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PSD and Minor Source Modeling

NDEQ's Ambient Air Impact Analysis Guideline for Performing Stationary Source Air Quality Modeling in Nebraska

Nebraska Department of Environmental Quality
August 2017

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List of Acronyms

AERMOD	AMS/EPA Regulatory Model
AQCR	Air Quality Control Region
ARM	Ambient Ratio Method
ARM2	Ambient Ratio Method Version 2
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon monoxide
EPA	Environmental Protection Agency
GEP	Good Engineering Practice
MCHM	Model Clearinghouse Memo
MERP	Modeled Emission Rates for Precursors
NAAQS	National ambient air quality standards
NDEQ	Nebraska Department of Environmental Quality
NED	National Elevation Dataset
NO_2	Nitrogen Dioxide
NOx	Nitrogen oxides
NSPS	New Source Performance Standards
OAQPS	Office of Air Quality Planning and Standards
OLM	Ozone Limiting Method
Pb	Lead
$PM_{2.5}$	Particulate matter, less than 2.5 micrometers in diameter
PM_{10}	Particulate matter, less than 10 micrometers in diameter
PTE	Potential To Emit
PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method
SCRAM	Support Center for Regulatory Air Models
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SOx	Sulfur oxides
tpy	Tons per year
$\mu g/m^3$	Micrograms per cubic meter
USGS	United States Geological Society
UTM	Universal Transverse Mercator coordinate system
VOC	Volatile Organic Compounds

Introduction

This air dispersion modeling guidance is intended to aid air quality construction permit applicants with both major source Prevention of Significant Deterioration (PSD) and minor source modeling demonstrations. The guidance is not intended to present a detailed outline of modeling procedures. It is intended for those who are already familiar with air dispersion modeling and provides a general overview of what is needed for a National Ambient Air Quality Standards (NAAQS) and PSD increment compliance demonstration in the State of Nebraska. Please contact a qualified modeling professional if you need assistance preparing your modeling analysis.

The primary differences between a modeling analysis for a minor source and one for a PSD major source are:

- Minor source analysis requires only a NAAQS analysis and does not include fugitive emissions from haul roads.
- PSD modeling analysis not only requires a NAAQS analysis but also includes:
    - PSD increment analysis,
    - visibility analysis,
    - population growth,
    - impacts on soils & vegetation,
    - includes fugitive emissions from haul roads, as per 40CFR Part 50, App W, Section 4.2.3.6(c), and
    - impacts from ozone and secondary $PM_{2.5}$ as per 40 CFR 52.21(k)(1) & 40 CFR 51.166(k)(1).

When is Modeling Required?

Air dispersion modeling is required when the significant net emissions increase equals or exceeds the Significant Emission Rate (SER) listed in Table 1 below. See the Code of Federal Regulations (40CFR 52.21(b)(3)) and Nebraska Administrative Code Title 129 – Nebraska Air Quality Regulations (Title 129, Chapter 19, Section 010) for the definition of "significant net emissions increase" and for a complete SER list. Net emissions increase is defined in Title 129, Chapter 1 and in general it is an increase or decrease in emissions from a particular modification plus any other increases and decreases in actual emissions at the facility that are creditable and contemporaneous with the modification.

Table 1 – Significant Emission Rate (SER)

Pollutant	SER (tpy)
CO	100
NO_2	40
SO_2	40
PM_{10}	15
$PM_{2.5}$	10
Lead (Pb)	0.6
Total Reduced Sulfur (including H_2S)	10

Reference: Title 129 Ch. 19, 010 and 40 CFR 51.166 (23)(i)

Additionally, the Department may require modeling if:

- a major source undergoing a modification has not previously conducted a cumulative impact analysis based on facility-wide emissions,
- the source-receptor geometry could result in concentrations near or above NAAQS levels either by the modification or the entire facility,
- elevated terrain or buildings within close proximity of the source,
- the source is located within an area of concern (e.g., significant nearby background sources),
- unique situations such as topography, meteorology, or existing adverse air quality necessitate an analysis,
- short stacks or adverse dispersive conditions exist,
- the new source or modification may produce ambient impacts predicting nonattainment based on modeling experience.

More details for modeling TRS can be found in Appendix D - Calculation of 30-minute rolling average Total Reduced Sulfur (TRS).

<u>Air Dispersion Modeling Protocol</u>

A protocol and a final modeling report are required for all modeling demonstrations. The protocol should be submitted prior to any modeling efforts since one intent of a protocol is to ensure extensive remodeling is avoided. Typically a protocol is a short document that outlines the procedures that will be followed to demonstrate compliance with the appropriate standards. A sample protocol is available on request from the Department.

<u>Final Modeling Report</u>

In addition to a protocol, a final modeling report needs to be submitted to the NDEQ that contains enough information to allow the modeling demonstration to be easily duplicated, including:

- a narrative explaining any deviations from the approved protocol
- a description of the project
- a plot plan of the project with a north arrow showing topographical features, facility exterior boundary fence lines, and locations of any nearby facilities that may have been included in the modeling demonstration
- for all emission sources the source design capacities, typical operating schedule(s), and respective modeling parameters for each source. For example, parameters for point, volume, and area sources shall include:
  - UTM coordinates together with the UTM zone, datum, and elevation
  - emission rates
  - point source stack heights
  - point source stack gas exit temperature
  - point source stack gas exit velocity
  - point source stack inside diameter
  - volume source initial lateral dimensions
  - volume source initial vertical dimensions
  - volume source release heights
  - area source X and Y lengths

    - area source angle
    - area source initial vertical dimension (when applicable)
- building dimensions and locations including coordinates, building height,
- fence line receptors
- a table presenting the modeled impact concentration, background concentration and total impact that is appropriate for comparison to the standard
- meteorological (met) data used in the analysis, including copies of met files
- copies of USGS National Elevation Dataset (NED) terrain files
- all modeling input/output including BPIP-Prime files

Stack gas exit temperature and velocity should be documented whenever possible. Calculations of volume source initial vertical dimension(s), initial lateral dimension(s), and release height(s) should be included with an explanation of assumptions used to perform the calculations.

