all model inputs (e.g., model used, met data, rural or urban dispersion coefficients, etc.);
- Comparison of all modeling results to the applicable standards; and
- Electronic copies of all modeling files, including input and output files, meteorological data, building downwash files.

F-3 USEPA April 30, 2024 Memorandum

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING AND
STANDARDS

April 30, 2024

MEMORANDUM

SUBJECT: Clarification on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program

FROM: Tyler Fox, Group Leader
Air Quality Modeling Group
Air Quality Assessment Division
Office of Air Quality Planning and Standards

TO: Regional Office Modeling Contacts

On February 7, 2024, the U.S. Environmental Protection Agency (EPA) strengthened the National Ambient Air Quality Standards (NAAQS) for Particulate Matter (PM). The EPA set the level of the primary (health-based) annual $PM_{2.5}$ standard at 9 micrograms per cubic meter to provide increased public health protection, consistent with the available health science. The EPA did not change the primary and secondary (welfare-based) 24-hour $PM_{2.5}$ standards, secondary annual $PM_{2.5}$ standard, or primary and secondary PM_{10} standards.[1]

To facilitate new source permitting under the Prevention of Significant Deterioration (PSD) program, the EPA updated the recommended significant impact levels (SILs) for the primary annual $PM_{2.5}$ NAAQS and PSD increments. On April 30, 2024, the EPA released the "Supplement to the Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program" (Supplemental SILs Guidance) that included these new SILs values along with the technical basis to support their update.[2]

As a result of the updates to the SIL values for the annual $PM_{2.5}$ NAAQS and PSD increments, updates to the April 30, 2019, "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting

[1] https://www.epa.gov/pm-pollution/national-ambient-air-quality-standards-naaqs-pm

[2] https://www.epa.gov/nsr/significant-impact-levels-ozone-and-fine-particles

Program" (MERPs Guidance) are necessary.[3] Specifically, the form of the MERP has changed to provide greater flexibility for a direct comparison with critical air quality thresholds (i.e., recommended SIL values for ozone and $PM_{2.5}$) rather than direct comparison to emission rates considered equivalent to a significant air quality threshold. Any MERP values presented as an emission rate published in the MERPs Guidance or through online tools should no longer be used for PSD permitting applications since the form of these values explicitly included a significant impact level that is no longer appropriate.

In lieu of re-releasing the MERPs Guidance, the EPA is providing through this memorandum clarifying information on methods to develop a normalized air quality impact to compare against critical air quality thresholds. This method is consistent with the practical application of the MERPs approach as a Tier 1 demonstration approach. We will append this memorandum to the front of that guidance document for ongoing clarity and future reference.

If there are any questions regarding the clarifying information regarding the development of normalized air quality impacts to compare against the new SILs for the annual $PM_{2.5}$ NAAQS and PSD increments presented in the Supplemental SILs Guidance, please contact George Bridgers or Alyssa Piliero of EPA's Air Quality Modeling Group at bridgers.george@epa.gov or piliero.alyssa@epa.gov.

Attachment

cc: Richard Wayland, C304-02
Scott Mathias, C504-01
Rochelle Boyd, C504-03
George Bridgers, C439-01
Alyssa Piliero, C439-01
EPA Air Program Managers
EPA Regional Modeling Contacts

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

Attachment

Clarification on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program

Background

In 2017, EPA finalized revisions to the *Guideline on Air Quality Models* (the "*Guideline,*" published as Appendix W to 40 CFR part 51) that recommend a two-tiered approach for addressing new or modified source impacts on ozone (O_3) and secondary particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) (U.S. Environmental Protection Agency, 2017). The first tier (or Tier 1) involves use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. The second tier (or Tier 2) involves more sophisticated case-specific application of chemical transport modeling (e.g., with an Eulerian grid or Lagrangian model).

As EPA introduced in the preamble to the 2015 proposed revisions to the *Guideline*, Modeled Emission Rates for Precursors (MERPs) can be viewed as a type of Tier 1 demonstration tool under the Prevention of Significant Deterioration (PSD) permitting program that provides a simple way to relate maximum downwind impacts with a critical air quality threshold (e.g., a significant impact level or SIL) (U.S. Environmental Protection Agency, 2018). The purpose of this document is to inform permit applicants that the form of the MERP has been changed from the original guidance document (U.S. Environmental Protection Agency, 2019) to provide greater flexibility for comparison with critical air quality thresholds. Any MERPs published in guidance documents or through online tools that are expressed as an emission rate should not be used to support permit applications since that form of the tool explicitly included a critical air quality threshold that may no longer be appropriate. Consistent with current real-world practice, permit applicants should instead develop a normalized air quality impact to compare with a critical air quality threshold as detailed in this document.

Properly supported MERPs provide a straightforward way to relate modeled downwind impacts with an air quality threshold that is used to determine if such an impact causes or contributes to a violation of the appropriate National Ambient Air Quality Standard (NAAQS). Facility specific air quality impacts estimated using MERPs can be compared to any air quality threshold of concern ("critical air quality threshold") including SILs. In practice, MERPs are the normalized modeled air quality impact related to a specific modeled emissions level that is intended to be used as an analytical tool for PSD air quality analyses. For $PM_{2.5}$, the modeled air quality impact of an increase in precursor emissions from the hypothetical source is expressed in units of $\mu g/m^3$. For O_3, the modeled air quality impact is expressed in ppb.

EPA recommends that the permit applicant in consultation with the appropriate reviewing authority follow a three-step process:

1) Identify a representative hypothetical source (or group of sources for an area) from EPA's modeling results.

    - ✓ If a representative hypothetical source is not available, then consider whether any of the derived MERP values (representing the normalized air quality impact per emission rate) available for the geographic location of the project source may be appropriate to use. Alternatively, one can consider conducting photochemical modeling to derive a source- or area-specific value.

2) Acquire the source characteristics and associated modeling results for the hypothetical source(s).

3) Apply the source characteristics and photochemical modeling results from Step 2 above to the MERP equation to project the air quality impact and compare to the appropriate SIL.

Permit applicants should provide a narrative explanation describing how project source emissions relate to the information provided as part of their Tier 1 demonstration. It should be made clear how the chemical and physical environments modeled as part of an existing set of information included in their Tier 1 demonstration are relevant to the geographic area of the project and key receptors.

For situations where project sources are required to assess multiple precursors of $PM_{2.5}$ or of O_3, EPA recommends that the impacts of multiple precursors should be estimated in a combined manner for comparison to the appropriate SIL such that the sum of precursor impacts would be lower than the SIL in a demonstration of compliance. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration.

At the start of this process, EPA recommends that the permit applicant consult with the appropriate reviewing authority in developing a modeling protocol (per Section 9 of the *Guideline*) and that both parties confirm, at that time, the appropriateness of using these modeling results for the permitting situation. As part of the protocol, the permit applicant should include a narrative that provides a technical justification that the existing information or planned photochemical modeling is appropriate for the project source(s).

The following sections provide details on the use of MERPs for PSD compliance demonstrations for: 1) source impact analysis, 2) $PM_{2.5}$ increment analysis, and 3) cumulative impact analysis.

Source Impact Analysis

The *Guideline* recommends a two-tiered approach for addressing single-source impacts on O_3 or secondary $PM_{2.5}$ (U.S. Environmental Protection Agency, 2017) with the first tier involving use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. Consistent with the recommendations in EPA's *Guideline*, the appropriate tier for a given application should be selected in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and after reviewing EPA guidance. This section describes how applicants might choose, in consultation with the appropriate permitting authority, to use MERPs in estimating single-source impacts on secondary pollutants under the first-tier approach (i.e., sections 5.3.2.b and 5.4.2.b of the *Guideline*).

Properly supported MERPs provide a simple way to relate modeled downwind impacts with an air quality threshold that is used to determine if such an impact causes or contributes to a violation of the appropriate NAAQS. Consistent with EPA's SILs guidance, to the extent a permitting authority elects to use a SIL to help quantify a level of impact that does not cause or contribute to a violation of the O_3 and/or $PM_{2.5}$ NAAQS or $PM_{2.5}$ PSD increment(s), such values will need to be justified on a case-by-case basis. The MERP value for the purposes of a PSD compliance demonstration represents the model predicted relationship between precursor emissions from hypothetical sources and their downwind modeled impacts. This normalized relationship can be combined with the project emissions and compared to the appropriate SIL value using the following equation:

Eq 1. $$\text{Project Air Quality Impact} = \text{Project emission rate} \times \frac{\text{Modeled air quality impact from hypothetical source}}{\text{Modeled emission rate from hypothetical source}}$$

For $PM_{2.5}$, the modeled air quality impact of an increase in precursor emissions from the hypothetical source is expressed in units of $\mu g/m^3$. For O_3, the modeled air quality impact is expressed in ppb. As discussed in Section 4, these modeled impacts would reflect the maximum downwind impacts for $PM_{2.5}$ and O_3. The SIL value is expressed as a concentration for $PM_{2.5}$ (in $\mu g/m^3$) and mixing ratio for O_3 (in ppb). Consistent with the air quality model application used here to predict a change in pollutant concentration, MERPs are expressed as an annual emissions rate (in this case as tons per year).

The use of MERPs as a Tier 1 demonstration tool can be based on either (1) EPA photochemical modeling with the source-specific value for a representative hypothetical source or (2) the source- or area-specific value derived from a more similar hypothetical source modeled by a permit applicant or permitting authority. In some situations, the most conservative (lowest) MERP value across a region/area could be considered representative. The relevant geographic area could range from a county or airshed to a state or multi-state region. The selection of this geographic area may be determined in consultation with the appropriate reviewing authority and technical justification should be provided in the modeling protocol and/or permit-related documentation.

The EPA recommends that the permit applicant follow a three-step process.

1) Identify a representative hypothetical source (or group of sources for an area) from EPA's modeling. If a representative hypothetical source is not available, then consider whether an EPA derived MERP value available for the broader geographic area of the project source may be adequately representative and thus appropriate to use. Alternatively, one can consider conducting photochemical modeling to derive appropriate information to derive a source- or area-specific value.

   The permit applicant should provide the appropriate permitting authority with a technically credible justification that the source characteristics (e.g., stack height, emissions rate) of the specific project source described in a permit application and the chemical and physical environment (e.g., meteorology, background pollutant concentrations, and regional/local emissions) near that project source are adequately represented by the selected hypothetical source(s).

2) Acquire the source characteristics and associated modeling results for the hypothetical source(s). If using EPA modeling, then access these data from the on-line spreadsheet on EPA's SCRAM website[4]. If using other modeling, then access these data from the relevant input and output files.

3) Apply the source characteristics and photochemical modeling results from Step 2 to the MERP equation with the project emissions to assess the project source impacts.

In general, for situations where the project source emits only one precursor for O_3 or secondary $PM_{2.5}$ (and no primary $PM_{2.5}$ emissions), the project source emissions for that precursor can be compared directly to the appropriate MERP value for that precursor to determine if the applicable SIL is exceeded or not. For situations where project sources are required to assess multiple precursors, EPA recommends that the project source impacts on O_3 or secondary $PM_{2.5}$ reflect the sum of air quality changes resulting from each of those precursors for comparison to the EPA recommended SIL. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration. In such cases, the project source impacts associated with their direct $PM_{2.5}$ emissions should be assessed through dispersion modeling.

$PM_{2.5}$ Increment Analysis

This section provides information for single source permit demonstrations for PSD increment of $PM_{2.5}$ at Class I areas. According to 40 CFR 51.166(c)(1) and 52.21(c), an allowable PSD increment based on an annual average may not be exceeded, and the allowable PSD increment

[4] https://www.epa.gov/scram/merps-view-qlik

for any other time period may be exceeded once per year at any one location. Currently there is no PSD increment for O_3 so no PSD increment demonstration for O_3 is necessary. The $PM_{2.5}$ PSD increment SIL values recommended by EPA for Class II and III areas are the same as the recommended $PM_{2.5}$ NAAQS SIL values so no separate PSD increment demonstration is needed for Class II and III areas.

The hypothetical model results provided in this document represent peak impacts for secondary $PM_{2.5}$, which are typically within 50 km from the source (see section 3.2.1). These impacts may not be applicable for PSD increment demonstrations at Class I area receptors that may be far downwind (beyond 50 km) of the project source. As stated in the *Guideline*, AERMOD is the preferred dispersion model for estimating primary $PM_{2.5}$ impacts from single sources for distances up to 50 km. Currently, there is no preferred modeling system for estimating long range transport impacts (i.e., beyond 50 km). The *Guideline* establishes a screening approach for such assessments (U.S. Environmental Protection Agency, 2017).

The screening approach for the primary $PM_{2.5}$ component of a PSD Class I area demonstration beyond 50 km could include AERMOD estimates at or about 50 km from the project source (Section 4.2.c.i of the *Guideline*) or a second level assessment based on modeling primary $PM_{2.5}$ that does not include plume-depleting processes to ensure a conservative estimate (Section 4.2.c.ii of the *Guideline*). The *Guideline* suggests a Lagrangian or comparable modeling system would be appropriate for a second level assessment. Photochemical grid models have been shown to demonstrate similar skill to Lagrangian models for long range pollutant transport when compared to measurements made from multiple mesoscale field experiments (ENVIRON, 2012; U.S. Environmental Protection Agency, 2016a). EPA modeled a subset of the hypothetical sources shown in Figure 3-2 with tracking of primary $PM_{2.5}$ contribution (N=36) using the CAMx model applied without chemistry. A table of maximum daily average and maximum annual average primary $PM_{2.5}$ impacts by emission rate are shown in Table 1. This table is intended to provide illustrative information about peak downwind primary $PM_{2.5}$ impacts at distances beyond 50 km and where agreed to by the appropriate reviewing authority may provide relevant information to support Tier 1 PSD Class I increment demonstrations.

Table 1. Maximum daily average and maximum annual average primary $PM_{2.5}$ impacts at 100, 200, and 300 km from modeled hypothetical source.

Emission Rate (tpy)	Distance from source (km)	Highest Daily Average Concentration (μg/m^3) - tall stack	Highest Daily Average Concentration (μg/m^3) - surface release	Highest Annual Average Concentration (μg/m^3) - tall stack	Highest Annual Average Concentration (μg/m^3) - surface release
100	300	0.0117	0.0123	0.0008	0.0009
100	200	0.0223	0.0212	0.0016	0.0015
100	100	0.0537	0.0445	0.0070	0.0049
150	300	0.0180	0.0184	0.0012	0.0013
150	200	0.0328	0.0311	0.0024	0.0022
150	100	0.0807	0.0632	0.0102	0.0073
500	300	0.0610	0.0625	0.0044	0.0045
500	200	0.1167	0.1095	0.0087	0.0078
500	100	0.2717	0.2536	0.0379	0.0238
1000	300	0.1186	0.1217	0.0087	0.0089
1000	200	0.2300	0.2161	0.0175	0.0157
1000	100	0.5445	0.5009	0.0731	0.0477

Single source impacts on secondary $PM_{2.5}$ tend to decrease as distance from the source increases (Baker, Kotchenruther, & Hudman, 2016), which means peak source impacts presented in previous sections to inform a $PM_{2.5}$ NAAQS air quality assessment may not provide relevant information for the spatial scales involved between project sources and Class I areas.

The hypothetical source impact information generated as part of the illustrative examples shown here or other credible existing single source modeling could provide information relevant for Class I SIL screening demonstrations. Rather than using the peak impact, the entirety of modeled information available for a specific project source (if available) or hypothetical source (such as but not limited to the sources modeled as part of this document) could be used to provide an estimate of secondary $PM_{2.5}$ impacts at distances further downwind.

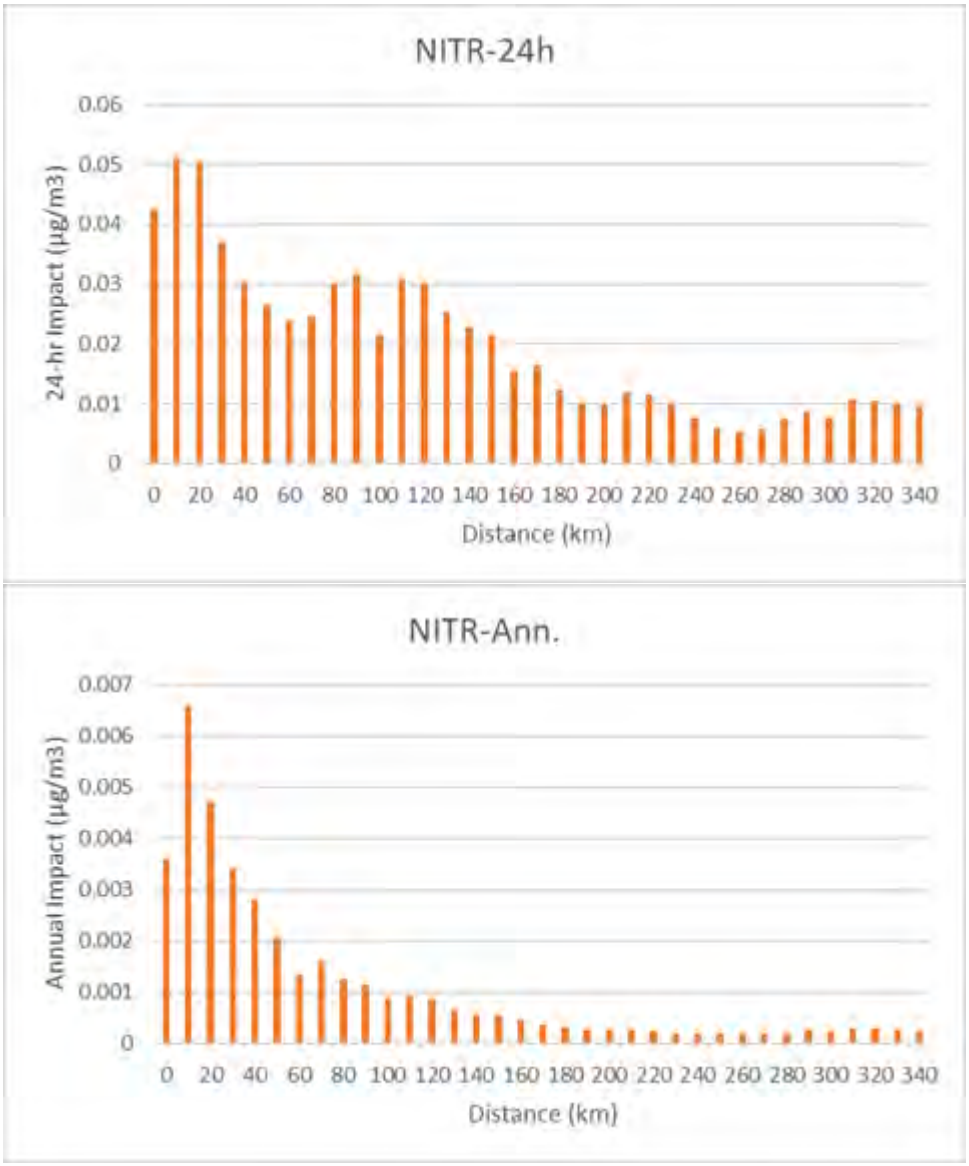
Consistent with the long-range transport (LRT) screening approach in the *Guideline*, the initial screening step would be to select one or more of the hypothetical sources modeled as part of the illustrative assessment provided in this document that are found to be similar to the project source. Then, modeled maximum secondary $PM_{2.5}$ impacts at or greater than 50 km would be used in combination with primary $PM_{2.5}$ impacts estimated with AERMOD at 50 km downwind of the source for comparison to the EPA recommended $PM_{2.5}$ Class I SIL value. Information about using AERMOD to support a LRT demonstration for primary pollutants is provided elsewhere (U.S. Environmental Protection Agency, 2016b).

If the results of the initial screening step show an exceedance of the $PM_{2.5}$ Class I SIL value, a second more refined screening step would involve selecting the highest modeled secondary $PM_{2.5}$ impact at or less than the downwind distance of the Class I area relative to the project source. That value would be combined with primary $PM_{2.5}$ impacts estimated with AERMOD at

50 km downwind and compared with the EPA recommended $PM_{2.5}$ Class I SIL. Another option for this screening step would also involve selecting the highest modeled secondary $PM_{2.5}$ impact at or near the downwind distance of the Class I area relative to the project source but include an estimate of primary $PM_{2.5}$ impacts estimated with a chemical transport model (e.g., Lagrangian or photochemical model) at or less than the downwind distance of the Class I area relative to the project source.

An illustrative example of this type of a screening demonstration for Class I $PM_{2.5}$ increment would be a 3,000 tons per year (tpy) NO_X project source that emits near the surface in the northeast U.S. This project source does not emit SO_2 so secondary formation of $PM_{2.5}$ sulfate ion does not need to be considered in addition to $PM_{2.5}$ nitrate formation from the NO_X emissions. The nearest Class I area is ~300 km downwind of the project source. Multiple hypothetical sources (3 for this particular example) with ground-level emission release characteristics near the project source were examined for annual and 24-hr average $PM_{2.5}$ nitrate impacts at or greater than 50 km and at or near 300 km downwind of the source in any direction. Figure 4-2 shows the peak hypothetical source impacts from 500 tpy of emissions at ~50 km downwind on $PM_{2.5}$ nitrate for daily $PM_{2.5}$ is 0.032 $\mu g/m^3$ and annual $PM_{2.5}$ is 0.002 $\mu g/m^3$. As shown, at approximately 310 km from the project source, the peak hypothetical source impacts on $PM_{2.5}$ nitrate for daily $PM_{2.5}$ would be 0.01 $\mu g/m^3$ and 0.0003 $\mu g/m^3$ for annual $PM_{2.5}$ (see Figure 1).

Figure 1. Modeled peak daily average (top) and annual average (bottom) $PM_{2.5}$ nitrate ion impacts from a hypothetical 500 tpy surface level source of NO_X emissions by distance downwind of the source.



The hypothetical source NO_X emission rate is 500 tpy and the project source emission rate is 3,000 tpy. Impacts from the 500 tpy hypothetical sources are linearly scaled (increased in this example) to be better representative of the project source emission rate. For example, the daily $PM_{2.5}$ nitrate impacts at 50 km downwind would be adjusted to 0.192 µg/m^3: 0.032 µg/m^3 * 3000 tpy/500 tpy = 0.192 µg/m^3. The annual $PM_{2.5}$ nitrate impacts at 300 km downwind would be adjusted to 0.0018 µg/m^3: 0.0003 µg/m^3 * 3000 tpy/500 tpy = 0.0018 µg/m^3.

As part of the initial screening step, the project source impact of 0.192 μg/m^3 for daily $PM_{2.5}$ at 50 km downwind is added to its primary impact estimated with AERMOD at 50 km for comparison with the EPA recommended 24-hr $PM_{2.5}$ Class I area SIL of 0.27 μg/m^3. Assuming the primary impacts are below 0.078 μg/m^3, the project source could include this screening demonstration in its PSD application. Otherwise, the project source would move on to the second step with more refined screening demonstration based on 0.01 μg/m^3 impacts per 500 tpy NO_X at 300 km distance downwind, i.e., 0.01 μg/m^3 * 3000 tpy/500 tpy = 0.06 μg/m^3 of $PM_{2.5}$ nitrate.

This estimate of secondary contribution at the distance of the Class I area from the project source would then be added to the primary impacts modeled with AERMOD at 50 km and be compared with the EPA recommended $PM_{2.5}$ Class I SIL. If the sum of the more refined secondary contribution paired with the primary $PM_{2.5}$ contribution exceeds the SIL, the next step in the screening demonstration would utilize an estimate of primary $PM_{2.5}$ using a chemical transport model (e.g., Lagrangian or photochemical model) that can be paired with the secondary impact at 300 km downwind (as shown above). In situations where the screening demonstration does not show downwind impacts of $PM_{2.5}$ at Class I areas below the SIL, then a more refined approach to estimate the impacts from their project source based on methods suggested for Tier 2 demonstrations may be considered prior to conducting a cumulative impact analysis.

Cumulative Impact Analysis

As detailed in Section 9 of the *Guideline*, for situations where the project source is not able to demonstrate compliance through the source impact analysis, a cumulative impact analysis can be conducted that accounts for the impacts from the project source, impacts from nearby sources (as appropriate), and monitored background levels. The cumulative impacts are then compared to the NAAQS to determine whether the project source could cause or contribute to a NAAQS exceedance.

The following section provides examples of developing a suitable Tier 1 demonstration tool for each precursor and secondary pollutant for the purposes of a cumulative impact analysis. Where only a single precursor of O_3 or $PM_{2.5}$ necessitates a demonstration, then a direct application of this approach would be appropriate. For situations where project sources are required to assess multiple precursors of $PM_{2.5}$ or of O_3, EPA recommends that the impacts of multiple precursors should be estimated in a combined manner for comparison to the appropriate SIL such that the sum of precursor impacts would be lower than the SIL in a demonstration of compliance. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration. In such cases, the project source impacts associated with their direct $PM_{2.5}$ emissions should be assessed through dispersion modeling. The examples below include each of these situations.

The Tier 1 demonstration approach can be used for a cumulative impact assessment. Here, existing relevant single source modeled impacts (Eq. 1) can be estimated and then added to the appropriate background contribution for comparison to the NAAQS. For simplicity in these examples, nearby and background levels are represented by the design value from a representative monitor. In this situation, the cumulative assessment would include the sum of equation 1 and that monitored design value.

Eq. 2 Projected Design Value with Project $=$ Project Impact (Eq. 1) + Monitored Design Value

If equation 2 results in an air quality level less that the NAAQS, then there is no NAAQS violation for which the source could cause or contribute to. However, if equation 2 results in an air quality level greater than the NAAQS, then the permit applicant should consult with the reviewing authority to determine the next step in the demonstrating project source impact at the location of the NAAQS violation. This may necessitate more refined modeling to reconcile project source impacts and monitored design values to complete the second phase of the cumulative impact analysis.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

APR 3 0 2019

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

MEMORANDUM

SUBJECT: Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program

FROM: Richard A. Wayland, Director Rachel A. Wayland
Air Quality Assessment Division

TO: Regional Air Division Directors

The Environmental Protection Agency (EPA) is providing the attached *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* in final form. This guidance reflects the EPA's recommendations for how air agencies conduct air quality modeling and related technical analyses to satisfy compliance demonstration requirements for ozone and secondary $PM_{2.5}$ under the Prevention of Significant Deterioration (PSD) permitting program.

This document is not binding and does not change or substitute for provisions of the Clean Air Act (CAA) or CAA regulations, nor is it a regulation or final agency action itself. As the term "guidance" indicates, it provides recommendations on compliance demonstration tools that may be used together with other relevant information in satisfying air quality modeling requirements for PSD permitting. Thus, it does not impose enforceable requirements on any party. In addition, the guidance may not apply to a particular situation based upon the circumstances. Permitting decisions by the EPA or an air agency regarding a PSD permit application are made based on the applicable statutory and regulatory provisions and the relevant permitting record.

A detailed framework is provided in this document that permit applicants may choose to use, subject to review by the appropriate permitting authority, to estimate single source impacts on secondary pollutants under the first tier (Tier 1) approach put forth in EPA's *Guideline on Air Quality Models* (Appendix W to 40 CFR part 51). For Tier 1 assessments, it is generally expected that applicants would use existing empirical relationships between precursors and secondary impacts based on modeling systems appropriate for this purpose as detailed in relevant EPA guidance. We are providing this guidance document for consideration and use by permitting authorities and permit applicants on a case-by-case basis under the PSD program in assessing the effects of precursors of $PM_{2.5}$ and ozone.

This document also presents the EPA's modeling of hypothetical single source impacts on ozone and secondary $PM_{2.5}$ to illustrate how this framework can be implemented by stakeholders. The modeling relationships and illustrative MERPs presented here, in some cases, may provide relevant technical information to assist or inform an applicant in providing a Tier 1 demonstration and also as a template for permit applicants and/or state or local agencies to develop information relevant to a specific area or source type.

If there are any questions regarding this guidance, please contact George Bridgers of EPA's Air Quality Modeling Group at (919) 541-5563 or *bridgers.george@epa.gov*.

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Attachment

Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program

EPA-454/R-19-003
April 2019

Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
Air Quality Modeling Group
Research Triangle Park, NC

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EXECUTIVE SUMMARY

EPA finalized revisions to the *Guideline on Air Quality Models* (the "*Guideline,*" published as Appendix W to 40 CFR part 51) that recommend a two-tiered approach for addressing single-source impacts on ozone (O_3) and secondary particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) (U.S. Environmental Protection Agency, 2017a). The first tier (or Tier 1) involves use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. The second tier (or Tier 2) involves more sophisticated case-specific application of chemical transport modeling (e.g., with an Eulerian grid or Lagrangian model).

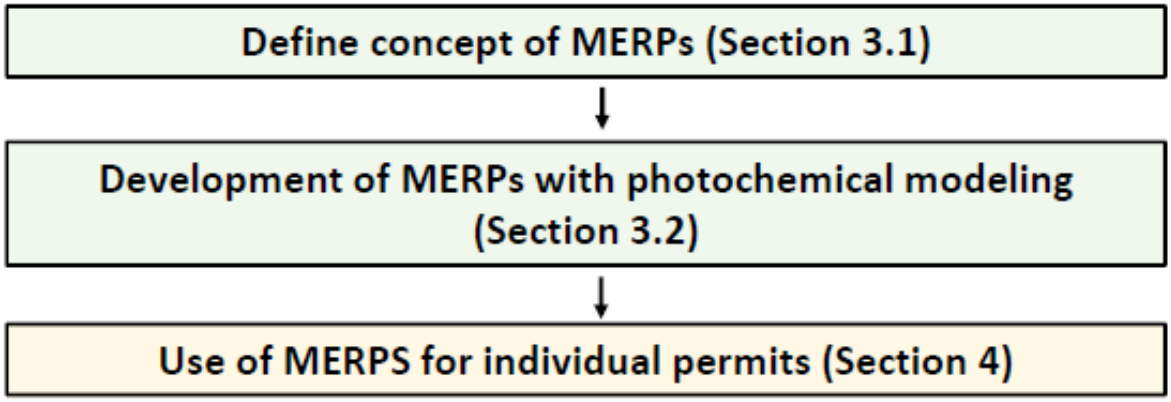
As EPA introduced in the preamble to the 2015 proposed revisions to the *Guideline*, Modeled Emission Rates for Precursors (MERPs) can be viewed as a type of Tier 1 demonstration tool under the Prevention of Significant Deterioration (PSD) permitting program that provides a simple way to relate maximum downwind impacts with a critical air quality threshold (e.g., a significant impact level or SIL) (U.S. Environmental Protection Agency, 2018). The purpose of this document is to provide a framework for permitting authorities and permit applicants on how air quality modeling can be used to develop relationships between precursors and maximum downwind impacts for the purposes of developing a technically credible Tier 1 demonstration tool.

