Wisconsin Air Dispersion Modeling Guidelines

March 2018

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Air Management Program
P.O. Box 7921
Madison, WI 53707

Publication Number: AM-528 2015

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Air Dispersion Modeling Guidelines for Major PSD Projects

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OVERVIEW

This document provides general information about the dispersion modeling and additional impact requirements associated with the ambient air assessment of a Prevention of Significant Deterioration (PSD) permit application. Dispersion modeling analyses are used to support that the emission limitations contained in the air permit are protective of ambient air quality standards. Dispersion modeling can be used to set a permit allowable limit that is greater than the emission rate that is based on the physical characteristics of the emission source. This permit allowable limit provides a margin for compliance while assuring protection of the air standards.

Applicants are responsible for completing the dispersion modeling and analyses according to the requirements set forth in Chapter NR 405, *Wisconsin Administrative Code*, and consistent with Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models). Additional information can be found in the U.S. Environmental Protection Agency (USEPA) Draft New Source Review Workshop Manual (October 1990) and the USEPA Support Center for Regulatory Atmospheric Modeling (SCRAM) website at: https://www.epa.gov/scram.

All PSD permit actions require an air quality analysis of ambient air impacts to be submitted as part of a complete application. This analysis includes an assessment of existing (pre-construction) air quality, an air dispersion modeling analysis, an additional impacts analysis, and an evaluation of any adverse impacts to any Class I area including analysis of impacts to Air Quality Related Values (AQRVs).

Prior to commencing an air quality analysis in support of a PSD application, applicants or their designated consultant should provide the Wisconsin Department of Natural Resources (WDNR) a dispersion modeling protocol. This protocol should detail the models and inputs that will be used for the modeling analysis and reference current WDNR and USEPA guidance.

Pre-construction ambient air monitoring may be required for criteria pollutants where the impact of the new or modified source is above the Significant Monitoring Concentrations (SMC) or if the applicable pollutant is particulate matter with aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$).

The air dispersion modeling analysis is required to demonstrate that applicable emissions from the proposed new or modified major source, in conjunction with applicable emissions from other existing sources, will not cause or exacerbate a violation of applicable National Ambient Air Quality Standards (NAAQS) or PSD increments. The initial, single-source impact analysis evaluates the potential increase of emission from the project or the net increase associated with the modification to determine if the emissions have a significant impact. If the single-source impact is significant, a cumulative impact analysis is required, accounting for all sources affecting the air quality in the area, including applicable nearby facilities as well as regional background concentrations. The cumulative impact analysis may also consider the impact of precursor emissions on secondarily formed pollutants.

The additional impact analysis is required to evaluate the impact of the proposed project emissions on growth, soils, vegetation and wildlife, and visibility impairment. Growth impact analysis quantifies growth resulting from both construction and operation of the proposed project and assesses resulting air quality impacts. Impacts to soils, vegetation, and wildlife are also assessed based on the proposed emissions. Visibility impairment analysis considers plume visibility from PSD Class II areas separate from viewing a steam 'cloud' released by a stack.

As of July 2017 there are two PSD Class I areas in Wisconsin: the Rainbow Lake Wilderness Area located in Bayfield County and certain lands of the Forest County Potawatomi Community (FCPC) located in Forest County. Rainbow Lake is a mandatory federal Class I area and FCPC is a non-federal Class I area. Proposed projects should assess impacts of criteria pollutant emissions upon the Class I areas. Further, PSD applicants anywhere in Wisconsin should contact the Federal or Tribal land manager of each area to establish the requirements of Class I increment assessment and AQRV analysis for those areas.

DISPERSION MODELING PROTOCOL

WDNR recommends that all PSD applicants provide a detailed modeling protocol prior to submitting the permit application. This protocol should describe all models, methods, and procedures that will be used to complete the air quality analysis. The protocol should follow the form and headers of this guidance document. It should provide complete information related to the modeled emissions inventory and any correspondence with USEPA. Upon review, WDNR can communicate the acceptability of the proposed methodology prior to the applicant or consultant performing the analysis. This interaction will reduce the chance of inadvertent exclusion of required information and provide the applicant with current methods and guidance. Adjustments to the protocol may occur as the analysis progresses; however, the protocol establishes a common understanding of the dispersion modeling requirements between the facility and WDNR.

PRE-CONSTRUCTION MONITORING

Ambient monitoring data for any criteria pollutant that the applicant proposes to emit in amounts above PSD thresholds may be required as part of the analysis. The data should represent the 12-month period immediately preceding receipt of the PSD application.

WDNR has discretionary authority to exempt an applicant from this data requirement if either the predicted ambient impact due to the proposed significant net emission increase (i.e. the highest modeled concentration using the applicable averaging time) is below the prescribed SMC or the existing ambient pollutant concentrations are less than the prescribed SMC.

Significant Monitoring Concentrations

POLLUTANT	SMC	AVERAGING TIME
CARBON MONOXIDE	575 $\mu g/m^3$	8-HOUR
NITROGEN DIOXIDE	14 $\mu g/m^3$	ANNUAL
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	10 $\mu g/m^3$	24-HOUR
PARTICULATE MATTER LESS THAN 2.5 MICRONS ($PM_{2.5}$)	*See "January 22, 2013 D.C. Circuit Court Decision (SMC)"*	
SULFUR DIOXIDE	13 $\mu g/m^3$	24-HOUR
LEAD	0.1 $\mu g/m^3$	3-MONTH
MERCURY	0.25 $\mu g/m^3$	24-HOUR
BERYLLIUM	0.0010 $\mu g/m^3$	24-HOUR
FLUORIDES	0.25 $\mu g/m^3$	24-HOUR
VINYL CHLORIDE	15 $\mu g/m^3$	24-HOUR
TOTAL REDUCED SULFUR	10 $\mu g/m^3$	1-HOUR
HYDROGEN SULFIDE	0.20 $\mu g/m^3$	1-HOUR
REDUCED SULFUR COMPOUNDS	10 $\mu g/m^3$	1-HOUR

January 22, 2013 D.C. Circuit Court Decision (SMC)

On January 22, 2013 a decision was issued by the Washington D.C. Circuit Court that vacated the Federal $PM_{2.5}$ SMC. The court stated that USEPA exceeded its statutory authority by allowing an exemption from the $PM_{2.5}$ SMC. As a result, applicants should not rely on the $PM_{2.5}$ SMC to avoid compiling air quality monitoring data specifically for $PM_{2.5}$. All applicants should submit ambient $PM_{2.5}$ monitoring data in accordance with requirements whenever either direct $PM_{2.5}$ or any $PM_{2.5}$ precursor emissions are above the respective PSD Significant Emission Rate. Applicants may submit data collected from existing $PM_{2.5}$ regulatory monitoring networks if the data is representative of air quality in the area of concern for the year preceding receipt of the application. Applicants will generally be able to rely on existing WDNR monitoring data to satisfy the monitoring requirement but should contact WDNR if concerns arise.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, line, or volume sources; emissions should be entered using the most representative source type. Each significant emission unit or process listed in the permit should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin use 'rural' dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered 'urban' under the Irwin/Auer land use technique. For facility locations within the 'urban' area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the 'urban' area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks with vertical, obstructed flow while the process is operating should be entered as POINTCAP source type; any non-vertical release should be entered as POINTHOR source type
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant proposes permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter (meters) = $9.88E-4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in aggregate in the permit should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that is considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed.

Fugitive Dust

When fugitive dust emissions originating on the facility property are affected by the permit, those emissions should be included in the dispersion modeling analysis. The most representative AERMOD source type should be assumed.

If the impact of emissions from wind erosion is analyzed, the AERMOD emission factor can be used to allow concentration calculation for only the highest wind speed category (WSPEED 0 0 0 0 0 1). When fugitive dust from roadways is analyzed, the provisions of the USEPA Haul Road Workgroup Final Report should be followed. The report is available at: http://www.epa.gov/ttn/scram/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours and can include some types of limited-use or emergency backup fuels. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by utilizing the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of complete permit application) or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but unfenced visitor parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- along the ambient air boundary every 25 meters
- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- on a 50-meter spaced grid from 500 meters to 1000 meters from the sources
- on a 100-meter spaced grid from 1000 meters to 2000 meters from the sources
- on a 250-meter spaced grid from 2000 meters to 5000 meters from the sources
- on a 500-meter spaced grid from 5 kilometers to 10 kilometers from the sources

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 10 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 40 km by 40 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

Significant Impact Analysis – Class II

The impact of the emissions from the proposed project, termed the first stage, single-source impact analysis, can be analyzed relative to the Significant Impact Levels (SILs). The level of each SIL is established by federal guidance. If the project involves the permanent shut down of existing, permitted emission units, credit (other than for NO_x) can be taken in the SIL analysis and those units modeled with a negative emission rate. Where credit is taken for permanent shut down emissions, the applicant should show that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

PSD Class II Significant Impact Levels

POLLUTANT	SIL	AVERAGING TIME	STATISTIC/METRIC
CARBON MONOXIDE	2,000 µg/m^3	1-HOUR	1ST HIGHEST
	500 µg/m^3	8-HOUR	1ST HIGHEST
NITROGEN DIOXIDE	7.5 µg/m^3	1-HOUR	5-YR AVG 1ST HIGH HRDAY
	1.0 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	5 µg/m^3	24-HOUR	1ST HIGHEST
	1.0 µg/m^3	ANNUAL	1ST HIGHEST
SULFUR DIOXIDE	7.8 µg/m^3	1-HOUR	5-YR AVG 1ST HIGH HRDAY
	25 µg/m^3	3-HOUR	1ST HIGHEST
	5 µg/m^3	24-HOUR	1ST HIGHEST
	1.0 µg/m^3	ANNUAL	1ST HIGHEST
*PARTICULATE MATTER LESS THAN 2.5 MICRONS ($PM_{2.5}$)**	*1.2 µg/m^3*	*24-HOUR*	*5-YR AVG 1ST HIGH DAY*
	0.2 µg/m^3	*ANNUAL*	*5-YR AVG YEAR*
*OZONE**	*1.0 ppb*	*8-HOUR*	*3-YR AVG 4TH HIGH MAX*

** Refer to discussion under "Draft Guidance on SIL for Ozone and Fine Particles"*

If the impact of the proposed project is less than the SIL, no further modeling for that pollutant and time period is required; the project has been shown to not cause or exacerbate a violation of an ambient air quality standard or ambient air increment for that pollutant and time period.

Draft Guidance on SIL for Ozone and Fine Particles

On August 18, 2016, USEPA issued draft guidance on SIL for both ozone and fine particles in the PSD program. USEPA is open to permit agencies using the draft guidance, where applicable. Applicants can assess the $PM_{2.5}$ and O_3 air quality around their facility following the methods described in the August 18, 2016 draft guidance, or in any subsequent update to the guidance including updates to the form of the SIL. The SIL may only be used in locations where ambient monitoring values are well below the standard. If the sum of the monitored concentration plus SIL could exceed the NAAQS, a cumulative PSD impact analysis should be performed. Applicants will generally be able to rely on existing WDNR monitoring data to determine if the cumulative PSD impact analysis will be required and not have to perform their own monitoring.