Pre-Application Meeting

A pre-application meeting with the Department's air permitting and modeling staff is strongly recommended. This meeting covers the construction permitting process including modeling requirements, pollutants and the averaging periods expected to trigger a modeling demonstration, major vs. minor modeling effort, preconstruction monitoring requirements, modeling protocols, and appropriate modeling methodologies. It is especially important to determine if preconstruction monitoring will be required by the source, since on site monitoring can take up to one year to complete.

Preconstruction Monitoring

An air quality construction permit application for a new major PSD source or any existing major PSD source modification shall contain an analysis of ambient air quality in the area of the major stationary source (reference: Title 129 Ch. 19, Section 020 and 40 CFR 52.21(m)(1)). The applicant is required to perform preconstruction monitoring unless a modeling demonstration determines the highest predicted impact is less than the de minimis concentrations, also called the Significant Monitoring Concentration (SMC), listed in Table 2 below.

If the predicted impacts are less than the SMC, the applicant is exempt from preconstruction monitoring. For a source whose predicted impacts are more than the SMC, site specific ambient monitoring is required over a period of one year directly *preceding the receipt of an application*.

A period of less than one year but more than four months can be used if it can be shown that an adequate analysis can be accomplished in a shorter period. Additionally, it may be possible for the facility to use pre-existing monitors operated by the NDEQ if the facility can show that ambient air concentrations at the pre-existing monitor is representative of the source's location.

Table 2 – Significant Monitoring Concentration (SMC)

Pollutant	Averaging Period	SMC or De Minimis Concentration (μg/m³)
CO	8-hour	575
NO_2	Annual average	14
SO_2	24-hour	13
PM_{10}	24-hour	10
$PM_{2.5}$	In accordance with Sierra Club v. EPA, 706 F.3d 428 (D.C. Cir. 2013), no exemption is available with regard to $PM_{2.5}$	
Lead (Pb)	3-month average	0.1
Total Reduced Sulfur	1-hour average	10

Reference: Title 129, Ch. 19, 016.07A and 40 CFR 52.21 (i)(5)(i)(a) thru (i)

Significant Impact Analysis

If the net emission increase is above the SER threshold, the initial step in an air quality analysis is to model the net emission increase to determine if the impacts are above the Significant Impact Level (SIL) concentrations, listed in Table 4. If the model predicts impacts that are below the SIL then it can be concluded that the project will not violate the NAAQS, and modeling is complete. If the model predicts impacts that are above the SIL, a full cumulative impact model is required.

The screening model AERSCREEN or the refined model AERMOD can be used to perform a SIL analysis. AERSCREEN can be quickly setup and run, and results from an AERSCREEN model are considered conservative. AERSCREEN runs only one emission unit at a time and predicts hourly impacts. To use AERSCREEN for multiple emission units, multiple runs of AERSCREEN can be used, and the results added together. The hourly impacts can be scaled to 3, 8, 24-hour and annual averaging periods using the factors in Table 3 below. AERMOD can be used when there are multiple emission units or a less conservative approach to a SIL analysis is desired.

Table 3 - AERSCREEN Scaling Factors

Model Results	1-hour	3-hour	8-hour	24-hour	Annual
1-hour	1.0	1.0	0.9	0.6	0.1

Reference: AERSCREEN User's Guide

If the model predicts impacts *above* the Significant Impact Level (SIL) listed in Table 4, a full impact, cumulative modeling analysis using AERMOD is required. A cumulative impact analysis includes all of the emissions from the source, not just the net emission increase, plus any nearby facilities expected to cause a significant concentration gradient in the area of the source under consideration, 40 CFR Part 51, App W 8.3.1, and these predicted modeled impacts are added to the background and compared to the NAAQS. The NDEQ will provide a list of nearby sources (nearbys) and their modeling parameters on request.

Table 4 - Significant Impact Levels (SIL)

Pollutant	Averaging Period	SIL ($\mu g/m^3$)	Form	Reference
CO	1-hour	2,000	Highest modeled impact	Title 129, Ch. 17, 009
	8-hour	500	Highest modeled impact	Title 129, Ch. 17, 009
NO_2	1-hour	7.5	Highest first high (H1H) concentration predicted each year at each receptor, averaged across five years	U.S. EPA MCHM, Mar 01, 2011
	Annual	1.0	Highest modeled annual mean	Title 129, Ch. 17, 009
SO_2	1-hour	7.9	Highest first high (H1H) concentration predicted each year at each receptor, averaged across five years	U.S. EPA MCHM, Aug 23, 2010
	3-hour Secondary Std	25	Highest modeled impact	Title 129, Ch. 17, 009
PM_{10}	24-hour	5	Highest modeled impact	Title 129, Ch. 17, 009
$PM_{2.5}$	24-hour	1.2	Highest modeled impact averaged across 5-years	Title 129, Ch. 17, 018.02A & 018.02B
	Annual	0.3	Highest modeled annual mean averaged across 5-years	Title 129, Ch. 17, 009
Total Reduced Sulfur (including H_2S)	30-minute	0.005 **ppm**	Highest modeled impact	

If a SIL analysis indicates a cumulative impact analysis is required, the facility can work with the NDEQ to determine if reasonable changes could appropriately limit the ambient air impacts. Reasonable changes may include reducing emissions, reducing operating hours, increasing stack heights, or increasing stack airflows as long as the changes and limitations conform to the restrictions found in 40CFR 51.100(hh) and included as a federally enforceable permit requirement:

Model Selection and Options

For most air dispersion modeling in Nebraska, the current version of EPA AERMOD is the preferred model. There may be circumstances when another refined model listed in Appendix A of Appendix W of Part 51 might be more suitable, and this should be first reviewed and approved by the NDEQ. CALPUFF is not an approved near field model and cannot be used to support a Construction Permit in Nebraska. (see Clarification on Regulatory Status of CALPUFF for Nearfield Applications - MCHM, 14Aug 2008)

The model and current model version must be included in the protocol. Regulatory defaults options should be used. Non-regulatory default options must be preapproved by the NDEQ and must satisfy 40CFR Appendix W, Section 3.2.2 (e) (i-v).