A conceptual understanding of an area's emission sources and which precursor emissions limit the formation of secondary pollutants such as O_3 and $PM_{2.5}$ is useful for interpreting modeled and monitored impacts due to changes in emissions to that area. O_3 formation is a complicated, nonlinear process that depends on meteorological conditions in addition to volatile organic compounds (VOC) and nitrogen oxides (NO_x) concentrations (Seinfeld and Pandis, 2012). Warm temperatures, clear skies (abundant levels of solar radiation), and stagnant air masses (low wind speeds) increase O_3 formation potential (Seinfeld and Pandis, 2012). In the case of $PM_{2.5}$, or fine PM, total mass is often categorized into two groups: primary (i.e., emitted directly as $PM_{2.5}$ from sources) and secondary (i.e., $PM_{2.5}$ formed in the atmosphere by precursor emissions from sources). $PM_{2.5}$ organic carbon is directly emitted from primary sources and also formed secondarily in the atmosphere by reactions involving VOCs. $PM_{2.5}$ sulfate, nitrate, and ammonium are predominantly the result of chemical reactions of the oxidized products of sulfur dioxide (SO_2) and NO_X emissions and direct ammonia (NH_3) emissions (Seinfeld and Pandis, 2012).

A Tier 1 demonstration tool, as described in the *Guideline,* consists of technically credible air quality modeling that relates precursor emissions and secondary pollutant impacts from specific or hypothetical sources (U.S. Environmental Protection Agency, 2017a). Existing credible air quality modeling generally may include single source modeling based on an approved State Implementation Plan (SIP) demonstration, a more recent submitted but not yet approved SIP demonstration, or modeling not used to support a SIP demonstration but considered representative of the current air quality in the area and of sufficient quality that is comparable to a model platform supporting a SIP demonstration.

Figure ES-1 illustrates the framework for MERPs as a Tier 1 demonstration tool. This framework is the organizing flow of this guidance and sequences from the concept of a MERP, how MERPs can be developed from either existing EPA modeling or other credible sources, and then how that information can be credibly used for a source impact analysis and, if necessary, a cumulative impact analysis.

Figure ES-1. Framework for MERPs as a Tier 1 demonstration tool.



Properly supported MERPs provide a straightforward way to relate modeled downwind impacts with an air quality threshold that is used to determine if such an impact causes or contributes to a violation of the appropriate National Ambient Air Quality Standard (NAAQS). To derive a MERP value for the purposes of a PSD compliance demonstration, the model predicted relationship between precursor emissions from hypothetical sources and their modeled downwind impacts can be combined with the appropriate SIL value using the following equation:

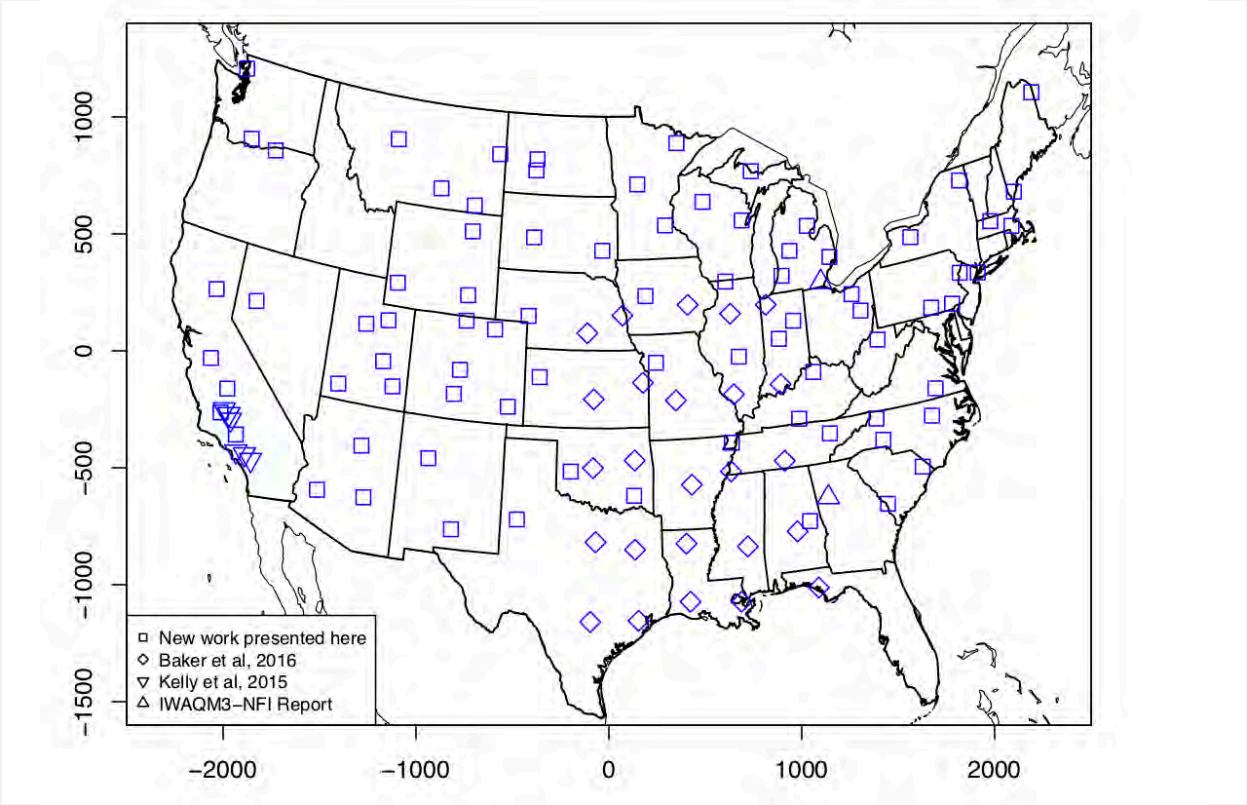
Eq 1. $$\text{MERP} = \text{appropriate SIL value} \times \frac{\text{Modeled emission rate from hypothetical source}}{\text{Modeled air quality impact from hypothetical source}}$$

MERPs can be derived using any air quality threshold of concern ("critical air quality threshold") and are not necessarily dependent on SILs. In practice, MERPs are intended to be used with SILs as analytical tools for PSD air quality analyses. For $PM_{2.5}$, the modeled air quality impact of an increase in precursor emissions from the hypothetical source is expressed in units of $\mu g/m^3$. For O_3, the modeled air quality impact is expressed in ppb.

As stated in the preamble to the 2017 final revisions to the *Guideline* (U.S. Environmental Protection Agency, 2017a), the EPA believes that use of photochemical models for the purpose of developing MERPs is scientifically appropriate and practical to implement. In this guidance

document, EPA presents existing and new photochemical modeling of hypothetical single source impacts on downwind O_3 and secondary $PM_{2.5}$. This modeling was configured, applied, and post-processed consistent with EPA single source modeling guidance (U.S. Environmental Protection Agency, 2016a). The locations of hypothetical sources included here are shown in Figure ES-2. The single source impacts detailed in this section are collected from various past and more recent photochemical grid model-based assessments. More than 100 locations were modeled with hypothetical source emissions and are presented here.

Figure ES-2. Hypothetical sources modeled for downwind secondary air quality impacts included in this assessment.



The relationships shown here for these hypothetical sources are not intended to provide an exhaustive representation of all combinations of source type, chemical, and physical source environments but rather to provide insightful information about secondary pollutant impacts from hypothetical single sources in different parts of the U.S. Based on these annual photochemical model simulations, the maximum impacts for daily $PM_{2.5}$, annual $PM_{2.5}$ and daily maximum 8-hr average O_3 are provided for each modeled source described in Appendix Table A-1 in an Excel spreadsheet on EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website. It is expected that the information in the Excel spreadsheet will be updated over time as newer modeling is done consistent with EPA's single source modeling guidance (U.S. Environmental Protection Agency, 2016a).

Based on these photochemical modeling data, EPA recommends that the permit applicant in consultation with the appropriate reviewing authority follow a three-step process:

1) Identify a representative hypothetical source (or group of sources for an area) from EPA's modeling results (as described in Section 3.2.1).

    - ✓ If a representative hypothetical source is not available, then consider whether any of these derived MERP values available for the geographic location of the project source may be appropriate to use. Alternatively, one can consider conducting photochemical modeling (as described in Section 3.2.2) to derive a source- or area-specific value.

2) Acquire the source characteristics and associated modeling results for the hypothetical source(s).

3) Apply the source characteristics and photochemical modeling results from Step 2 above with the appropriate SIL to the MERP equation for comparison with the project emission rate.

Section 4 provides details on the use of MERPs for PSD compliance demonstrations for: 1) source impact analysis, 2) $PM_{2.5}$ increment analysis, and 3) cumulative impact analysis. It also provides illustrative examples that show how existing EPA hypothetical source modeling can be used to support a Tier 1 demonstration.

For $PM_{2.5}$, based on EPA modeling presented here and recommended $PM_{2.5}$ SILs, the illustrative MERPs for NO_X as a precursor to daily $PM_{2.5}$ range from 1,073 tons per year (tpy) to over 100,000 tpy, while the illustrative MERPs for sulfur dioxide (SO_2) as a precursor to daily $PM_{2.5}$ range from 188 tpy to over 27,000 tpy. The illustrative MERPs for NO_X as a precursor to annual $PM_{2.5}$ range from 3,182 tpy to over 700,000 tpy, while the illustrative MERPs for SO_2 to annual $PM_{2.5}$ range from 859 tpy to over 100,000 tpy. For this assessment, the illustrative MERPs are generally lower for SO_2 than NO_X reflecting that SO_2 tends to form $PM_{2.5}$ more efficiently than NO_X.

For O_3, based on EPA modeling presented here and recommended O_3 SIL, the illustrative MERPs for NO_X as a precursor to daily maximum 8-hr O_3 range from 125 tpy to over 5,000 tpy, while the illustrative MERPs for VOC as a precursor to daily maximum 8-hr O_3 range from 1,049 tpy to over 140,000 tpy. For this assessment, illustrative MERPs for NO_X tend to be lower than VOC which suggests most areas included in this assessment are more often NO_X limited rather than VOC limited in terms of O_3 formation.

1. Background

EPA finalized revisions to the *Guideline on Air Quality Models* (the "*Guideline,*" published as Appendix W to 40 CFR part 51) that recommend a two-tiered approach for addressing single-source impacts on ozone (O_3) and secondary particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) (U.S. Environmental Protection Agency, 2017a). The first tier (or Tier 1) involves use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. The second tier (or Tier 2) involves more sophisticated case-specific application of chemical transport modeling (e.g., with an Eulerian grid or Lagrangian model). This guidance document is intended to provide a detailed framework that applicants may choose to apply, in consultation with the appropriate permitting authority, to estimate single-source impacts on secondary pollutants under the first-tier approach put forth in the *Guideline* (i.e., Sections 5.3.2.b and 5.4.2.b).

For Tier 1 assessments, EPA generally expects that applicants would use existing empirical relationships between precursors and secondary impacts based on modeling systems (e.g., chemical transport models) appropriate for this purpose. The use of existing credible technical information that appropriately characterizes the emissions to air quality relationships will need to be determined on a case-by-case basis. Existing credible air quality modeling would generally include single source modeling based on an approved State Implementation Plan (SIP) demonstration, a more recent submitted but not yet approved SIP demonstration, or modeling not used to support a SIP demonstration but considered representative of the current air quality in the area and of sufficient quality that is comparable to a model platform supporting a SIP demonstration. The applicant should describe how the existing modeling reflects the formation of O_3 or $PM_{2.5}$ in that geographic area. Information that could be used to describe the comparability of two different geographic areas include average and peak temperatures, humidity, terrain, rural or urban nature of the area, nearby local and regional sources of pollutants and their emissions (e.g., other industry, mobile, biogenic), and ambient concentrations of relevant pollutants where available.

As EPA introduced in the preamble to the 2015 proposed revisions to the *Guideline*, Modeled Emission Rates for Precursors (MERPs) can be viewed as a type of Tier 1 demonstration tool under the Prevention of Significant Deterioration (PSD) permitting program that provides a simple way to relate maximum downwind impacts with a critical air quality threshold (e.g., a significant impact level or SIL) (U.S. Environmental Protection Agency, 2018). EPA had initially planned to establish generally applicable MERPs through a future rulemaking. However, after further consideration, EPA believes it is preferable for permit applicants and permitting authorities to consider site-specific conditions when deriving MERPs and to allow for the development and application of locally and regionally appropriate values in the permitting process. Thus, instead of deriving generally-applicable MERP values, the EPA is providing this guidance document for consideration and use by permitting authorities and permit applicants on a permit specific basis.

This guidance is relevant for the PSD program and focuses on assessing the ambient impacts of precursors of $PM_{2.5}$ and O_3 for purposes of that program. The MERP framework may be used to describe an emission rate of an individual precursor that is expected to result in a change in the level of ambient O_3 or $PM_{2.5}$, as applicable, that would be less than a specific air quality threshold for O_3 or $PM_{2.5}$ that a permitting authority adopts and chooses to use in determining whether a projected impact causes or contributes to a violation of the NAAQS for O_3 or $PM_{2.5}$, such as the SILs recommended by EPA. In the context of the PSD program, precursors to O_3 include volatile organic compounds (VOC) and nitrogen oxides (NO_X) and precursors to $PM_{2.5}$ generally include sulfur dioxide (SO_2) and NO_X. MERPs relate emissions of a specific precursor of O_3 or $PM_{2.5}$ to ambient impacts of O_3 or $PM_{2.5}$ and do not provide a single demonstration for all NAAQS pollutants.

If approved by the permitting authority as a $PM_{2.5}$ Tier 1 demonstration tool for a PSD source in a $PM_{2.5}$ attainment or unclassifiable area, a finding that projected increases in the $PM_{2.5}$ precursor emissions of NO_X and/or SO_2 from a project are below the respective MERPs may be part of a sufficient demonstration that the project will not cause or contribute to violation of the applicable NAAQS (hereafter "demonstration of compliance" or "compliance demonstration"). Similarly, for the O_3 NAAQS, an appropriate Tier 1 demonstration may include a finding that the projected increases in O_3 precursor emissions of NO_X and/or VOC are below the respective MERPs.

For situations where project sources are required to assess multiple precursors of $PM_{2.5}$ or of O_3, EPA recommends that the impacts of multiple precursors should be estimated in a combined manner for comparison to the appropriate SIL such that the sum of precursor impacts would be lower than the SIL in a demonstration of compliance. Examples of combining precursor impacts are provided in Section 4 of this document. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration. An example of combining primary and secondary impacts is provided in Section 4 of this document.

The purpose of this document is to provide a framework for using air quality modeling to develop relationships between precursors and maximum downwind impacts for the purposes of developing and using MERPs as a Tier 1 demonstration tool. We provide hypothetical single source impacts on O_3 and secondary $PM_{2.5}$ to illustrate how this framework can be implemented by permit applicants. The relationships presented here in some cases may provide relevant technical information to assist or inform an applicant in providing a first-tier demonstration for their specific permit situation and as a template for stakeholders and/or state or local agencies to develop information relevant to a specific area or source type. Based on the EPA modeling conducted to inform these illustrative MERPs provided here, such values will vary across the nation reflecting different sensitivities of an area's air quality level to changes in levels of precursor emissions thereby providing an appropriate technical basis for evaluating the impacts of these precursors to $PM_{2.5}$ and O_3 formation because they reflect the

regional or local atmospheric conditions for particular situations.

This document is not a final agency action and does not reflect a final determination by the EPA that any particular proposed source with emissions below an illustrative MERP value developed by EPA (or a MERP developed by another party using methods recommended by EPA) will not cause or contribute to a violation of an O_3 or $PM_{2.5}$ NAAQS or $PM_{2.5}$ PSD increments. A determination that a proposed source does not cause or contribute to a violation can only be made by a permitting authority on a permit-specific basis after consideration of the permit record. The illustrative MERP values identified by the EPA have no practical effect unless and until permitting authorities decide to use those values in particular permitting actions. This guidance document does not require the use, nor does it require acceptance of the use, of this framework or any result using this framework by a permit applicant or a permitting authority. Permit applicants and permitting authorities retain the discretion to use other methods to complete a first-tier assessment under Sections 5.3.2.b and 5.4.2.b of the Guideline and to require additional information from a permit applicant to make the required air quality impact demonstration. This guidance document does not create any binding requirements on EPA, permitting authorities, permit applicants, or the public.

Subsequent sections of this document include information about O_3 and secondary $PM_{2.5}$ formation in the atmosphere, a conceptual description of MERPs, information about developing MERPs using photochemical modeling, using MERPs for individual permit demonstrations, and several illustrative examples of using MERPs to support hypothetical permit applications.

2. O_3 and Secondary $PM_{2.5}$ Formation in the Atmosphere

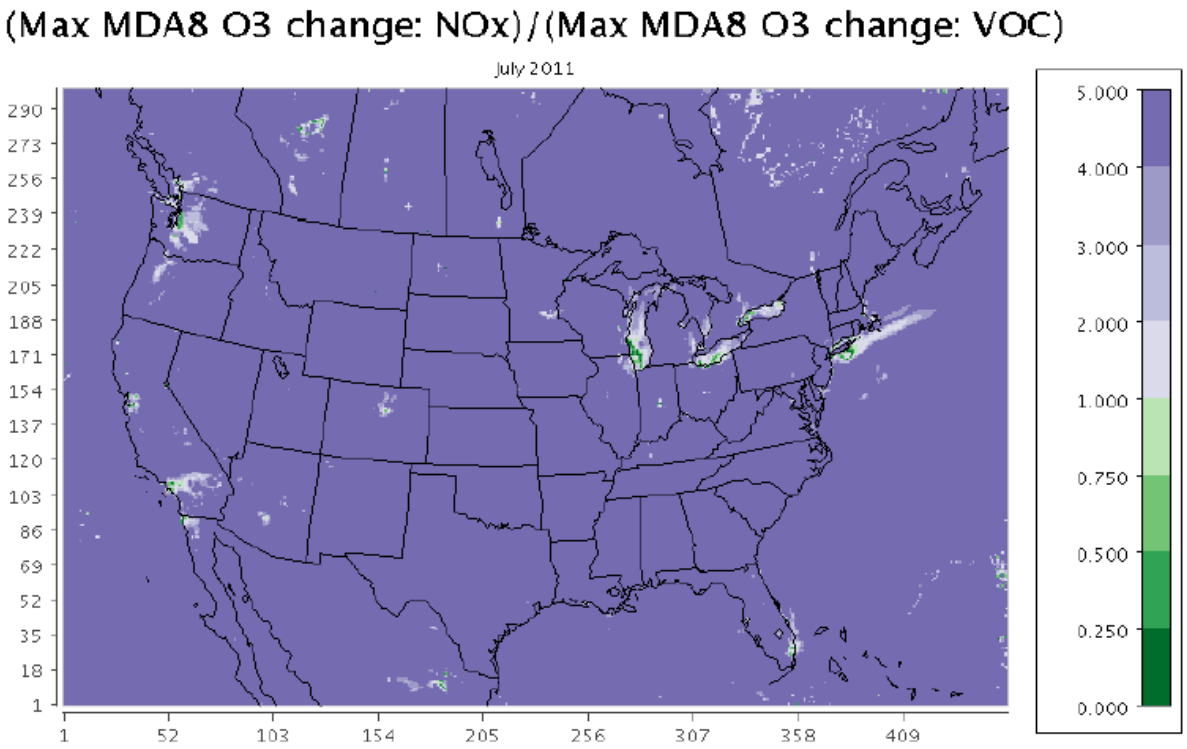
A conceptual understanding of an area's emissions sources and which precursor emissions limit the formation of secondary pollutants such as O_3 and $PM_{2.5}$ is useful for interpreting modeled and ambient impacts due to changes in emissions in that area. The formation regime favoring a particular precursor may vary seasonally, day to day, and by hour of the day. It is important to understand how the atmosphere will respond to changes in emissions to make informed decisions about how changes in emissions from a source might impact ambient pollutant levels. Typically, reductions in emissions of primary pollutants or precursors of secondary pollutants result in some level of reduction in ambient pollutant concentrations.

Secondary $PM_{2.5}$ and O_3 are closely related to each other in that they share common sources of emissions and are formed in the atmosphere from chemical reactions with similar precursors (U.S. Environmental Protection Agency, 2017a). Air pollutants formed through chemical reactions in the atmosphere are referred to as secondary pollutants. For example, ground-level O_3 is predominantly a secondary pollutant formed through photochemical reactions driven by emissions of NO_x and VOCs in the presence of sunlight. O_3 formation is a complicated nonlinear process that depends on meteorological conditions in addition to VOC and NO_x concentrations (Seinfeld and Pandis, 2012). Warm temperatures, clear skies (abundant levels of solar radiation), and stagnant air masses (low wind speeds) increase O_3 formation potential (Seinfeld and Pandis, 2012).

O_3 Formation

O_3 formation may be limited by either NO_X or VOC emissions depending on the meteorological conditions and the relative mix of these pollutants. When O_3 concentrations increase (decrease) because of increases (decreases) in NO_X emissions, the O_3 formation regime is termed "NO_X limited." Alternatively, the O_3 formation regime is termed "VOC limited" when ambient ozone concentrations are very sensitive to changes in ambient VOC. The VOC-limited regime is sometimes referred to as "radical-limited" or "oxidant-limited" because reactions involving VOCs produce peroxy radicals that can lead to O_3 formation by converting nitric oxide (NO) to nitrogen dioxide (NO_2) in the presence of sunlight. In a NO_X-limited regime, ozone decreases with decreasing NO_X and has very little response to changes in VOC. The NOx-limited formation regime is more common in rural areas of the U.S. where high levels of biogenic VOC exist and relatively few man-made, or anthropogenic, NOx emissions occur. O_3 decreases with decreasing VOC in a VOC-limited formation regime. The O_3 formation regime for some urban areas in the U.S. is locally VOC-limited during daytime hours due to large NO_X emissions from mobile and industrial sources and relatively smaller amount of biogenic and anthropogenic VOC emissions. Additional information on O_3 formation regimes based on modeling (U.S. Environmental Protection Agency, 2017b) and satellites (Chang et al., 2016; Duncan et al., 2010; Jin et al., 2017) are available elsewhere. An example is shown in Figure 2-1.

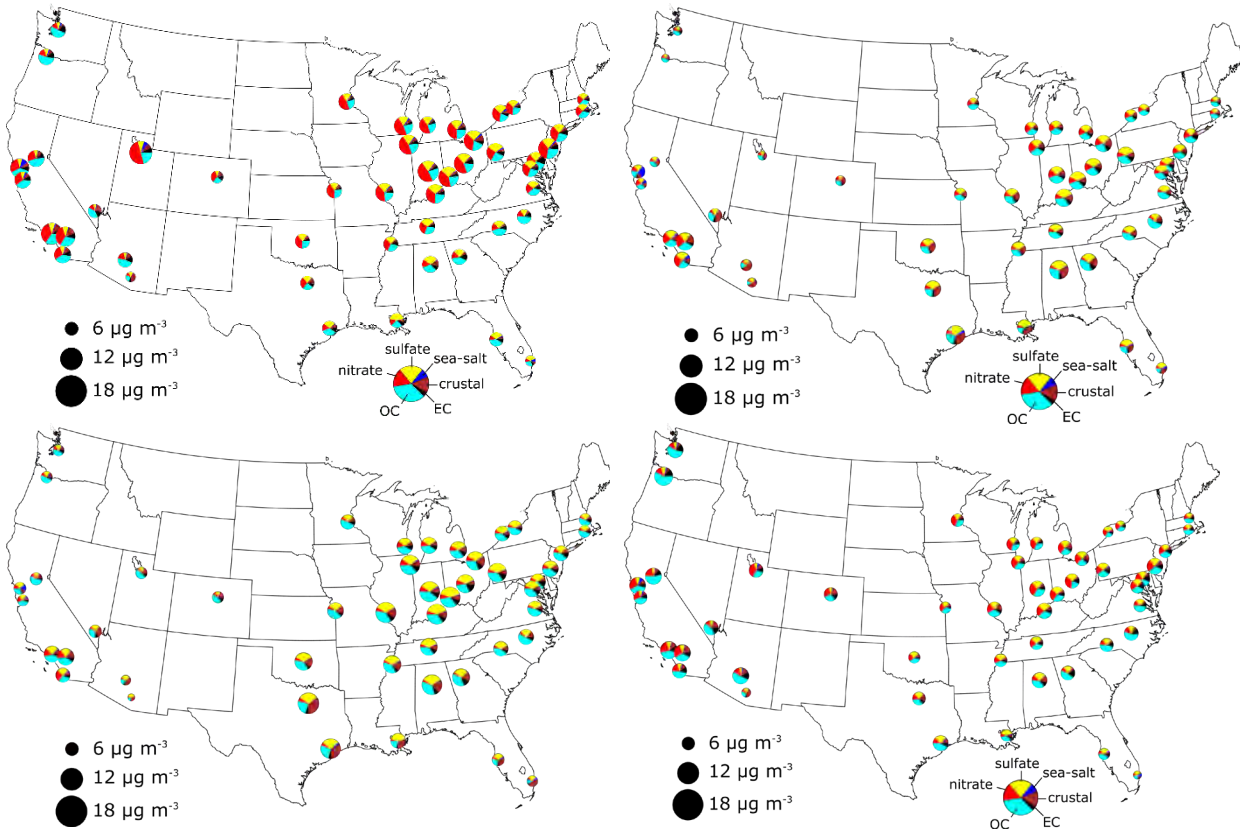
Figure 2-1. The ratio of the change in monthly peak daily maximum 8-hr (MDA8) O_3 from the 50% reduction in NO_X to the change in monthly peak MDA8 O_3 from a 50% reduction in VOC.
Note: Ratios greater than one (shown in purple) indicate that ozone was reduced more effectively by similar percentage reductions in NO_X emissions than reductions in VOC emissions. Ratios less than one (shown in green) indicate that ozone was reduced more effectively by similar percentage reductions in VOC emissions than reductions in NO_X emissions.
Source: https://www.epa.gov/sites/production/files/2017-05/documents/national_modeling.advance.may_2017.pdf



$PM_{2.5}$ Formation

In the case of $PM_{2.5}$, or fine PM, total mass is often categorized into two groups: primary (i.e., emitted directly as $PM_{2.5}$ from sources) and secondary (i.e., $PM_{2.5}$ formed in the atmosphere by precursor emissions from sources). The ratio of primary to secondary $PM_{2.5}$ varies by location and season. In the U.S., $PM_{2.5}$ is dominated by a variety of chemical components: sulfate, nitrate, ammonium, organic carbon (OC), elemental carbon (EC), crustal elements, sea-spray constituents, and oxidized metals. $PM_{2.5}$ EC, crustal elements, and sea spray are directly emitted into the atmosphere from primary sources. $PM_{2.5}$ OC is directly emitted from primary sources but is also formed secondarily in the atmosphere by reactions involving VOCs. $PM_{2.5}$ sulfate, nitrate, and ammonium are predominantly the result of chemical reactions of the oxidized products of SO_2 and NO_X emissions and direct NH_3 emissions (Seinfeld and Pandis, 2012). Figure 2-2 shows the average composition by season (spring, summer, fall and winter) for $PM_{2.5}$ data collected during 2013-15. In the eastern United States, sulfate is high in the spring (March-May) and summer (July-September). Nitrate is most evident in the Midwest and western cities and highest during the winter. Organic mass (OM) is a large component throughout the year.

Figure 2-2. Average composition by season for $PM_{2.5}$ data collected during 2013-15.
Note: Quarter 1 (top left), quarter 2 (top right), quarter 3 (bottom left), and quarter 4 (bottom right).



Sulfur dioxide emissions are oxidized in the atmosphere and form sulfuric acid, which has a very low vapor pressure and tends to exist in the particulate phase. Particulate sulfuric acid reacts with NH_3 to form ammonium bisulfate and ammonium sulfate. Aqueous phase reactions are also an important pathway for particulate sulfate formation. SO_2 dissolves into cloud and fog droplets and is oxidized to sulfate via reaction pathways involving hydrogen peroxide, O_3, and other oxidants. Since sulfate is essentially non-volatile under atmospheric conditions, sulfate formed in clouds persists as particulate sulfate after the cloud evaporates. Sulfur dioxide emission reductions lead to reductions in particulate sulfate. The process is not completely linear, especially when aqueous phase production is significant, and so changes in SO_2 emissions may not result in the same proportion of change in $PM_{2.5}$ sulfate concentration.

Emissions of NO_X are chemically transformed to nitric acid (HNO_3) through gas-phase and heterogeneous reactions. Nitric acid may condense onto particles to form particulate nitrate depending on the conditions. Condensation of HNO_3 onto particles is favored by low temperature, high relative humidity, and relatively less acidic conditions associated with high levels of NH_3 and particulate cations. HNO_3 formation may be oxidant or NOx-limited, and $PM_{2.5}$ ammonium nitrate formation may be limited by the availability of either nitric acid or NH_3 or by

meteorological conditions. When $PM_{2.5}$ ammonium nitrate is limited by the availability of NH_3, the formation regime is termed “ammonia-limited,” and the formation regime is termed “nitric acid-limited” when the opposite situation exists (Stockwell et al., 2000). In general, a decrease in NO_X emissions will result in a decrease in $PM_{2.5}$ nitrate concentration (Pun et al., 2007). Since $PM_{2.5}$ ammonium nitrate formation is preferred under low temperature and high relative humidity conditions and in the presence of NH_3, ammonium nitrate concentrations tend to be greater during colder months and in areas with significant NH_3 emissions. NO_X emission changes during warm temperatures may result in less change in ambient $PM_{2.5}$ compared to cold months due to HNO_3 staying in the gas rather than particle phase due to higher temperatures. Additionally, NO_X emission changes in places with very little or no ambient ammonia may result in little change in ambient $PM_{2.5}$ ammonium nitrate.