PSD Increment Analysis

If the impact of the emissions from the proposed project is above the SIL, a PSD increment analysis should be performed for those pollutants and time periods. The impact of the proposed project's allowable emissions plus emissions from increment-consuming sources in the immediate area must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
CARBON MONOXIDE	None	N/A	N/A
NITROGEN DIOXIDE	25 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM$_{10}$)	30 µg/m^3 17 µg/m^3	24-HOUR ANNUAL	HIGH 2ND HIGHEST 1ST HIGHEST
PARTICULATE MATTER LESS THAN 2.5 MICRONS (PM$_{2.5}$)	9.0 µg/m^3 4.0 µg/m^3	24-HOUR ANNUAL	HIGH 2ND HIGHEST 1ST HIGHEST
SULFUR DIOXIDE	512 µg/m^3 91 µg/m^3 20 µg/m^3	3-HOUR 24-HOUR ANNUAL	HIGH 2ND HIGHEST HIGH 2ND HIGHEST 1ST HIGHEST

The first complete (as determined by WDNR permit staff) PSD application in a county establishes the minor source baseline date (baseline date), for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

Where the baseline has been previously set (refer to the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html), additional increment consuming sources may exist near the facility. Additional increment consuming sources will be identified by WDNR during the protocol process.

As with SIL analysis, credit (other than for NO$_x$) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and will be permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

NAAQS Analysis

If the impact of the emissions from the proposed project is above the SIL, an analysis should be performed of the impact relative to the NAAQS for those pollutants and time periods (in addition to the increment analysis). The combined impact of the allowable emissions from the facility, the emissions from nearby sources, and the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
Lead	0.15 $\mu g/m^3$	3-month	1st Highest
Ozone	0.070 ppm	8-hour	3-Yr Avg 4th High Daily Max
Carbon Monoxide	40,000 $\mu g/m^3$	1-hour	High 2nd Highest
	10,000 $\mu g/m^3$	8-hour	High 2nd Highest
Nitrogen Dioxide	188 $\mu g/m^3$	1-hour	5-Yr Avg 8th High HrDay
	100 $\mu g/m^3$	Annual	1st Highest
Particulate Matter Less than 10 Microns (PM_{10})	150 $\mu g/m^3$	24-hour	6th Highest in 5 Years
Particulate Matter Less than 2.5 Microns ($PM_{2.5}$)	35 $\mu g/m^3$	24-hour	5-Yr Avg 8th High Day
	12.0 $\mu g/m^3$	Annual	5-yr Avg Year
Sulfur Dioxide	196 $\mu g/m^3$	1-hour	5-Yr Avg 4th High HrDay
	1,300 $\mu g/m^3$	3-hour	High 2nd Highest

Every NAAQS analysis for PSD applications should include both the discrete impact of nearby sources and the regional background concentration. Additional sources to be included in the NAAQS analysis will be identified by WDNR during the protocol process.

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

Secondary Formation Analysis

USEPA recommends a two-tiered approach to estimate the impact of single-source emissions on secondary formation of ozone and $PM_{2.5}$. For first tier assessments, the applicant should use existing technical information (e.g. existing photochemical grid modeling, reduced-form models, or published empirical estimates of source specific impacts) in combination with other supporting information to estimate secondary impacts from the source. This can include information provided in the December 2, 2016, USEPA draft guidance of modeled emission rates for precursors (MERPs) and any subsequent updates to the guidance. Most analyses of impact on secondary formation will use this first tier approach.

If existing technical information is not available or the first tier demonstration indicates a more refined assessment is needed, chemical transport models should be used for assessment of single-source impacts. Guidance on the use of models for the second tier analysis for demonstrating the impact of single sources on secondary formation of O_3 and $PM_{2.5}$ is available from USEPA.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of ozone to become NO_2, and NO_2 reacts with sunlight to reform ozone and NO_x. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes NO_x emissions are always in the form of NO_2 (i.e. no conversion). Tier 2 assumes that the conversion of NO_x into NO_2 will reach an equilibrium level in the atmosphere. This ambient ratio method (ARM2) uses a minimum and a maximum ratio that varies based on the modeled level of NO_x. The national default minimum ARM2 ratio is 0.5 and the maximum ratio is 0.9. The minimum ARM2 ratio can be lowered based on the actual, tested in-stack ratio of NO_x to NO_2 provided by the PSD applicant during the protocol process.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. These methods shall occur with consultation by both WDNR and USEPA. WDNR dispersion modeling staff should be contacted prior to proposing to use either Tier 3 conversion algorithm.

When using either Tier 2 or Tier 3 conversion methods, individual source groups should not be used. If analyzing multiple operational scenarios, each scenario should be run separately, with only the sources emitting under the scenario included.

All three tiers of NO_x-to-NO_2 conversion are classified as screening techniques, and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 SIL or increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

ADDITIONAL IMPACT ANALYSIS

PSD permit applicants must prepare an additional impact analysis for each pollutant subject to PSD (i.e. each pollutant with emissions greater than the respective PSD Significant Emission Rate threshold). This analysis assesses the impacts of the proposed or modified facility on industrial growth, soils and vegetation, and visibility in the vicinity of the facility. The depth of the analysis generally depends on existing air quality, the quantity of emissions, and the sensitivity of local soils, vegetation, 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.

Growth Analysis

The growth analysis is an estimate of the projected residential, commercial, and industrial growth that may occur as a result of the project and an estimate of the emissions associated with the growth as well as from any construction-related activities.

Soils & Vegetation Analysis

The soils and vegetation analysis should be based on an inventory of the soil and vegetation types found in the impact area. This inventory should include all vegetation with any commercial or recreational value. For most types of soil and vegetation, ambient concentrations of criteria pollutants below the NAAQS will not result in harmful effects.

Local Visibility Analysis

The local visibility analysis is concerned with impacts that occur within the area affected by the PSD-applicable emissions. This analysis is separate and distinct from the Class I area visibility requirement. The suggested components of the local visibility analysis include a determination of the visual quality of the area and initial screening of emission sources to assess the possibility of visibility impairment. Under certain meteorological conditions the stacks emit a visible steam plume that, after traveling a relatively short distance, dissipates by dispersion and evaporation. A visible steam plume may occur when ambient air temperatures are relatively low with respect to plume temperature and ambient humidity levels are relatively high. The persistence of the plume is dependent upon wind speed and the time required for evaporation. If a more in-depth analysis is warranted, please refer to the 1988 USEPA document, “Workbook for Plume Visual Impact Screening and Analysis”, available from USEPA.

PSD CLASS I ANALYSIS

Under the PSD program, areas of special national or regional natural, scenic, recreational, or historic value are provided special protection. As of 2016, Wisconsin has two PSD Class I areas: Rainbow Lake Wilderness Area, in Bayfield County, and certain lands of the Forest County Potawatomi Community (FCPC) in Forest County. Other PSD Class I areas are located in both Michigan and Minnesota.

WDNR must provide notification to the Land Manager of a Class I area if a proposed new major source or major modification may affect a Class I area. WDNR will notify the Land Manager of PSD applications from sources located within 300 km of a Class I area for purposes of an Air Quality Related Value (AQRV) analysis. Unique provisions apply to the FCPC Class I area. These provisions are contained in negotiated agreements between the State of Wisconsin and the Tribe. Refer to the WDNR PSD Class I Areas web page (http://dnr.wi.gov/topic/AirPermits/ClassI.html) for maps and details on the PSD Class I areas in Wisconsin.

Class I Significant Impact & Increment

For PSD applications, compliance demonstration for Class I increments may be necessary. If the modeled impact (including secondary formation if applicable) is below the Class I SIL for the applicable pollutant, then further analysis is not necessary. If the PSD applicant facility is located more than 50 km from a Class I area, significance is modeled at 50 km using the near-field model (AERMOD) for an arc of receptors extending +/- 45° from the line connecting the facility and the Class I area. If this modeled concentration is above the threshold, long-range transport models may be necessary to refine the estimated impact to the Class I area increments. USEPA does not consider long-range transport (beyond 50 km) NAAQS assessment necessary if the near-field NAAQS compliance is required.

PSD Class I Threshold Concentrations

POLLUTANT	CLASS I SIL	AVERAGING TIME	STATISTIC/METRIC
NITROGEN DIOXIDE	0.1 µg/m³	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	0.3 µg/m³	24-HOUR	1ST HIGHEST
	0.2 µg/m³	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 2.5 MICRONS ($PM_{2.5}$)	0.07 µg/m³	24-HOUR	5-YR AVG 1ST HIGH DAY
	0.06 µg/m³	ANNUAL	5-YR AVG YEAR
SULFUR DIOXIDE	1.0 µg/m³	3-HOUR	1ST HIGHEST
	0.2 µg/m³	24-HOUR	1ST HIGHEST
	0.1 µg/m³	ANNUAL	1ST HIGHEST

POLLUTANT	CLASS I INCREMENT	AVERAGING TIME	STATISTIC/METRIC
NITROGEN DIOXIDE	2.5 µg/m³	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	8 µg/m³	24-HOUR	HIGH 2ND HIGHEST
	4 µg/m³	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 2.5 MICRONS ($PM_{2.5}$)	2.0 µg/m³	24-HOUR	HIGH 2ND HIGHEST
	1.0 µg/m³	ANNUAL	1ST HIGHEST
SULFUR DIOXIDE	25 µg/m³	3-HOUR	HIGH 2ND HIGHEST
	5 µg/m³	24-HOUR	HIGH 2ND HIGHEST
	2 µg/m³	ANNUAL	1ST HIGHEST

Air Quality Related Values

An Air Quality Related Value (AQRV) is a feature or property of the Class I area that could be adversely affected by air pollution, even if the pollutant concentrations are below the Class I increments. Land Managers are responsible for protecting AQRVs and will advise the applicant of the level of analysis needed to assess potential impacts on the resource. Refer to the WDNR PSD Class I Areas web page (http://dnr.wi.gov/topic/AirPermits/ClassI.html) for the appropriate Land Manager contact of the specified Class I area.

Forest County Potawatomi Class I Area

A portion of the Forest County Potawatomi Community (FCPC) Reservation located in Forest County was designated as a tribal (non-federal) Class I area in 2008. The State of Wisconsin negotiated two agreements with FCPC that provided the framework for implementation of Class I area provisions. Proposed PSD permit applications from facilities farther than 10 miles from the FCPC Class I area are subject to an increment analysis and consumption requirements using Class II standards, rather than Class I standards.

FCPC has identified three AQRVs: aquatic systems and water quality, visibility, and vegetation. FCPC provided threshold effect levels that were recognized by WDNR in April 2015. The AQRV's and threshold levels can be found at the WDNR PSD Class I Areas web page (http://dnr.wi.gov/topic/AirPermits/ClassI.html). Additional documentation and agreements relative to FCPC AQRV analysis are found at the same web location.