NAAQS Analysis

The Clean Air Act identifies primary and secondary national ambient air quality standards. These primary standards are set for public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards have also been set to provide public welfare protection, such as protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The NAAQS for six principal pollutants, called "criteria" pollutants, are set by EPA. These standards are also reviewed periodically by EPA and may be revised. The current standards on the date this guidance document was prepared are listed below. Units of measure for the standards are in micrograms per cubic meter of air (μg/m^3), except for TRS, which is in parts per million (ppm) by volume. Additional information for modeling TRS can be found in Appendix D - Calculation of 30-minute rolling average Total Reduced Sulfur (TRS).

Pollutants considered in this guidance include all criteria pollutants. In addition to criteria pollutants, Nebraska's AAQS for Total Reduced Sulfur (including H_2S) is listed in Table 5.

Table 5 - Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Primary/ Secondary	NAAQS (μg/m^3)	Design Value Form	Reference
CO	1-hour	primary	40,000	Highest second high (H2H) concentrations for each year modeled	40 CFR Appendix W 9.1 (d) 2016
	8-hour		10,000	Highest second high (H2H) concentrations for each year modeled	40 CFR Appendix W 9.1 (d) 2016

Table 5 - Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Primary/ Secondary	NAAQS ($\mu g/m^3$)	Design Value Form	Reference
NO_2	1-hour	primary	188	Highest eighth high (H8H) of the 98th percentile of the annual distribution of maximum daily 1-hour concentrations averaged across five years	U.S. EPA MCHM, June 28, 2010a & U.S. EPA MCHM, March 1, 2011d
	annual	primary and secondary	100	Highest first high (H1H) annual average concentration, each year analyzed separately	40 CFR Appendix W 9.1 (d) 2016
SO_2	1-hour	primary	196	Highest fourth high (H4H) of the 99th percentile of the annual distribution of maximum daily 1-hour concentrations averaged across five years	U.S. EPA MCHM, August 23, 2010.
	3-hour	secondary	1300	Highest second high (H2H) concentration , each year analyzed separately	40 CFR Appendix W 9.1 (d) 2016
PM_{10}	24-hour	primary and secondary	150	Highest 6th high (H6H) concentration for the five years modeled (and, in general, when n years are modeled, the (n+1)th highest concentration over the n-year period))	40 CFR Appendix W 7.2.1 (U.S. EPA, 2005)
$PM_{2.5}$	24-hour	primary	35	Highest 8th high (H8H) of the 9**8**th percentile of the annual distribution of 24 hour concentrations, averaged over 5 years	U.S. EPA MCHM, March 4, 2013

Table 5 - Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Primary/ Secondary	NAAQS ($\mu g/m^3$)	Design Value Form	Reference
	Annual	primary	12.0	Highest first high (H1H) of the modeled annual averages, averaged over 5 years	U.S. EPA MCHM, March 4, 2013
	Annual	secondary	15.0	Highest first high (H1H) of the modeled annual averages, averaged over 5 years	U.S. EPA MCHM, March 4, 2013
Pb	Rolling 3 month average	primary and secondary	0.15	Maximum 3-month rolling average in the five year period at each receptor	40 CFR Appendix W 9.1 (d)
Ozone	8-hour	primary and secondary	0.070 **ppm**	Highest forth high (H4H) modeled concentration averaged over 5 years	
TRS	30-minute	primary and secondary	0.10 **ppm**	Highest first high (H1H) modeled concentration for for each of the 5 years modeled	Title 129, Ch. 4, <u>007</u>

The emission rates used in a NAAQS or a PSD analysis is based on 40CFR Part 50, Appendix W, Table 8-2, "Point Source Model Emission Inputs for NAAQS Compliance in PSD Demonstrations."

<u>Increment Analysis</u>

PSD major source modeling requires an increment analysis showing compliance with the Class II ambient air increments. The State of Nebraska contains no Class I areas. The entire State is classified as a Class II area. When a PSD increment analysis is required, ambient air impacts from the source's proposed actual emissions plus increment-consuming sources surrounding the source should be less than or equal to the ambient air Class II increments. If actual emissions are not available, PTEs, also known as allowable emissions, will be modeled. A list of increment-consuming nearby sources and the appropriate modeling parameters is available from the NDEQ.

Table 6 - Ambient Air Class II PSD Increments

Pollutant	Averaging Period	Class II Increment (1) $\mu g/m^3$
NO_2	Annual arithmetic mean	25
SO_2	Annual arithmetic mean	20
	24-hour maximum	91
	3-hour maximum	512
PM_{10}	Annual arithmetic mean	17
	24-hour maximum	30
$PM_{2.5}$	Annual arithmetic mean	4
	24-hour maximum	9

Reference: Title 129 Ch. 19, 012 and 40 CFR 51.166

NO_2 Analysis

Ambient air impacts from NOx follows a three tiered screening approach for point sources:

- Tier 1 - Assumes complete conversion of NOx to NO_2
- Tier 2 - Ambient Ratio Methods, ARM and ARM2
    - ARM uses default values, 0.75 for annual NO2, and 0.80 for 1-hour NO_2
    - ARM2 uses a variable ambient ratio
- Tier 3 - OLM and PVMRM

Options ARM, ARM2, PVMRM, and OLM are regulatory default options. A Tier 3 analysis using OLM or PVMRM requires values for both in-stack ratios and an ambient air ratio, which should be fully documented in the final modeling report. Additionally, a Tier 3 OLM and PVMRM analysis requires hourly ozone files and those files are available from the NDEQ.

Ozone and Secondary $PM_{2.5}$

Ozone and secondary $PM_{2.5}$ emissions are formed in the atmosphere as a result of photochemical reactions with gaseous pollutants like sulfates, nitrates, and ammonia in the atmosphere. On January 4, 2012, EPA agreed to initiate rulemaking in response to a July 28, 2010 Sierra Club petition to designate air quality models for ozone and secondary $PM_{2.5}$. Since then, EPA has promulgated guidance documents to address ozone and secondary $PM_{2.5}$ emissions.

- December 02, 2016: US EPA "Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier l Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program."
- December, 2016: US EPA "Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$".

For single source impacts, primary $PM_{2.5}$ can be evaluated using AERMOD. Ozone and secondary $PM_{2.5}$ formation need to be evaluated using models incorporating the chemical and physical processes in the formation, decay, and transport of ozone and secondary $PM_{2.5}$, e.g., photochemical grid models. At the time this document was being prepared, single source models like SCICHEM are being developed to address ozone and secondary $PM_{2.5}$ but are not yet available to the regulated community, except on a case-by-case basis with approval from EPA Region 7.