3. Framework for Developing MERPs as a Tier 1 Demonstration Tool

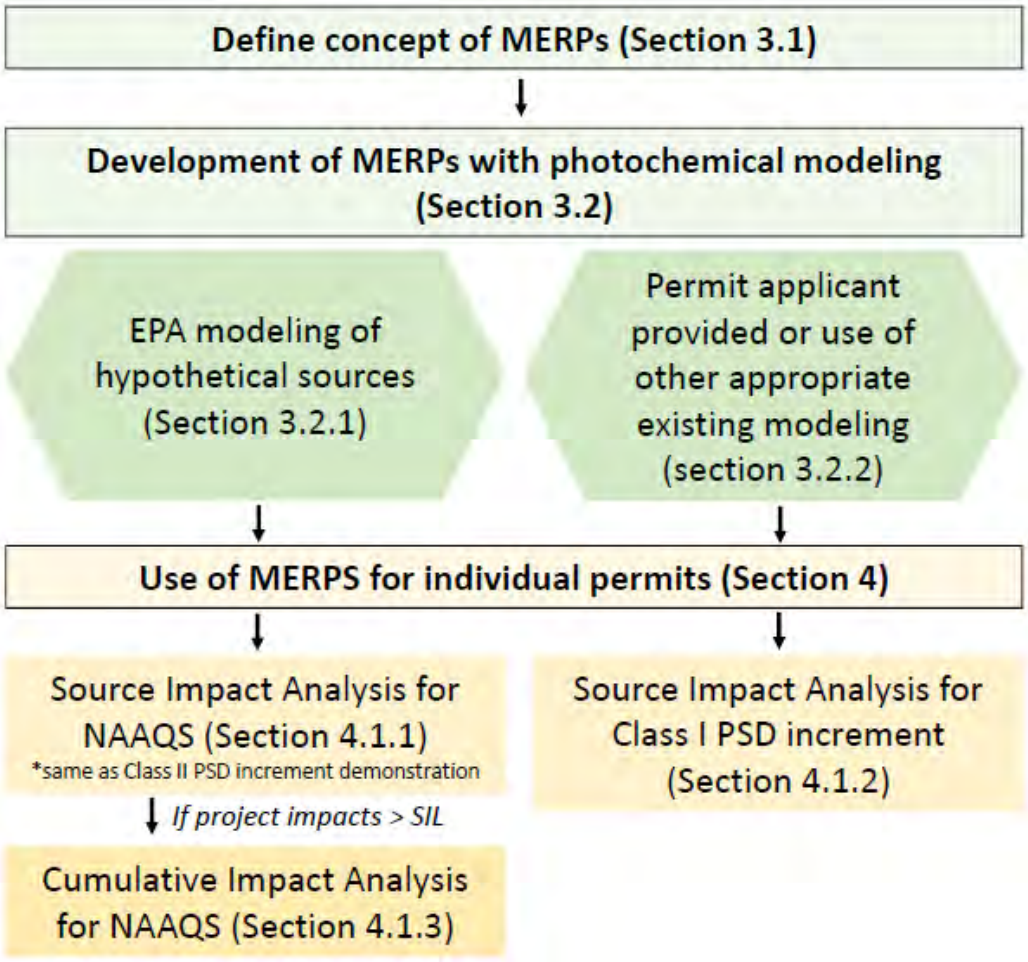
A Tier 1 demonstration tool as described in the *Guideline* consists of technically credible air quality modeling done to relate precursor emissions and peak secondary pollutant impacts from specific or hypothetical sources (U.S. Environmental Protection Agency, 2017a). With appropriate supporting information, permit applicants may use existing appropriate air quality modeling as part of an assessment of air quality impacts from a proposed new or modified source under the PSD permitting program. Permit applicants should provide a narrative explanation describing how project source emissions relate to the information provided as part of their Tier 1 demonstration. It should be made clear how the chemical and physical environments modeled as part of an existing set of information included in their Tier 1 demonstration are relevant to the geographic area of the project and key receptors.

As detailed below, this framework for developing MERPs focuses on use of photochemical modeling to relate the modeled air quality impacts and a critical air quality threshold (e.g., appropriate SIL value) to estimate a MERP for comparison with the project source emissions. However, a similar screening approach would be to adjust the modeled air quality impacts based on the relationship between the modeled and project source emissions to then compare the resulting air quality impact with the appropriate SIL.

Existing credible air quality modeling generally may include single source modeling based on an approved SIP demonstration, a more recent submitted but not approved SIP demonstration, or modeling not used to support a SIP demonstration but considered representative of the current air quality in the area and of sufficient quality that is comparable to a model platform supporting a SIP demonstration. The specifications for single source demonstration model platforms (e.g., horizontal grid spacing, vertical resolution, non-project source emission treatment, etc.) are detailed in the 2016 EPA guidance document "Guidance on the use of models for assessing the impacts of emissions from single sources on the secondarily formed pollutants O_3 and $PM_{2.5}$" (U.S. Environmental Protection Agency, 2016a).

Figure 3-1 illustrates the EPA's framework for MERPs as a Tier 1 demonstration tool. This framework is intended to show how the elements and concepts described in this document relate to each other and where more information is provided in this document about each step of the process. This flow diagram shows how MERPs can be developed from either existing EPA modeling or another source of data and how that information can be credibly used for a source impact analysis and, if necessary, a cumulative impact analysis. In this framework, the source impact analysis for the $PM_{2.5}$ NAAQS may also satisfy Class II PSD increment since the recommended EPA SILs are the same.

Figure 3-1. EPA's framework for MERPs as a Tier 1 Demonstration Tool.



3.1. Definition of MERPs as a Tier 1 Demonstration Tool

Properly-supported MERPs provide a simple way to relate modeled downwind impacts with an air quality threshold that is used to determine if such an impact causes or contributes to a violation of the appropriate NAAQS. In the discussion that follows and in reported results in computing MERP values, we use the EPA's recommended SIL values for O_3 and $PM_{2.5}$ as the relevant air quality threshold (U.S. Environmental Protection Agency, 2018). Consistent with EPA's SILs guidance, to the extent a permitting authority elects to use a SIL to help quantify a level of impact that does not cause or contribute to a violation of the O_3 and/or $PM_{2.5}$ NAAQS or $PM_{2.5}$ PSD increment(s), such values will need to be justified on a case-by-case basis. To derive a MERP value for the purposes of a PSD compliance demonstration, the model predicted relationship between precursor emissions from hypothetical sources and their downwind modeled impacts can be combined with the appropriate SIL value using the following equation:

Eq. 1 $$\text{MERP} = \text{appropriate SIL value} \times \frac{\text{Modeled emission rate (tpy) from hypothetical source}}{\text{Modeled air quality impact from hypothetical source}}$$

For $PM_{2.5}$, the modeled air quality impact of an increase in precursor emissions from the hypothetical source is expressed in units of $\mu g/m^3$. For O_3, the modeled air quality impact is expressed in ppb. As discussed in Section 4, these modeled impacts would reflect the maximum downwind impacts for $PM_{2.5}$ and O_3. The SIL value is expressed as a concentration for $PM_{2.5}$ (in $\mu g/m^3$) and mixing ratio for O_3 (in ppb). Consistent with the air quality model application used here to predict a change in pollutant concentration, MERPs are expressed as an annual emissions rate (in this case as tons per year).

3.2. Development of MERPs through Photochemical Modeling

As stated in the preamble to the 2017 revisions to the Guideline (U.S. Environmental Protection Agency, 2017a), the EPA believes that use of photochemical models for estimating single source secondary pollutant impacts is scientifically appropriate and practical to implement. Publicly available and fully documented Eulerian photochemical grid models such as the Comprehensive Air Quality Model with Extensions (CAMx) (Ramboll ENVIRON, 2016) and the Community Multiscale Air Quality (CMAQ) (Byun and Schere, 2006) model treat emissions, chemical transformation, transport, and deposition using time and space variant meteorology. These modeling systems simulate primarily emitted species and secondarily formed pollutants such as O_3 and $PM_{2.5}$ (Chen et al., 2014; Civerolo et al., 2010; Russell, 2008; Tesche et al., 2006). Even though single source emissions are injected into a grid volume, photochemical transport models have been shown to adequately capture single source impacts when compared with downwind in-plume measurements (Baker and Kelly, 2014; Baker and Woody, 2017; Zhou et al., 2012). Where set up appropriately for the purposes of assessing the air quality impact of single sources to ambient levels of primary and secondarily formed pollutants, photochemical grid models could be used with a variety of approaches to estimate these impacts. These approaches generally fall into the categories of source sensitivity (how air quality changes due to changes in emissions) and source apportionment (what air quality impacts are related to certain emissions).

The simplest source sensitivity approach, commonly referred to as a brute-force change to emissions, would be to simulate two sets of conditions, one with all emission sources and a subsequent simulation with all emission sources and the post-construction characteristics of the new source or modification being the only difference from the original baseline simulation (Cohan and Napelenok, 2011). The difference between these model simulations provides an estimate of the air quality change related to the change in emissions from the project source. In addition to the brute force approach, some photochemical models have been "instrumented" with techniques that allow tracking of air quality impacts from the emissions of a particular sector or source. One sensitivity approach is the decoupled direct method (DDM), which tracks the sensitivity of an emission source through all chemical and physical processes in the modeling system (Dunker et al., 2002). Sensitivity coefficients relating source emissions to air quality are estimated during the model simulation and output at the resolution of the host

model. Unlike the brute force approach, a second simulation is not necessary when using DDM, although additional resources are required as part of the initial baseline simulation when DDM is applied.

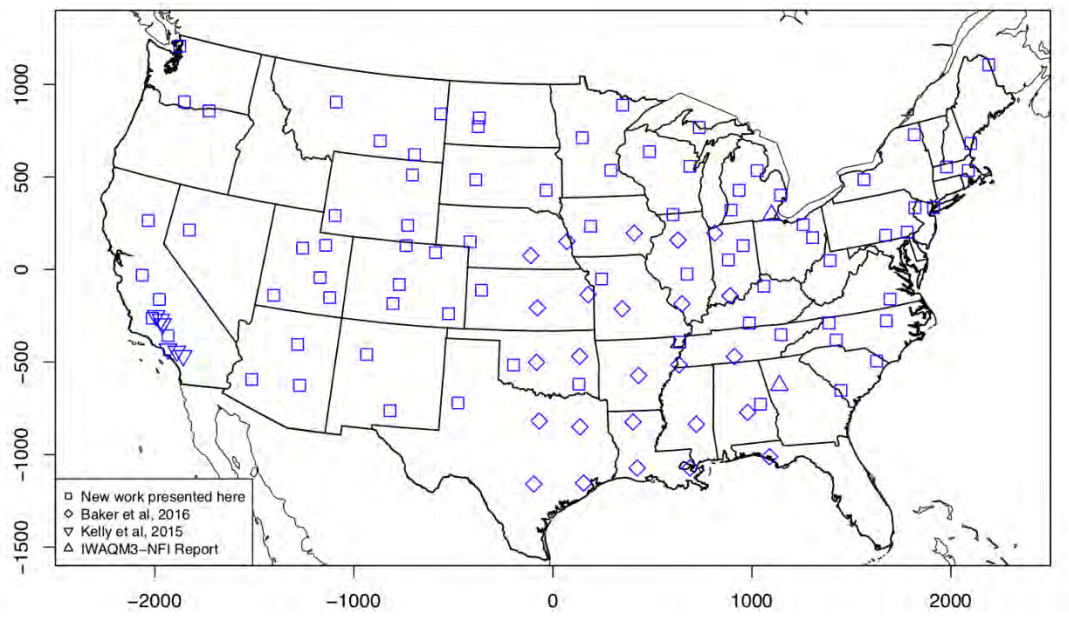
Some photochemical models have been instrumented with source apportionment capabilities which tracks emissions from specific sources through chemical transformation, transport, and deposition processes to estimate source-specific impacts to predicted air quality at downwind receptors (Kwok et al., 2015; Kwok et al., 2013). Source apportionment has been used to differentiate the air quality impact from single sources on model predicted O_3 and $PM_{2.5}$ (Baker and Foley, 2011; Baker and Kelly, 2014; Baker and Woody, 2017). DDM has also been used to estimate O_3 and $PM_{2.5}$ impacts from specific sources (Baker and Kelly, 2014; Bergin et al., 2008; Kelly et al., 2015) as well as the simpler brute-force sensitivity approach (Baker and Kelly, 2014; Bergin et al., 2008; Kelly et al., 2015; Zhou et al., 2012). Limited comparison of single source impacts between models (Baker et al., 2013) and approaches to differentiate single source impacts (Baker and Kelly, 2014; Kelly et al., 2015) show generally similar downwind spatial gradients and impacts.

Near-source in-plume aircraft based measurement field studies provide an opportunity to evaluate model estimates of (near-source) downwind transport and chemical impacts from single stationary point sources (ENVIRON, 2012b). Photochemical grid model source apportionment and source sensitivity simulation of single-source downwind impacts compare well against field study primary and secondary ambient in-plume measurements (Baker and Kelly, 2014; Baker and Woody, 2017; ENVIRON, 2012b). This work indicates photochemical grid models using source apportionment or source sensitivity approaches provide meaningful estimates of single source impacts.

3.2.1. EPA Single Source Photochemical Modeling for O_3 and Secondary $PM_{2.5}$

This section presents a summary of EPA photochemical modeling of hypothetical single source impacts on downwind O_3 and secondary $PM_{2.5}$. The locations of hypothetical sources modeled are shown in Figure 3-2. A total of 113 locations were modeled. The single source impacts detailed in this section were collected from various past and recent photochemical grid model-based assessments. The resulting relationships were based on photochemical modeling studies that estimated single source impacts in California (Kelly et al., 2015), the Detroit and Atlanta urban areas (U.S. Environmental Protection Agency, 2016b), and at rural and suburban locations in the central and eastern United States (Baker et al., 2016). Additional photochemical modeling was conducted by EPA consistent with the approach described in Baker et al., 2016 for hypothetical sources in the western, central, and eastern U.S. to provide broader geographic coverage across the nation.

Figure 3-2. Location of hypothetical sources modeled for downwind secondary air quality impacts included in EPA's assessment.



Atlanta and Detroit both include a single hypothetical source modeled at 4 km horizontal grid resolution for an entire year. The California sources were also modeled at 4 km but only include a sub-set of an entire year meaning the maximum impact from those hypothetical sources may not be realized as part of that study design. The western, central, and eastern U.S. sources were modeled at 12 km horizontal grid resolution for the entire year of 2011. It is possible that the maximum impacts from each of these hypothetical sources may not have been realized using a single year of meteorology and that another year with more conducive meteorology for secondary formation of O_3 and/or $PM_{2.5}$ might be more appropriate and result in greater downwind impact. As shown, we define the following source types throughout the continental U.S. that reflect different release heights and multiple emissions rates:

- Source release type "L" refers to sources modeled with surface level emissions releases: stack height of 10 m, stack diameter of 5 m, exit temperature of 311 K, exit velocity of 27 m/s, and flow rate of 537 m^3/s.
- Source release type "H" refers to sources modeled with tall stack emissions releases: stack height of 90 m, stack diameter of 5 m, exit temperature of 311 K, exit velocity of 27 m/s, and flow rate of 537 m^3/s.

Hypothetical sources for this assessment include impacts based on multiple emission rates and emitted with a near-surface release or tall stack. Information about each hypothetical source modeled is provided in Appendix A.

The relationships shown here for these hypothetical sources are not intended to provide an exhaustive representation of all combinations of source type, chemical, and physical source environments but rather to provide insightful information about secondary pollutant impacts from single sources in different parts of the U.S. The maximum impacts for daily $PM_{2.5}$, annual $PM_{2.5}$ and daily maximum 8-hr average O_3 are shown in the following sub-sections for the hypothetical sources modeled for an entire year and do not include sources modeled for an episode.

Tables showing the maximum impacts for sources modeled with annual simulations are provided in an Excel spreadsheet on EPA's SCRAM website. Impacts for each source include the maximum daily $PM_{2.5}$ impacts, maximum annual $PM_{2.5}$ impacts, and maximum daily 8-hr O_3 impacts over annual simulations. Emissions are shown in tpy and release height in meters. VOC speciation used for these assessments is shown in Table 3-1. More information about these hypothetical sources and how the model output was processed to generate maximum impacts are described in more detail in (Baker et al., 2016).

Table 3-1. Assumed VOC speciation for hypothetical sources presented here.

Carbon bond specie	Fraction	Carbon bond specie	Fraction
ALD2	0.0152	MEOH	0.0054
ALDX	0.0155	NVOL	0.0008
ETH	0.0324	OLE	0.1143
ETHA	0.0094	PAR	0.4057
ETOH	0.0090	TERP	0.0170
FORM	0.0757	TOL	0.1148
IOLE	0.0088	UNR	0.1080
ISOP	0.0007	XYL	0.0674

Additional information has been provided for each source to facilitate qualitative comparison between hypothetical sources with project sources. The additional information includes the terrain within 50 km of the source and maximum grid cell percent urban landcover within 50 km of the source to provide some additional information about nearby orography and whether the source is in proximity to population centers. This additional information is illustrated in Figure 3-3.

The spreadsheet also includes the climate zone where the source is located as shown in Figure 3-4. These regional classifications are used to aggregate impacts in summarizing modeling results in subsequent sections.

Figure 3-3. Maximum terrain height (top) and fractional urban coverage (bottom) within 50 km of each of the hypothetical sources modeled.

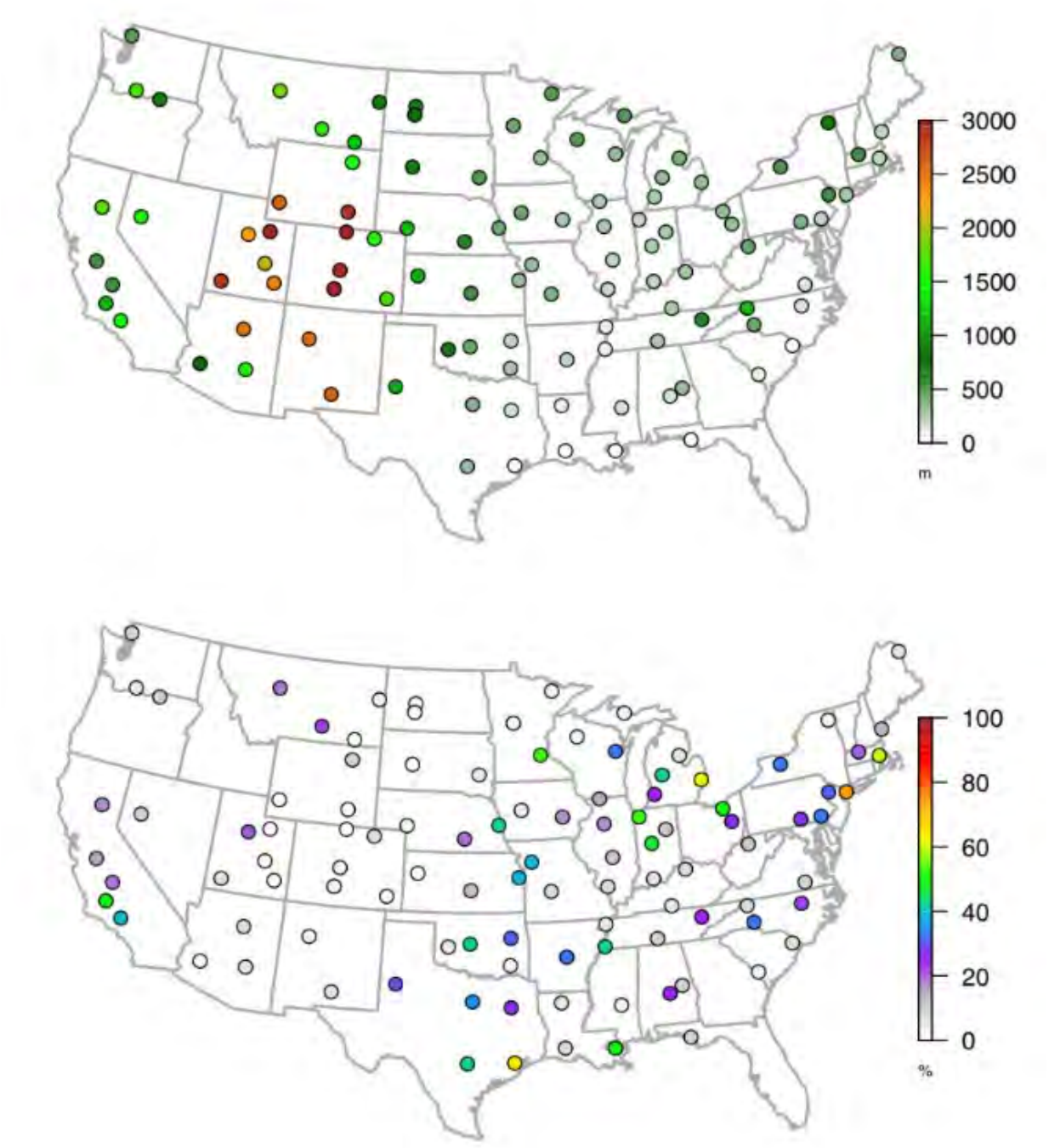
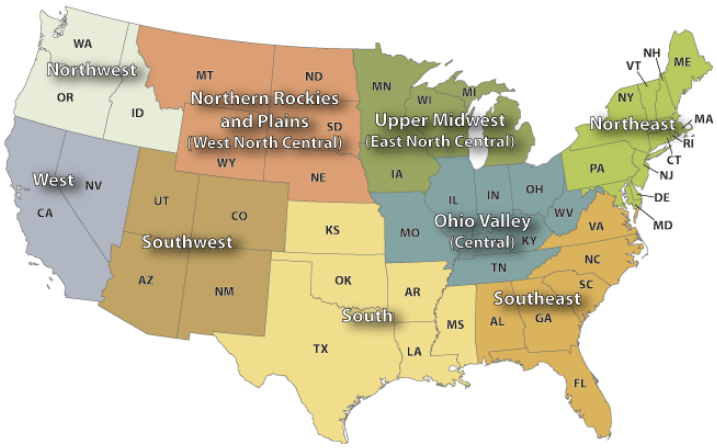


Figure 3-4. NOAA climate zone map with number of hypothetical source locations modeled in each climate zone.
Source: https://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php



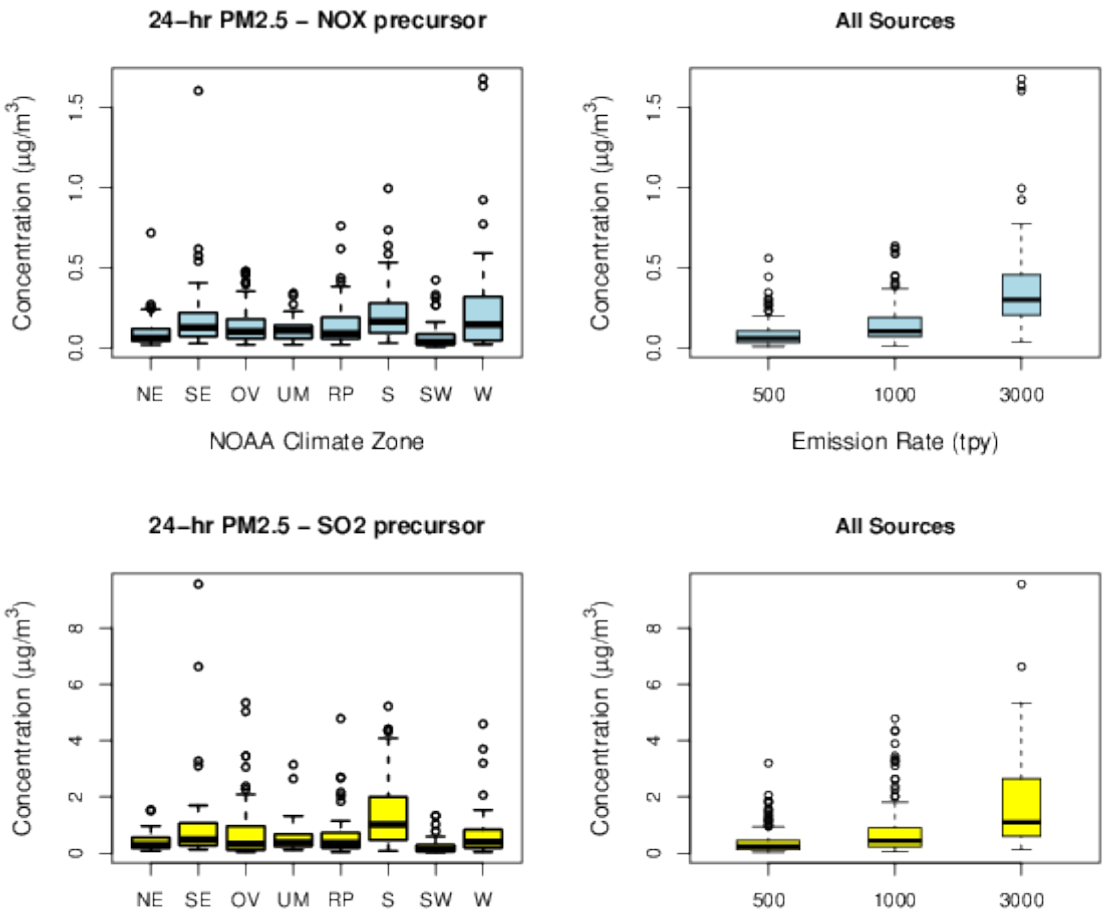
Climate Zone	Sources
Northeast	10
Southeast	9
Ohio Vally	19
Upper Midwest	12
Rockies/Plains	14
South	17
Southwest	15
West	6
Northwest	3

3.2.1.1. EPA Modeled Impacts: Annual and Daily PM2.5

The maximum daily average $PM_{2.5}$ sulfate ion from SO_2 emissions and maximum daily average $PM_{2.5}$ nitrate ion from NO_X emissions are shown in Figure 3-5 by emission rate and area. Downwind maximum $PM_{2.5}$ impacts generally increase as rates of precursor emissions increase. However, differences in chemical (e.g. NO_X/VOC ratio, NH_3 concentrations) and physical (e.g., terrain and meteorology) regimes among these hypothetical sources result in differences in downwind impacts even for similar types of sources. Differences in maximum impacts can also be seen between the different areas and studies. One such example is described in Section 3.2.1.3 of this document.

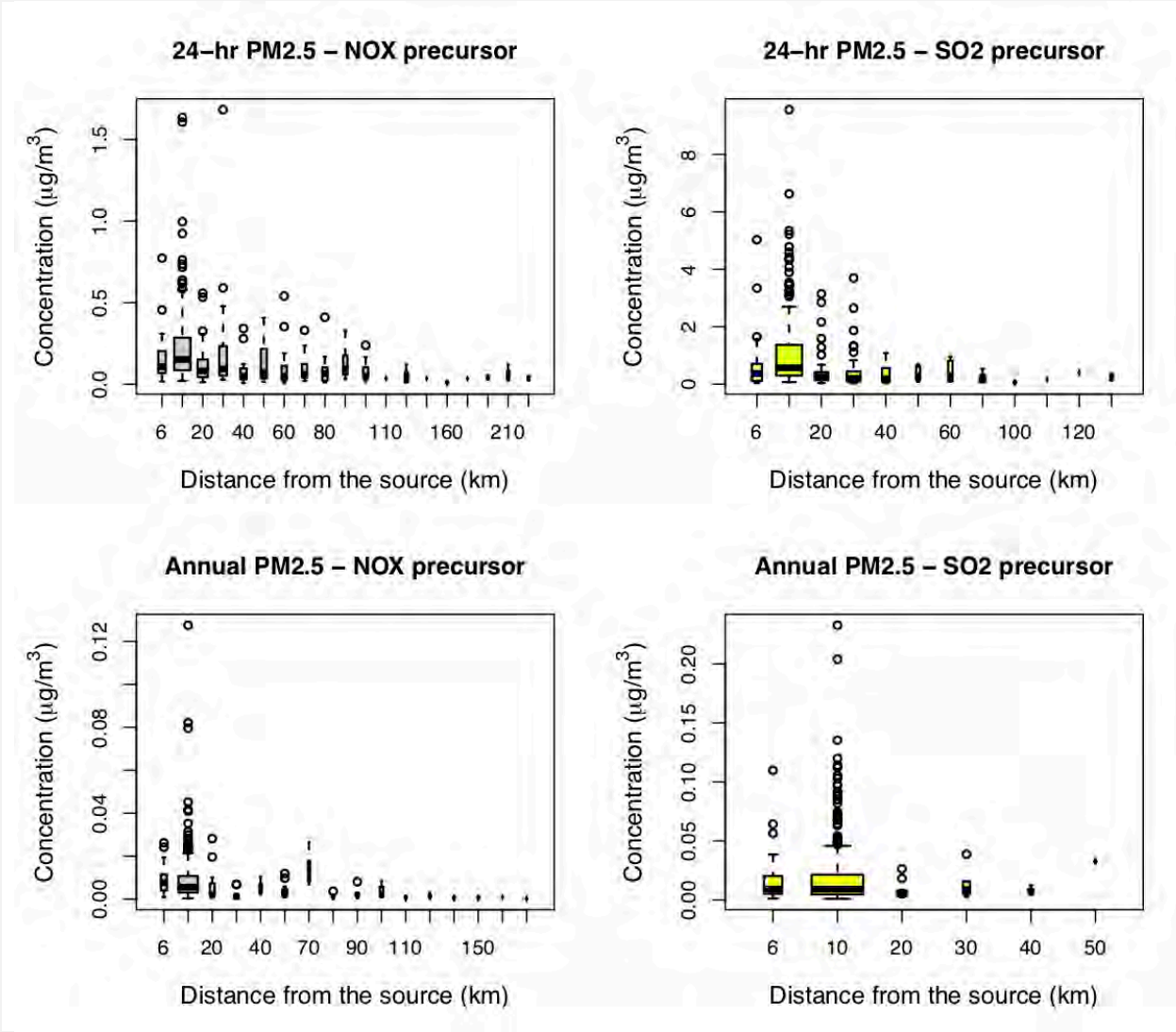
Figure 3-5. Maximum daily average $PM_{2.5}$ nitrate ion impacts from NO_X emissions and $PM_{2.5}$ sulfate ion impacts from SO_2 emissions.

Note: These impacts are from multiple modeling studies estimating downwind impact from hypothetical sources. The distribution shown for each climate zone represents multiple emission rates.