SUBMITTAL REQUIREMENTS

Prior to performing detailed dispersion modeling, WDNR recommends that a protocol document be submitted and approved. The agreed-upon protocol will establish the most recent federal and state guidance and policy to follow in the dispersion modeling analysis. However, at the time of submission of the draft permit to USEPA, the dispersion modeling will follow the guidance and policy in place at that time. Every effort will be made to notify applicants of notable changes to policy.

In addition to the standard permit application forms, a detailed report of the dispersion modeling should be submitted. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol plus details on source parameters, emission rates, and modeled scenarios. This report should also contain pertinent information on secondary formation analyses and should indicate if the Tier 3 NO_x-to-NO_2 conversion algorithms were used, and which algorithm was used along with justification. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin.

The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Minor NSR Projects

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with minor source (below Prevention of Significant Deterioration [PSD] threshold) construction permit applications. Dispersion modeling analyses are used to support that the emission limitations contained in the air permit are protective of ambient air quality standards. Dispersion modeling can be used to set a permit allowable limit that is greater than the emission rate that is based on the physical characteristics of the emission source. This permit allowable limit provides a margin for compliance while assuring protection of the air standards.

Applicants are not required to submit an air quality analysis, but any analysis performed should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at https://www.epa.gov/scram.

The Wisconsin Department of Natural Resources (WDNR) is required to make a determination of impact to ambient air prior to permit issuance in order to show that a source will not cause or exacerbate a violation of an air quality standard. This determination can take the form of a dispersion modeling analysis, but dispersion modeling is not specifically a criterion of permit approvability.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the new or modified source, in conjunction with applicable emissions from other existing sources, will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standards (NAAQS) or PSD increments. An initial analysis evaluates the potential increase of emission from the project or the net increase associated with the modification to determine if the emissions have a significant impact. If a facility analysis is required, then existing emission units at the facility are included along with any applicable nearby facilities, as well as regional background concentrations.

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

Special Note Regarding 1-hour NO_2

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded, based on the weight of evidence, that direct emissions of NO_x from existing sources, minor new sources, and minor modifications of sources at facilities with no individual combustion unit with heat input of 250 mmBTU/hr or higher will not cause or exacerbate violations of the 1-hour NO_2 standard. The details of this determination are available in the Technical Support Document titled *Air Quality Dispersion*

Modeling of Industrial Stationary Sources on Ambient NO_2 Concentrations in Wisconsin, dated February 2018 and attached as Appendix C.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each significant emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin use ‘rural’ dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered ‘urban’ under the Irwin/Auer land use technique. For facility locations within the ‘urban’ area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the ‘urban’ area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks with vertical, obstructed flow while the process is operating should be entered as POINTCAP source type; any non-vertical release should be entered as POINTHOR source type
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either ‘on’ or ‘off’ with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant proposes permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with a visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter (meters) = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that is considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours and can include some types of limited-use or emergency backup fuels. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of a complete permit application) or construction plan, and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered.   Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but visitor parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

Significant Impact Analysis – Class II

The impact of the emissions from the proposed project, termed the first stage, single-source impact analysis, can be analyzed relative to the Significant Impact Levels (SILs). The level of each SIL is established by federal guidance and not by rule. If the project involves the permanent shut down of existing, permitted emission units, credit (other than for NO_x) can be taken in the SIL analysis and those units modeled with a negative emission rate. Where credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

PSD Class II Significant Impact Levels

POLLUTANT	SIL	AVERAGING TIME	STATISTIC/METRIC
CARBON MONOXIDE	2,000 µg/m^3	1-HOUR	1ST HIGHEST
	500 µg/m^3	8-HOUR	1ST HIGHEST
NITROGEN DIOXIDE	7.5 µg/m^3	1-HOUR	5-YR AVG 1ST HIGH HRDAY
	1.0 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	5 µg/m^3	24-HOUR	1ST HIGHEST
	1.0 µg/m^3	ANNUAL	1ST HIGHEST
SULFUR DIOXIDE	7.8 µg/m^3	1-HOUR	5-YR AVG 1ST HIGH HRDAY
	25 µg/m^3	3-HOUR	1ST HIGHEST
	5 µg/m^3	24-HOUR	1ST HIGHEST
	1.0 µg/m^3	ANNUAL	1ST HIGHEST

If the impact of the proposed project is less than the SIL, no further modeling for that pollutant and time period is required; the project has been shown to not cause or exacerbate a violation of an ambient air quality standard or ambient air increment for that pollutant and time period.

PSD Increment Analysis

If the impact of the emissions from the proposed project is above the SIL, and the facility is located in a county where the minor source baseline has been set, a PSD increment analysis should be performed for those pollutants and time periods. Refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for baseline status. Increment consuming sources near the facility will also be included in the analysis.

The impact of the proposed project's allowable emissions plus the impact of emissions from other increment consuming sources in the immediate area must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
CARBON MONOXIDE	None	N/A	N/A
NITROGEN DIOXIDE	25 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	30 µg/m^3 17 µg/m^3	24-HOUR ANNUAL	HIGH 2ND HIGHEST 1ST HIGHEST
SULFUR DIOXIDE	512 µg/m^3 91 µg/m^3 20 µg/m^3	3-HOUR 24-HOUR ANNUAL	HIGH 2ND HIGHEST HIGH 2ND HIGHEST 1ST HIGHEST

The first complete (as determined by WDNR permit staff) PSD application in a county establishes the minor source baseline date (baseline date), for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

As with SIL analysis, credit (other than for NO_x) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and will be permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused a modeled exceedance of any ambient air standard.

NAAQS Analysis

If the impact of the emissions from the proposed project is above the SIL, an analysis should be performed of the impact relative to the NAAQS for those pollutants and time periods (in addition to the increment analysis, if applicable). The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
LEAD	0.15 µg/m³	3-MONTH	1ST HIGHEST
CARBON MONOXIDE	40,000 µg/m³ 10,000 µg/m³	1-HOUR 8-HOUR	HIGH 2ND HIGHEST HIGH 2ND HIGHEST
NITROGEN DIOXIDE	188 µg/m³ 100 µg/m³	1-HOUR ANNUAL	5-YR AVG 8TH HIGH HRDAY 1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	150 µg/m³	24-HOUR	6TH HIGHEST IN 5 YEARS
SULFUR DIOXIDE	196 µg/m³ 1,300 µg/m³	1-HOUR 3-HOUR	5-YR AVG 4TH HIGH HRDAY HIGH 2ND HIGHEST

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of ozone to become NO_2, and NO_2 reacts with sunlight to reform ozone and NO_x. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes NO_x emissions are always in the form of NO_2 (i.e. no conversion). Tier 2 assumes that the conversion of NO_x into NO_2 will reach an equilibrium level in the atmosphere. This ambient ratio method (ARM2) uses a minimum and a maximum ratio that varies based on the modeled level of NO_x. Based upon review of USEPA data and stack testing by facilities, the Wisconsin default minimum ARM2 ratio is 0.2 and the maximum ratio is 0.9. The minimum ARM2 ratio can be lowered based on the actual, tested in-stack ratio of NO_x to NO_2 provided by the applicant.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. Due to issues with consistent application of these methods, specifically the choice of algorithm and processing of hourly ozone concentrations, WDNR discourages the use of either Tier 3 conversion algorithm.

When using Tier 2 conversion methods, individual source groups should not be used. If analyzing multiple operational scenarios, each scenario should be run separately, with only the sources emitting under the scenario included.

All tiers of NO_x-to-NO_2 conversion are classified as screening techniques and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 SIL or increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling a detailed report of the dispersion modeling should be submitted in addition to the standard permit application forms. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol, if one was submitted, plus details on source parameters, emission rates, and modeled scenarios. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin. The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Individual Operation Permit Actions

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with individual operation permit applications, including initial issuance, revisions, and renewals. Dispersion modeling analyses are used to support that the emission limitations contained in the air permit are protective of ambient air quality standards. Dispersion modeling can be used to set a permit allowable limit that is greater than the emission rate that is based on the physical characteristics of the emission source. This permit allowable limit provides a margin for compliance while assuring protection of the air standards.

Applicants are not required to submit an air quality analysis for these permit actions, but any analysis performed should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at https://www.epa.gov/scram.

The Wisconsin Department of Natural Resources (WDNR) is required to make a determination of impact to ambient air prior to permit issuance in order to show that a source will not cause or exacerbate a violation of an air quality standard. This determination can take the form of a dispersion modeling analysis, but dispersion modeling is not a condition of permit approvability.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the entire facility, in conjunction with applicable emissions from other existing sources and regional background concentrations, will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standard (NAAQS) or Prevention of Significant Deterioration (PSD) increment.

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

Special Note Regarding 1-hour NO_2

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded, based on the weight of evidence, that direct emissions of NO_x from existing sources, minor new sources, and minor modifications of sources at facilities with no individual combustion unit with heat input of 250 mmBTU/hr or higher will not cause or exacerbate violations of the 1-hour NO_2 standard. The details of this determination are available in the Technical Support Document titled *Air Quality Dispersion Modeling of Industrial Stationary Sources on Ambient NO_2 Concentrations in Wisconsin*, dated February 2018 and attached as Appendix C.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be entered with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin use ‘rural’ dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered ‘urban’ under the Irwin/Auer land use technique. For facility locations within the ‘urban’ area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the ‘urban’ area.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks with vertical, obstructed flow while the process is operating should be entered as POINTCAP source type; any non-vertical release should be entered as POINTHOR source type
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis can consider all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot operate simultaneously, and the applicant proposes permit limitations to this effect, the dispersion modeling analysis can be adjusted to reflect this scenario. Similarly, if the facility proposes permit limitations on the hours of operation per day or per year, the dispersion modeling analysis can also be adjusted.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter (meters) = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that is considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

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Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan (required as part of complete permit application) or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered. Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but visitor parking lots, public roadways, and public waterways are ambient air.

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With limited exception, receptors should be placed as follows:

- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

PSD Increment Analysis

Although dispersion modeling analyses for operation permit actions consider existing emissions, PSD increment consumption should be considered for the applicable emissions if the facility is located in a county where the minor source baseline has been set. Refer WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for baseline status. Additional increment consuming sources near the facility will be included in the analysis. The impact of all the analyzed increment consuming sources must be below the Class II increment concentrations.

PSD Class II Increment Concentrations

POLLUTANT	CLASS II INCREMENT	AVERAGING TIME	STATISTIC/METRIC
CARBON MONOXIDE	None	N/A	N/A
NITROGEN DIOXIDE	25 µg/m^3	ANNUAL	1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	30 µg/m^3	24-HOUR	HIGH 2ND HIGHEST
	17 µg/m^3	ANNUAL	1ST HIGHEST
SULFUR DIOXIDE	512 µg/m^3	3-HOUR	HIGH 2ND HIGHEST
	91 µg/m^3	24-HOUR	HIGH 2ND HIGHEST
	20 µg/m^3	ANNUAL	1ST HIGHEST

The first complete (as determined by WDNR permit staff) PSD application in a county establishes the minor source baseline date (baseline date) for that county and pollutant. The baseline is set for the entire county once the PSD application is complete, regardless of the level of impact.