40CFR Part 51, Appendix W, Sections 5.3.2 and 5.4.2 outlines a two tiered approach for ozone and secondary $PM_{2.5}$. The first tier analysis involves using technical information from existing photochemical grid modeling, or published empirical estimates of source specific impacts in combination with other supportive information and analyses for the purposes of estimating secondary impacts from a particular source. The second tier analysis would include those cases when existing technical information is not available, making photochemical grid models more appropriate to assess single source impacts.

In Nebraska, it is anticipated that a first tier approach will be utilized for nearly all construction permit modeling. At the time this modeling guidance was written, the Department was not requiring minor sources to account for ozone or secondary $PM_{2.5}$.

Fugitive emissions: Lead (Pb), PM_{10}, $PM_{2.5}$

Fugitive dust refers to wind-blown dust from plowed fields, dirt roads, or sandy areas with little vegetation. Fugitive emissions refers to emissions from an industrial process not captured and vented through a stack, but are released due to activities at the facility. Because of the difficulties encountered characterizing and modeling fugitive dust and fugitive emissions, a proposed procedure shall be determined in consultation with the Department before the modeling exercise is begun. Fugitive emissions from haul roads are not required in any minor source modeling demonstration, but are required for all major source modeling as per Appendix W Section 5.2.2.2 (e) and 5.2.5. Haul road emissions should be characterized as volume sources, although line or area sources can be used at the facility's discretion. Appendix C - Modeling haul roads, provides detailed guidance for estimating modeling parameters. Other sources of fugitives from processes that are not captured and vented through a stack such as transfer points, crushing operations, etc., shall be quantified and modeled.

Intermittent Emissions: Emergency Engines and 1-Hour NO2

For intermittent sources, such as emergency generators and fire pumps restricted to 500 hours/year operating time and use exclusively during an emergency, the owner or operator is not required to model 1-hour NO_2. However, annual NO_2 modeling is required using federally an enforceable PTE emission rate based on 500 hours/year, evenly spread across 8760 hours/year.

Additional Impact Analyses for Major Source PSD

Major source PSD modeling demonstrations shall provide an additional analysis of the air quality impact for each pollutant subject to PSD to evaluate impacts on regional haze, population growth, and impacts on soils and vegetation in the area of the facility, Title 129, Ch. 19, 022, 40 CFR 51.166. The complexity of this analysis will generally depend on existing air quality, the quantity of emissions, the chance the project would result in significant population increase, the sensitivity of local soils & vegetation having significant commercial or recreational value, and visibility in the source impact area. Data from the additional impacts analysis should be presented so that it is logical and understandable to the interested public.

Regional Haze Screening of Class I Areas: Guidance from Federal Land Managers

The owner or operator of any proposed PSD project within 100 km of an affected Federal Land Managers Class I area is required to assess the impacts of criteria pollutants in conformity with 40 CFR Section 51.307. While there are no Federal Class I areas in Nebraska, two Federal Class I areas are within 100 km of the border of Nebraska; Badlands Wilderness and Wind Cave National Park, both in South Dakota. To determine if the owner or operator of the proposed facility needs to analyze regional haze, the *Federal Land Managers' Air Quality Related Values Work Group (FLAG), Phase I Report – Revised 2010* recommends the following screening test:

$(Q/D) \leq 10$

Where

Q (tpy) = sum of emission increase in SO_2, NO_2, PM_{10}, and sulfuric mist (H_2SO_4)

D (km) = distance from Class I area (km)

Good Engineering Practice (GEP) Stack Height and Building Downwash

Good engineering practice (GEP) is defined in 40 CFR 51.100 as a stack height that is the greater of:

(1) 65 meters, measured from the ground-level elevation at the base of the stack;

(2)

(i) For stacks in existence on January 12, 1979, and for which the owner or operator had obtained all applicable permits or approvals required under 40 CFR parts 51 and 52:

Hg = 2.5H, provided the owner or operator produces evidence that this equation was actually relied on in establishing an emission limitation:

(ii) For all other stacks:

Hg = H 1.5L

where:

Hg = good engineering practice stack height, measured from the ground-level elevation at the base of the stack,

H = height of nearby structure(s) measured from the ground-level elevation the base of the stack.

L = lesser dimension, height or projected width, of nearby structure(s) provided that the EPA, State or local control agency may require the use of a field study or fluid model to verify GEP stack height for the source; or

(3) The height demonstrated by a fluid model or a field study approved by the EPA, State, or local control agency, which ensures that the emissions from a stack do not result in excessive concentrations of any air pollutant as a result of atmospheric downwash,

wakes, or eddy effects created by the source itself, nearby structures or nearby terrain features.

Plumes emitted from stack heights less than the GEP stack height can experience cavity or wake effects (also called building downwash) due to nearby building structures. Building downwash can have a dramatic impact on predicted or modeled impacts. Nearby buildings within a distance up to five times the lesser of the height or the width dimension of a structure, but not greater than 0.8 km (1⁄2 mile) should be evaluated using Building Profile Input Program for PRIME (BPIP-Prime) available at EPA's SCRAM Web site. Include a BPIP-Prime analysis for any structure with a solid face from the ground to the top of the structure; open lattice structures do not need to be analyzed for building downwash Average roof heights should be used for peaked or sloped roofs , and structures with several roof heights should be assessed as a single building with multiple tiers. All point sources should be analyzed using the BPIP-Prime building processor.

Model Parameters

Use of unrealistic modeling parameters such as stack flow rates, stack gas temperatures, or volume source release heights, can significantly influence the predicted modeled impacts. This can result in under or over-estimation of modeled impacts. Reasonably accurate release parameters should be used and documented in the modeling report. Documentation can be satisfied using calculations that clearly provides all assumptions, manufacturer's specifications, stack testing data, or any other appropriate documentation that supports the value used to calculate the modeling parameter. In some instances, when expected parameters are highly variable, it may be more appropriate to use multiple operational scenarios to evaluate the effects of varying parameters.