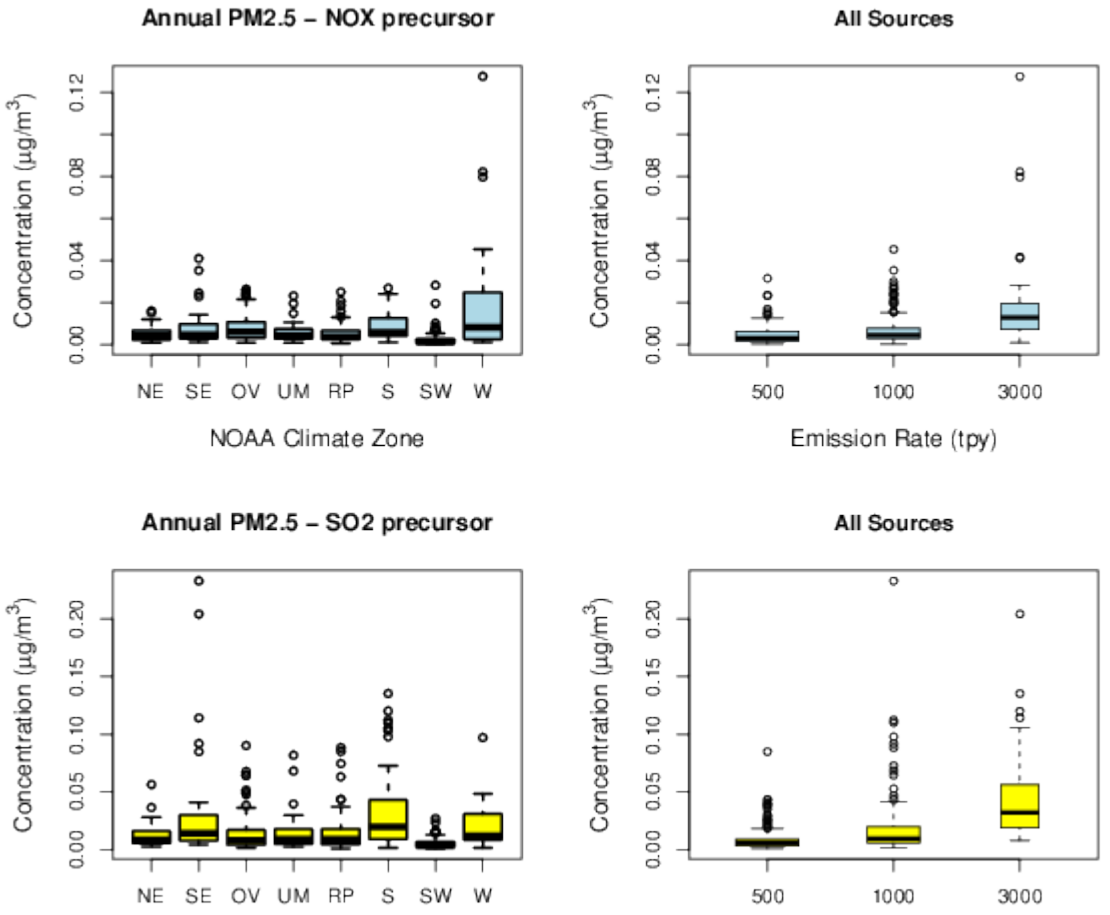
The distance from the source of maximum daily and annual average secondary $PM_{2.5}$ impact is shown in Figure 3-6. Peak impacts tend to be in close proximity to the source. For NO_X precursor, the peak 24-hour $PM_{2.5}$ impacts are typically within 20 to 50 kilometers, while peak annual average $PM_{2.5}$ impacts are typically within 20 kilometers of the source. For SO_2 precursor, the peak 24-hour $PM_{2.5}$ impacts are shown to be mostly within 10 to 40 kilometers, while peak annual average $PM_{2.5}$ impacts are largely within 20 kilometers. These peak impacts become less common as distance from the source increases. Figure 3-7 shows maximum annual average impacts from SO_2 emissions on modeled $PM_{2.5}$ sulfate ion and NO_X emissions on modeled $PM_{2.5}$ nitrate ion. Downwind impacts tend to increase as emissions of precursors increase. Also, impacts vary from area to area.

Figure 3-6. Maximum daily and annual average secondary $PM_{2.5}$ nitrate ion impacts from NO_X emissions and $PM_{2.5}$ sulfate ion impacts from SO_2 emissions shown by distance from the source.



The tendency for secondary $PM_{2.5}$ to be larger near the source is important when considering how to use impact estimates to inform different types of permit demonstrations. For NAAQS demonstrations, peak impacts tend to be near the source. Class I impacts are likely to be further downwind of the project source, so a near-source impact estimate would typically not be as relevant.

Figure 3-7. Maximum annual average secondary $PM_{2.5}$ nitrate ion impacts from NO_X emissions and $PM_{2.5}$ sulfate ion impacts from SO_2 emissions.
Note: These impacts are from multiple modeling studies estimating downwind impact from hypothetical sources. The distribution shown for each climate zone represents multiple emission rates.



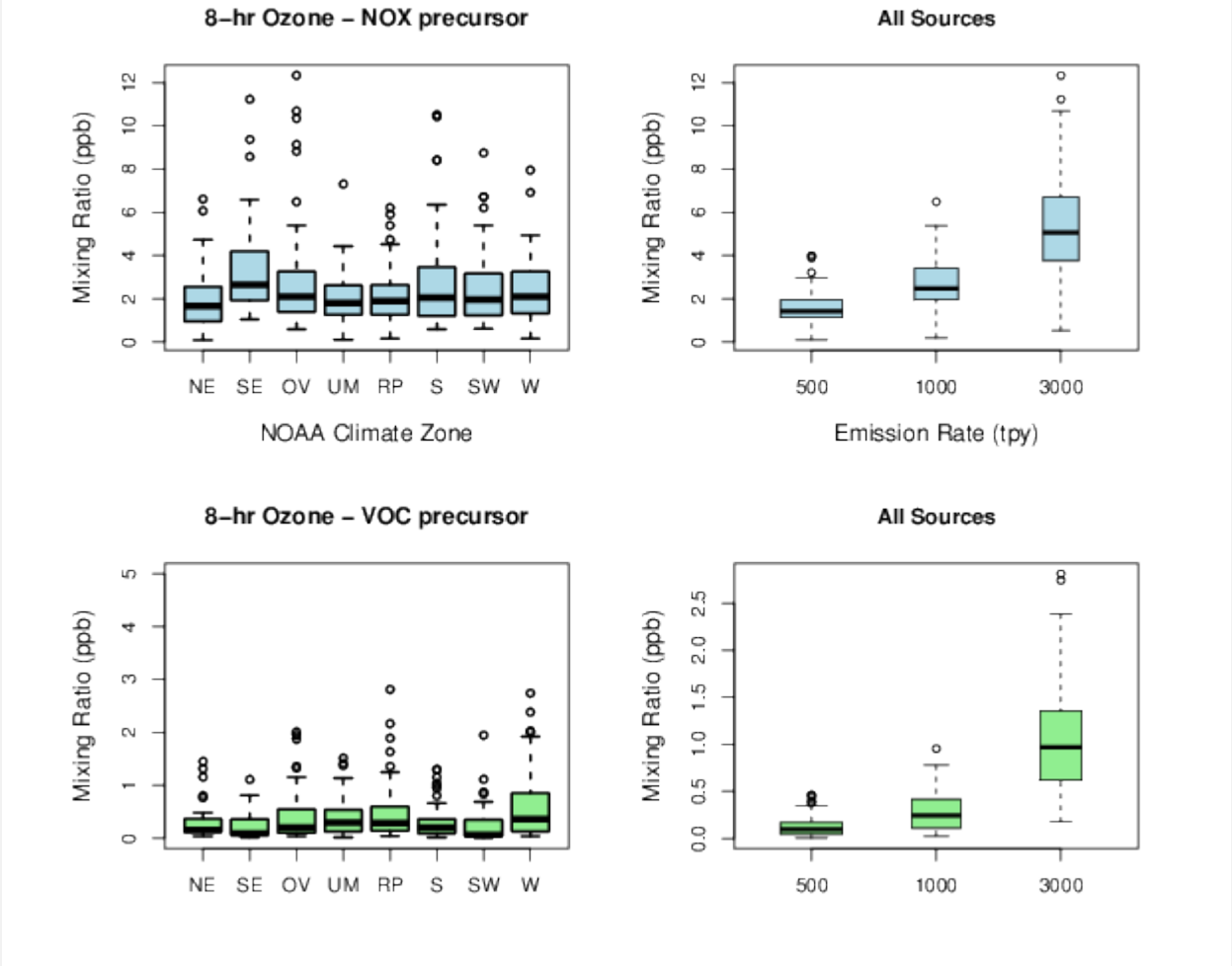
3.2.1.2. EPA Modeled Impacts: 8-hour Ozone

Maximum 8-hr O_3 impacts are shown in Figure 3-8 compared to single source precursor emission rates. These relationships are based on photochemical modeling studies that estimated single source impacts in California (Kelly et al., 2015), the Detroit and Atlanta urban areas (U.S. Environmental Protection Agency, 2016b), and at rural and suburban locations in the central and eastern United States (Baker et al., 2016). Additional modeling was conducted consistent with the approach described in Baker et al., 2016 for hypothetical sources in the western and eastern U.S. to provide broader geographic coverage of the U.S.

Downwind maximum 8-hr O_3 impacts generally increase as rates of precursor emissions increase. However, differences in chemical (e.g., NO_X/VOC ratio, radical concentrations) and

physical (e.g., terrain and meteorology) regimes among these hypothetical sources result in differences in downwind impacts even for similar types of sources.

Figure 3-8. Maximum 8-hr ozone impacts from NO_X emissions and from VOC emissions.
Note: These impacts are from multiple modeling studies estimating downwind impact from hypothetical sources. The distribution shown for each climate zone represents multiple emission rates.

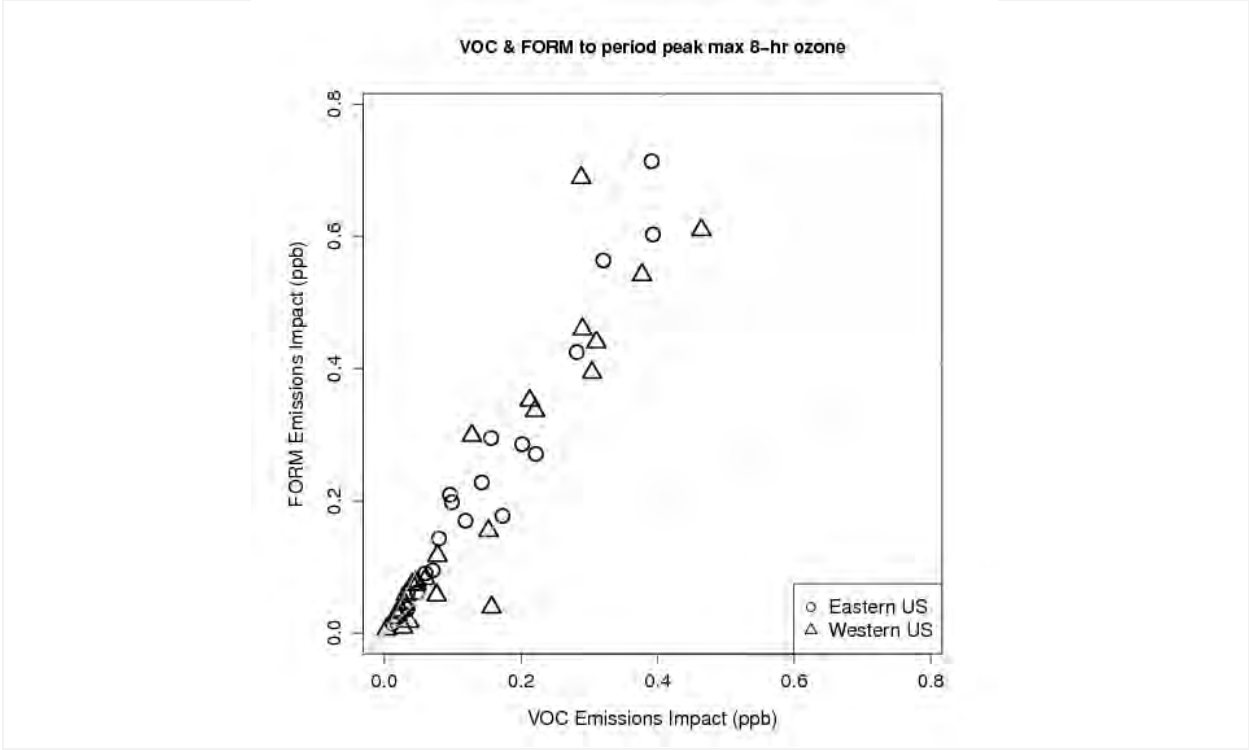


Each of the hypothetical source impacts modeled as part of EPA's assessment used a typical industrial assumption for speciation of VOC emissions (see Table 3-1 for VOC speciation profile). To better understand the influence of VOC speciation, as a sensitivity analysis, EPA modeled a set of hypothetical sources with near-surface releases in the western and eastern U.S. with an alternative VOC emissions speciation that assumed 100% of the VOC emissions were emitted as formaldehyde to provide a more reactive profile than typically used. Figure 3-9 shows a comparison of the downwind maximum daily 8-hr average O_3 impacts using the typical VOC profile compared with impacts where these same sources are modeled with formaldehyde-only VOC emissions. For both sets of emissions scenarios, a total of 500 tpy of VOC was emitted, the only difference being the VOC speciation. The formaldehyde only simulations for these sources generally resulted in higher downwind O_3 impacts than the simulations of hypothetical sources

with VOC speciation shown in Table 3-1. The increases in impacts are typically between 1.5 and 2 times higher (Figure 3-9).

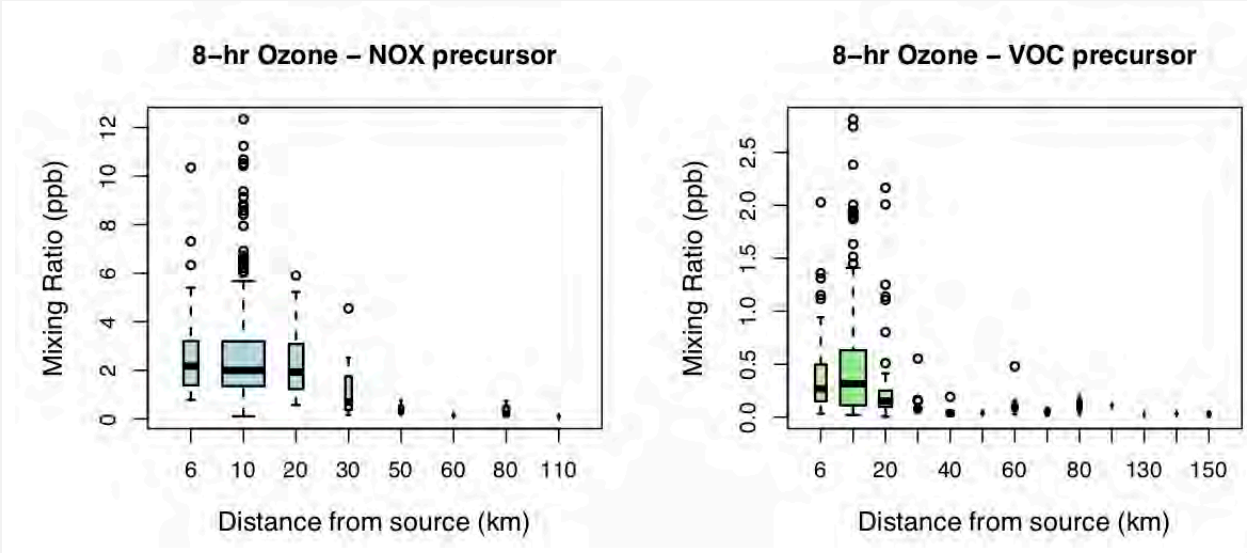
Since VOC reactivity can be important, some areas may want to develop separate VOC to O_3 relationships using typical VOC profiles and VOC profiles that may be more reflective of certain types of sources that exist in that area or are anticipated to operate in that area in the future.

Figure 3-9. Maximum 8-hr ozone impacts from 500 tpy of near-surface VOC emissions using a typical industrial VOC speciation profile and assuming all VOC emissions are formaldehyde.
Note: these impacts are for the eastern and western U.S. hypothetical sources presented here and do not include information from any other studies.



The distance from the source of the maximum daily 8-hr average O_3 impacts are shown in Figure 3-10. Like maximum daily $PM_{2.5}$ impacts, maximum daily 8-hr average O_3 impacts tend to be in close proximity to the source and are less frequent as distance from the source increases. This is particularly notable where distance from the source exceeds 50 km.

Figure 3-10. Maximum 8-hr ozone impacts from NO_X emissions and from VOC emissions by distance from the source.
Note: These impacts are from multiple modeling studies estimating downwind impact from hypothetical sources.



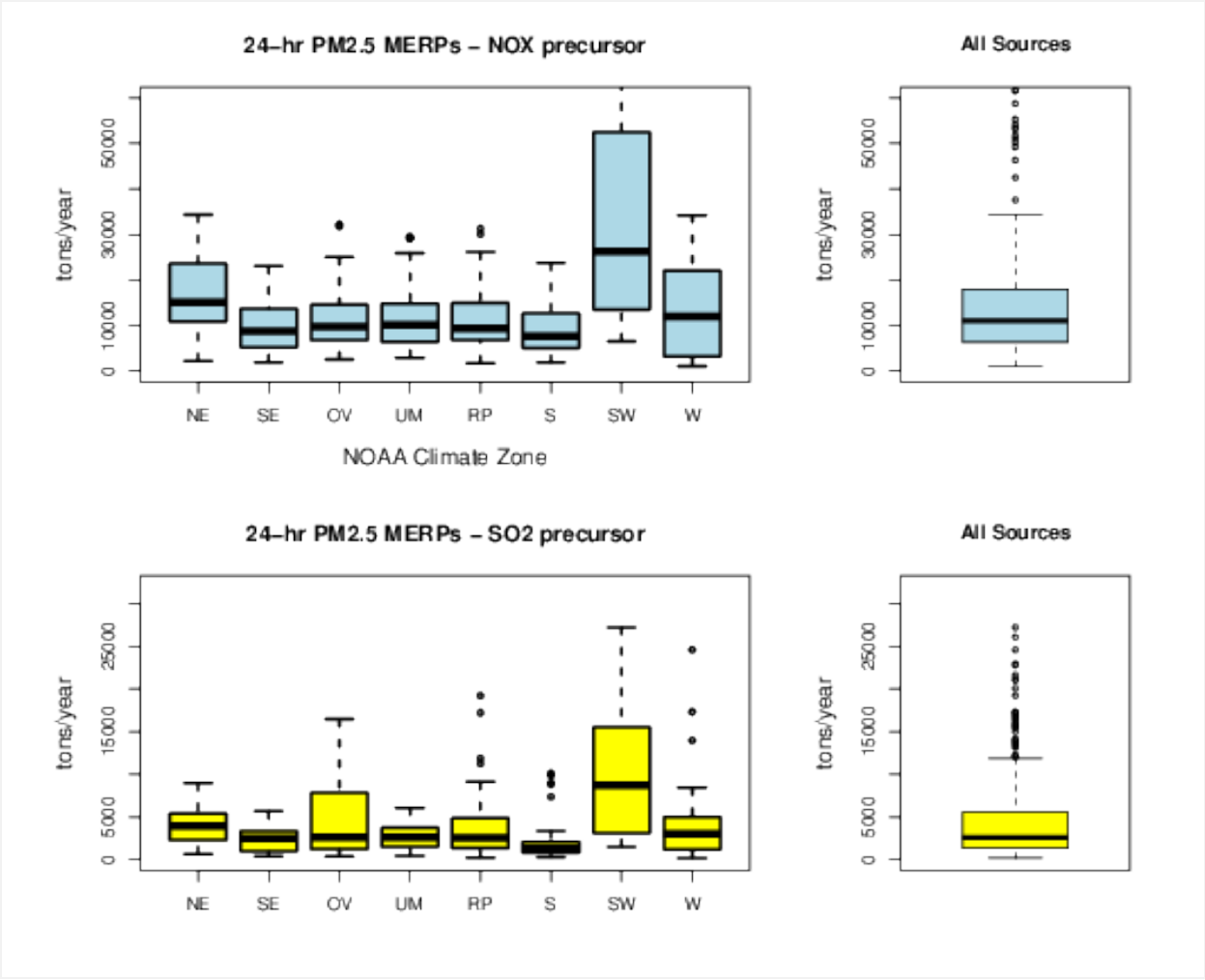
3.2.1.3. EPA Illustrative MERPs: Annual and Daily PM2.5

The hypothetical single source modeling presented here was used to develop illustrative MERPs based on equation 1 and the EPA recommended SIL. Based on the EPA's photochemical modeling results across all hypothetical sources presented above and detailed in Appendix A of this document, Figure 3-11 shows NO_X to annual maximum daily average $PM_{2.5}$ nitrate ion and SO_2 to annual maximum daily average $PM_{2.5}$ sulfate ion MERPs that illustrate the range of potential values for these sources and time period. Neither $PM_{2.5}$ sulfate nor $PM_{2.5}$ nitrate was assumed to be neutralized by ammonium. For this illustrative example, consistent with EPA's SILs guidance (U.S. Environmental Protection Agency, 2018), the EPA recommended 24-hour $PM_{2.5}$ NAAQS SILs value of 1.2 µg/m^3 was used to estimate daily average $PM_{2.5}$ MERPs.

The illustrative MERPs for NO_X to daily $PM_{2.5}$ range from 1,073 tpy to over 100,000 tpy, while the illustrative MERPs for SO_2 to daily $PM_{2.5}$ range from 188 tpy to over 27,000 tpy for the hypothetical sources modeled and presented here based on the selected air quality threshold. The variation from source to source is related to different chemical and meteorological environments around the source that range in terms of conduciveness toward secondary $PM_{2.5}$ formation.

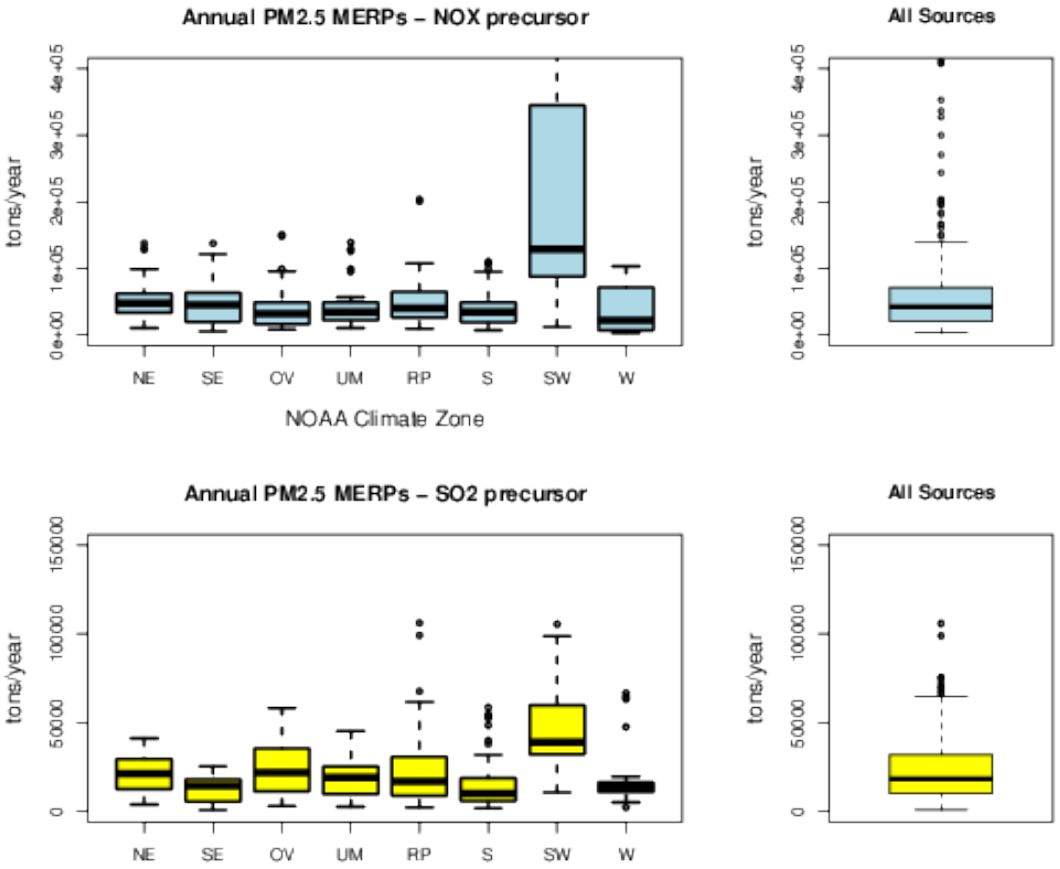
Similarly, based on EPA's photochemical modeling results of hypothetical sources, Figure 3-12 shows NO_X to maximum annual average $PM_{2.5}$ nitrate ion and SO_2 to maximum annual average $PM_{2.5}$ sulfate ion MERPs to illustrate the range of potential values for these sources and this time period. Neither $PM_{2.5}$ sulfate nor $PM_{2.5}$ nitrate were assumed to be neutralized by ammonium.

Figure 3-11. NO_X and SO_2 daily average $PM_{2.5}$ MERPs estimated from single source hypothetical emissions impacts on $PM_{2.5}$ nitrate ion and $PM_{2.5}$ sulfate ion respectively.
Note: Daily $PM_{2.5}$ MERPs derived here based on EPA recommended 24-hour $PM_{2.5}$ NAAQS SIL value of 1.2 µg/m^3 and neither $PM_{2.5}$ sulfate nor nitrate is assumed to be neutralized by ammonia.



For this illustrative example, consistent with EPA's SILs guidance, the EPA recommended annual $PM_{2.5}$ NAAQS SILs value of 0.2 µg/m^3 was used to estimate annual average $PM_{2.5}$ MERPs. The illustrative MERPs for NO_X to annual $PM_{2.5}$ range from 3,182 tpy to over 700,000 tpy, while the illustrative MERPs for SO_2 to annual $PM_{2.5}$ range from 859 tpy to over 100,000 tpy for the hypothetical sources presented here based on the selected air quality threshold. The variation from source to source is related to different chemical and meteorological environments around the source that range in terms of conduciveness toward secondary $PM_{2.5}$ formation.

Figure 3-12. NO_X and SO_2 annual average $PM_{2.5}$ MERPS shown by geographic region.
Note: Annual $PM_{2.5}$ MERPs derived here based on EPA recommended annual $PM_{2.5}$ NAAQS SIL value of 0.2 µg/m^3 and neither $PM_{2.5}$ sulfate nor nitrate is assumed to be neutralized by ammonia.



As shown, the illustrative MERPs are generally lower for SO_2 than NO_X meaning that SO_2 tends to form $PM_{2.5}$ more efficiently than NO_X. This is consistent with the conceptual model of secondary $PM_{2.5}$ formation in many parts of the United States reflecting that the $PM_{2.5}$ sulfate ion has a lower vapor pressure than $PM_{2.5}$ nitrate ion and tends to stay in the particulate phase in a greater range of meteorological conditions.

The distribution of illustrative MERPs for both SO_2 and NO_X to daily $PM_{2.5}$ are shown to vary between regions of the United States. This is expected since the chemical (e.g., oxidants, neutralizing agents) and physical (e.g., terrain) environments vary regionally in the United States. Figure 3-13 shows the lowest MERP at each hypothetical source location for daily (left panels) and annual (right panels) $PM_{2.5}$ from SO_2 (top panels) and NO_X (bottom panels) emissions. These plots show broad regional patterns in $PM_{2.5}$ formation potential which are generally related to regions with conducive meteorology, available neutralizing agents, and other emission sources competing for these neutralizing agents.

Figure 3-13. Lowest MERP value at each hypothetical source location for daily (left panels) and annual (right panels) $PM_{2.5}$ from SO_2 (top panels) and NO_X (bottom panels) emissions.

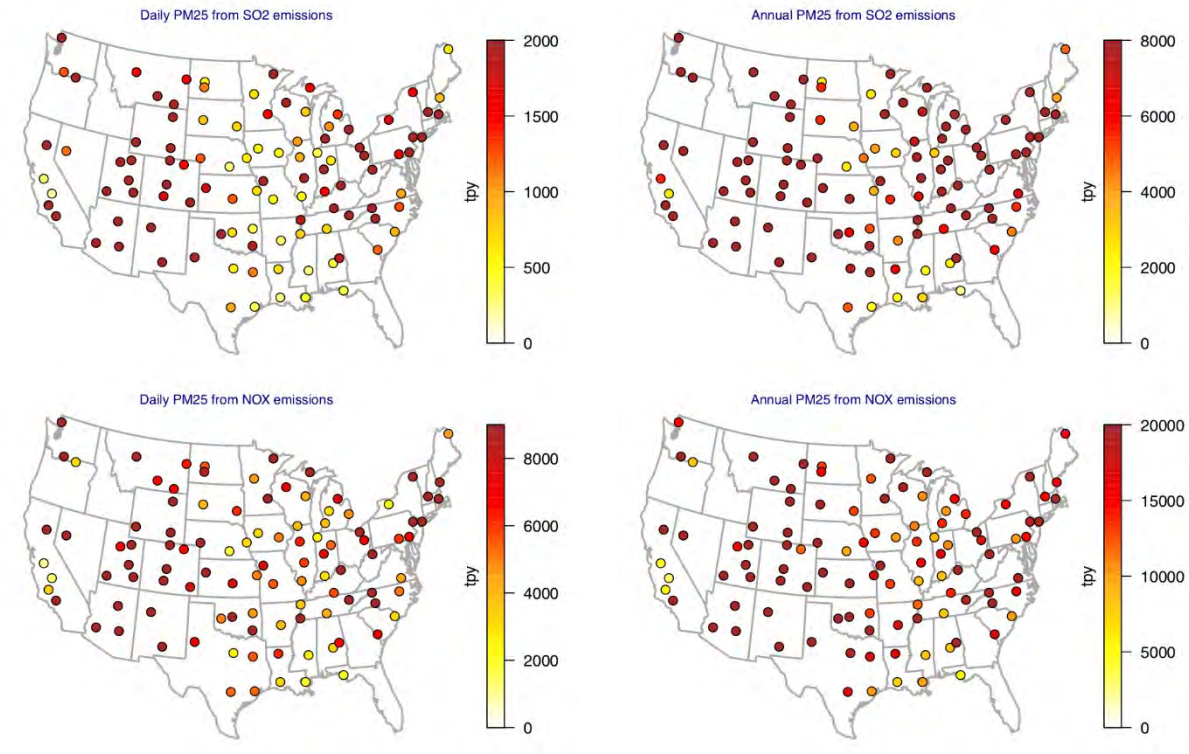


Figure 3-13 also shows that sometimes there are notable differences in $PM_{2.5}$ formation potential for sources in close proximity. Again, these differences are related to differences in local to regional mix of pollution, terrain, and meteorology. This also shows that spatial interpolation between these hypothetical sources would not always provide a realistic representation of model response to the introduction of new precursor emissions.

One interesting example of sources in close proximity with different $PM_{2.5}$ formation potential for sulfate and nitrate are the two hypothetical sources in western North Dakota. These sources are in fairly close proximity but are situated by very different types of emissions sources (e.g., large complex of industrial sources, animal operations). Figure 3-14 shows the location of these sources relative to modeled monthly average ammonia concentration and annual NO_2 emissions from the oil and gas sector.

Figure 3-14. Monthly average ammonia concentrations estimated by CAMx for July 2011 and annual total NO_2 emissions from the oil and gas sector based on the 2011 National Emission Inventory.