Credit (other than for NO_x) can be taken for permanent removal of certain emission units. If the unit existed prior to the baseline date and was permanently shut down, those emissions are considered to expand the available increment and can be modeled with a negative emission rate. If credit is taken for permanent shut down emissions, it should be shown that the credited emissions would not have solely caused modeled exceedance of any ambient air standard.

NAAQS Analysis

In addition to any applicable increment analysis, an analysis should be performed of the impact relative to the NAAQS for applicable pollutants and time periods. The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
LEAD	0.15 µg/m³	3-MONTH	1ST HIGHEST
CARBON MONOXIDE	40,000 µg/m³ 10,000 µg/m³	1-HOUR 8-HOUR	HIGH 2ND HIGHEST HIGH 2ND HIGHEST
NITROGEN DIOXIDE	188 µg/m³ 100 µg/m³	1-HOUR ANNUAL	5-YR AVG 8TH HIGH HRDAY 1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	150 µg/m³	24-HOUR	6TH HIGHEST IN 5 YEARS
SULFUR DIOXIDE	196 µg/m³ 1,300 µg/m³	1-HOUR 3-HOUR	5-YR AVG 4TH HIGH HRDAY HIGH 2ND HIGHEST

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of ozone to become NO_2, and NO_2 reacts with sunlight to reform ozone and NO_x. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes NO_x emissions are always in the form of NO_2 (i.e. no conversion). Tier 2 assumes that the conversion of NO_x into NO_2 will reach an equilibrium level in the atmosphere. This ambient ratio method (ARM2) uses a minimum and a maximum ratio that varies based on the modeled level of NO_x. Based upon review of USEPA data and stack testing by facilities, the Wisconsin default minimum ARM2 ratio is 0.2 and the maximum ratio is 0.9. The minimum ARM2 ratio can be lowered based on the actual, tested in-stack ratio of NO_x to NO_2 provided by the applicant.

Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. Due to issues with consistent application of these methods, specifically the choice of algorithm and processing of hourly ozone concentrations, WDNR discourages the use of either Tier 3 conversion algorithm.

When using Tier 2 conversion methods, individual source groups should not be used. If analyzing multiple operational scenarios, each scenario should be run separately, with only the sources emitting under the scenario included.

All tiers of NO_x-to-NO_2 conversion are classified as screening techniques, and negative emission rates (credit rates) cannot be used to account for emission reductions when analyzing net impacts relative to the NO_2 increment. WDNR dispersion modeling staff should be contacted if applicants propose alternative methods for addressing negative emissions.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling a detailed report of the dispersion modeling should be submitted in additions to the standard permit application forms. This report (preferably in electronic form) should contain provisions from the dispersion modeling protocol, if one was submitted, plus details on source parameters, emission rates, and modeled scenarios. While a facility plot plan (indicating true north, all peak and edge tier heights, and stack locations) is considered part of a complete permit application, the dispersion modeling report should also contain additional information on the specific geographic location of all stacks and structures with enough detail to accurately locate the facility in Wisconsin. The full set of dispersion modeling files should also be submitted, both input and output files from AERMOD and the building downwash analysis. If using commercial software, the full archive can be submitted – including any specific files. Electronic dispersion modeling files can be transmitted in a multitude of ways, including email (~15Mb limit per message), file transfer protocol (FTP), disc (CD or DVD), or any other accessible service.

Air Dispersion Modeling Guidelines for Registration Permits

Contents

OVERVIEW

This document provides general information about the dispersion modeling performed in association with registration permit actions, including granting of coverage for registration construction permit (RCPA, RCPB, RCPC) or registration operation permit (ROPA, ROPB, ROPC) actions. When all stacks at the facility do not vent vertically without obstruction, or the results of a dispersion modeling analysis are required because emissions exceed certain thresholds, the analysis should be consistent with this document, Federal Guidance 40 CFR Part 51 Appendix W (Guideline on Air Quality Models), and information available from the U.S. Environmental Protection Agency (USEPA) Support Center for Regulatory Atmospheric Modeling (SCRAM) website at https://www.epa.gov/scram.

When dispersion modeling is performed, the analysis should show that the impact of the emissions from the facility and regional background concentrations will not cause or exacerbate a violation of any applicable National Ambient Air Quality Standards (NAAQS).

Special Note Regarding $PM_{2.5}$

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded that direct emissions of $PM_{2.5}$ from existing sources, minor new sources, and minor modifications of sources will not cause or exacerbate violations of any $PM_{2.5}$ standard or increment. The details of this determination are available in the Technical Support Document titled *Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources in Wisconsin*, dated February 2016 and attached as Appendix B.

Special Note Regarding 1-hour NO_2

Pursuant to Section 285.63(1)(b), *Wisconsin Statutes*, WDNR has concluded, based on the weight of evidence, that direct emissions of NO_x from existing sources, minor new sources, and minor modifications of sources at facilities with no individual combustion unit with heat input of 250 mmBTU/hr or higher will not cause or exacerbate violations of the 1-hour NO_2 standard. The details of this determination are available in the Technical Support Document titled *Air Quality Dispersion Modeling of Industrial Stationary Sources on Ambient NO_2 Concentrations in Wisconsin*, dated February 2018 and attached as Appendix C.

SOURCE & MODEL INFORMATION

WDNR uses the latest version of the regulatory model AERMOD for dispersion modeling analyses. Source locations should be input with Universal Transverse Mercator (UTM) coordinates in the 1983 North American Datum (NAD83). Ground elevations for sources entered into the model should be obtained from the facility; as-built ground elevations may be different from publicly available terrain information.

AERMOD can compute concentrations for point, area, or volume sources; emissions should be entered using the most representative source type. Each emission unit, or process listed in a permit, should be included in the analysis. If an emission unit vents out multiple locations, each release location should be included discretely as well. Analyzed emission rates should reflect the short-term maximum (hourly) permit limitation.

Based on USEPA dispersion modeling guidance, most locations in Wisconsin use ‘rural’ dispersion coefficients. Only a portion of the Milwaukee metropolitan area is considered ‘urban’ under the Irwin/Auer land use technique. For facility locations within the ‘urban’ area, the analysis should use a population of 1,000,000 (based on Milwaukee County) and a roughness length of 1.0 meter in AERMOD. Refer to Appendix A for the location of the ‘urban’ area.

USEPA developed AERSCREEN, a screening version of AERMOD, but WDNR recommends AERMOD be used when modeling is performed. Either model can be used to determine the impact of emissions on ambient air quality. Some degree of familiarity with dispersion modeling is recommended when using either model.

Source Parameters

The following information is necessary for each source that is entered into AERMOD.

Point Source:

- Stack height as measured from the ground or finished floor elevation
- Stack inside circular diameter at the release point
- Exit gas velocity (refer to Operational Loads for more information); stacks with vertical, obstructed flow while the process is operating should be entered as POINTCAP source type; any non-vertical release should be entered as POINTHOR source type
- Exit gas temperature (refer to Operational Loads for more information); stacks emitting at outdoor ambient temperature should be analyzed with a gas temperature of -0.1 K.

Area Source:

- Release height above ground
- Lateral dimensions of source, either square, rectangular, circular, or polygon
- Initial vertical mixed dimension, if applicable

Volume (or Line) Source:

- Center of initial volume above ground
- Initial estimate of lateral dispersion coefficient; volume sources are assumed to be small and square in the lateral dimension, so multiple volume sources may be needed for large and /or irregularly shaped emissions
- Initial estimate of vertical dispersion coefficient

Operational Loads or Scenarios

The emissions from certain stack vented emission units can have variable exhaust parameters (exit gas velocity and temperature) as emission rates vary. Other types of emission units may be either 'on' or 'off' with limited variation. The dispersion modeling analysis should capture all possible emission load scenarios for each unit.

For an emission unit, multiple load conditions can be analyzed separately and the resulting worst-case impact determined. One load scenario must reflect the stack conditions when emitting at the maximum permit emission rate. Alternatively, a single stack can be analyzed for an emission unit assuming the exit gas velocity and temperature expected to occur most often (normal conditions) along with the maximum permit limitation.

If all emission units at the facility cannot physically operate simultaneously, the dispersion modeling analysis can be adjusted to reflect this scenario. If the facility has legal restrictions on the hours of operation due to local ordinances, state, or federal regulations, the dispersion modeling analysis can be adjusted to reflect the restrictions.

Flares

In accordance with USEPA Region V policy, external flares (those with visible flame) are modeled using the following methodology:

- Stack height is the level above ground of gas release
- Exit gas temperature is set to 1273 K
- Exit gas velocity is set to 20 ms^{-1}
- Stack diameter (meters) = $9.88E\text{-}4(Q_h)^{0.5}$, where $Q_h = 0.45H$ and H = total heat release in cal/sec

Fugitive (non-point source) Emissions

Emissions created within a structure that are not vented to a stack but are considered in the permit in aggregate should be included in the dispersion modeling analysis. Similarly, any outdoor source (e.g. tank or pond) that is considered in the permit should be included in the analysis. The most representative AERMOD source type should be assumed. Due to large uncertainties associated with establishing rates and the difficulties in modeling them, fugitive dust emissions (e.g. roadways, piles, dumping, crushing, etc.) are considered only for PSD applications.

Intermittent Emissions

Emission units are considered intermittent when they do not have a set operating schedule, operate for short periods of time during the year (generally outside of the facilities' control) and do not contribute to the normal operation of the facility. An intermittent source is not defined by a specific number of yearly operating hours and can include some types of limited-use or emergency backup fuels. Emergency generators as defined by Chapters NR 400, NR 406, and NR 436, *Wis. Adm. Code* and emergency fire pumps are considered intermittent. Operation of an emission unit that meets the definition of "essential service" in Section NR 445.02(6), *Wis. Adm. Code* is also considered intermittent. If a facility proposes permit conditions for a given emission unit consistent with intermittent operation, that emission unit does not have to be included in the dispersion modeling analysis.

Building Downwash

Aerodynamic building downwash effects can greatly affect dispersion modeling concentrations. Dispersion modeling analyses should include the geometry of the buildings by using the Building Profile Input Program for PRIME (BPIP-PRIME). Building base elevations should be determined from the facility plot plan or construction plan and should match the associated source base elevations.

Structures that are four feet or less above ground level should not be entered into BPIP-PRIME. All other structures that present a solid face from the ground to the top of the structure and that have angled corners should be included. Average roof heights should be used for peaked or sloped tiers. Structures off the ground (e.g. on stilts) should not be included. Single, individual silos that are taller than they are wide should also not be included. But groupings of silos should be included in addition to large, wide circular grain bins using the eave height as the structure height.