Receptors and Terrain

Ambient air is the area where public access is excluded by a fence or other physical barrier or when there is reasonable expectation that the public will be excluded. When a public road cuts through a facility's property, that roadway shall be treated as ambient air.

Receptors are generally spaced along a Cartesian coordinate system spaced to determine the highest impacts. Concentrations should be decreasing at the edge of the grid. The grid shall be extended when the terrain elevations are rising at the edge of the grid. Appropriate receptor grid spacing is given in the following Table.

Table 7 - Receptor Spacing (meters)

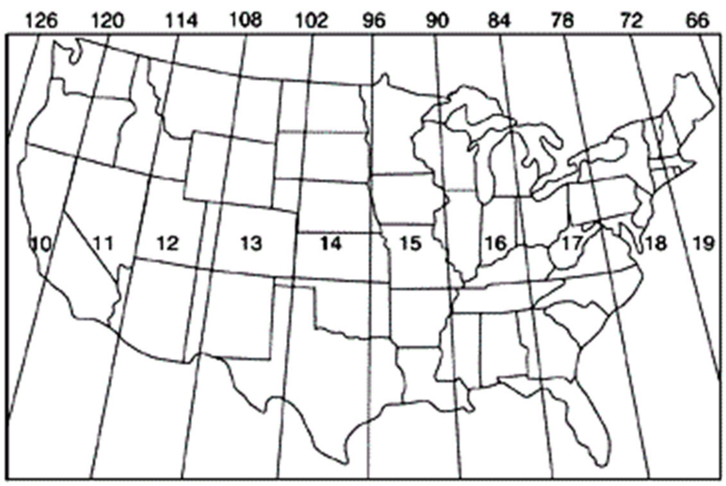
Along fenceline	50
Fenceline to 400 meters	50
400 meters to 2 km	100
2 km to 5 km	250
5 km to 7 km	500
Greater than 7 km	1000

AERMAP

AERMAP calculates elevations using either USGS Digital Elevation Model (DEM) files or USGS National Elevation Dataset (NED) files. DEM files are no longer supported by the USGS and should not be used in a modeling demonstration. NED files are maintained by the USGS and all the data is in the public domain. NED files for each county in Nebraska are available from the NDEQ.

Check the datum: When updating a model that used DEM files in the past, care must be taken to ensure the datum is set correctly. DEM files in Nebraska use the North American CONUS 1927 datum, and NED files use North American CONUS 1984 datum, which is equivalent to WGS 1983 datum used by Google Earth.

Check the UTM zone: Most of Nebraska lies in UTM zone 14. There are two counties in southeast Nebraska in zone 15 and the panhandle area of western Nebraska is in UTM zone 13.



UTM Zones *U.S. Geological Survey, 2004*

Meteorological Data

The Department will supply appropriate meteorological files. The protocol should list the meteorological years, surface air location, and the versions of AERMET, AERSURFACE, and AERMINUTE used to process the data by the NDEQ.

Background Concentrations

The Department will supply appropriate background concentrations.

Modeled Exceedances

When the model predicts an exceedance of a NAAQS, a culpability analysis can determine if this exceedance is due to emissions from the proposed project or if the exceedance is due to emissions from a nearby facility. It is never appropriate to delete receptors when preforming a culpability analysis.

The purpose of a culpability analysis is to demonstrate whether or not the facility's contribution to a PSD increment or NAAQS exceedance at a receptor is below the SIL concentration for that pollutant and averaging period at that receptor. This can be accomplished using source groups, MAXFILE, EVENT file processing, or the MAXDCONT option available in AERMOD. If the proposed project does not significantly contribute to the exceedance (it is less than or equal to the SIL) then the proposed project does not contribute to the predicted PSD increment or NAAQS exceedance. Document this analysis in the final modeling report. However, if it is demonstrated that the proposed facility or modification of an existing facility contributes impacts above the SIL, then additional control technology may be required to demonstrate compliance with the PSD increment or NAAQS.

Modeling Data Submittal

On a write-protected DVD, submit to the Department for review all of the final modeling files used to demonstrate that proposed permit conditions will not cause an exceedance of the NAAQS or PSD Increments. This submission should include a copy of the approved protocol, final modeling report, and a complete set of all modeling files including all input, output, plot or graphics files, building downwash files, USGS terrain files and copies of the nearby list and meteorological data obtained from the NDEQ.

The final modeling report should contain, when appropriate, the following:

- table of modeled impacts including receptor location, elevation of receptor, concentrations, background and the applicable standard
- ambient air and in-stack ratios used in Tier 3 NOx analysis
- secondary $PM_{2.5}$ formation
- beta option documentation satisfying 40 CFR Part 51, App. W, 3.2.2(e)(i-v)
- a facility plot plan with locations of all sources (point, volume, area, etc.), buildings, fence line, roads, surrounding terrain, locations of met tower, monitors
- a table of all emission units with the associated modeling parameters for point, volume and area sources

Appendix A - Definitions

Actual emissions - The average rate, in tons per year, at which the unit actually emitted the pollutant during the most recent consecutive 24-month period which is representative of normal source operation. Actual emissions shall be calculated using the unit's actual operating hours, production rates, existing control equipment, and types of materials processed, stored, or combusted during the selected time period. Any emissions unit which has not begun normal operations shall use the potential to emit instead of actual emissions for that emission unit.

Allowable emissions (also called the Potential To Emit or PTE) – are emissions for a stationary source calculated using the maximum rated capacity of the source (unless the source is subject to federally enforceable limits which restrict the operating rate, or hours of operation, or both) and the most stringent of the following:

- The applicable standards set forth in 40 CFR Parts 60 (Standards of Performance for New Stationary Sources) or Parts 61 or 63 (National Emission Standards for Hazardous Air Pollutants);
- Any applicable State Implementation Plan emissions limitation including those with a future compliance date; or
- The emissions rate specified as a federally enforceable permit condition, including those with a future compliance date.

Air Quality Control Region - is an area of the State which has been designated by the Administrator as an air quality control region. For the purpose of modeling, air quality control regions are used to track PM_{10} minor source baseline dates.

Ambient air - is that portion of the atmosphere, external to buildings, to which the general public has access. For modeling purposes, ground level receptors will be placed everywhere the general public has access outside of contiguous plant property.