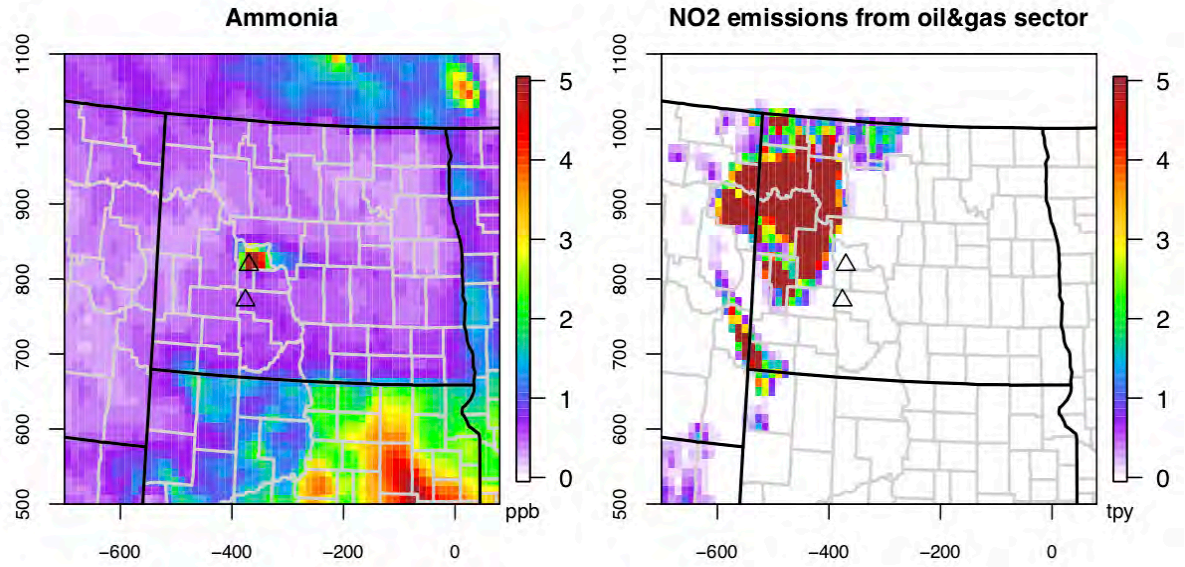
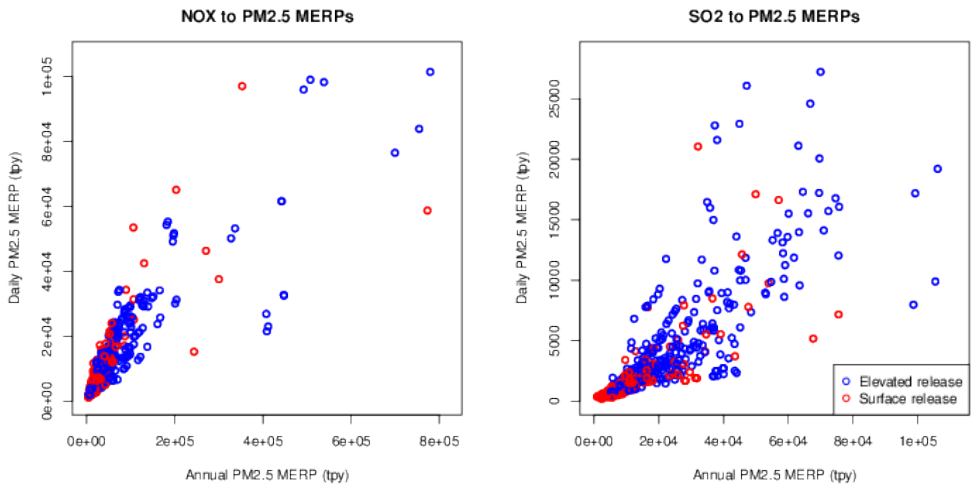


Figure 3-14 shows that the northern source is in very close proximity to a very large ammonia source which provides a readily available neutralizing agent for $PM_{2.5}$ formation when weather conditions are favorable. However, when winds are out of the north the southern source is in closer proximity to ammonia emissions located to the south in South Dakota. Further, the northern source is closer to the Bakken shale which is an area of high emissions that can provide oxidants for secondary chemical production and compete for neutralizing agents like ammonia.

Therefore, depending on meteorology, these sources will often have different potential for $PM_{2.5}$ production given their proximity to other industrial emissions sources and ammonia emissions sources. Figure 3-15 shows illustrative MERPs estimated for modeled sources for the daily and annual average forms of the $PM_{2.5}$ NAAQS.

Figure 3-15. Illustrative $PM_{2.5}$ MERPs for NO_X (left panel) and SO_2 (right panel) estimated from single source hypothetical emissions impacts on $PM_{2.5}$ nitrate ion and $PM_{2.5}$ sulfate ion respectively. Note: Daily average $PM_{2.5}$ MERPs are directly compared with annual average $PM_{2.5}$ MERPs.



3.2.1.4. EPA Illustrative MERPs: 8-hour Ozone

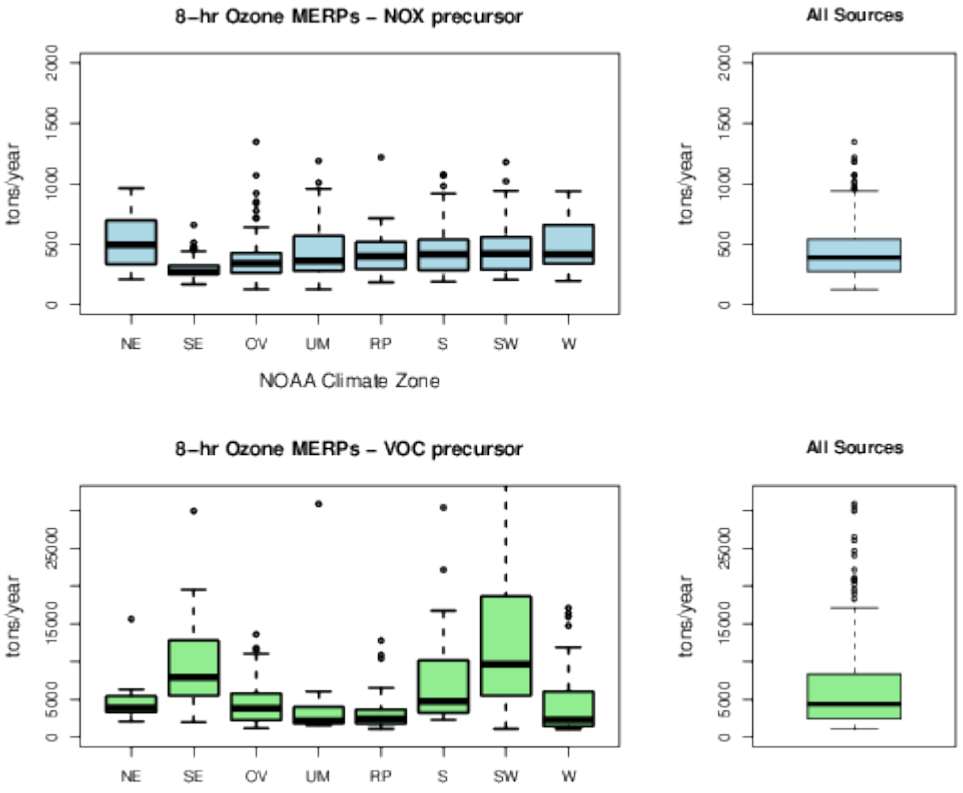
The hypothetical single source modeling presented here was used to develop illustrative MERPs based on equation 1 and the EPA recommended SIL. Figure 3-16 shows illustrative MERPs for NO_X and VOC to daily maximum 8-hr average O_3 to illustrate the variability between regions/studies for the hypothetical sources included in this assessment. The modeled impacts reflect the highest annual 8-hr O_3 impacts from various hypothetical sources presented in this assessment (Baker et al., 2016; Kelly et al., 2015; U.S. Environmental Protection Agency, 2016b). The hypothetical source impacts presented here were not intended to capture O_3 formation associated with winter time cold pool events and are not appropriate for situations where peak impacts would be expected during these meteorological conditions.

Based on EPA's SILs guidance (U.S. Environmental Protection Agency, 2018), the recommended 8-hour O_3 NAAQS SIL of 1.0 ppb was used for this illustrative example. The illustrative VOC MERPs are based on single source VOC impacts on downwind daily maximum 8-hr O_3, while the illustrative NO_X MERPs are based on single source NO_X impacts on downwind daily maximum 8-hr O_3. The illustrative MERPs for NO_X to daily maximum 8-hr O_3 range from 125 tpy to over 5,000 tpy, while the illustrative MERPs for VOC to daily maximum 8-hr O_3 range from 1,049 tpy to over 140,000 tpy for the hypothetical sources presented here.

For this assessment, illustrative MERPs for NO_X tend to be lower than VOC which suggests most areas included in this assessment are often more NO_X limited rather than VOC limited in terms of O_3 formation regime. This finding is consistent with the information provided in Section 2. The distribution of illustrative MERPs for both NO_X and VOC are shown to vary between areas

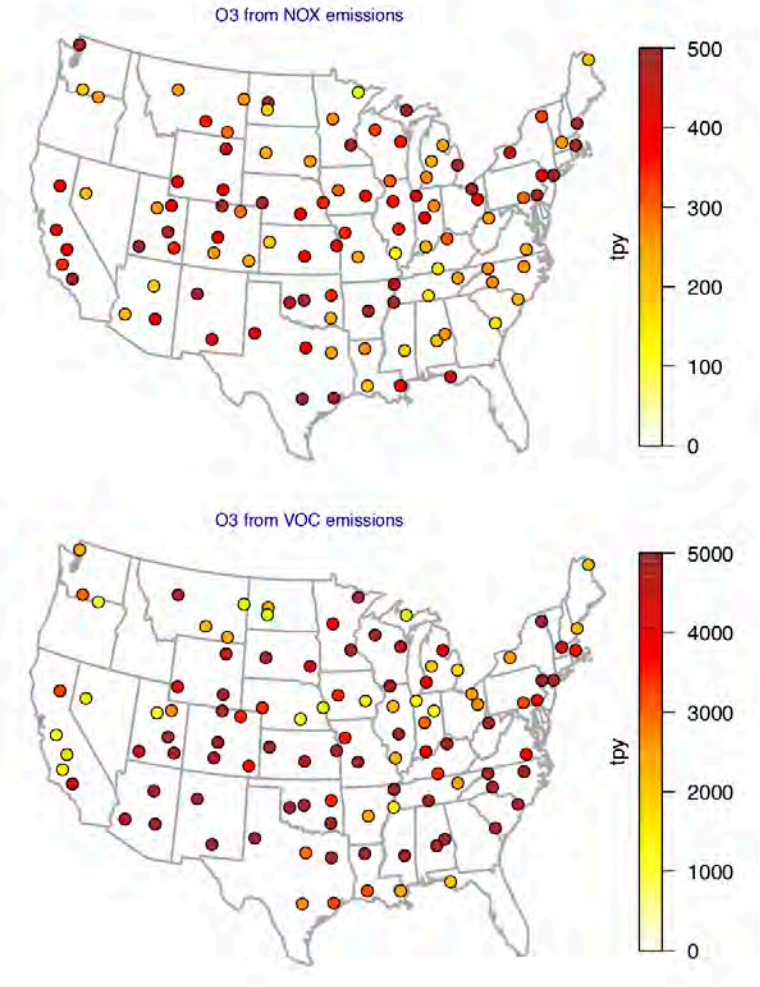
modeled as part of this assessment. Similar to $PM_{2.5}$, this is expected since the chemical (e.g., oxidants) and physical (e.g., terrain) environments vary regionally in the United States. The area-to-area availability of oxidants will determine whether O_3 production is NO_X or VOC limited which will be an important factor in how much an emissions source of NO_X or VOC will impact O_3 production.

Figure 3-16. NO_X (top panels) and VOC (bottom panels) MERPs estimated from single source hypothetical emissions impacts on daily maximum 8-hr O_3.
Note: 8-hr O_3 MERPs derived here based on EPA recommended 8-hour O_3 NAAQS SIL value of 1.0 ppb



The lowest MERP value for each of the hypothetical source locations is shown for NO_X (top) and VOC (bottom) in Figure 3-17. This shows that even within geographic areas there are sometimes notable differences in O_3 production potential for these precursors. Some broader patterns do emerge such as VOC emissions having less potential for O_3 formation in areas rich in regional VOC such as the southeast and intermountain west. Differences are also sometimes seen for sources located in fairly close proximity, which is related to local scale differences in emissions and meteorology. Figure 3-3 provides additional information about each of the hypothetical sources to help interpret conceptual differences in O_3 formation that may be related to terrain or proximity to urban areas.

Figure 3-17. Lowest MERP value for each hypothetical source location for O_3 from NO_X (top panel) and VOC (bottom panel) emissions.



3.2.2. Use of Other Photochemical Modeling to Develop MERPs for O_3 and Secondary $PM_{2.5}$

Given the spatial variability in illustrative MERPs for each precursor for $PM_{2.5}$ and O_3, stakeholders choosing to develop their own Tier 1 demonstration tool will need to conduct air quality modeling. Therefore, the air quality modeling should be consistent with the type of modeling system, model inputs, model application and estimation approach for O_3 and secondary $PM_{2.5}$ recommended in the *Guideline* and the "Guidance on the use of models for assessing the impacts from single sources on secondarily formed pollutants ozone and $PM_{2.5}$" (U.S. Environmental Protection Agency, 2016a). The chosen modeling system should be applied with a design scope similar to that shown in this document where multiple hypothetical single sources with varying emission rates and stack release parameters are simulated for a period that includes meteorology conducive to the formation of O_3 and/or secondary $PM_{2.5}$. A

modeling protocol should be developed and shared with the EPA Regional office that details the planned approach for developing MERPs based on photochemical modeling to ensure a sound technical basis for development of a suitable Tier 1 demonstration tool.

There is no minimum number of hypothetical sources to include in developing a MERPs Tier 1 demonstration tool, but the benefit of including more hypothetical sources is that more information is available for future sources to use in predicting secondary pollutant impacts from their post-construction emissions. Permitting authorities or permit applicants should examine existing recent (e.g., last 5 to 10 years) permit applications in that area to determine what types of emission rates and stack characteristics (e.g., surface and elevated release) should be reflected in the hypothetical project sources included in the model simulations. These model simulations should include a credible representation of current or post-construction conditions around the project source and key receptors.

Existing regulatory modeling platforms can be used to minimize resource burden. The most recently submitted regulatory demonstration (e.g., O_3 or $PM_{2.5}$ attainment demonstration, Regional Haze SIP demonstration) modeling platform considered appropriate for the purposes of permit related single source secondary impact demonstrations by the reviewing authority could provide a platform for development of a MERPs Tier 1 demonstration tool. This could include the last approved SIP demonstration, a more recent submitted but not yet approved SIP demonstration, or modeling not used to support a SIP demonstration but considered representative of the current air quality in the area and of sufficient quality that is comparable to a model platform supporting a SIP demonstration.

Where multiple appropriate modeling platforms are available for a particular area, the platform that is considered to be the most reflective of the current atmosphere in a particular area should be used for the demonstration to account for growth in an area and the changing mix of sources. For instance, if an area has a SIP modeling platform with a baseline year of 2011 and projected future year of 2018 and the current year is 2018, then the projected future year may better represent air quality in that area.

For areas that do not have an existing regulatory demonstration modeling platform, a new modeling platform that represents the current air quality and conforms to the specifications outlined for attainment demonstration modeling could be acceptable. The specifications for permit related demonstration model platforms (e.g., horizontal grid spacing, vertical resolution, non-project source emission treatment) are detailed in the “Guidance on the use of models for assessing the impacts from single sources on secondarily formed pollutants ozone and PM2.5” (U.S. Environmental Protection Agency, 2016a).

These platforms should be assessed for reasonableness with respect to predictive capability compared to ambient data to ensure that single sources are modeled in a realistic chemical and physical environment.

3.2.2.1. Developing Area Specific MERPs

Photochemical modeling conducted for an area by a source, a governmental agency, or some other entity that is deemed sufficient may be adequate for air agencies to conduct permit related demonstrations and also or alternatively leading to the development of area-specific MERPs.

8-hr Ozone: The general framework for such developmental efforts for O_3 should include the following steps:

1) Define the geographic area(s)
2) Conduct a series of source sensitivity simulations with appropriate air quality models to develop a collection of modeled O_3 impacts associated with emissions of O_3 precursors (i.e., VOC and NO_X) from typical industrial point sources within the area of interest.
3) Extract the highest daily 8-hr average modeled impact related to each hypothetical source anywhere in the domain from each model simulation (U.S. Environmental Protection Agency, 2016a).
4) Calculate the MERP estimate(s) using Equation 1.
5) Conduct quality assurance of the resulting MERP estimate(s) and evaluate the interpretation and appropriateness given the nature of O_3 precursor emissions sources and chemical formation in the area of interest. This evaluation will likely require emissions inventory data, observed ambient data for O_3 and precursors, a comparison of baseline total model predictions against ambient data, and qualitative comparison to MERPs estimated here and elsewhere.

Daily $PM_{2.5}$: The general framework for such developmental efforts for daily $PM_{2.5}$ should include the following steps:

1) Define the geographic area(s)
2) Conduct a series of source sensitivity simulations with appropriate air quality models to develop a collection of modeled $PM_{2.5}$ impacts associated with emissions of $PM_{2.5}$ precursors (i.e., SO_2 and NO_X) from typical industrial point sources within the area of interest.
3) Extract the highest daily 24-hr average modeled impact related to each hypothetical source anywhere in the domain from each model simulation (U.S. Environmental Protection Agency, 2016a).
4) Calculate the MERP estimate(s) using Equation 1.
6) Conduct quality assurance of the resulting MERP estimate(s) and evaluate the interpretation and appropriateness given the nature of $PM_{2.5}$ precursor emissions sources and chemical formation in the area of interest. This evaluation will likely require emissions inventory data, observed ambient data for $PM_{2.5}$ and precursors, a comparison of baseline total model predictions against ambient data, and qualitative comparison to MERPs estimated here and elsewhere.

Annual $PM_{2.5}$: The general framework for such developmental efforts for annual $PM_{2.5}$ should include the following steps:

1) Define the geographic area(s)
2) Conduct a series of source sensitivity simulations with appropriate air quality models to develop a collection of modeled $PM_{2.5}$ impacts associated with emissions of $PM_{2.5}$ precursors (i.e., SO_2 and NO_X) from typical industrial point sources within the area of interest.
3) Extract the highest annual average modeled impact related to each hypothetical source anywhere in the domain from each model simulation (U.S. Environmental Protection Agency, 2016a).
4) Calculate the MERP estimate(s) using the Equation 1.
7) Conduct quality assurance of the resulting MERP estimate(s) and evaluate the interpretation and appropriateness given the nature of $PM_{2.5}$ precursor emissions sources and chemical formation in the area of interest. This evaluation will likely require emissions inventory data, observed ambient data for $PM_{2.5}$ and precursors, a comparison of baseline total model predictions against ambient data, and qualitative comparison to MERPs estimated here and elsewhere.

If there are questions about what steps are appropriate in each instance or how to apply the steps described above, air agencies should contact their Regional office modeling contact for further technical consultation.

4. Application of the MERPs to Individual Permit Applications

The *Guideline* recommends a two-tiered approach for addressing single-source impacts on O_3 or secondary $PM_{2.5}$ (U.S. Environmental Protection Agency, 2017a) with the first tier involving use of appropriate and technically credible relationships between emissions and ambient impacts developed from existing modeling studies deemed sufficient for evaluating a project source's impacts. Consistent with the recommendations in EPA's *Guideline*, the appropriate tier for a given application should be selected in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and after reviewing EPA guidance. This section describes how applicants might choose, in consultation with the appropriate permitting authority, to use MERPs in estimating single-source impacts on secondary pollutants under the first-tier approach (i.e., sections 5.3.2.b and 5.4.2.b of the *Guideline*).

The use of MERPs as a Tier 1 demonstration tool can be based on either (1) EPA photochemical modeling with the source-specific value for a representative hypothetical source (as described in Section 3.2.1) or (2) the source- or area-specific value derived from a more similar hypothetical source modeled by a permit applicant or permitting authority (as described in Section 3.2.2). In some situations, the most conservative (lowest) MERP value across a region/area could be considered representative. The relevant geographic area could range from a county or airshed to a state or multi-state region. The selection of this geographic area may be determined in consultation with the appropriate reviewing authority and technical justification should be provided in the modeling protocol and/or permit-related documentation.

EPA recommends that the permit applicant follow a three-step process as shown in Figure 4-1.

1) Identify a representative hypothetical source (or group of sources for an area) from EPA's modeling as detailed in Appendix Table A-1 or the Excel spreadsheet available on SCRAM. If a representative hypothetical source is not available, then consider whether an EPA derived MERP value available for the broader geographic area of the project source may be adequately representative and thus appropriate to use (see Table 4-1). Alternatively, one can consider conducting photochemical modeling (as described in Section 3.2.2) to derive appropriate information to derive a source- or area-specific value.

   The permit applicant should provide the appropriate permitting authority with a technically credible justification that the source characteristics (e.g., stack height, emissions rate) of the specific project source described in a permit application and the chemical and physical environment (e.g., meteorology, background pollutant concentrations, and regional/local emissions) near that project source are adequately represented by the selected hypothetical source(s).

2) Acquire the source characteristics and associated modeling results for the hypothetical source(s). If using EPA modeling, then access these data from the on-line spreadsheet on

EPA's SCRAM website. If using other modeling, then access these data from the relevant input and output files.

3) Apply the source characteristics and photochemical modeling results from Step 2 to the MERP equation with the appropriate SIL value to assess the project source impacts.

   Section 4.1 provides several example PSD permit application scenarios that illustrate how to use source characteristics and photochemical modeling results to derive a MERP Tier 1 demonstration tool. In general, for situations where the project source emits only one precursor for O_3 or secondary $PM_{2.5}$ (and no primary $PM_{2.5}$ emissions), the project source emissions for that precursor can be compared directly to the appropriate MERP value for that precursor to determine if the applicable SIL is exceeded or not. For situations where project sources are required to assess multiple precursors, EPA recommends that the project source impacts on O_3 or secondary $PM_{2.5}$ reflect the sum of air quality changes resulting from each of those precursors for comparison to the EPA recommended SIL. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration. In such cases, the project source impacts associated with their direct $PM_{2.5}$ emissions should be assessed through dispersion modeling.

At the start of this process, EPA recommends that the permit applicant consult with the appropriate reviewing authority in developing a modeling protocol (per Section 9 of the *Guideline*) and that both parties confirm, at that time, the appropriateness of using these modeling results for the permitting situation. As part of the protocol, the permit applicant should include a narrative that provides a technical justification that the existing information or planned photochemical modeling is appropriate for the project source(s).

Derived from EPA modeling results, Table 4-1 summarizes the distribution of illustrative MERPs values across climate zones showing the lowest, highest and median values. Consistent with Step 1 outlined above, the most conservative (lowest) illustrative MERP value may, in some cases, be considered adequately representative to characterize the responsiveness of ozone or secondary $PM_{2.5}$ to precursors emitted in a region or area and then be considered for the Tier 1 demonstration in an individual permit application. Climate zones are only used here to summarize the MERPs values for the reader. EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant geographic area and/or hypothetical source from which to select a representative MERP value.

Figure 4-1. EPA recommended multi-step process for use of MERPs in PSD compliance demonstrations.

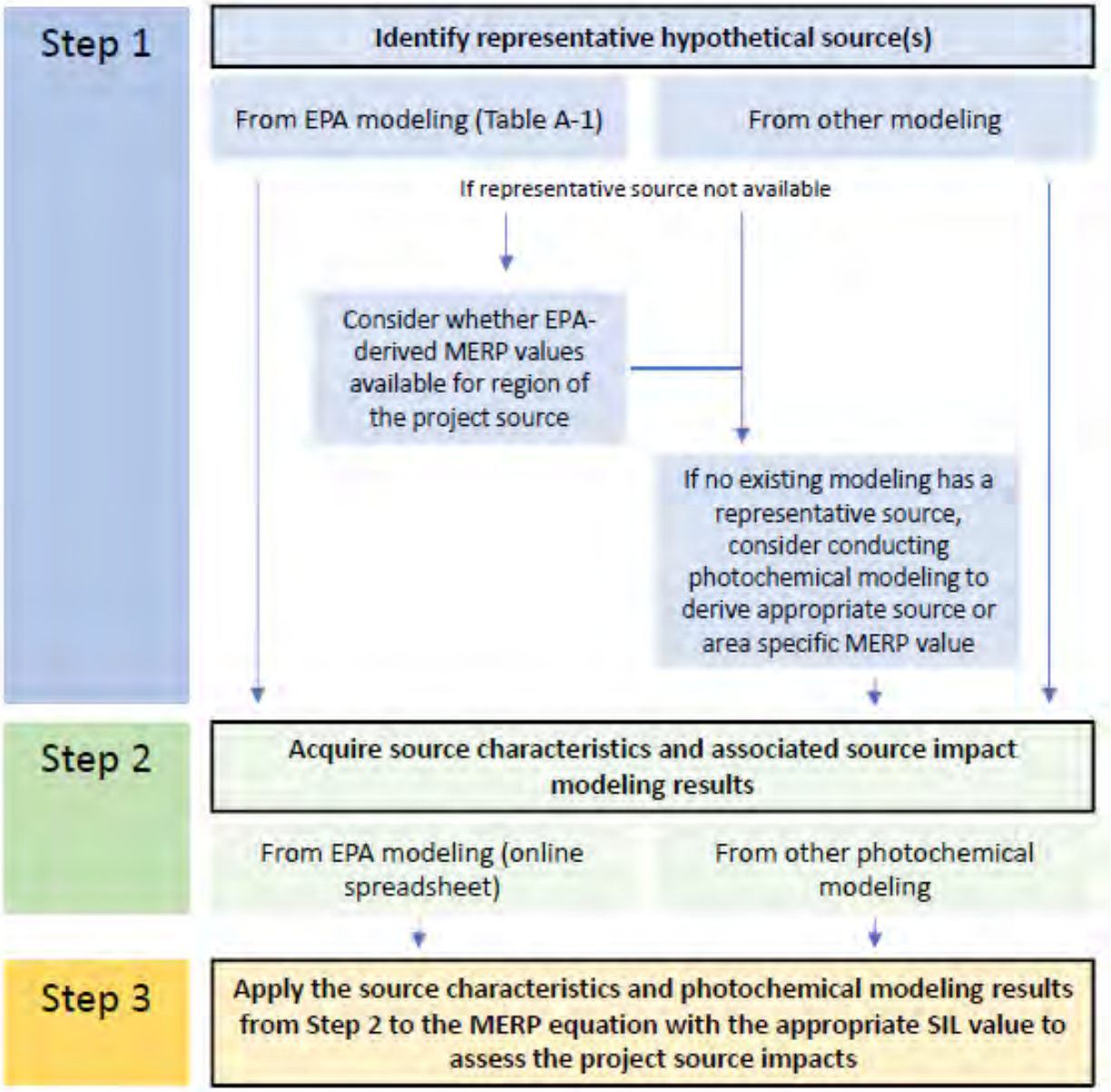


Table 4-1. Lowest, median, and highest illustrative MERP values (tons per year) by precursor, pollutant and climate zone.

Note: illustrative MERP values are derived based on EPA modeling and EPA recommended SILs from EPA's final SILs guidance (U.S. Environmental Protection Agency, 2018).

	8-hr O_3 from NO_X			8-hr O_3 from VOC		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	209	495	5,773	2,068	3,887	15,616
Southeast	170	272	659	1,936	7,896	42,964
Ohio Valley	126	340	1,346	1,159	3,802	13,595
Upper Midwest	125	362	4,775	1,560	2,153	30,857
Rockies/Plains	184	400	3,860	1,067	2,425	12,788
South	190	417	1,075	2,307	4,759	30,381
Southwest	204	422	1,179	1,097	10,030	144,744
West	218	429	936	1,094	1,681	17,086
Northwest	199	373	4,031	1,049	2,399	15,929

	Daily PM2.5 from NO_X			Daily PM2.5 from SO_2		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	2,218	15,080	34,307	623	3,955	8,994
Southeast	1,943	8,233	23,043	367	2,475	5,685
Ohio Valley	2,570	10,119	32,257	348	3,070	16,463
Upper Midwest	2,963	10,043	29,547	454	2,482	6,096
Rockies/Plains	1,740	9,389	31,263	251	2,587	19,208
South	1,881	8,079	24,521	274	1,511	10,112
Southwest	6,514	26,322	101,456	1,508	8,730	27,219
West	1,073	8,570	34,279	188	2,236	24,596
Northwest	3,003	11,943	20,716	1,203	3,319	8,418

	Annual PM2.5 from NO_X			Annual PM2.5 from SO_2		
Climate Zone	Lowest	Median	Highest	Lowest	Median	Highest
Northeast	10,142	47,396	137,596	4,014	21,353	41,231
Southeast	5,679	45,076	137,516	859	14,447	25,433
Ohio Valley	7,625	31,931	150,868	3,098	23,420	58,355
Upper Midwest	10,011	33,497	139,184	2,522	17,997	45,113
Rockies/Plains	9,220	39,819	203,546	2,263	16,939	106,147
South	7,453	41,577	110,478	1,781	11,890	58,612
Southwest	11,960	128,564	779,117	10,884	38,937	105,417
West	3,182	29,779	103,000	2,331	11,977	66,773
Northwest	7,942	21,928	71,569	11,276	15,507	18,263

4.1. Illustrative MERP Tier 1 Demonstrations for Example PSD Permit Scenarios

In this section, several example PSD permit application scenarios are presented to illustrate how modeled emissions and secondary pollutant impacts from EPA's modeling of hypothetical sources (described in Section 3.2.1) could be used to derive a MERP Tier 1 demonstration tool (as described in Section 3.1) for a given location. Some of these examples demonstrate how to account for multiple precursor impacts on secondary $PM_{2.5}$ formation. One scenario (i.e., scenario D) reflects a situation where a project source emits both primary $PM_{2.5}$ and precursors to secondary $PM_{2.5}$. In those situations, applicants should consult the appropriate sections of the *Guideline* (U.S. Environmental Protection Agency, 2017a) and related permit modeling guidance for information about estimating primary PM2.5 impacts**.** As illustrated in these examples, representative MERPs for each precursor may be developed based on either the most conservative (lowest) value across a region/area or the source-specific value derived from a more similar hypothetical source modeled by a permit applicant, permitting authority, or EPA.

For multiple areas, Table 4.1 shows an example of the most conservative (i.e., lowest) illustrative MERP for each precursor and NAAQS across all sources and studies. These illustrative values in Table 4.1 are based on the EPA modeling of hypothetical sources described in Section 3.2.1. For reference at the individual source level, the maximum predicted downwind impacts for each of the hypothetical sources modeled with annual simulations are provided in the Excel spreadsheet available on EPA's SCRAM website.