Stacks of any shape or size should not be considered.   Any enclosure built to enhance the appearance of the stack should also not be entered into BPIP-PRIME.

Structures with several roof heights should be entered into BPIP-PRIME as a single building with multiple tiers. The lowest tier should completely encompass the foot print of the structure, with higher tiers assumed to be stacked on top of the lower tiers, similar to a wedding cake. Do not enter each roof height as a single building (similar to books on a bookshelf).

RECEPTOR INFORMATION

Receptors should be placed where the modeled impact to ambient air is greatest, taking into account topography, residences, building downwash, and meteorology. Cartesian receptor grids should be used, with additional receptors near the ambient air boundary and sensitive locations. Polar coordinate grids should not be used.

Ambient Air (Fence) Boundary

Ambient air is the portion of the atmosphere to which the general public has access. Ambient air is not the atmosphere over buildings or the air over land owned by the source to which public access is precluded by a fence or other physical barrier. Active work areas of a facility (e.g. conveyors, piles, trailers, etc.) are generally not considered ambient air, but visitor parking lots, public roadways, and public waterways are ambient air.

Any installed fence must be permanent and meet the dictionary definition of a fence. Ambient air boundaries must enclose an area (other than driveway or pedestrian access) for receptors to be eliminated within that area.

Note that analysis of compounds regulated under Chapter NR 445, *Wis. Adm. Code* considers modeled impact off the facility property. Applicants can use the property line receptor grid only for NR 445 analysis.

Receptor Spacing

With limited exception, receptors should be placed as follows:

- on a Cartesian grid with 25-meter spacing extending from the ambient air boundary to 500 meters from the sources
- 50-meter spaced grid from 500 meters to 1000 meters from the sources

Additional receptors can be placed beyond 1000 meters to assess possible impacts.

If the location of the maximum impact is not within 1000 meters of the sources, additional 50-meter spaced grids should be used in the area of maximum impact.

Terrain Considerations

Receptor elevations and hill scaling heights should be determined using AERMAP, the AERMOD terrain processor. A recent tile of 1/3 arc second National Elevation Dataset (NED) information should be obtained from the U.S. Geologic Survey (USGS) and used in AERMAP. The data can be downloaded from the National Map Viewer at http://nationalmap.gov/viewer.html. The extent of the terrain information and the AERMAP domain should encompass a minimum of 10 kilometers beyond the furthest extent of the receptor grid. For receptors extending 1 km from the source in all directions, the terrain information and the AERMAP domain should have lateral dimensions of 22 km by 22 km.

Receptors placed above the terrain (i.e. set on a flag pole) are not used in regulatory dispersion modeling. Ambient air is represented by ground level concentrations and the default mode in AERMOD assumes a receptor height of zero meters above ground level.

METEOROLOGICAL DATA

Pre-processed meteorological data for use in AERMOD is provided on the WDNR Dispersion Modeling web page at http://dnr.wi.gov/topic/AirPermits/Modeling.html. AERMOD implementation guidance stresses the importance of using a meteorological data set that is representative of both the meteorological characteristics and the surface roughness characteristics of the application location. To aid in meteorological data selection, aerial photos centered on the anemometer are available for each station on the web page. WDNR modeling staff can be consulted with any selection questions.

AIR QUALITY IMPACT RESULTS

NAAQS Analysis

An analysis should be performed of the impact relative to the NAAQS for applicable pollutants and time periods. The impact of the allowable emissions from the facility added to the background concentration must be below the NAAQS.

National Ambient Air Quality Standards

POLLUTANT	NAAQS	AVERAGING TIME	STATISTIC/METRIC
LEAD	0.15 µg/m^3	3-MONTH	1ST HIGHEST
CARBON MONOXIDE	40,000 µg/m^3 10,000 µg/m^3	1-HOUR 8-HOUR	HIGH 2ND HIGHEST HIGH 2ND HIGHEST
NITROGEN DIOXIDE	188 µg/m^3 100 µg/m^3	1-HOUR ANNUAL	5-YR AVG 8TH HIGH HRDAY 1ST HIGHEST
PARTICULATE MATTER LESS THAN 10 MICRONS (PM_{10})	150 µg/m^3	24-HOUR	6TH HIGHEST IN 5 YEARS
SULFUR DIOXIDE	196 µg/m^3 1,300 µg/m^3	1-HOUR 3-HOUR	5-YR AVG 4TH HIGH HRDAY HIGH 2ND HIGHEST

Background Concentration

Background concentrations are added to modeled concentrations to estimate the total air quality impact relative to the NAAQS. Regional background values include the impact of both distant emissions as well as those of mobile sources and fugitive releases. Please refer to the WDNR Dispersion Modeling web page (http://dnr.wi.gov/topic/AirPermits/Modeling.html) for regional background concentrations.

NO_x-to-NO_2 Conversion

Emissions of NO_x react in the presence of ozone to become NO_2, and NO_2 reacts with sunlight to reform ozone and NO_x. To account for these reactions, USEPA provides for three tiers of conversion. Tier 1 assumes NO_x emissions are always in the form of NO_2 (i.e. no conversion). Tier 2 assumes that the conversion of NO_x into NO_2 will reach an equilibrium level in the atmosphere. This ambient ratio method (ARM2) uses a minimum and a maximum ratio that varies based on the modeled level of NO_x.

Based upon review of USEPA data and stack testing by facilities, the Wisconsin default minimum ARM2 ratio is 0.2 and the maximum ratio is 0.9. The minimum ARM2 ratio can be lowered based on the actual, tested in-stack ratio of NO_x to NO_2 provided by the applicant.

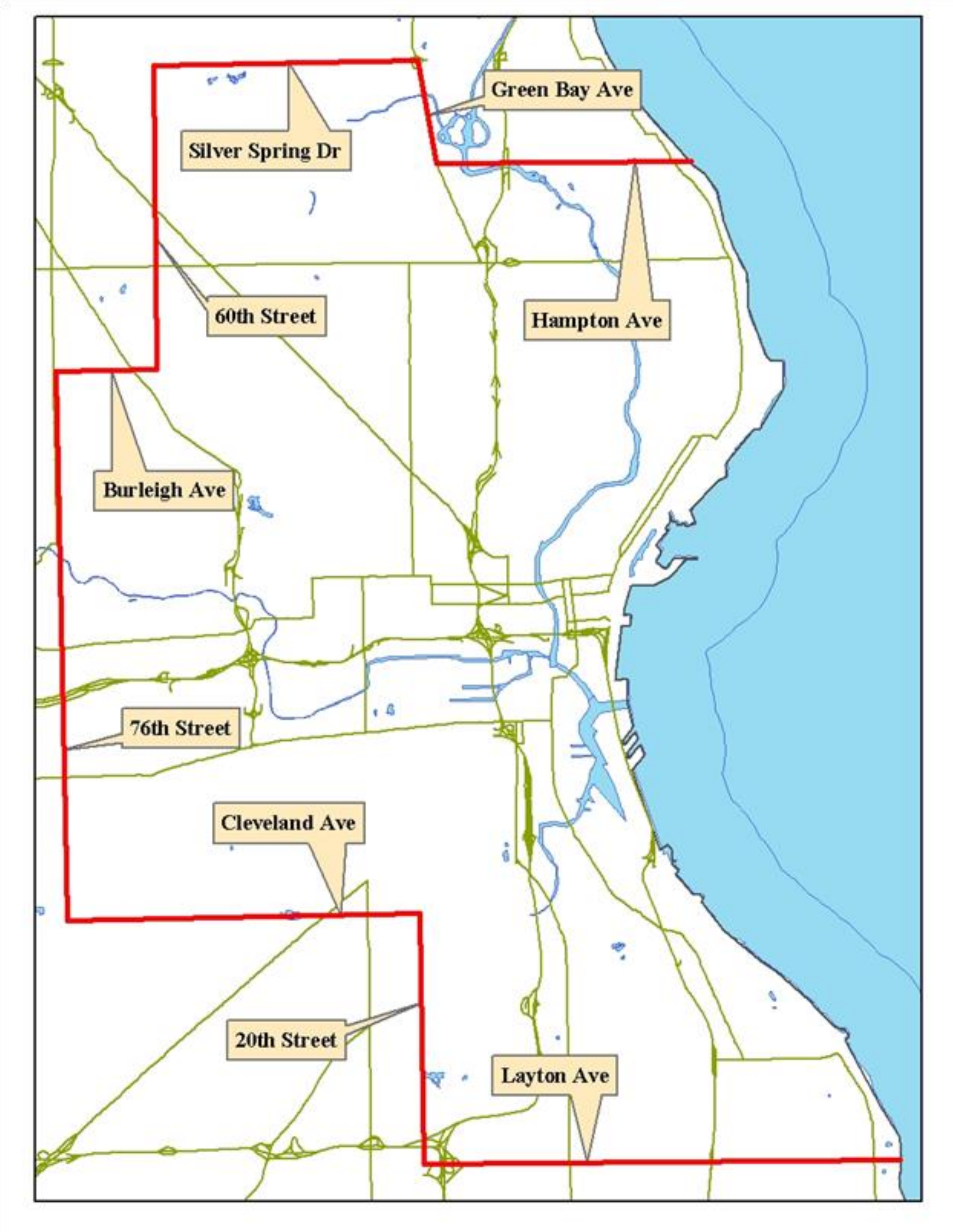
Tier 3 conversion uses one of the two algorithms within AERMOD that incorporates hourly ozone concentrations to convert NO_x emissions into NO_2 for each modeled hour. Due to issues with consistent application of these methods, specifically the choice of algorithm and processing of hourly ozone concentrations, WDNR discourages the use of either Tier 3 conversion algorithm.

When using Tier 2 conversion methods, individual source groups should not be used. If analyzing multiple operational scenarios, each scenario should be run separately, with only the sources emitting under the scenario included.

SUBMITTAL INFORMATION

When applicants perform dispersion modeling, the results are supplied to the WDNR as part of the Registration Permit application. Applicants are required to maintain records from the analysis for the duration of the permit coverage. It is recommended that facilities prepare a detailed modeling report for their records at the time of the analysis. This report should contain details on source parameters, emission rates, and modeled scenarios. The facility plot plan (indicating true north and all peak and edge tier heights as well as stack locations) is considered part of the dispersion modeling analysis and should be retained as well.

APPENDIX A - Urban Dispersion Coefficient Map



APPENDIX B - $PM_{2.5}$ Technical Support Document

Air Quality Review of Industrial $PM_{2.5}$ Emissions from Stationary Sources In Wisconsin

February 2016

Wisconsin Department of Natural Resources
Air Management Program
P.O. Box 7921
Madison, WI 53707

Publication Number: AM-527 2015

This document is intended solely as guidance and does not include any mandatory requirements except where requirements found in statute or administrative rule are referenced. This guidance does not establish or affect legal rights or obligations and is not finally determinative of any of the issues addressed. This guidance does not create any rights enforceable by any party in litigation with the State of Wisconsin or the Department of Natural Resources. Any regulatory decisions made by the Department of Natural Resources in any manner addressed by this guidance will be made by applying the governing statutes and administrative rules to the relevant facts.