Complete when used in reference to an application for an air quality construction permit, means that an application contains all the information necessary for processing the application. Designating an application complete for purposes of permit processing does not preclude the Department from requesting or accepting additional information.

Department is the Nebraska Department of Environmental Quality, or the NDEQ.

Elevated terrain – is the terrain which may affect the calculation of good engineering practice stack height.

Emissions unit – is any part or activity of a stationary source, which emits or would have the potential to emit any regulated air pollutant ("regulated NSR pollutant" for purposes of the Prevention of Significant Deterioration program) or any pollutant.

Emissions – are the releases or discharges into the outdoor atmosphere of any air contaminant or combination thereof.

Exceedance - is one or more occurrences of a measured or modeled concentration that exceeds the specified concentration level of a standard for the averaging period specified by the standard.

Federally enforceable – means all limitations, conditions, and requirements within any applicable State Implementation Plan, any permit requirements established in any permit issued pursuant to this Title, and any requirements in Chapters 18 and 23, 27, or 28 which are enforceable by the Administrator.

Fugitive dust - is the solid airborne particulate matter emitted from any source other than a flue or stack.

Fugitive emission - are those emissions which could not reasonably pass through a stack, chimney, vent, or other functionally equivalent opening.

Major source baseline date - The Major Source Baseline Date is set by Federal Regulation. The Major Source Baseline Date is January 6, 1975 for both PM_{10} and SO_2, February 8, 1988 for NO_2, and October 20, 2010 for $PM_{2.5}$.

Minor source baseline date - The Minor Source Baseline Date is the earliest date after the trigger date on which a major stationary source or a major modification subject to the Prevention of Significant Deterioration Program, as defined in Title 129, Chapter 1, submits a complete permit application. The trigger date is, in the case of PM_{10} and sulfur dioxide, August 7, 1977, in the case of nitrogen dioxide, February 8, 1988, and in the case of $PM_{2.5}$, October 20, 2011.

$PM_{2.5}$ – is particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.

PM_{10} – is particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.

Potential To Emit (PTE) – is the maximum capacity of a stationary source to emit a pollutant under its physical and operational design. Any physical or operational limitation on the capacity of the source to emit a pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation or the effect it would have on emissions is federally enforceable. Secondary emissions do not count in determining the potential to emit of a stationary source.

Prevention of Significant Deterioration Program (PSD) program – is the major source preconstruction air quality permit program that has been approved by the Administrator and incorporated into Title 129 to implement the requirements of 40 CFR 51.166 or 40 CFR 52.21. Any permit issued under such a program is a major NSR permit.

Primary Standard - is a standard set by the EPA to the maximum permissible ambient air level concentration which will protect the health of any sensitive group of the population.

Secondary emissions - are those emissions which occur as a result of the construction, modification, or operation of a source but are not directly emitted by the source itself. Secondary emissions must be specific, well defined, quantifiable, and impact the same general area as the stationary source or modification which causes the secondary emissions. Secondary emissions include emissions from any offsite support facility which would not be constructed or increase its emissions except as a result of the construction or operation of the major stationary source or major modification. Secondary emissions do not include any emissions which come directly from a mobile source, such as emissions from the tailpipe of a motor vehicle, from a train, or from a vessel.

Secondary standard - is a standard set by the EPA to provide protection against pollutant related public welfare effects, including visibility impairment, effects on vegetation and ecosystems, and materials damage and soiling.

Stack - is any point in a source designed to emit solids, liquids, or gases into the air, including a pipe or duct but not including flares.

Stack height - is the distance measured from the ground level elevation of a stack to the elevation of the stack outlet.

Stationary source - is any building, structure, facility, or installation which emits or may emit any air pollutant subject to regulation under Title 129.

Total reduced sulfur - means total sulfur from the following compounds: hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide.

UTM coordinates - The Universal Transverse Mercator Coordinate (UTM) system provides coordinates on a worldwide flat grid. The UTM coordinate system divides the world into 60 zones, each six degrees longitude wide and extending from 80 degrees south latitude to 84 degrees north latitude. The first zone starts at the International Date Line and proceeds eastward.

Volatile organic compound (VOC) - means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. VOC includes any such organic compound other than the compounds listed in 40 CFR 51.100(s)(1) and (5), effective July 1, 2013, which have been determined to have negligible photochemical reactivity.

Appendix C - Modeling Haul Roads

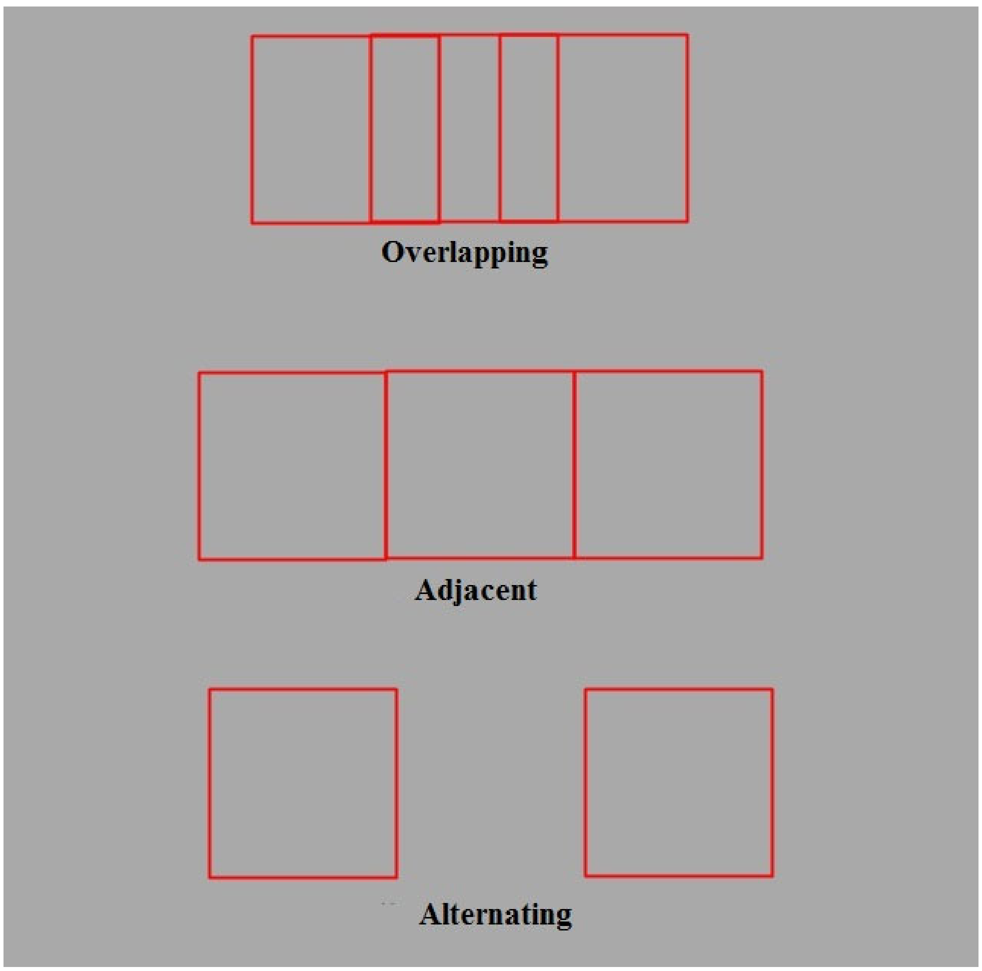
The preferred method for characterizing haul road emissions is to use volume sources. However, area sources or line sources can also be used at the facility's discretion.