4.1.1. Source Impact Analysis: O_3 and $PM_{2.5}$ NAAQS

The following section provides examples of developing a suitable Tier 1 demonstration tool for each precursor and secondary pollutant as part of a PSD source impact analysis for the O_3 and $PM_{2.5}$ NAAQS. Where only a single precursor of O_3 or $PM_{2.5,}$ and no direct $PM_{2.5}$, is emitted by the project source, then the MERP for that precursor may be directly applied. For situations where project sources are required to assess multiple precursors of $PM_{2.5}$ or of O_3, EPA recommends that the impacts of multiple precursors should be estimated in a combined manner for comparison to the appropriate SIL such that the sum of precursor impacts would be lower than the SIL in a demonstration of compliance. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD compliance demonstration. In such cases, the project source impacts associated with their direct $PM_{2.5}$ emissions should be assessed through dispersion modeling.

In this assessment, the maximum downwind impact from each source is chosen over the length of the model simulation period and matched with the annual emission rate. The maximum impact is selected since a single year of meteorology (or less in some instances) is used to generate these relationships. Additional or alternative meteorological patterns may result in

different impacts in some areas. The following illustrative examples are intended to show how MERP values may be used in specific PSD permit air quality demonstrations.

Scenario A: Single precursor assessment for $PM_{2.5}$ and additive O_3 impacts

In this scenario, a PSD permit applicant with a proposed increase in emissions of 0 tpy of primary $PM_{2.5}$, 130 tpy of VOC, 72 tpy of NO_X, and 0 tpy of SO_2 located in the upper midwest region.

O_3 analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of either NO_X or VOC, or meteorology. Thus, the climate zone may be defined as the relevant geographic area such that the lowest MERPs from Table 4-1 for the upper midwest region could be considered representative and chosen for comparison with the project emissions rather than selecting a particular hypothetical source from this same climate zone. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

The NO_X emissions of 72 tpy and VOC emissions of 130 tpy from the project source are well below the lowest (most conservative) MERP values for NO_X as an O_3 precursor (i.e., 125 tpy) and VOC as an O_3 precursor (i.e., 1,560 tpy), respectively, of all sources modeled by EPA in the upper midwest region, as shown in Table 4-1. In this case, air quality impacts for each O_3 precursor from this source would be expected to be below the EPA recommended 8-hour O_3 SIL.

However, for this example, EPA recommends that the NO_X and VOC precursor impacts on 8-hr daily maximum O_3 be considered together to determine if the project source's air quality impact would exceed the O_3 SIL. In such a case, the project source's emissions increase can be expressed as a percent of the MERP for each precursor and then the percentages can be summed. A value less than 100% indicates that the EPA recommended 8-hour O_3 SIL will not be exceeded when considering the combined impacts of these precursors on 8-hr daily maximum O_3.

Example calculation for additive precursor impacts on 8-hr daily maximum O_3:

> (72 tpy NO_X from source/125 tpy NO_X 8-hr daily maximum O_3 MERP) + (130 tpy VOC from source/1,560 tpy VOC 8-hr daily maximum O_3 MERP) = .58 + .08 = .66 * 100 = 66%

A value less than 100% indicates that the O_3 SIL would not be exceeded when considering the combined impacts of these precursors. Thus, the project level O_3 impacts associated with both NO_X and VOC precursor emissions from this source would be expected to be below the EPA recommended 8-hour O_3 SIL.

$PM_{2.5}$ analysis: The project source is not located in an area with unusual circumstances

regarding complex terrain, proximity to very large sources of pollutants that impact atmospheric chemistry (i.e., NO_X, SO_2, NH_3) or meteorology. Thus, similar to the O_3 analysis above, the climate zone may be defined as the relevant geographic area such that the lowest MERPs from Table 4-1 for the upper midwest region could be considered adequately representative and chosen for comparison with the project emissions rather than selecting a particular hypothetical source from this same region. EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

The project source emits no direct $PM_{2.5}$ nor SO_2 so the demonstration focuses only on the NO_X emissions increase of 72 tpy, which is well below the lowest (most conservative) MERP value in the upper midwest region for NO_x as a precursor for the daily and annual $PM_{2.5}$ NAAQS shown in Table 4-1, i.e., 2,963 tpy and 10,011 tpy respectively. In this case, air quality impacts of $PM_{2.5}$ from this source are expected to be below the EPA recommended 24-hour and annual $PM_{2.5}$ SILs.

Scenario B: Single precursor assessment for O_3 impacts and additive secondary $PM_{2.5}$ impacts

In this scenario, a facility with a proposed increase in emissions of 0 tpy of primary $PM_{2.5}$, 0 tpy of VOC, 220 tpy of NO_X, and 75 tpy of SO_2 located in the southeast region.

O_3 analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of either NO_X or VOC, or meteorology. The project source does not emit VOC so the demonstration focuses only on the NOx emission increase of 220 tpy, which is greater than the lowest (most conservative) NO_X MERP for 8-hr O_3 in the southeast region (i.e., 170 tpy). Thus, for this example, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind O_3 impacts, it is likely more appropriate to use a specific hypothetical source in the same region or other appropriate geographic area for comparison.

A comparable hypothetical source is identified to be representative of this source (e.g., southeast region source located in Tallapoosa County, Alabama with elevated emissions release). Here, equation 1 is used with the modeled emissions rates and air quality impact information from this hypothetical source. Since multiple hypothetical sources were modeled at this location with an elevated release, the source with the lowest MERP was selected for comparison with the project source, i.e.,

> MERP for selected representative hypothetical source (tpy) = 1.0 ppb * (500 tpy /1.528 ppb) = 327 tpy

In this case, based on EPA modeling results for a representative hypothetical source, the project source emissions are less than the calculated NO_X to 8-hr O_3 MERP such that air quality impacts of O_3 from this source would be expected to be less than the EPA recommended 8-hour O_3 SIL.

$PM_{2.5}$ analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of pollutants that impact atmospheric chemistry (i.e., NO_X, SO_2, NH_3) or meteorology. Thus, the climate zone may be defined as the relevant geographic area such that the lowest MERPs from Table 4-1 for the southeast region could be considered adequately representative and chosen for comparison with the project emissions rather than selecting a particular hypothetical source from this same region. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

For this example, both the NO_X emissions of 220 tpy and SO_2 emissions of 75 tpy are well below the lowest (most conservative) daily $PM_{2.5}$ MERP values of any source modeled in the southeastern region, i.e., 1,943 tpy for NO_X and 367 tpy for SO_2 respectively. These emission rates are also well below the annual $PM_{2.5}$ MERP values of any source modeled in the southeastern region (see Table 4-1).

However, for this example, EPA recommends that the NO_X and SO_2 precursor impacts to both daily and annual average $PM_{2.5}$ are considered together to determine if the project source's air quality impact on $PM_{2.5}$ would exceed the $PM_{2.5}$ SILs. In this case, the project source's emissions increase can be expressed as a percent of the MERP for each precursor and then the percentages can be summed. A value less than 100% indicates that the EPA recommended daily or annual $PM_{2.5}$ SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual $PM_{2.5}$.

Example calculation for additive secondary impacts on daily $PM_{2.5}$:

> (220 tpy NO_X from source/1,943 tpy NO_X daily $PM_{2.5}$ MERP) + (75 tpy SO_2 from source/367 tpy SO_2 daily $PM_{2.5}$ MERP) = .11 + .20 = .31 * 100 = 31%

Example calculation for additive secondary impacts on annual $PM_{2.5}$:

> (220 tpy NO_X from source/5,679 tpy NO_X annual $PM_{2.5}$ MERP) + (75 tpy SO_2 from source/859 tpy SO_2 annual $PM_{2.5}$ MERP) = .04 + .09 = .13 * 100 = 13%

A value less than 100% indicates that the $PM_{2.5}$ SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual $PM_{2.5}$. Thus, in this case, the air quality impacts of $PM_{2.5}$ from precursor emissions of NO_X and SO_2 from this source would be expected to be less than the EPA recommended daily and annual $PM_{2.5}$ SILs.

Scenario C: Single precursor assessment for O_3 and additive $PM_{2.5}$ impacts

In this scenario, a facility with a proposed increase in emissions of 0 tpy of primary $PM_{2.5}$, 0 tpy of VOC, 920 tpy of NO_X, and 259 tpy of SO_2 located in the Rockies region.

O_3 analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of either NO_X or VOC, or meteorology. The project source does not emit VOC so the demonstration focuses only on the NOx emission increase of 920 tpy, which is greater than the lowest (most conservative) NO_X MERP for 8-hr O_3 in the Rockies region (i.e., 184 tpy). Thus, for this example, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind O_3 impacts, it is likely more appropriate to use a hypothetical source for comparison.

A comparable hypothetical source is identified to be representative of this source (e.g., Rockies region in Iron County, Utah with elevated release). Here, equation 1 is used with the modeled emissions rates and air quality impact information from the selected comparable source. Since multiple hypothetical sources were modeled at this location with an elevated release, the source with the most similar emission rate was selected for comparison with the project source, i.e.,

> MERP for selected representative hypothetical source (tpy) = 1.0 ppb * (1000 tpy / 1.314 ppb) = 761 tpy

In this case, based on EPA modeling results for a representative hypothetical source, the project source emissions are greater than the calculated NO_X to 8-hr O_3 MERP such that air quality impacts of O_3 from this source are expected to exceed the EPA recommended 8-hour O_3 SIL. Given that the NO_X emissions from this project source are expected to have air quality impacts that exceed the O_3 SIL, a cumulative impact analysis would be the next step in this scenario. More information for this type of demonstration is provided in Section 4.1.3.

$PM_{2.5}$ analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of pollutants that impact atmospheric chemistry (i.e., NO_X, SO_2, NH_3) or meteorology. The NO_X emissions of 920 are below the lowest (most conservative) daily and annual $PM_{2.5}$ MERP value of any source modeled in the Rockies region (i.e., 1.740 tpy and 9,220 tpy respectively), while the SO_2 emissions of 259 tpy are slightly higher than the lowest daily $PM_{2.5}$ MERP value of any source modeled in the Rockies region (i.e., 251 tpy for daily and 2,263 tpy for annual). Thus, for this example, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind secondary $PM_{2.5}$ impacts, it is likely more appropriate to use a hypothetical source for comparison.

A hypothetical representative source is identified to be representative of this source (e.g., Rockies region in Iron County, Utah) and has a 1,000 tpy elevated release NO_X MERP for daily $PM_{2.5}$ of 25,754 tpy and SO_2 MERP for daily $PM_{2.5}$ of 7,515 tpy, which are both much larger than the increase in emissions of the project source such that the source's impact on daily $PM_{2.5}$ would be expected to be less than the EPA recommended daily $PM_{2.5}$ SIL. The same hypothetical source has a NO_X MERP for annual $PM_{2.5}$ of 166,670 tpy and SO_2 MERP for annual $PM_{2.5}$ of 37,997 tpy, which are both much larger than the increase in emissions of the project source such that the source's impact on annual $PM_{2.5}$ would be expected to be less than the

EPA recommended annual $PM_{2.5}$ SIL. However, for this example, EPA recommends that the NO_X and SO_2 precursor contributions to both daily and annual average $PM_{2.5}$ are considered together to determine if the project source's air quality impact of $PM_{2.5}$ would exceed the $PM_{2.5}$ SILs. In this case, the project source's emissions increase can be expressed as a percent of the MERP for each precursor and then the percentages can be summed.

Example calculation for additive secondary impacts on daily $PM_{2.5}$:

> (920 tpy NO_X from source/25,754 tpy NO_X daily $PM_{2.5}$ MERP) + (259 tpy SO_2 from source/7,515 tpy SO_2 daily $PM_{2.5}$ MERP) = .036 + .034 = .07 * 100 = 7%

Example calculation for additive secondary impacts on annual $PM_{2.5}$:

> (920 tpy NO_X from source/166,670 tpy NO_X annual $PM_{2.5}$ MERP) + (259 tpy SO_2 from source/37,997 tpy SO_2 annual $PM_{2.5}$ MERP) = .006 + .007 = .013 * 100 = 1.3%

A value less than 100% indicates that the $PM_{2.5}$ SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual $PM_{2.5}$. Thus, in this case, the air quality impacts of $PM_{2.5}$ from precursor emissions of NO_X and SO_2 from this source would be expected to be less than both the EPA recommended daily and annual $PM_{2.5}$ SILs.

Scenario D: NO_X and SO_2 precursor assessment for additive secondary $PM_{2.5}$ impacts along with direct $PM_{2.5}$

In this scenario, a facility with a proposed increase in emissions of 250 tpy of primary $PM_{2.5}$, 0 tpy of VOC, 220 tpy of NO_X, and 75 tpy of SO_2 located in the southeast region. This scenario is like Scenario B above, except that EPA recommends that in assessing $PM_{2.5}$ the primary $PM_{2.5}$ emissions be accounted for along with the secondary impacts of $PM_{2.5}$ precursor emissions as part of the Tier 1 demonstration.

O_3 analysis: See scenario B above.

$PM_{2.5}$ analysis: Same as Scenario B as to $PM_{2.5}$ precursors. The combined impacts of the proposed increases in $PM_{2.5}$ precursor emissions of NO_X and SO_2 would not exceed the EPA recommended daily or annual $PM_{2.5}$ SILs.

However, for this example, EPA recommends that the primary $PM_{2.5}$ impacts be added to the secondary impacts for a full account of total $PM_{2.5}$ impacts in comparison to the daily and annual $PM_{2.5}$ SILs. The primary $PM_{2.5}$ impacts should be estimated using AERMOD or an approved alternative model as outlined in the *Guideline* (U.S. Environmental Protection Agency, 2017a) and consistent with EPA guidance for combining primary and secondary impacts of $PM_{2.5}$ for permit program assessments.

In this scenario, a representative secondary $PM_{2.5}$ impact for this source is added to the

appropriately estimated primary $PM_{2.5}$ impacts. The highest ambient impact at any receptor for primary $PM_{2.5}$ should be divided by the daily or annual $PM_{2.5}$ SIL values to estimate the primary impact calculated as a percentage of the SIL value and then added to the previously calculated secondary impacts.

For the daily $PM_{2.5}$ NAAQS, a peak primary $PM_{2.5}$ impact from AERMOD in this scenario is estimated to be 0.41 $\mu g/m^3$. Compared with a 1.2 $\mu g/m^3$ SIL for daily $PM_{2.5}$ means that the primary impact is 34% of the SIL. When this primary impact is summed with the secondary impacts of 31% the total is 65% which is below 100% suggesting this source impact is below the EPA recommended daily $PM_{2.5}$ SIL.

For the annual $PM_{2.5}$ NAAQS, annual average primary $PM_{2.5}$ impact from AERMOD is estimated to be 0.11 $\mu g/m^3$ for the scenario above. Compared with a 0.2 $\mu g/m^3$ SIL for annual $PM_{2.5}$ means that the primary impact is 55% of the SIL. When this primary impact is summed with the secondary impacts of 13% the total is 68% which is below 100% suggesting this source impact is below the EPA recommended annual $PM_{2.5}$ SIL.

Accounting for spatial correlation of primary and secondary impacts: As a variant on this scenario, for the daily $PM_{2.5}$ NAAQS, if the peak primary $PM_{2.5}$ impact from AERMOD is estimated to be 0.90 $\mu g/m^3$ for the above scenario, then the percent primary contribution to the SIL would be 75%. When summed with the secondary contribution of 31%, the total source impact exceeds 100% and, therefore, is greater than the EPA recommended daily $PM_{2.5}$ SIL. In this case, the spatial nature of the primary and secondary $PM_{2.5}$ impacts of the project source may be resolved in a more detailed manner to gain a better estimate of the project source impact for comparison to the $PM_{2.5}$ SILs. Primary impacts tend to be higher in closer proximity of the source, whereas secondary impacts can be higher further downwind (beyond the property fence line). For example, the primary and secondary $PM_{2.5}$ impacts could be resolved at varying distances from the source (e.g., within 5-10 km, between 10 and 25 km, and between 25 and 50 km) and then combined at each distance range for a comparison with the EPA recommended $PM_{2.5}$ SILs. If the more spatially resolved assessment still finds combined percentages above 100%, then a cumulative impact analysis would be the next step for this demonstration. More information for this type of demonstration is provided in Section 4.1.3.

4.1.2. Source Impact Analysis: Class 1 PSD Increment for $PM_{2.5}$

This section provides information for single source permit demonstrations for PSD increment of $PM_{2.5}$ at Class I areas. According to 40 CFR 51.166(c)(1) and 52.21(c), an allowable PSD increment based on an annual average may not be exceeded, and the allowable PSD increment for any other time period may be exceeded once per year at any one location. Currently there is no PSD increment for O_3 so no PSD increment demonstration for O_3 is necessary. The $PM_{2.5}$ PSD increment SIL values recommended by EPA for Class II and III areas are the same as the recommended $PM_{2.5}$ NAAQS SIL values so no separate PSD increment demonstration is needed for Class II and III areas.

The hypothetical model results provided in this document represent peak impacts for secondary $PM_{2.5}$, which are typically within 50 km from the source (see section 3.2.1). These impacts may not be applicable for PSD increment demonstrations at Class I area receptors that may be far downwind (beyond 50 km) of the project source. As stated in the *Guideline*, AERMOD is the preferred dispersion model for estimating primary $PM_{2.5}$ impacts from single sources for distances up to 50 km. Currently, there is no preferred modeling system for estimating long range transport impacts (i.e., beyond 50 km). The *Guideline* establishes a screening approach for such assessments (U.S. Environmental Protection Agency, 2017a).

The screening approach for the primary $PM_{2.5}$ component of a PSD Class I area demonstration beyond 50 km could include AERMOD estimates at or about 50 km from the project source (Section 4.2.c.i of the *Guideline*) or a second level assessment based on modeling primary PM2.5 that does not include plume-depleting processes to ensure a conservative estimate (Section 4.2.c.ii of the *Guideline*). The *Guideline* suggests a Lagrangian or comparable modeling system would be appropriate for a second level assessment. Photochemical grid models have been shown to demonstrate similar skill to Lagrangian models for long range pollutant transport when compared to measurements made from multiple mesoscale field experiments (ENVIRON, 2012a; U.S. Environmental Protection Agency, 2016c). EPA modeled a subset of the hypothetical sources shown in Figure 3-2 with tracking of primary $PM_{2.5}$ contribution (N=36) using the CAMx model applied without chemistry. A table of maximum daily average and maximum annual average primary $PM_{2.5}$ impacts by emission rate are shown in Table 4-2. This table is intended to provide illustrative information about peak downwind primary $PM_{2.5}$ impacts at distances beyond 50 km and where agreed to by the appropriate reviewing authority may provide relevant information to support Tier 1 PSD Class I increment demonstrations.

Table 4-2. Maximum daily average and maximum annual average primary $PM_{2.5}$ impacts at 100, 200, and 300 km from modeled hypothetical source.

Emission Rate (tpy)	Distance from source (km)	Highest Daily Average Concentration (μg/m^3) - tall stack	Highest Daily Average Concentration (μg/m^3) - surface release	Highest Annual Average Concentration (μg/m^3) - tall stack	Highest Annual Average Concentration (μg/m^3) - surface release
100	300	0.0117	0.0123	0.0008	0.0009
100	200	0.0223	0.0212	0.0016	0.0015
100	100	0.0537	0.0445	0.0070	0.0049
150	300	0.0180	0.0184	0.0012	0.0013
150	200	0.0328	0.0311	0.0024	0.0022
150	100	0.0807	0.0632	0.0102	0.0073
500	300	0.0610	0.0625	0.0044	0.0045
500	200	0.1167	0.1095	0.0087	0.0078
500	100	0.2717	0.2536	0.0379	0.0238
1000	300	0.1186	0.1217	0.0087	0.0089
1000	200	0.2300	0.2161	0.0175	0.0157
1000	100	0.5445	0.5009	0.0731	0.0477

Single source impacts on secondary $PM_{2.5}$ tend to decrease as distance from the source increases (Baker et al., 2016), which means peak source impacts presented in previous sections

to inform a $PM_{2.5}$ NAAQS air quality assessment may not provide relevant information for the spatial scales involved between project sources and Class I areas. Given that project source impacts will be lower at greater distances (see also Figure 3.6), the illustrative MERPs listed in Section 4 would not usually be relevant (unless the source and Class I area were in close proximity), so applicants should follow the screening approach described in this section for a Tier 1 demonstration of compliance with the Class I PSD increment for $PM_{2.5}$.

The hypothetical source impact information generated as part of the illustrative examples shown here or other credible existing single source modeling could provide information relevant for Class I SIL screening demonstrations. Rather than using the peak impact, the entirety of modeled information available for a specific project source (if available) or hypothetical source (such as but not limited to the sources modeled as part of this document) could be used to provide an estimate of secondary $PM_{2.5}$ impacts at distances further downwind.

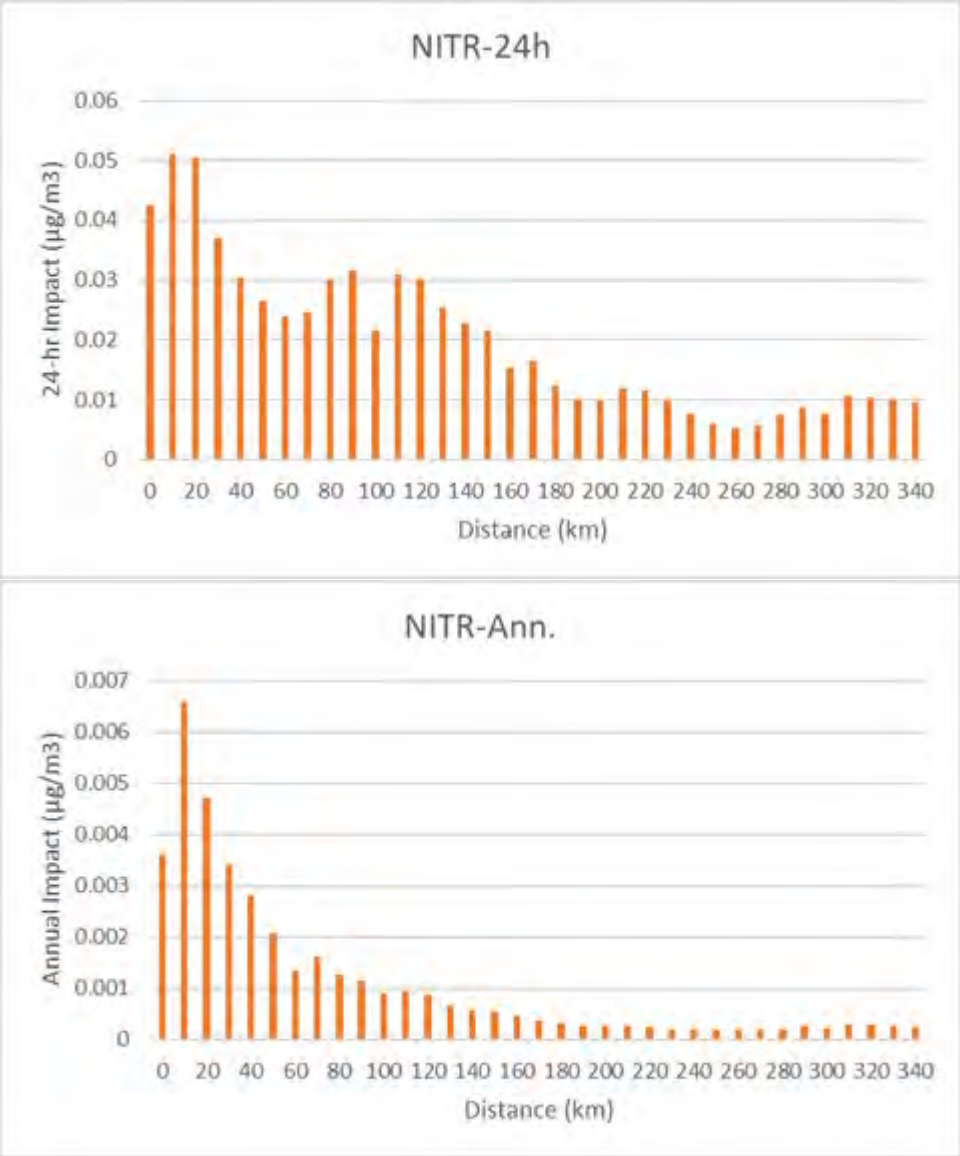
Consistent with the long-range transport (LRT) screening approach in the *Guideline*, the initial screening step would be to select one or more of the hypothetical sources modeled as part of the illustrative assessment provided in this document that are found to be similar to the project source. Then, modeled maximum secondary $PM_{2.5}$ impacts at or greater than 50 km would be used in combination with primary $PM_{2.5}$ impacts estimated with AERMOD at 50 km downwind of the source for comparison to the EPA recommended $PM_{2.5}$ Class I SIL value. Information about using AERMOD to support a LRT demonstration for primary pollutants is provided elsewhere (U.S. Environmental Protection Agency, 2016d).

If the results of the initial screening step show an exceedance of the $PM_{2.5}$ Class I SIL value, a second more refined screening step would involve selecting the highest modeled secondary $PM_{2.5}$ impact at or less than the downwind distance of the Class I area relative to the project source. That value would be combined with primary $PM_{2.5}$ impacts estimated with AERMOD at 50 km downwind and compared with the EPA recommended $PM_{2.5}$ Class I SIL. Another option for this screening step would also involve selecting the highest modeled secondary $PM_{2.5}$ impact at or near the downwind distance of the Class I area relative to the project source but include an estimate of primary $PM_{2.5}$ impacts estimated with a chemical transport model (e.g., Lagrangian or photochemical model) at or less than the downwind distance of the Class I area relative to the project source.

An illustrative example of this type of a screening demonstration for Class I $PM_{2.5}$ increment would be a 3,000 tpy NO_X project source that emits near the surface in the northeast U.S. This project source does not emit SO_2 so secondary formation of $PM_{2.5}$ sulfate ion does not need to be considered in addition to $PM_{2.5}$ nitrate formation from the NO_X emissions. The nearest Class I area is ~300 km downwind of the project source. Multiple hypothetical sources (3 for this particular example) with ground-level emission release characteristics near the project source were examined for annual and 24-hr average $PM_{2.5}$ nitrate impacts at or greater than 50 km and at or near 300 km downwind of the source in any direction. Figure 4-2 shows the peak hypothetical source impacts from 500 tpy of emissions at ~50 km downwind on $PM_{2.5}$ nitrate for

daily $PM_{2.5}$ is 0.032 µg/m^3 and annual $PM_{2.5}$ is 0.002 µg/m^3. As shown, at approximately 310 km from the project source, the peak hypothetical source impacts on $PM_{2.5}$ nitrate for daily $PM_{2.5}$ would be 0.01 µg/m^3 and 0.0003 µg/m^3 for annual $PM_{2.5}$ (see Figure 4-2).

Figure 4-2. Modeled peak daily average (top) and annual average (bottom) $PM_{2.5}$ nitrate ion impacts from a hypothetical 500 tpy surface level source of NO_X emissions by distance downwind of the source.



The hypothetical source NO_X emission rate is 500 tpy and the project source emission rate is 3,000 tpy. Impacts from the 500 tpy hypothetical sources are linearly scaled (increased in this example) to be better representative of the project source emission rate. For example, the daily $PM_{2.5}$ nitrate impacts at 50 km downwind would be adjusted to 0.192 µg/m^3: 0.032 µg/m^3 *

3000 tpy/500 tpy = 0.192 μg/m^3. The annual $PM_{2.5}$ nitrate impacts at 300 km downwind would be adjusted to 0.0018 μg/m^3: 0.0003 μg/m^3 * 3000 tpy/500 tpy = 0.0018 μg/m^3.

As part of the initial screening step, the project source impact of 0.192 μg/m^3 for daily $PM_{2.5}$ at 50 km downwind is added to its primary impact estimated with AERMOD at 50 km for comparison with the EPA recommended 24-hr $PM_{2.5}$ Class I area SIL of 0.27 μg/m^3. Assuming the primary impacts are below 0.078 μg/m^3, the project source could include this screening demonstration in its PSD application. Otherwise, the project source would move on to the second step with more refined screening demonstration based on 0.01 μg/m^3 impacts per 500 tpy NO_X at 300 km distance downwind, i.e., 0.01 μg/m^3 * 3000 tpy/500 tpy = 0.06 μg/m^3 of $PM_{2.5}$ nitrate.

This estimate of secondary contribution at the distance of the Class I area from the project source would then be added to the primary impacts modeled with AERMOD at 50 km and be compared with the EPA recommended $PM_{2.5}$ Class I SIL. If the sum of the more refined secondary contribution paired with the primary $PM_{2.5}$ contribution exceeds the SIL, the next step in the screening demonstration would utilize an estimate of primary $PM_{2.5}$ using a chemical transport model (e.g., Lagrangian or photochemical model) that can be paired with the secondary impact at 300 km downwind (as shown above). In situations where the screening demonstration does not show downwind impacts of $PM_{2.5}$ at Class I areas below the SIL, then a more refined approach to estimate the impacts from their project source based on methods suggested for Tier 2 demonstrations may be considered prior to conducting a cumulative impact analysis.

4.1.3. Cumulative Impact Analysis: O_3 and $PM_{2.5}$ NAAQS

As detailed in Section 9 of the *Guideline*, for situations where the project source is not able to demonstrate compliance through the source impact analysis, a cumulative impact analysis can be conducted that accounts for the impacts from the project source, impacts from nearby sources (as appropriate), and monitored background levels. The cumulative impacts are then compared to the NAAQS to determine whether the project source could cause or contribute to a NAAQS exceedance.

The following section provides examples of developing a suitable Tier 1 demonstration tool for each precursor and secondary pollutant for the purposes of a cumulative impact analysis. Where only a single precursor of O_3 or $PM_{2.5}$ necessitates a demonstration, then a direct application of this approach would be appropriate. For situations where project sources are required to assess multiple precursors of $PM_{2.5}$ or of O_3, EPA recommends that the impacts of multiple precursors should be estimated in a combined manner for comparison to the appropriate SIL such that the sum of precursor impacts would be lower than the SIL in a demonstration of compliance. Further, where project sources are required to assess both primary $PM_{2.5}$ and precursors of secondary $PM_{2.5}$, EPA recommends that applicants combine the primary and secondary impacts to determine total $PM_{2.5}$ impacts as part of the PSD

compliance demonstration. In such cases, the project source impacts associated with their direct $PM_{2.5}$ emissions should be assessed through dispersion modeling. The examples below include each of these situations.