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The Wisconsin Department of Natural Resources provides equal opportunity in its employment, programs, services, and functions under an Affirmative Action Plan. If you have any questions, please write to Equal Opportunity Office, Department of Interior, Washington D.C. 20240.

This publication is available in alternate format (large print, Braille, audio tape, etc) upon request. Please call the Air Dispersion Modeling Team (608 267-0805) for more information.

EXECUTIVE SUMMARY

The Wisconsin Department of Natural Resources (WDNR) under the authority of the Wisconsin State Statutes (Statutes) and the Wisconsin Administrative Code (Code), issues air pollution control permits to industrial, direct stationary sources of air pollution[1]. An air permit application may be approved if WDNR finds, "The source will not cause or exacerbate a violation of any ambient air quality standard or ambient air increment;" [s. 285.63(1)(b), Wis. Stats.]

National Ambient Air Quality Standards (NAAQS) were established by the United States Environmental Protection Agency (USEPA) for particulate matter with aerodynamic diameter of 2.5 micrometers or less ($PM_{2.5}$) in 1997 and were revised in 2006 and again in 2012. Initially, Federal guidance supported a surrogate approach for determining when a source will not cause or exacerbate violation of the $PM_{2.5}$ standards. Under the surrogate approach, if it was determined that emissions of PM_{10} (particulate matter with aerodynamic diameter of 10 micrometers or less) did not cause or exacerbate violation of the PM_{10} standards, then compliance with $PM_{2.5}$ standards was assumed. This policy was deemed necessary considering the various technical issues associated with $PM_{2.5}$ air quality analysis.

After the surrogate approach was eliminated in 2011, WDNR turned to air quality dispersion modeling to determine whether emissions from direct sources of $PM_{2.5}$ meet the obligations for permit approval. Dispersion modeling is used to assess the impact of direct emissions of several other compounds (e.g. sulfur dioxide) and it was presumed that modeling of $PM_{2.5}$ would be effective. However, examination of the science behind $PM_{2.5}$ has raised questions about treating $PM_{2.5}$ solely as a directly emitted compound.

Dispersion modeling of direct $PM_{2.5}$ emissions is ineffective as a means for meeting the obligations of the Statutes and Code. This analysis shows that air quality dispersion modeling of an industrial source of direct emission of $PM_{2.5}$ does not provide information useful to understanding of the impact of the source on ambient air quality. The WDNR approach to determine whether a direct $PM_{2.5}$ source causes or exacerbates violation of an air standard or increment, and thus can be issued an air permit, will be consistent with the determination used for other regional pollutants such as ozone. This conclusion serves as the WDNR determination pursuant to s. 285.63(1)(b), Wis. Stats.

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[1] For purposes of this document, when using the term "direct source" or "direct industrial source", the Department is referring to stationary industrial sources such as power plants, foundries, paper mills, etc. Direct sources do not include emissions from cars, trucks, locomotives, or other mobile sources.

Wisconsin is committed to regulating $PM_{2.5}$ and its precursors consistent with federal requirements, even though there are currently no specific federal requirements for direct emissions of $PM_{2.5}$. The regulation of industrial, direct stationary sources of nitrogen oxides (NO_x) and sulfur dioxide (SO_2) through the hourly standards is expected to further decrease ambient concentrations of $PM_{2.5}$ precursors. If ambient concentrations of $PM_{2.5}$ increase in the future, WDNR will consider regulatory requirements to address reductions of emissions of $PM_{2.5}$ precursors via advances in technology. Wisconsin will continue to regulate emissions of NO_x and SO_2 and will follow USEPA guidance on assessing the impact of secondarily formed $PM_{2.5}$ under the Prevention of Significant Deterioration permit program.

BACKGROUND[2]

Particulate matter is not a single pollutant but rather a mixture of solid particles and liquid droplets distributed among numerous gases that interact with solid and liquid phases. Particle diameters span more than four orders of magnitude, ranging from a few nanometers to one hundred micrometers. A typical strand of human hair is 70 micrometers thick, and particles less than 20 micrometers generally are not detectable by the human eye. Fine particles like $PM_{2.5}$ are classified based on their diameter, but fine particles are not simply a subset of total particulate matter. Fine particles have different emission sources than coarse particles and behave like gases in the atmosphere.

A fundamental division of atmospheric particles into a fine mode and a coarse mode exists, as shown in Figure 1 (USEPA, 1996). Fine particles have long atmospheric lifetimes and are able to penetrate deep into the lungs. Fine particles also come from different sources than coarse particles, and have different chemical, physical, and biological properties. Fine and coarse particles have different formation mechanisms. Coarse particles are generated by mechanical processes such as crushing, grinding, abrasion of surfaces, evaporation of sprays, or suspension of dusts. Common sources of direct emissions of coarse particulates are silicates and oxides found in soil dust; fugitive dust from roads, industry, agriculture, construction and demolition activities; fly ash; and additional contributions from plant and animal material. Fine particles contain primary particles from combustion sources but also secondary particles that result from condensation, coagulation, or nucleation of low-volatility vapors formed in chemical reactions.

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[2] Information in this section is taken from "*Guidance for PM2.5 Permit Modeling Appendix A", EPA-454/B-14-001, May 2014* and *"Air Quality Criteria for Particulate Matter Chapters 3 & 5", EPA/600/P-95/001aF, April 1996*.

Figure 1 – Size Distribution of Fine Mode and Coarse Mode Particles

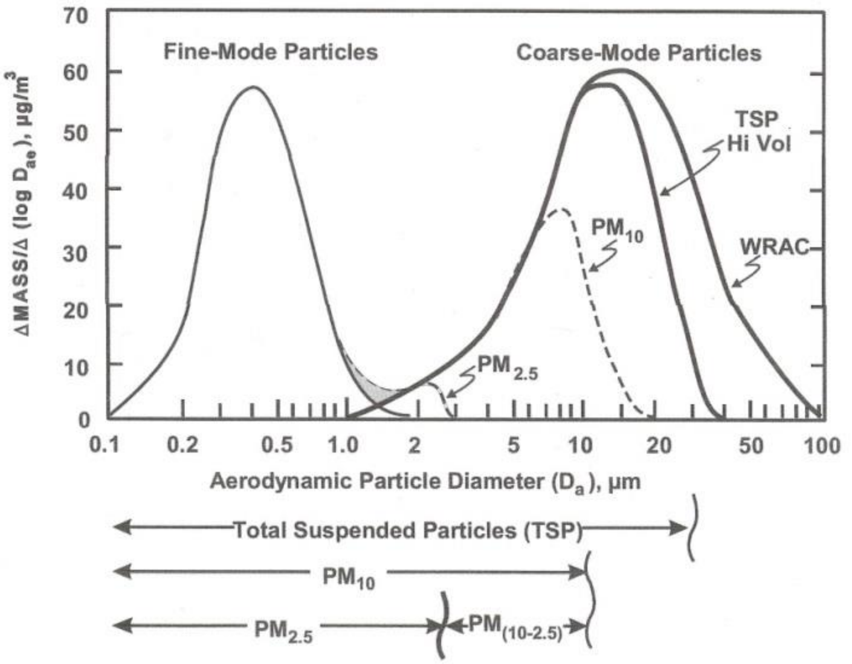


Figure 3-3. An idealized distribution of ambient particulate matter showing fine-mode particles and coarse-mode particles and the fractions collected by size-selective samplers.

Source: Adapted from Wilson and Suh (1996).

Common sources of direct emissions of fine particulates are fossil fuel combustion, vegetation burning, and the smelting or other processing of metals. The formation of secondary $PM_{2.5}$ in the atmosphere depends on reactions involving the hydroxyl radical (OH), ozone (O_3), and peroxide (H_2O_2) that are present in the atmosphere and which are generated during the photochemical smog formation process. Sulfur dioxide (SO_2), nitrogen oxides (NO_x), and certain organic compounds are also major precursors of fine secondary $PM_{2.5}$. Sulfuric and nitric acid, produced from emissions of SO_2 and NO_x, react with ammonia to form ammonium sulfate and ammonium nitrate, major components of ambient $PM_{2.5}$. Certain types of organic compounds react with OH and O_3 to form oxygenated compounds that condense onto existing particles. Fine particles in the atmosphere consist mainly of sulfate, nitrate, ammonium ions, water, organic aerosols, and metallic components.

Fine and coarse particulates also have different atmospheric transport and fates once they become airborne. Fine particles have long lifetimes in the atmosphere (days to weeks), travel long distances (hundreds to thousands of kilometers), and are uniformly distributed over larger regions i.e. thousands of square kilometers. As a result, they are not easily traced back to an individual source. Fine particles are removed from the atmosphere primarily by forming cloud droplets and falling out in raindrops. Coarse particles normally have short lifetimes (minutes to hours), only travel short distances (tens of kilometers), and tend to be unevenly distributed with localized effects and impacts. Coarse particles are removed mainly by gravitational settling.

Due to these fundamental differences between fine and coarse particulates, it is not appropriate to treat them as the same pollutant for permitting and modeling purposes. Coarse particles from industrial stationary sources are appropriately modeled for permitting purposes because they are directly emitted. Fine particles are not appropriately modeled for permitting purposes using the current tools because they are secondarily formed in the atmosphere.

Figure 2 (USEPA, 1996) summarizes the differences between fine and coarse particles.