Example using Volume Sources

Haul roads characterized as a series of volume sources are calculated as follows:

Top of plume height = 1.7 x vehicle height
Release height = 0.5 x top of plume height
Plume width = Vehicle width + 6 m for single lane or road width + 6 m for two-lanes
Initial lateral dimension (σ_{YO}) = Width of plume / 2.15
Initial vertical dimension (σ_{ZO}) = Top of plume / 2.15

The volume sources can be overlapping, adjacent, or alternating.



<u>**Appendix D - Calculation of 30-Minute Rolling Average Total Reduced Sulfur (TRS)**</u>

The total reduced sulfur (TRS) as hydrogen sulfide (H2S) as established in Title 129, Chapter 4, Section 007 is 0.10 ppm, based on a 30-minute average. The 30-minute results can be calculated from the 1-hour average (AERMOD or AERSCREEN) results by using the "1/5th Power Law", as described in Appendix H of the September 2005 NDEQ Atmospheric Dispersion Modeling Guidance for Permits document. The equation for this conversion is as follows:

$C_l/Cs = (ts/t_l)^{1/5}$

where:
C_l = concentration estimate for sampling time, t_l
Cs = concentration estimate for shorter sampling time, ts

For t_l = 60 minutes and ts = 30 minutes, the conversion from modeled results (C_l) to NDEQ TRS AAQS results (Cs) is:

$Cs = C_l / [(30/60)^{1/5}]$
or
$Cs = 1.15\ C_l$

To convert µg/m^3 to ppm, the equation is:

ppm = [(Cs)(24.5)] / [(MW)(1000)]

where:
Cs = 30-minute concentration calculated above, expressed in micrograms per cubic meter
MW = molecular weight of the compounds, expressed in terms of hydrogen sulfide (MW_{H2S} = 34.08 gram/gram-mole)

ppm = [(Cs)(24.5)] / [(34.08)(1000)] = (0.00072)(Cs)

Results should be reported in a Table, see example below:

Emission Unit(s)	XUTM	YUTM (m)	Modeled Impact for 60-minutes	1/5 Power Law Corrected to 30-minute		NE TRS Standard
	(m)	(m)	(µg/m^3)	(µg/m^3)	(ppm)	(ppm)
						0.10

Appendix E - Rounding Modeled Design Values

Rounding modeled results may be done as long as the level of rounding does not alter the compliance demonstration. Rounding may never be used to eliminate a modeled exceedance of a standard, increment, or threshold. All standards, increments, and thresholds are absolute limits.

53 FR Oct 17, 1988 Federal Register, page 40657

> *"It should be noted that these increments, like those for particulate matter and sulfur dioxide, are absolute limits. This means, for example, that a modeled impact of 25.1μg/m³ for a proposed new source would result in an exceedance of the Class II increment of 25 μg/m³, while a modeled impact of 24.9 μg/m³ would not. In neither case is the result rounded off to 25 μg/m³."*

As an example, if a standard, increment, or threshold is 25 $\mu g/m^3$, and the modeled result is 25.00001 $\mu g/m^3$, that result is an exceedance.

Appendix F - Culpability Analysis

When the model predicts an exceedance of a NAAQ standard or a PSD increment, a culpability analysis can determine if this exceedance is due to emissions from the proposed project or due to emissions from a nearby facility. There are several approaches to a culpability analysis that can determine the contributions of the facility versus the contribution of a nearby facility.

One approach is to determine if the receptor predicting an exceedance is located within the fence line of a nearby facility and what the predicted modeled impact would be for that receptor due only to the emissions of the proposed project. This can be done using the source group ALL and a source group for your facility. If the proposed project, excluding impacts of the nearby facility does not cause an exceedance within the fence line of the nearby facility, then document this analysis in the final modeling report.

If the receptor predicting the impact is not located inside the fence line of a nearby facility, then look at the impact predicted at that receptor caused by the proposed project of your facility alone. If the proposed new project or proposed modification to an existing facility has no significant contribution to the exceedance (is less than or equal to the SIL at that receptor) then the proposed project does not contribute to the predicted exceedance. Document this analysis in the final modeling report. However, if it is demonstrated that the proposed facility or modification of an existing facility contributes impacts above the SIL, then additional control technology may be required for the proposed facility or modification of an existing facility to demonstrate compliance with the NAAQS or PSD increment.

Following are two example methods for setting up a culpability analyses in AERMOD:

1. MAXFILE output option provides the receptor location and date of an impact and can be used with short term averaging periods such as 24-hour PM_{10}.

   First run
   - Source Group ALL
   - Set a threshold value equal to the NAAQS minus background
   - The output file will provide a list of the receptors that will be in nonattainment

   Second run
   - Use the receptors identified by the first MAXFILE run
   - Include source groups for the facility and each nearby
   - Set a threshold value equal to the appropriate SIL value
   - The output file provides a date stamp for any day when the facility exceeds the SIL and potentially contributes to a violation of the NAAQS. A significant contribution to a NAAQS violation would be predicted to occur if the date stamps for source groups ALL and the facility matched.