The Tier 1 demonstration approach detailed in Section 3 of this document can be modified for use in a cumulative impact assessment. Here, existing relevant single source modeled impacts can be estimated and then added to the appropriate background contribution for comparison to the NAAQS. The MERP equation (Eq. 1) can be rearranged such that instead of calculating a modeled emission rate based on a critical air quality threshold such as a SIL value, a project specific impact would be estimated. Equation 2 shows how a project source impact would be the product of the relevant hypothetical source air quality impact relative to emissions scaled either upwards or downwards to the emission rate of the project.

$$\text{Eq. 2} \quad \text{Project Impact} = \text{Project emission rate} \times \frac{\text{Modeled air quality impact from hypothetical source}}{\text{Modeled emission rate from hypothetical source}}$$

For simplicity in these examples, nearby and background levels are represented by the design value from a representative monitor. In this situation, the cumulative assessment would include the sum of equation 2 and that monitored design value.

$$\text{Eq. 3} \quad \text{Projected Design Value with Project} = \text{Project Impact (Eq. 2)} + \text{Monitored Design Value}$$

If equation 3 results in an air quality level less that the NAAQS, then there is no NAAQS violation for which the source could cause or contribute to. However, if equation 3 results in an air quality level greater than the NAAQS, then the permit applicant should consult with the reviewing authority to determine the next step in the demonstrating project source impact at the location of the NAAQS violation. This may necessitate more refined modeling to reconcile project source impacts and monitored design values to complete the second phase of the cumulative impact analysis.

The following illustrative examples are intended to show how existing modeling information may be used in specific permit demonstrations.

Scenario A: Single precursor assessment for O_3 and additive secondary $PM_{2.5}$ impacts

In this scenario, a facility with a proposed increase in emissions of 0 tpy of primary $PM_{2.5}$, 0 tpy of VOC, 600 tpy of NO_X, and 3,100 tpy of SO_2 located in the southeast region.

<u>O_3 source impact analysis</u>: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of either NO_X or VOC, or meteorology. However, the NO_X emissions of 600 tpy are larger than the lowest (most conservative) NO_X MERP for 8-hr O_3 in the southeast region (i.e., 170 tpy). Thus, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind O_3 impacts, it is likely more appropriate to use a hypothetical source

in the same region or other appropriate geographic area for comparison. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

A comparable hypothetical source is identified to be representative of the project (e.g., southeast region source located in Tallapoosa County, Alabama with elevated emissions release). Since multiple hypothetical sources were modeled at this location with an elevated release, the source with the lowest MERP was selected for comparison with the project source. The project source does not emit VOC so a MERP approach addressing only NO_X emission is sufficient in this example. For this example, equation 2 was used to estimate air quality impacts using the hypothetical source information rather than equation 1 because this form of the Tier 1 demonstration approach more clearly fits into the subsequent cumulative assessment.

Project source impact (ppb) = 600 tpy * (1.528 ppb / 500 tpy) = 1.83 ppb

In this case, based on EPA modeling results for a representative hypothetical source, air quality impacts of O_3 from this project source would be expected to exceed the EPA recommended 8-hour O_3 SIL.

O_3 cumulative impact analysis: For the cumulative impact analysis, the impact estimated with equation 2 in the source impact analysis was used with an estimate of nearby source impacts and background O_3, which was a nearby monitor design value. The representative monitor near the project source has a design value of 65 ppb.

Projected Design Value with Project Source (ppb) = 1.83 ppb + 65 ppb = 66.83 ppb

When the source impact is combined with the nearby monitor design value using equation 3, the projected value is below the level of the O_3 NAAQS of 70 ppb.

$PM_{2.5}$ source impact analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of pollutants that impact atmospheric chemistry (i.e., NO_X, SO_2, NH_3) or meteorology. Both the NO_X and SO_2 emissions are below the lowest (most conservative) daily and annual $PM_{2.5}$ MERP values of any source modeled in the southeast region. The SO_2 emissions are not very far below the most conservative MERP relating SO_2 emissions to daily PM2.5 impacts. Thus, for simplicity in this example, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind secondary $PM_{2.5}$ impacts, it is likely more appropriate to use a specific hypothetical source in the same region or other appropriate geographic area for comparison. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

A comparable hypothetical source is identified to be representative of this project (e.g.,

southeast region source located in Tallapoosa County, Alabama with elevated emissions release) and has a source derived NO_X MERP for 24-hr $PM_{2.5}$ of 12,686 tpy and SO_2 MERP for 24-hr PM2.5 of 2,593 tpy. This hypothetical source has a derived NO_X MERP for annual $PM_{2.5}$ of 116,399 tpy and SO_2 MERP for annual PM2.5 of 21,106 tpy.

For this example, EPA recommends that the NO_X and SO_2 precursor impacts on both daily and annual average $PM_{2.5}$ are considered together to determine if the project source's air quality impact of $PM_{2.5}$ would exceed the $PM_{2.5}$ SILs. In this case, the project source's emissions increase can be expressed as a percent of the MERP for each precursor and then the percentages can be summed. A value less than 100% indicates that the EPA recommended $PM_{2.5}$ SILs would not be exceeded when considering the combined impacts of these precursors on daily and annual $PM_{2.5}$.

Example calculation based on equation 1 for additive precursor impacts on daily $PM_{2.5}$:

> (600 tpy NO_X from source/12,686 tpy NO_X daily $PM_{2.5}$ MERP) + (3,100 tpy SO_2 from source/2,593 tpy SO_2 daily $PM_{2.5}$ MERP) = .05 + 1.20 = 1.21 * 100 = 121%

Example calculation based on equation 1 for additive precursor impacts on annual $PM_{2.5}$:

> (600 tpy NO_X from source/116,399 tpy NO_X annual $PM_{2.5}$ MERP) + (3,100 tpy SO_2 from source/21,106 tpy SO_2 annual $PM_{2.5}$ MERP) = .005 + .147 = .15 * 100 = 15%

A value less than 100% indicates that the EPA recommended $PM_{2.5}$ SIL would not be exceeded when considering the combined impacts of these precursors on daily or annual $PM_{2.5}$. Thus, in this case, the air quality impacts of $PM_{2.5}$ from precursor emissions of NO_X and SO_2 from this source would be expected to be above the daily $PM_{2.5}$ SIL and less than the annual $PM_{2.5}$ SIL.

<u>$PM_{2.5}$ cumulative impact analysis</u>: For the cumulative impact analysis on daily $PM_{2.5}$ impacts, equation 2 is used with the modeled emissions rates and air quality impact information from this representative hypothetical source with an elevated release. Since multiple hypothetical sources were modeled at this location with an elevated release the source with the lowest MERP was selected for comparison with the project source.

> Source nitrate impact ($\mu g/m^3$) = 600 tpy * (0.047 $\mu g/m^3$ / 500 tpy) = 0.056 $\mu g/m^3$
> Source sulfate impact ($\mu g/m^3$) = 3,100 tpy * (0.891 $\mu g/m^3$ / 3,000 tpy) = 0.921 $\mu g/m^3$

A representative monitor near the project source has a 24-hour $PM_{2.5}$ design value of 14 $\mu g/m^3$.

> Projected Design Value with Project Source ($\mu g/m^3$) = 0.056 $\mu g/m^3$ + 0.921 $\mu g/m^3$ + 14 $\mu g/m^3$ = 14.98 $\mu g/m^3$

When the source impact is combined with the nearby monitor design value using equation 3, the projected value is below the level of the daily $PM_{2.5}$ NAAQS of 35 $\mu g/m^3$.

Scenario B: Additive demonstration for O_3 and secondary $PM_{2.5}$ with primary $PM_{2.5}$ impacts

In this scenario, a facility with a proposed increase in emissions of 500 tpy of primary $PM_{2.5}$, 62 tpy of VOC, 920 tpy of NO_X, and 259 tpy of SO_2 located in the western region.

O_3 source impact analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of either NO_X or VOC, or meteorology. However, the NO_X emissions of 920 tpy are larger than the lowest (most conservative) NO_X MERP for 8-hr O_3 in the western region of the U.S. Thus, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind O_3 impacts, it is likely more appropriate to use a specific hypothetical source in the same region or other appropriate geographic area for comparison. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

A comparable hypothetical source is identified to be representative of this source (e.g., western (Rockies) region in Iron County, Utah with elevated release). Here, equation 1 is used with the modeled emissions rates and air quality impact information from the selected comparable source. Since multiple hypothetical sources were modeled at this location with an elevated release the source with the MERP with the most similar emission rate was selected for comparison with the project source, i.e.,

1. NO_X MERP for selected representative hypothetical source (tpy) = 1.0 ppb * (1000 tpy / 1.314 ppb) = 761 tpy
2. VOC MERP for selected representative hypothetical source (tpy) = 1.0 ppb * (500 tpy / 0.0407 ppb) = 12,275 tpy
3. Combining impacts from both NO_X and VOC: (920/761 + 62/12,275) * 100 = 121%

In this case, based on modeling results for a representative hypothetical source, the project source emissions are greater than the calculated 8-hr O_3 MERP such that air quality impacts of O_3 from this source are expected to exceed the EPA recommended 8-hour O_3 SIL.

O_3 cumulative impact analysis: For the cumulative impact analysis, equation 2 is used with the modeled emissions rates and air quality impact information from this representative hypothetical source with an elevated release. Since multiple hypothetical sources were modeled at this location with an elevated release the source with the most similar emission rate was selected for comparison with the project source.

Source impact from NO_X (ppb) = 920 tpy * (1.314 ppb / 1000 tpy) = 1.208 ppb
Source impact from VOC (ppb) = 62 tpy * (0.0407 ppb / 500 tpy) = 0.005 ppb

A representative monitor near the project source has a design value of 62 ppb.

Projected Design Value with Project Source (ppb) = 1.213 ppb + 62 ppb = 63.213 ppb

When the source impact is combined with the nearby monitor design value using equation 3, the projected value is below the level of the O_3 NAAQS.

$PM_{2.5}$ source impact analysis: The project source is not located in an area with unusual circumstances regarding complex terrain, proximity to very large sources of pollutants that impact atmospheric chemistry (i.e., NO_X, SO_2, NH_3) or meteorology. However, the NO_X emissions of 920 are marginally below the lowest (most conservative) daily and annual $PM_{2.5}$ MERP value of any source modeled in the continental U.S., while the SO_2 emissions of 259 tpy are slightly higher than the lowest daily $PM_{2.5}$ MERP value of any source modeled in the western U.S. region.

Thus, for simplicity in this example, even though the project source's surrounding environment does not raise an obvious regional feature that would influence downwind secondary $PM_{2.5}$ impacts, it is likely more appropriate to use a hypothetical source in the same region or other appropriate geographic area for comparison. In practice, EPA recommends that the permit applicant consult with the appropriate reviewing authority to determine the relevant hypothetical source and geographic area from which to select representative MERP values.

A hypothetical source is identified to be representative of this source (e.g., western (Rockies) region in Iron County, Utah). Since multiple hypothetical sources were modeled at this location with an elevated release the source with the lowest MERP was selected for comparison with the project source. The 1,000 tpy MERP was chosen for NO_X and the 500 tpy MERP for SO_2 impacts. Both reflect elevated emissions release.

For this example, EPA recommends that the NO_X and SO_2 precursor contributions to both daily and annual average $PM_{2.5}$ are considered together to determine if the project source's air quality impact of $PM_{2.5}$ would exceed the EPA recommended $PM_{2.5}$ SILs. In this case, the project source's emissions increase can be expressed as a percent of the MERP for each precursor and then the percentages can be summed.

Example calculation for additive precursor impacts on daily $PM_{2.5}$:

(920 tpy NO_X from source/25,754 tpy NO_X daily $PM_{2.5}$ MERP) + (259 tpy SO_2 from source/6,386 tpy SO_2 daily $PM_{2.5}$ MERP) = 0.04 + 0.04 = 0.08 * 100 = 8%

Example calculation for additive precursor impacts on annual $PM_{2.5}$:

(920 tpy NO_X from source/166,670 tpy NO_X daily $PM_{2.5}$ MERP) + (259 tpy SO_2 from source/33,561 tpy SO_2 daily $PM_{2.5}$ MERP) = 0.0055+ 0.0077 = 0.013 * 100 = 1.3%

The emissions rates for both NO_X and SO_2 are much lower than the daily and annual $PM_{2.5}$ MERP based on the modeling results for a representative hypothetical source. However, for purposes of illustration in this hypothetical example, an assumption is made that primary $PM_{2.5}$ modeling with AERMOD (daily impact assumed to be 1.8 $\mu g/m^3$ and annual impact assumed to be 0.02 $\mu g/m^3$) showed an exceedance of the EPA recommended daily (but not annual) $PM_{2.5}$ SIL so that a cumulative impact analysis example is presented below for the daily form of the NAAQS. Note that no AERMOD simulations were done to relate primary $PM_{2.5}$ emissions and downwind impacts; the levels of impact used here are purely to support this illustrative example. When considering primary and secondary impacts for the annual form of the NAAQS, the source's impact would be expected to be less than the EPA recommended $PM_{2.5}$ SIL.

$PM_{2.5}$ cumulative impact analysis: For the cumulative impact analysis, equation 2 is used with the modeled emissions rates and air quality impact information from this representative hypothetical source with an elevated release.

> Source nitrate impact ($\mu g/m^3$) = 920 tpy * (0.047 $\mu g/m^3$ / 1000 tpy) = 0.043 $\mu g/m^3$
> Source sulfate impact ($\mu g/m^3$) = 259 tpy * (0.094 $\mu g/m^3$ / 500 tpy) = 0.049 $\mu g/m^3$

A representative monitor near the project source has a daily $PM_{2.5}$ design value of 11 $\mu g/m^3$. A hypothetical downwind primary $PM_{2.5}$ impact from other analysis for this source was determined to be 1.8 $\mu g/m^3$, which is included in the CIA together with the secondary impact analysis.

> Projected Design Value with Project Source ($\mu g/m^3$) = 0.043 $\mu g/m^3$ + 0.049 $\mu g/m^3$ + 11 $\mu g/m^3$ + 1.8 $\mu g/m^3$ = 12.89 $\mu g/m^3$

When the project source primary impact (from AERMOD) and secondary impacts (from MERP equation) are combined with the nearby monitor design value using equation 3, the projected value is below the level of the daily $PM_{2.5}$ NAAQS.

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Appendix A. Hypothetical Sources Included in the EPA's Modeling Assessment

Table A-1. Complete list of EPA modeled hypothetical sources presented in this document. A list of emission rates and stack height combinations modeled for each domain are provided in Table A-2. The "Max Nearby Urban (%)" column provides the highest percentage urban landcover in any grid cell near (within 50 km) the source. Source locations are shown in Figures A-1, A-2, A-3, and A-4.

FIPS	State	County	Domain	Source	Latitude	Longitude	Max Nearby Terrain (m)	Max Nearby Urban (%)
1001	Alabama	Autauga	12EUS2	4	32.522	-86.550	179	25
1123	Alabama	Tallapoosa	12EUS3	19	32.848	-85.809	306	10
4005	Arizona	Coconino	12US2	36	35.428	-111.270	2483	7.4
4007	Arizona	Gila	12WUS1	14	33.469	-110.789	1592	4.3
4012	Arizona	La Paz	12WUS1	17	33.400	-113.408	757	0.9
5119	Arkansas	Pulaski	12EUS2	13	34.724	-92.275	235	32.2
6029	California	Kern	12WUS1	26	35.356	-119.508	1195	49.1
6037	California	Los Angeles	12WUS1	21	34.696	-118.414	1528	39.9
6047	California	Merced	12WUS1	25	37.274	-120.708	547	14.6
6063	California	Plumas	12WUS1	24	39.920	-121.263	1773	17.5
6107	California	Tulare	12WUS1	20	36.324	-119.404	566	18.1
8011	Colorado	Bent	12WUS1	4	37.685	-102.994	1698	1.4
8069	Colorado	Larimer	12WUS1	8	40.841	-105.826	3288	0.5
8093	Colorado	Park	12US2	31	38.919	-105.990	3535	2.2
8109	Colorado	Saguache	12WUS1	9	37.965	-106.234	3374	2.7
8109	Colorado	Saguache	12WUS1	9	37.965	-106.234	3374	2.7
8123	Colorado	Weld	12WUS1	3	40.621	-104.037	1609	6.2
12005	Florida	Bay	12EUS2	5	30.269	-85.700	55	9.8
17021	Illinois	Christian	12US2	16	39.509	-89.092	209	11.6
17145	Illinois	Perry	12EUS2	7	38.078	-89.547	194	6.8
17155	Illinois	Putnam	12EUS2	6	41.200	-89.446	243	16.4
17177	Illinois	Stephenson	12US2	15	42.455	-89.606	296	14.4
18011	Indiana	Boone	12US2	11	40.009	-86.574	290	47.3
18037	Indiana	Dubois	12EUS2	2	38.255	-86.724	224	4.4
18053	Indiana	Grant	12EUS3	17	40.623	-85.589	285	10.3
18127	Indiana	Porter	12EUS2	1	41.380	-87.185	235	52.3
19027	Iowa	Carroll	12US2	20	42.092	-94.693	435	3.9
19095	Iowa	Iowa	12EUS2	11	41.674	-92.060	295	17.3
20091	Kansas	Johnson	12EUS2	17	38.746	-94.949	325	38.8
20109	Kansas	Logan	12US2	26	38.909	-101.173	1121	1.6
20155	Kansas	Reno	12EUS2	22	38.121	-97.899	542	12.7

21009	Kentucky	Barren	12EUS3	18	36.828	-85.830	269	4.5
21187	Kentucky	Owen	12US2	33	38.536	-84.707	279	7.4
22001	Louisiana	Acadia	12EUS2	15	30.241	-92.616	16	6.5
22061	Louisiana	Lincoln	12EUS2	14	32.476	-92.711	97	5.8
22071	Louisiana	Orleans	12EUS2	10	30.092	-89.879	10	50.4
23003	Maine	Aroostook	12EUS3	1	46.772	-67.850	365	4.6
23031	Maine	York	12EUS3	2	43.367	-70.580	237	13.3
25011	Massachusetts	Franklin	12EUS3	4	42.582	-72.459	583	21.6
25021	Massachusetts	Norfolk	12EUS3	3	42.139	-71.234	224	60
26099	Michigan	Macomb	12EUS3	11	42.822	-82.872	317	63.9
26103	Michigan	Marquette	12EUS3	15	46.570	-87.395	518	4
26117	Michigan	Montcalm	12EUS3	16	43.319	-85.368	309	42.8
26129	Michigan	Ogemaw	12US2	5	44.164	-84.069	382	4.4
26159	Michigan	Van Buren	12US2	10	42.410	-86.027	273	25.3
27037	Minnesota	Dakota	12US2	19	44.785	-93.311	339	52.4
27137	Minnesota	St Louis	12US2	13	47.913	-92.331	485	2.8
27159	Minnesota	Wadena	12US2	18	46.401	-95.086	464	2.2
28129	Mississippi	Smith	12EUS2	9	32.177	-89.345	142	2.3
29029	Missouri	Camden	12EUS2	12	38.014	-93.006	378	6.2
29155	Missouri	Pemiscot	12US2	17	36.223	-89.851	104	5.1
29177	Missouri	Ray	12US2	21	39.504	-94.135	305	39
30013	Montana	Cascade	12US2	28	47.367	-111.447	1803	18.1
30075	Montana	Powder River	12WUS1	7	45.299	-105.895	1238	0.6
30083	Montana	Richland	12WUS1	6	47.367	-104.447	862	2.3
30111	Montana	Yellowstone	12WUS1	11	45.786	-108.207	1641	22.2
31001	Nebraska	Adams	12EUS2	21	40.673	-98.327	655	18.2
31055	Nebraska	Douglas	12EUS2	16	41.364	-96.155	424	43.3
31101	Nebraska	Keith	12US2	25	41.247	-102.006	1197	2.1
32001	Nevada	Churchill	12WUS1	19	39.941	-118.748	1599	9.2
34041	New Jersey	Warren	12US2	2	41.017	-75.000	577	31.2
35031	New Mexico	Mc Kinley	12US2	32	35.368	-107.382	2577	3.6
35035	New Mexico	Otero	12WUS1	10	32.757	-105.767	2618	4.4
36005	New York	Bronx	12EUS3	5	40.819	-73.909	273	75.4
36019	New York	Clinton	12US2	1	44.477	-73.836	889	3.2
36051	New York	Livingston	12EUS3	7	42.877	-77.603	532	34
37009	North Carolina	Ashe	12EUS3	13	36.301	-81.374	1168	6.9
37109	North Carolina	Lincoln	12US2	8	35.439	-81.154	457	32.1
37127	North Carolina	Nash	12US2	4	35.922	-78.187	123	22.1
38057	North Dakota	Mercer	12WUS1	1	47.287	-101.879	719	1.8
38059	North Dakota	Morton	12WUS1	2	46.861	-101.925	799	1
39103	Ohio	Medina	12US2	6	41.238	-81.813	344	51.7
39157	Ohio	Tuscarawas	12EUS3	12	40.541	-81.396	356	26.9
40017	Oklahoma	Canadian	12EUS2	23	35.463	-97.913	473	43.1

40101	Oklahoma	Muskogee	12EUS2	18	35.751	-95.507	236	30.4
40127	Oklahoma	Pushmataha	12US2	22	34.390	-95.567	294	2.5
40149	Oklahoma	Washita	12US2	27	35.311	-99.187	662	4.4
41049	Oregon	Morrow	12WUS1	18	45.790	-119.475	894	8.2
42001	Pennsylvania	Adams	12EUS3	8	40.009	-77.111	364	26.9
42029	Pennsylvania	Chester	12US2	3	39.940	-75.822	188	32.2
45005	South Carolina	Allendale	12EUS3	14	32.973	-81.407	84	2.2
45051	South Carolina	Horry	12EUS3	10	34.083	-79.187	33	7.1
46055	South Dakota	Haakon	12US2	23	44.287	-101.879	842	1.4
46097	South Dakota	Miner	12US2	24	43.861	-97.425	535	5.4
47001	Tennessee	Anderson	12US2	12	36.079	-84.149	611	25.4
47055	Tennessee	Giles	12EUS2	3	35.291	-86.897	286	8.4
47157	Tennessee	Shelby	12EUS2	8	35.124	-90.002	117	42.4
48187	Texas	Guadalupe	12EUS2	25	29.553	-97.991	349	43.8
48201	Texas	Harris	12EUS2	20	29.592	-95.418	41	64.7
48213	Texas	Henderson	12EUS2	19	32.314	-95.556	155	27.6
48367	Texas	Parker	12EUS2	24	32.610	-97.736	384	35.7
48445	Texas	Terry	12WUS1	5	33.369	-102.146	1112	31.9
49013	Utah	Duchesne	12WUS1	12	40.407	-110.618	3395	0.9
49015	Utah	Emery	12US2	35	38.804	-110.630	2090	0.6
49021	Utah	Iron	12WUS1	16	37.608	-113.092	2870	5.5
49037	Utah	San Juan	12WUS1	13	37.905	-109.899	2450	0.2
49049	Utah	Utah	12WUS1	15	40.110	-111.936	2235	21.7
51053	Virginia	Dinwiddie	12EUS3	9	36.919	-77.707	133	9
53039	Washington	Klickitat	12WUS1	23	45.938	-121.191	1699	4.9
53057	Washington	Skagit	12WUS1	22	48.466	-122.559	497	9.6
54017	West Virginia	Doddridge	12US2	7	39.299	-80.633	454	10.4
55107	Wisconsin	Rusk	12US2	14	45.596	-90.768	482	2.3
55115	Wisconsin	Shawano	12US2	9	44.733	-88.263	309	32.2
56001	Wyoming	Albany	12US2	30	41.829	-105.857	2898	0.3
56005	Wyoming	Campbell	12US2	29	44.299	-105.895	1532	8.1
56023	Wyoming	Lincoln	12US2	34	41.905	-110.326	2585	1.3

Table A-2. A list of emission rates and stack release height combinations modeled for each domain. A complete list of hypothetical sources in each domain are provided in Table A-1. Figures showing the location of specific sources by domain are provided in Figures A1-A4.

Geographic Region	# hypothetical sources within the region	Release Type	Emission Rate (tpy)	NAAQS & Precursors Modeled		
				8-hr O3	Daily PM2.5	Annual PM2.5
12EUS3	18	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(eastern US)	18	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	18	H	500	NOX, VOC	NOX, SO2	NOX, SO2
	18	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12EUS2	25	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(central US)	25	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	25	L	1000	VOC	NOX, SO2	NOX, SO2
	25	H	500	NOX	NOX, SO2	NOX, SO2
	25	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12WUS1	26	H	3000	NOX, VOC	NOX, SO2	NOX, SO2
(western US)	26	H	1000	NOX, VOC	NOX, SO2	NOX, SO2
	26	H	500	NOX, VOC	NOX, SO2	NOX, SO2
	26	L	500	NOX, VOC	NOX, SO2	NOX, SO2
12US2	36	H	1000	NOX	NOX, SO2	NOX, SO2
(contiguous US)	36	H	500	NOX	NOX, SO2	NOX, SO2
	36	L	500	NOX, VOC	NOX, SO2	NOX, SO2

Figure A-1. Hypothetical source locations for the eastern U.S. (12EUS3) domain.

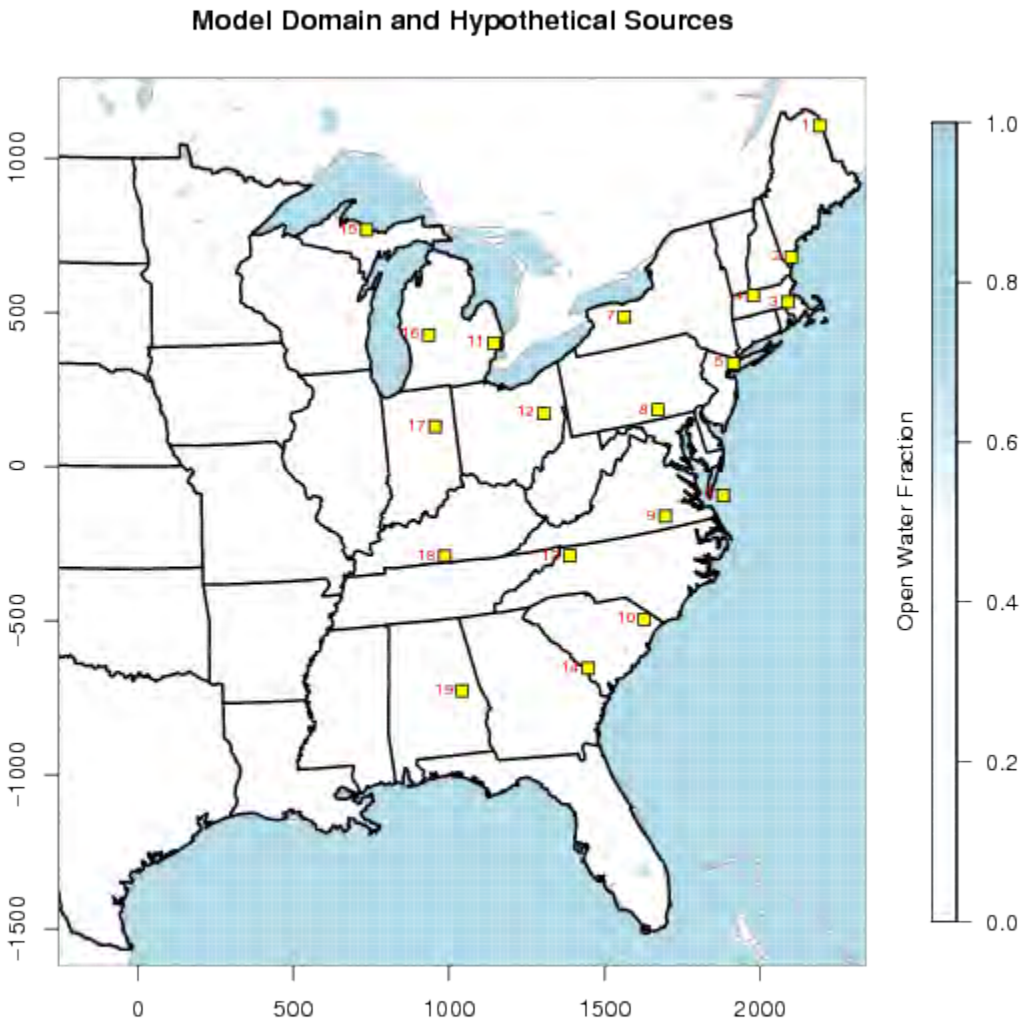


Figure A-2. Hypothetical source locations for the central U.S. (12EUS2) domain.

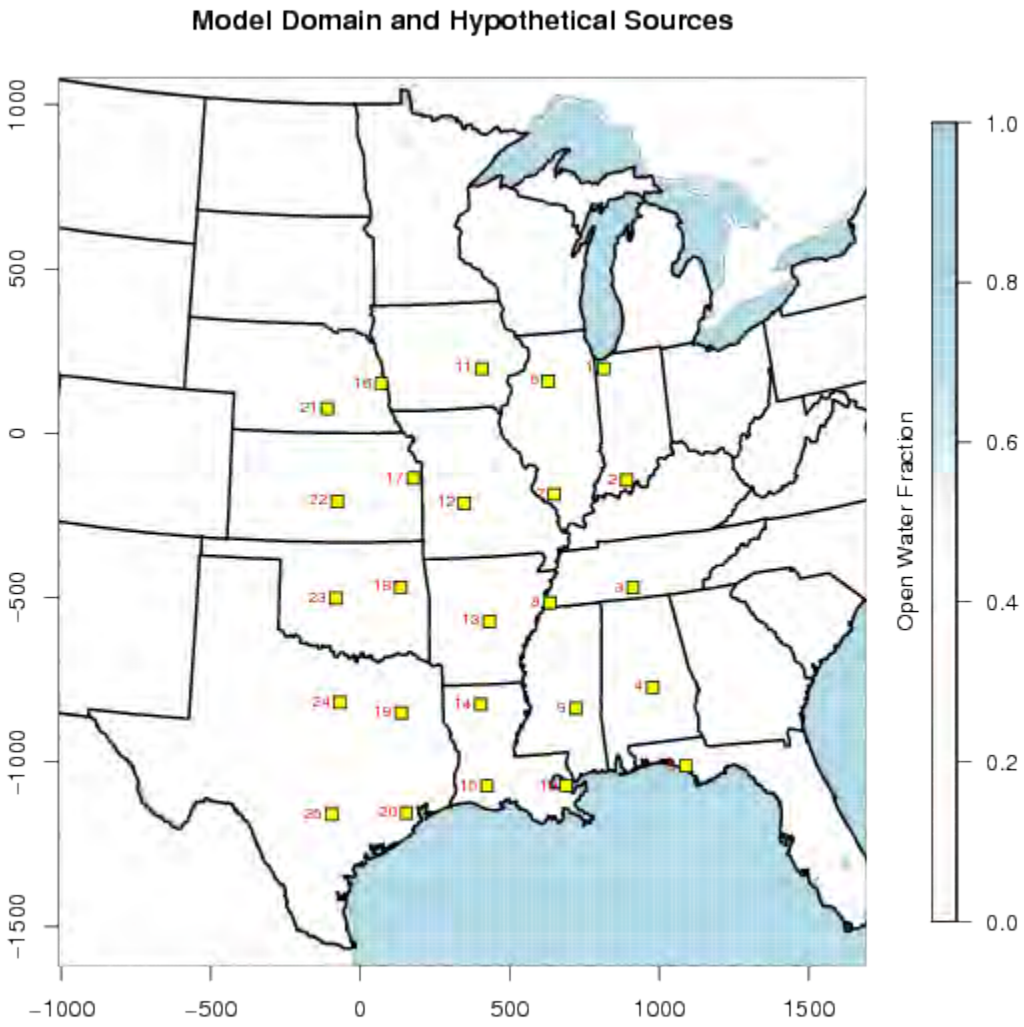


Figure A-3. Hypothetical source locations for the western U.S. (12WUS1) domain.