Figure 2 – Comparison of Ambient Fine and Coarse Particles

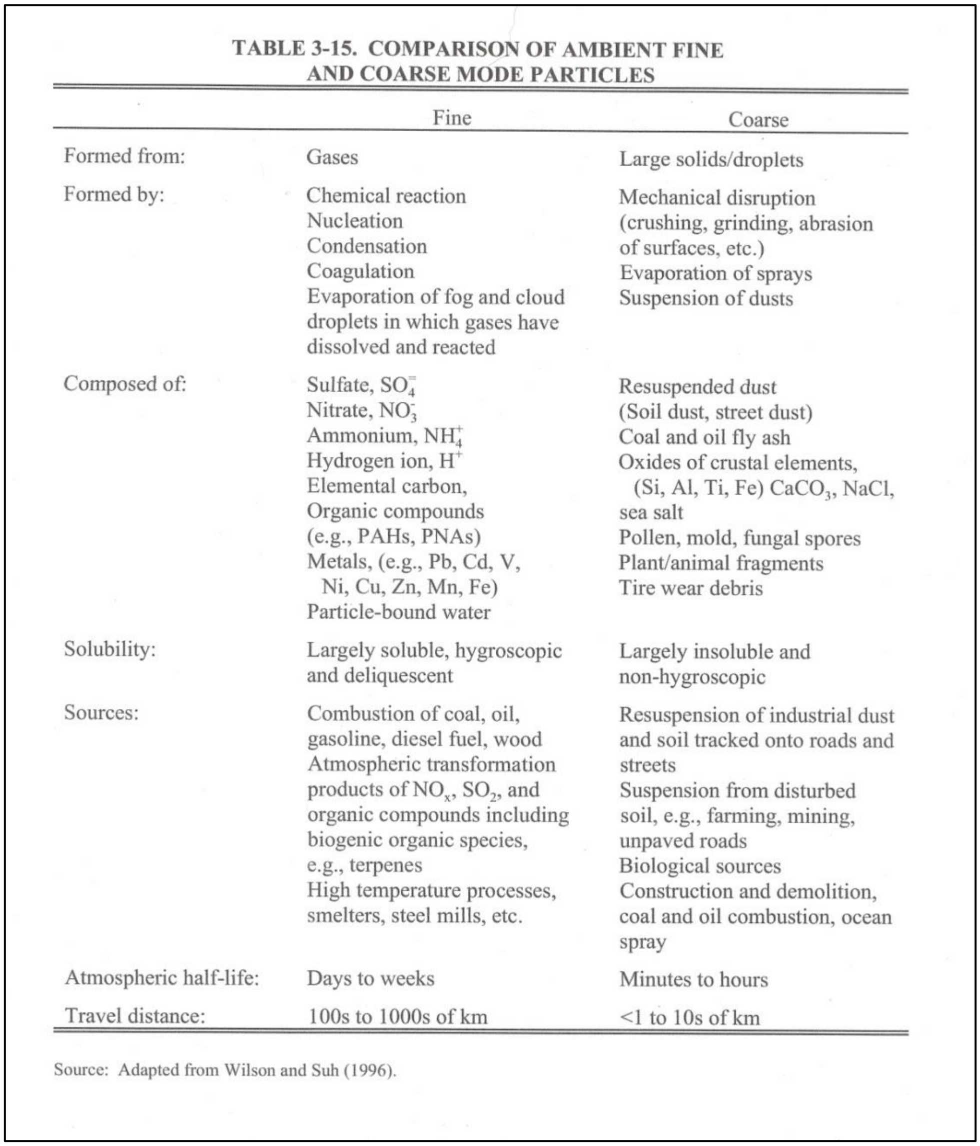


TABLE 3-15. COMPARISON OF AMBIENT FINE AND COARSE MODE PARTICLES

	Fine	Coarse
Formed from:	Gases	Large solids/droplets
Formed by:	Chemical reaction Nucleation Condensation Coagulation Evaporation of fog and cloud droplets in which gases have dissolved and reacted	Mechanical disruption (crushing, grinding, abrasion of surfaces, etc.) Evaporation of sprays Suspension of dusts
Composed of:	Sulfate, $SO_4^=$ Nitrate, NO_3^- Ammonium, NH_4^+ Hydrogen ion, H^+ Elemental carbon, Organic compounds (e.g., PAHs, PNAs) Metals, (e.g., Pb, Cd, V, Ni, Cu, Zn, Mn, Fe) Particle-bound water	Resuspended dust (Soil dust, street dust) Coal and oil fly ash Oxides of crustal elements, (Si, Al, Ti, Fe) $CaCO_3$, NaCl, sea salt Pollen, mold, fungal spores Plant/animal fragments Tire wear debris
Solubility:	Largely soluble, hygroscopic and deliquescent	Largely insoluble and non-hygroscopic
Sources:	Combustion of coal, oil, gasoline, diesel fuel, wood Atmospheric transformation products of NO_x, SO_2, and organic compounds including biogenic organic species, e.g., terpenes High temperature processes, smelters, steel mills, etc.	Resuspension of industrial dust and soil tracked onto roads and streets Suspension from disturbed soil, e.g., farming, mining, unpaved roads Biological sources Construction and demolition, coal and oil combustion, ocean spray
Atmospheric half-life:	Days to weeks	Minutes to hours
Travel distance:	100s to 1000s of km	<1 to 10s of km

Source: Adapted from Wilson and Suh (1996).

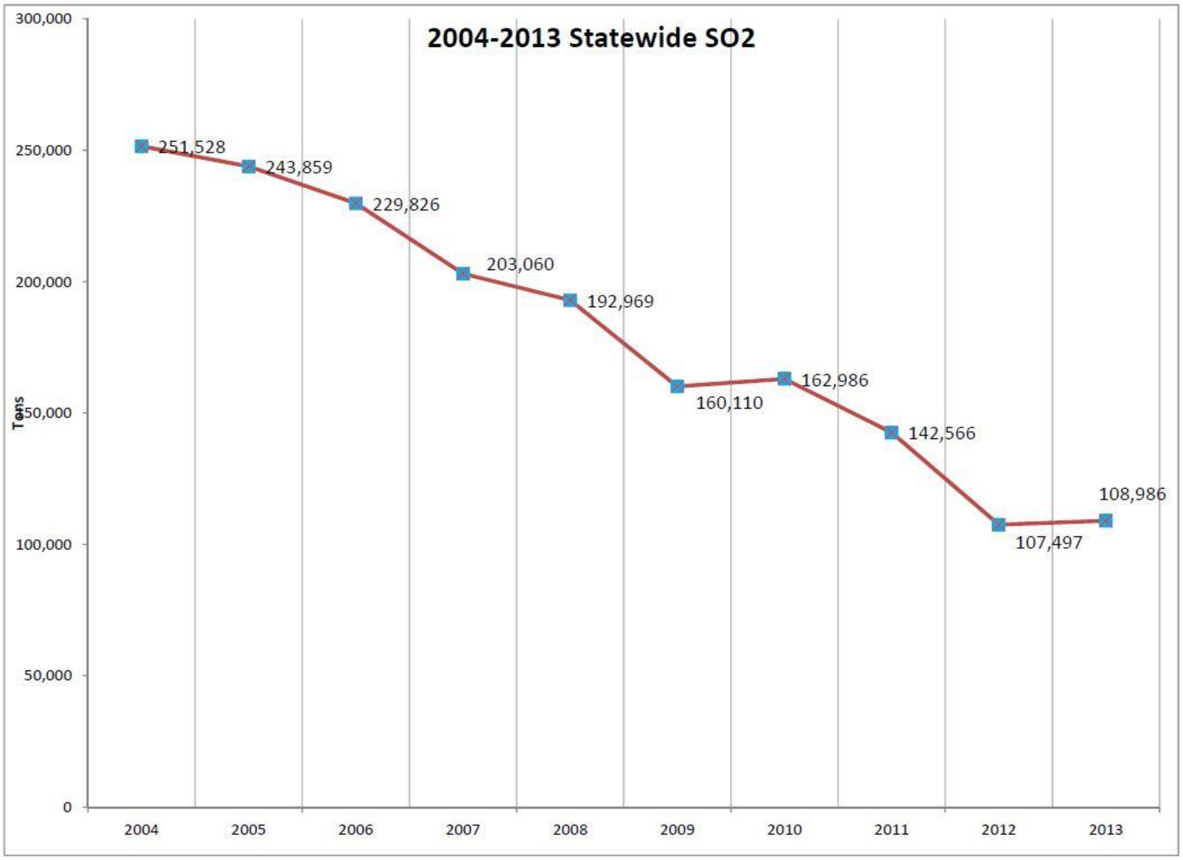
$PM_{2.5}$, SO_2, & NO_x EMISSION TRENDS

According to the USEPA National Emissions Inventory (NEI), total emissions of directly emitted $PM_{2.5}$ (primary $PM_{2.5}$) in the United States have remained steady at around 5 million tons per year, excluding emissions from wildfires. Total emissions include industrial sources as well as mobile sources (e.g. cars, trucks, trains) and area sources (e.g. home heating). Less than 20% of total directly emitted $PM_{2.5}$ is assumed to come from fossil fuel combustion, and less than 10% of directly emitted $PM_{2.5}$ is from on-road and off-road tailpipe emissions[3].

From the NEI, emissions of SO_2 in the U.S. have dropped from approximately 9 million tons per year in 2009 to around 5 million tons per year in 2013, the most recent reported year. Emissions of NO_x in the U.S. have dropped from about 16 million tons per year in 2009 to 13 million tons in 2013.

The trend in SO_2 and NO_x emissions is also seen from Wisconsin industrial stationary sources[4]. Emissions of SO_2 in Wisconsin have dropped from 160,000 tons in 2009 to 109,000 tons in 2013, while emissions of NO_x have dropped from 68,000 tons in 2009 to 56,000 tons in 2013. {Wisconsin collects estimates of total particulate matter industrial emissions for billing purposes and not direct $PM_{2.5}$}

Figure 3 – Wisconsin Reported Annual SO_2 Emissions from Industrial Sources



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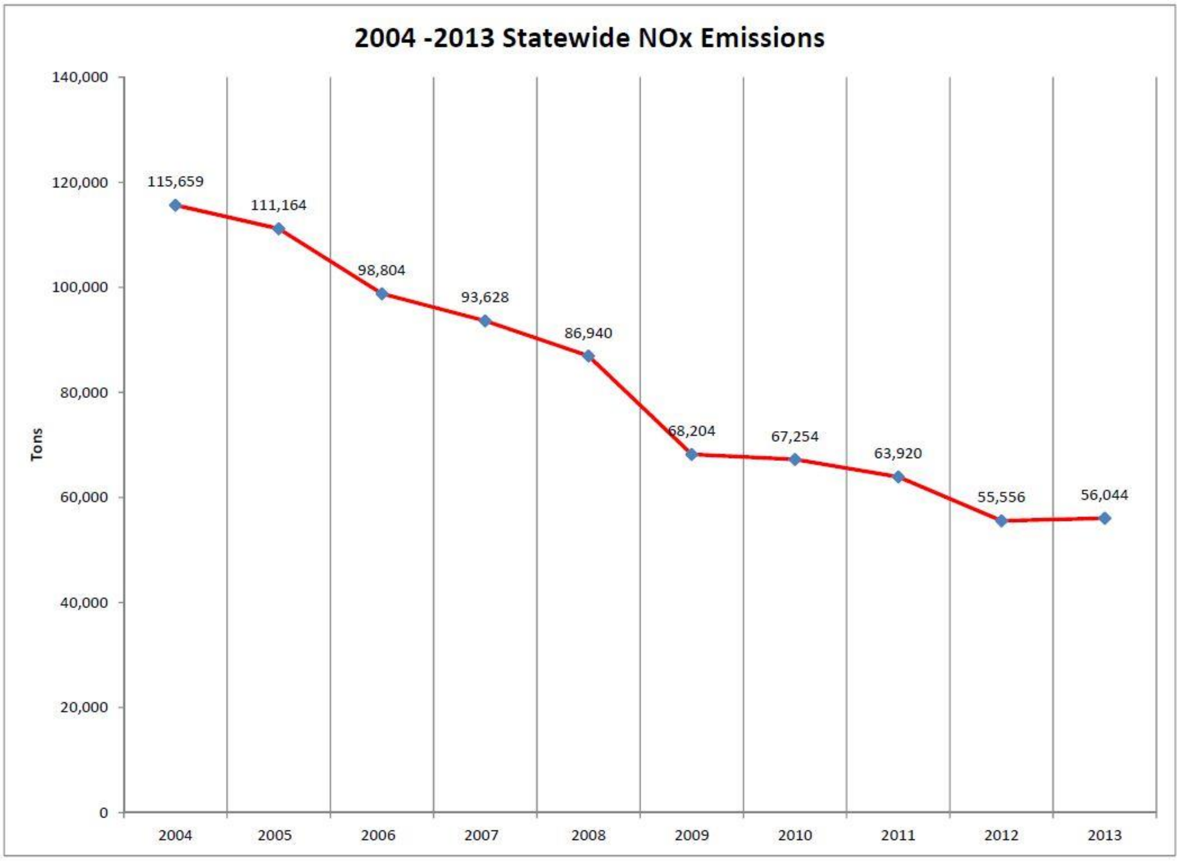
[3] http://www.epa.gov/ttn/chief/trends (accessed Jan 7, 2015)