2. MAXDCONT is an output option for the 1-hour NO_2 and SO_2 NAAQS and 24-hour $PM_{2.5}$ NAAQS
   - Upper rank is the Design Value, for example, the H8H for 1-hour NO2
   - Lower rank can be entered as a rank or as a threshold concentration value and should capture impacts above the project allowable threshold value (NAAQS-background)
   - Source groups should include the facility, and each of the nearby facilities
   - Output file will display impacts from each source group, matched temporally and spatially. If the facility's source group predicted impact is below the SIL for any receptor showing nonattainment in the source group ALL, then the facility is not culpable for the violation.

Appendix G - Frequently Used Tables

Tables used frequently in a modeling demonstration are reproduced in the following pages for easy look-up and reference.

Significant Emission Rate (SER)

Pollutant	SER (tpy)
CO	100
NO_2	40
SO_2	40
PM_{10}	15
$PM_{2.5}$	10
Lead (Pb)	0.6
Total Reduced Sulfur (including H_2S)	10

Reference: Title 129 Ch. 19, 010 and 40 CFR 51.166 (23)(i)

Significant Monitoring Concentration (SMC)

Pollutant	Averaging Period	SMC or De Minimis Concentration (µg/m^3)
CO	8-hour	575
NO_2	Annual average	14
SO_2	24-hour	13
PM_{10}	24-hour	10
$PM_{2.5}$	In accordance with Sierra Club v. EPA, 706 F.3d 428 (D.C. Cir. 2013), no exemption is available with regard to $PM_{2.5}$	
Lead (Pb)	3-month average	0.1
Total Reduced Sulfur	1-hour average	10

Reference: Title 129, Ch. 19, 016.07A and 40 CFR 52.21 (i)(5)(i)(a) thru (i)

Ambient Air Class II PSD Increments

Pollutant	Averaging Period	Class II Increment (1) µg/m³
NO_2	Annual arithmetic mean	25
SO_2	Annual arithmetic mean	20
	24-hour maximum	91
	3-hour maximum	512
PM_{10}	Annual arithmetic mean	17
	24-hour maximum	30
$PM_{2.5}$	Annual arithmetic mean	4
	24-hour maximum	9

Reference: Title 129 Ch. 19, 012 and 40 CFR 51.166

Significant Impact Levels (SIL)

Pollutant	Averaging Period	SIL ($\mu g/m^3$)	Form	Reference
CO	1-hour	2,000	Highest modeled impact	Title 129, Ch. 17, 009
	8-hour	500	Highest modeled impact	Title 129, Ch. 17, 009
NO_2	1-hour	7.5	Highest first high (H1H) concentration predicted each year at each receptor, averaged across five years	U.S. EPA MCHM, Mar 01, 2011
	Annual	1.0	Highest modeled annual mean	Title 129, Ch. 17, 009
SO_2	1-hour	7.9	Highest first high (H1H) concentration predicted each year at each receptor, averaged across five years	U.S. EPA MCHM, Aug 23, 2010
	3-hour Secondary Std	25	Highest modeled impact	Title 129, Ch. 17, 009
PM_{10}	24-hour	5	Highest modeled impact	Title 129, Ch. 17, 009
$PM_{2.5}$	24-hour	1.2	Highest modeled impact averaged across 5-years	Title 129, Ch. 17, 018.02A & 018.02B
	Annual	0.3	Highest modeled annual mean averaged across 5-years	Title 129, Ch. 17, 009
Total Reduced Sulfur (including H_2S)	30-minute	0.005 **ppm**	Highest modeled impact	

Ambient Air Quality Standards (NAAQS)

Pollutant	Averaging Period	Primary/ Secondary	NAAQS ($\mu g/m^3$)	Design Value Form	Reference
CO	1-hour	primary	40,000	Highest second high (H2H) concentrations for each year modeled	40 CFR Appendix W 9.1 (d) 2016
	8-hour		10,000	Highest second high (H2H) concentrations for each year modeled	40 CFR Appendix W 9.1 (d) 2016
NO_2	1-hour	primary	188	Highest eighth high (H8H) of the 98th percentile of the annual distribution of maximum daily 1-hour concentrations averaged across five years	U.S. EPA MCHM, June 28, 2010a & U.S. EPA MCHM, March 1, 2011d
	annual	primary and secondary	100	Highest first high (H1H) annual average concentration, each year analyzed separately	40 CFR Appendix W 9.1 (d) 2016
SO_2	1-hour	primary	196	Highest fourth high (H4H) of the 99th percentile of the annual distribution of maximum daily 1-hour concentrations averaged across five years	U.S. EPA MCHM, August 23, 2010.
	3-hour	secondary	1300	Highest second high (H2H) concentration , each year analyzed separately	40 CFR Appendix W 9.1 (d) 2016
PM_{10}	24-hour	primary and secondary	150	Highest 6th high (H6H) concentration for the five years modeled (and, in general, when n years are modeled, the (n+1)th highest concentration over the n-year period))	40 CFR Appendix W 7.2.1 (U.S. EPA, 2005)
$PM_{2.5}$	24-hour	primary	35	Highest 8th high (H8H) of the 9**8**th percentile of the annual distribution of 24 hour concentrations, averaged over 5 years	U.S. EPA MCHM, March 4, 2013
	Annual	primary	12.0	Highest first high (H1H) of the modeled annual averages, averaged over 5 years	U.S. EPA MCHM, March 4, 2013
	Annual	secondary	15.0	Highest first high (H1H) of the modeled annual averages, averaged over 5 years	U.S. EPA MCHM, March 4, 2013
Pb	Rolling 3 month average	primary and secondary	0.15	Maximum 3-month rolling average in the five year period at each receptor	40 CFR Appendix W 9.1 (d)
Ozone	8-hour	primary and secondary	0.070 **ppm**	Highest forth high (H4H) modeled concentration averaged over 5 years	
TRS	30-minute	primary and secondary	0.10 **ppm**	Highest first high (H1H) modeled concentration for for each of the 5 years modeled	Title 129, Ch. 4, 007