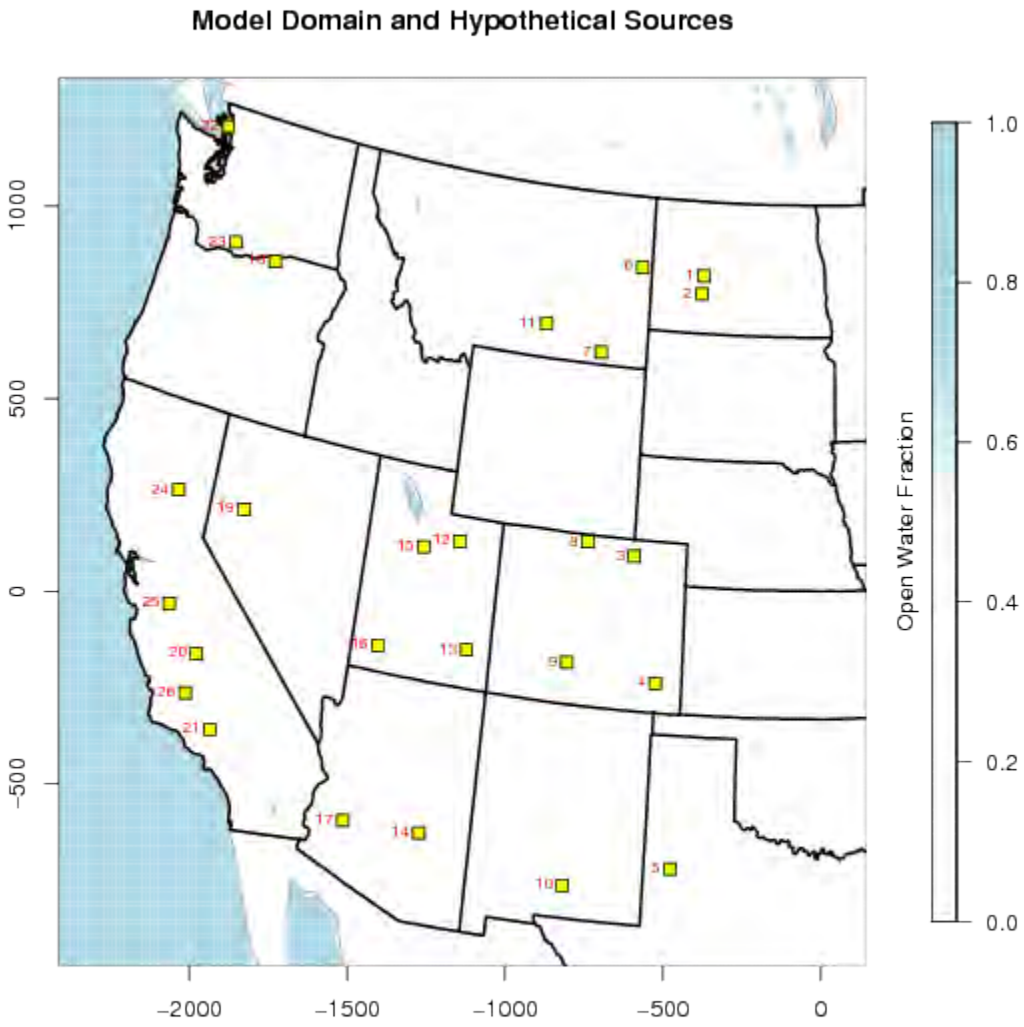
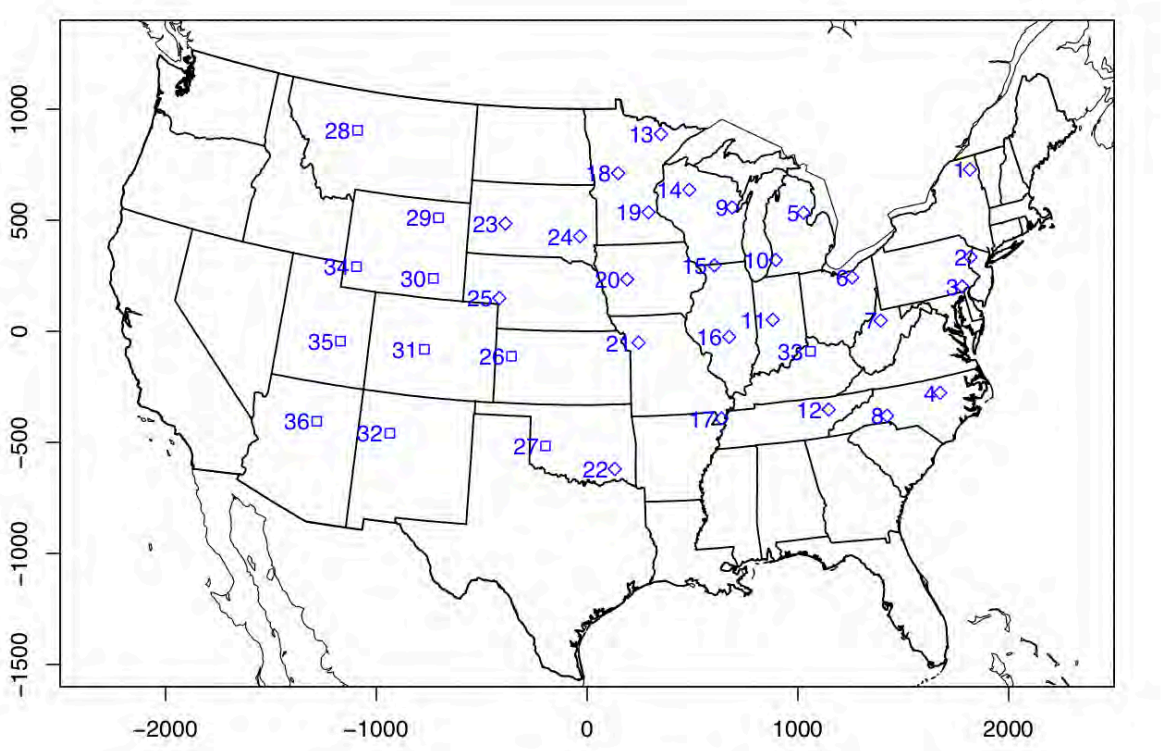


Figure A-4. Hypothetical source locations for the contiguous U.S. (12US2) domain.



United States Environmental Protection Agency

Office of Air Quality Planning and Standards
Air Quality Assessment Division
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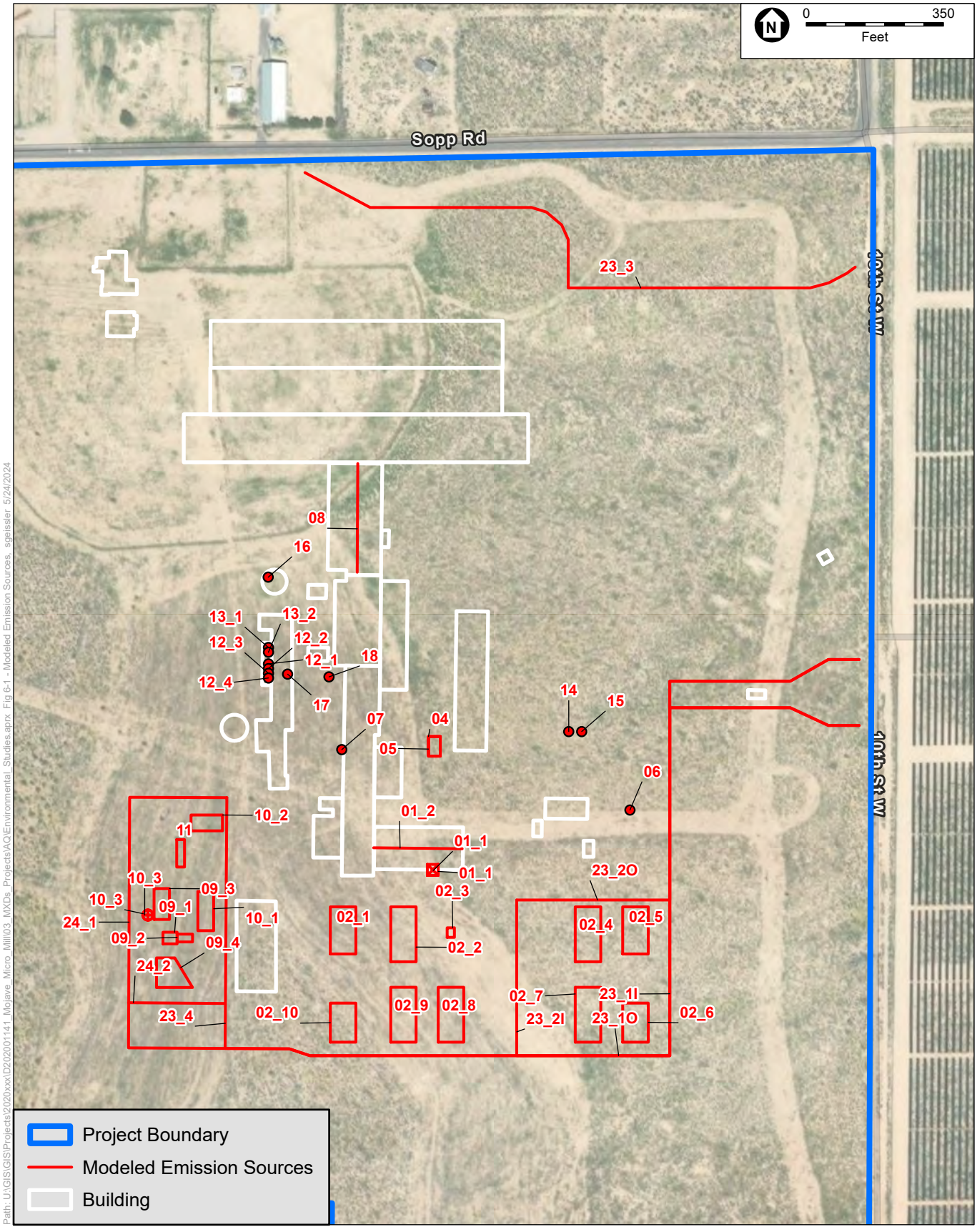
Appendix G
Air Dispersion Modeling Figures



SOURCE: ESA, 2024

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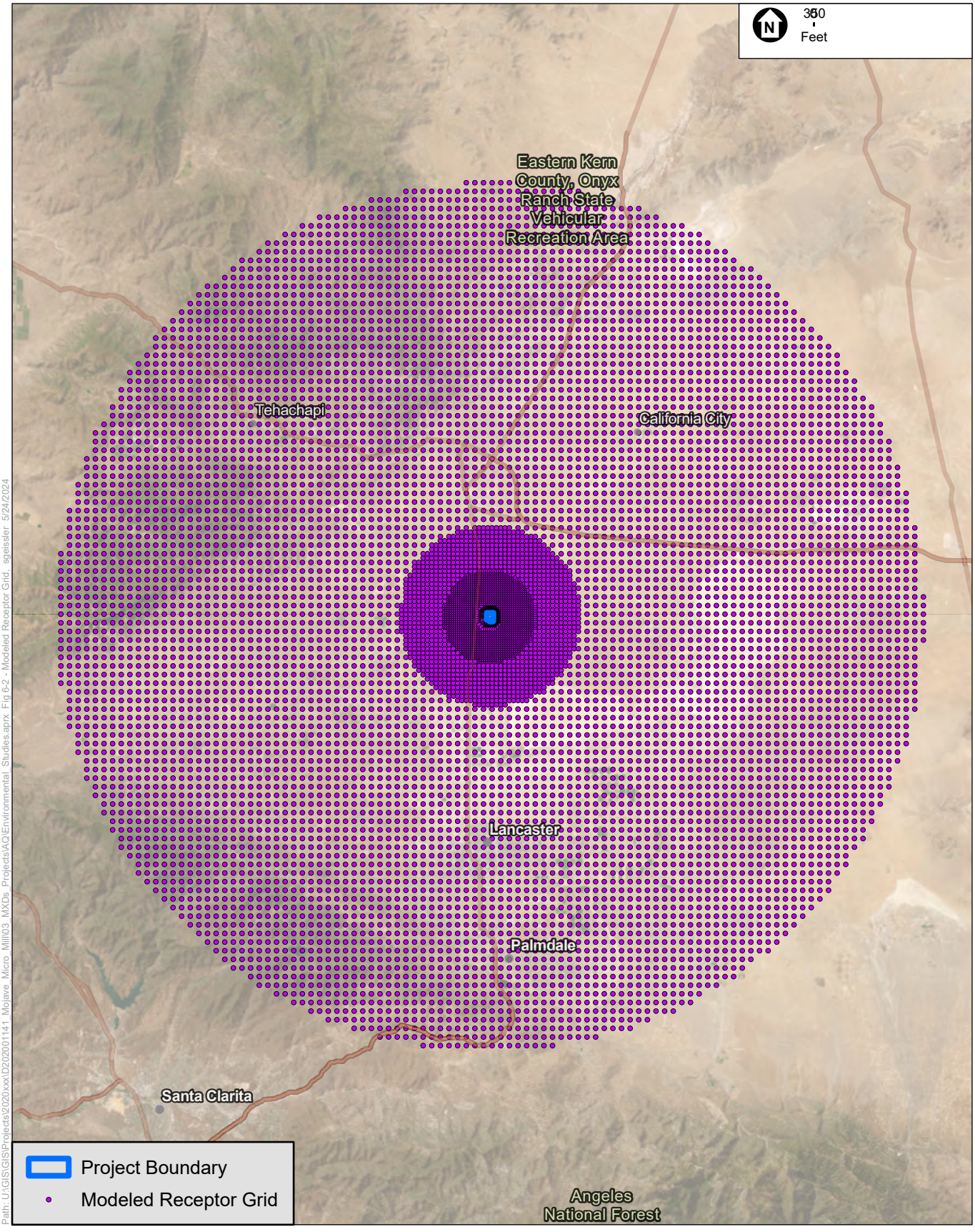
Figure 6-1
Modeled Emission Sources

ESA



SOURCE: ESA, 2024

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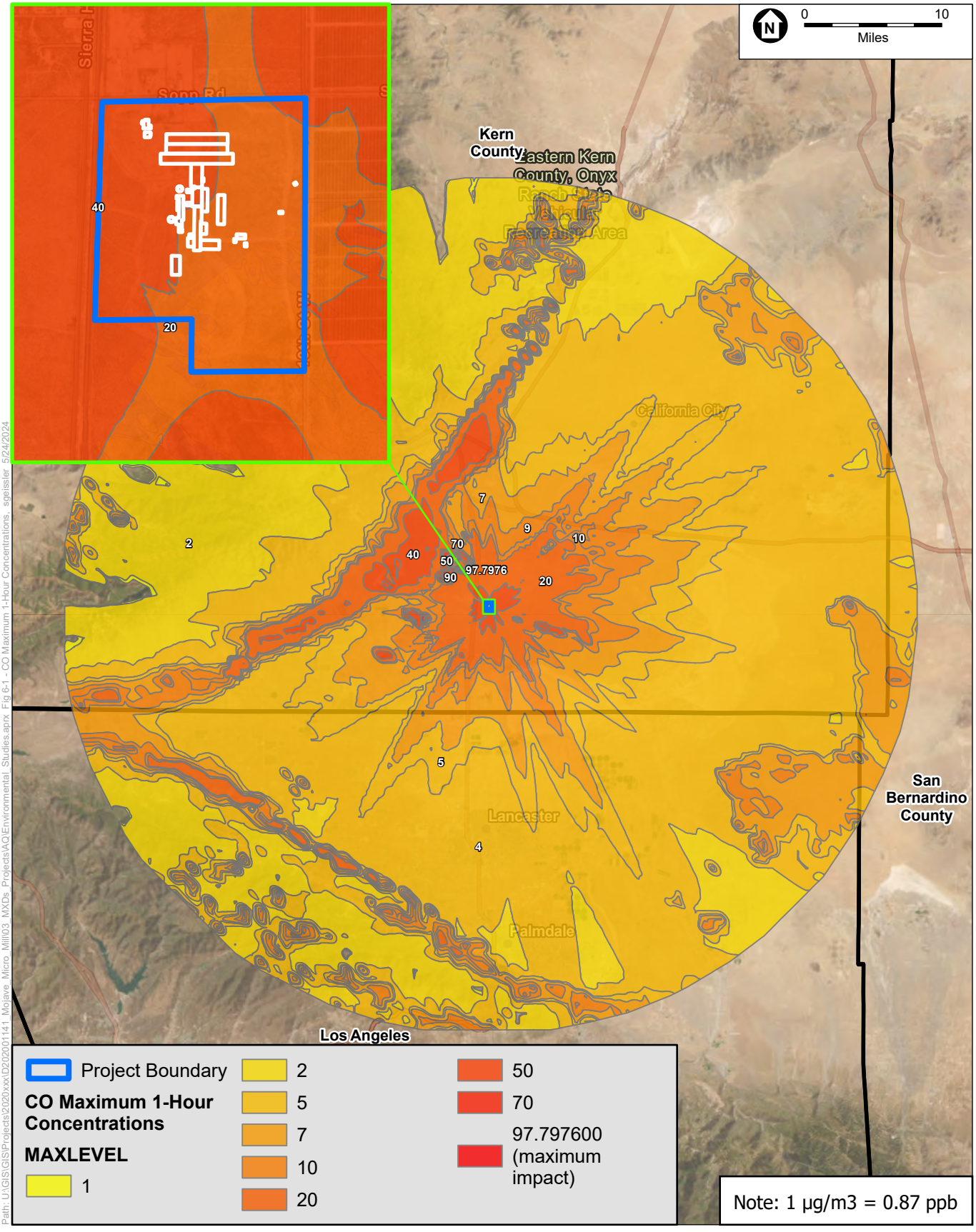
Figure 6-2
Modeled Receptor Grid

ESA



SOURCE: ESA, 2024

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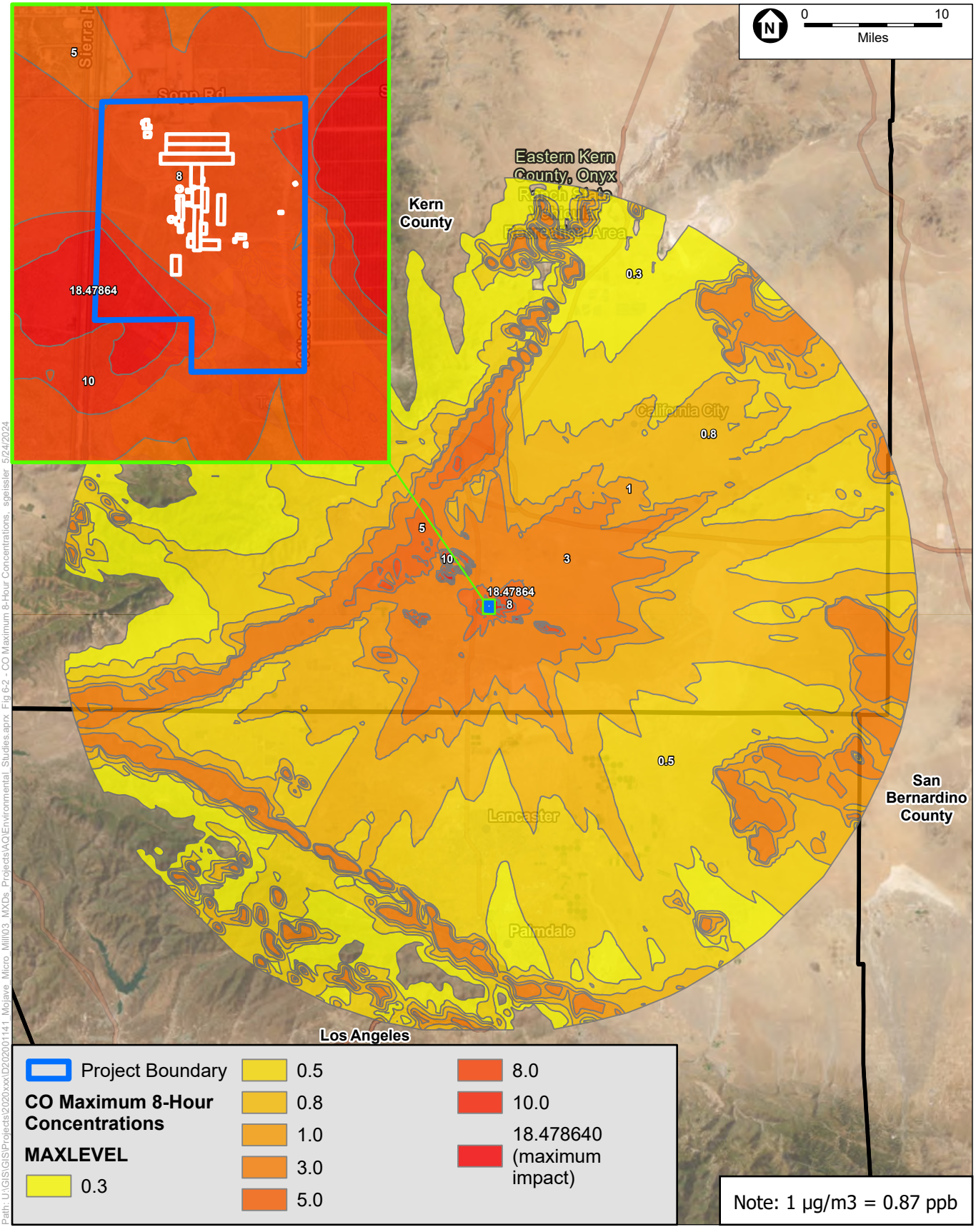
Figure 6-3
CO Maximum 1-Hour Concentrations

ESA



SOURCE: ESA, 2024

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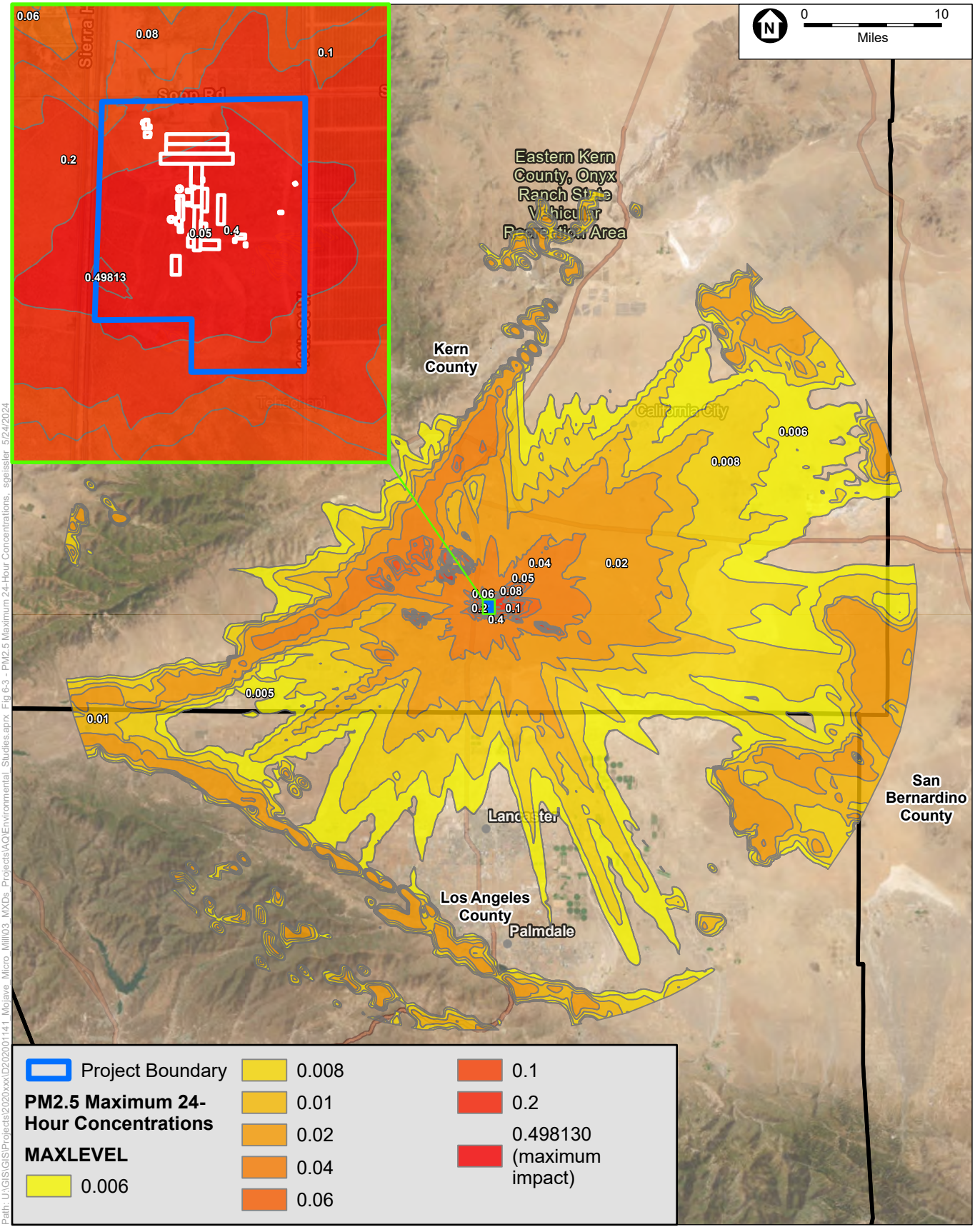
Figure 6-4
CO Maximum 8-Hour Concentrations

ESA



SOURCE: ESA, 2024

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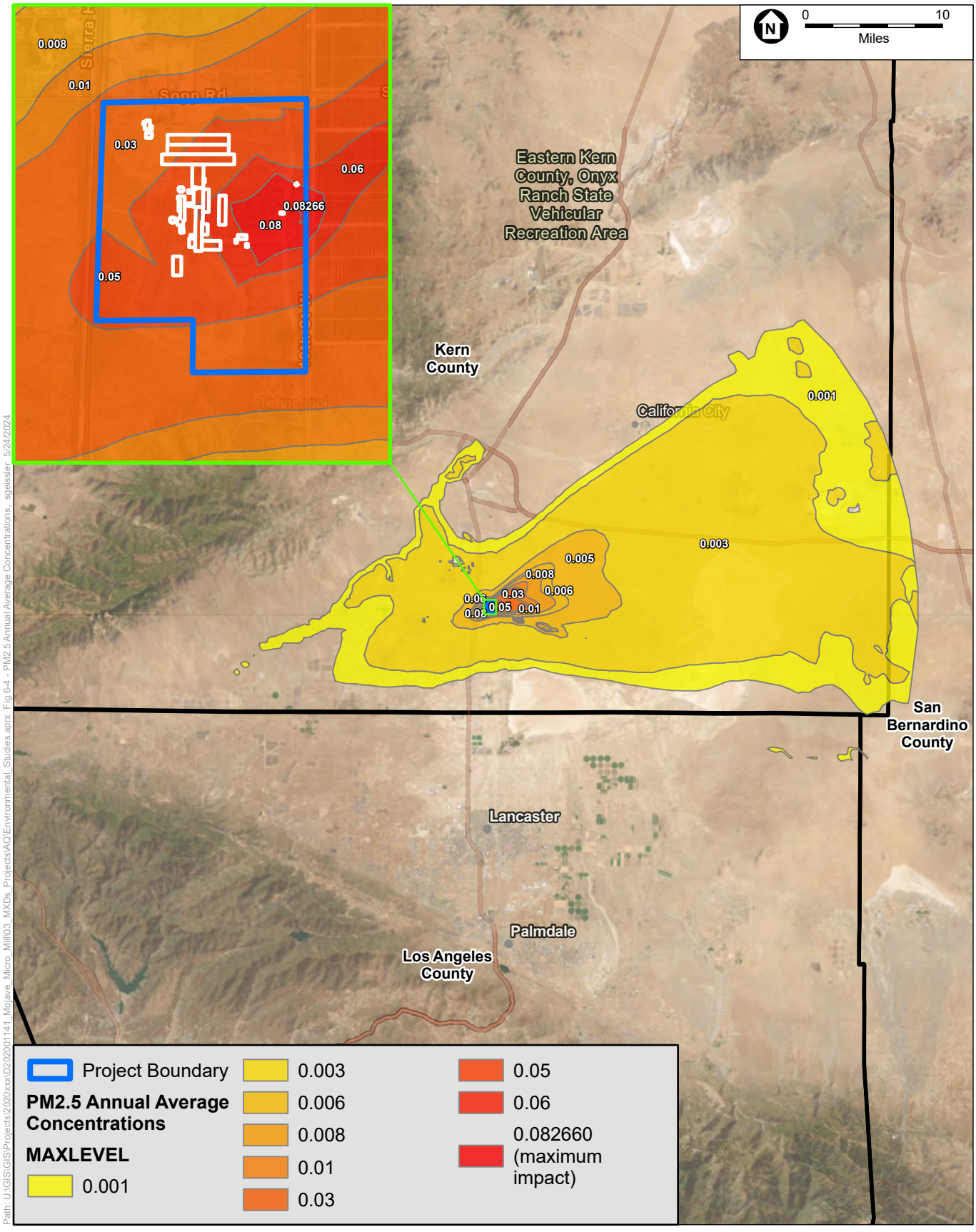
Figure 6-5
PM2.5 Maximum 24-Hour Concentrations

ESA



SOURCE: ESA, 2024

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Figure 6-6
PM2.5 Annual Average Concentrations

ESA

Appendix H
Air Dispersion Modeling Files

Air dispersion modeling files have been submitted electronically to the Eastern Kern Air Pollution Control District.