[4] http://dnr.wi.gov/topic/AirEmissions/Historical.html (accessed Jan 7, 2015)

Figure 4 – Wisconsin Reported Annual NO_x Emissions from Industrial Sources



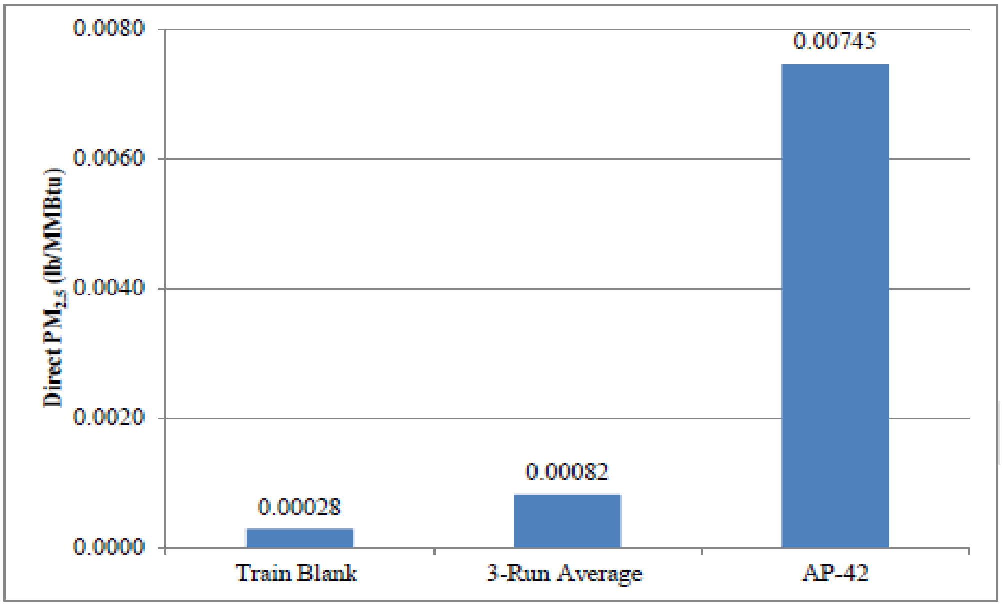
DIRECT SOURCE EMISSIONS OF $PM_{2.5}$

Wisconsin DNR stack testing staff reviewed and concurs with recently published data that suggests estimates of direct industrial emissions of $PM_{2.5}$ may be overestimated by as much as nine times[5]. This indicates that the contribution of direct sources of $PM_{2.5}$ to ambient air historically has been overstated. Using these incorrect emission estimates in dispersion modeling results in overestimates of facility impact.

Emission estimates for $PM_{2.5}$ typically come from EPA emission factors based on stack test data from select facilities. USEPA emission factors vary in quality from a rating of "A", meaning excellent data with minimal variability, to a rating of "E", meaning poor data with strong evidence of variability. Most USEPA $PM_{2.5}$ emissions factors are ranked either "D" or "E" in quality[6].

The National Council for Air and Stream Improvement (NCASI) has evaluated stack testing methods for estimating emissions and found evidence of incorrect and overly conservative $PM_{2.5}$ emission rates. In comments submitted to USEPA dated May 31, 2013, NCASI attached a report titled, "Evaluation of the Performance of EPA Methods 201A and 202 on a Natural Gas-Fired Package Boiler". Figure 5, taken from the NCASI report, illustrates the anomalously high emission estimates that result from factors derived from the aforementioned EPA tests. The EPA emission factor could result in an emission estimate as much as nine times higher than actual measured values for these types of sources. Therefore the actual emissions of direct, primary $PM_{2.5}$ that are used in permit review are likely far lower than what is currently used. As facilities utilize the correct stack testing methods, both the national emission estimates and the permit allowable direct $PM_{2.5}$ emissions will be greatly reduced.

Figure 5 – Comparison of Measured Direct $PM_{2.5}$ to USEPA Emission Factor



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[5] NCASI report titled, "Evaluation of the Performance of EPA Methods 201A and 202 on a Natural Gas-Fired Package Boiler"

[6] http://cfpup.epa.gov/webfire/index.cfm?action=fire.detailedSearch (accessed Dec 30, 2014)

AMBIENT MONITOR DATA

While the trend of emissions of direct $PM_{2.5}$ has remained steady, the measured ambient concentrations of $PM_{2.5}$ have decreased in Wisconsin[7]. Referring to Figure 6, both daily and annual concentrations throughout Wisconsin decreased between 2009 and 2013. The trend of decreasing $PM_{2.5}$ ambient air quality values, in light of steady trend of direct emissions of $PM_{2.5}$, can be explained by a decrease in the precursor pollutants SO_2 and NO_x. The overall concentrations in the Milwaukee area decreased enough that in April 2014 USEPA redesignated the counties of Milwaukee, Waukesha, and Racine to attainment for the 24-hour $PM_{2.5}$ standard. These were the only counties designated nonattainment for $PM_{2.5}$ in Wisconsin. In addition, a December 18, 2014 letter from USEPA to Wisconsin indicated the entire state of Wisconsin is designated as attainment for both the 24-hour and the revised annual $PM_{2.5}$ standard.

Figure 6 – Daily and Annual Wisconsin $PM_{2.5}$ Concentration[8]

Site Name	County	24-Hour Design Value (ug/m^3)			Annual Design Value (ug/m^3)		
		2009-11	**2010-12**	**2011-13**	**2009-11**	**2010-12**	**2011-13**
Bad River	Ashland	17	17	17	5.5	5.3	5.1
GRB East	Brown	33	29	24	10.4	9.6	8.8
MSN Well	Dane	29	28	25	10.6	9.9	9.7
Horicon	Dodge	29	27	23	9.5	9.3	8.7
FCPC	Forest	19	21	19	6.0	5.6	5.1
Potosi	Grant	29	25	21	10.7	10.0	9.5
Chiwaukee	Kenosha	28	25	24	9.7	9.5	9.1
La Crosse	La Crosse	29	25	21	9.6	9.0	8.5
Health Ctr	Milwaukee	32	29	27	11.1	10.9	10.5
DNR SER	Milwaukee	31	26	22	10.8	10.2	9.6
College Ave	Milwaukee	29	29	24	11.6	11.2	9.9
Appleton	Outagamie	31	28	23	9.8	9.2	8.6
Harrington	Ozaukee	27	23	21	9.5	9.1	8.4
Devils Lake	Sauk	29	24	21	9.0	8.6	8.2
Perkinstown	Taylor	26	26	20	7.9	7.8	7.2
Trout Lake	Vilas	21	17	15	6.1	5.8	5.4
Cleveland Ave	Waukesha	31	27	24	11.7	11.3	10.8

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[7] AM-526-2054 "Wisconsin Air Quality Trends 2015"

[8] http://www.epa.gov/airquality/airdata (accessed Jan 7, 2015)

Figure 7 shows the 24-hour $PM_{2.5}$ design value from 2000 through 2013. These plots show the downward trend in $PM_{2.5}$ concentrations throughout Wisconsin.

Figure 7a – Daily Wisconsin $PM_{2.5}$ Design Value Concentration

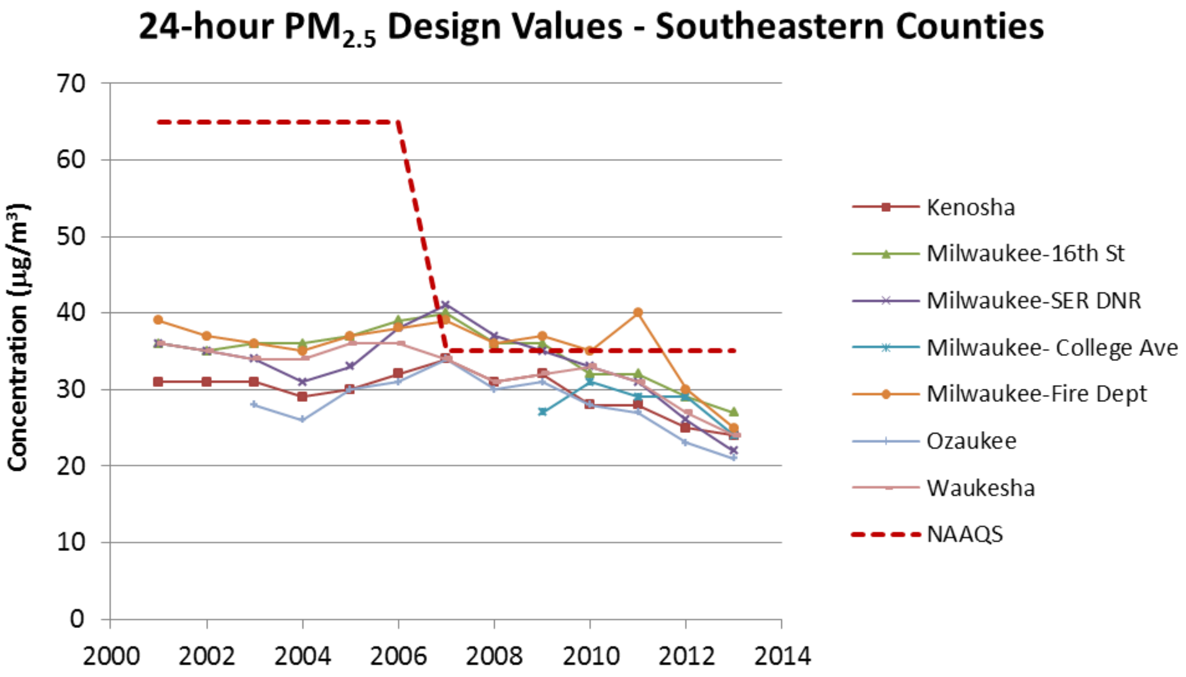
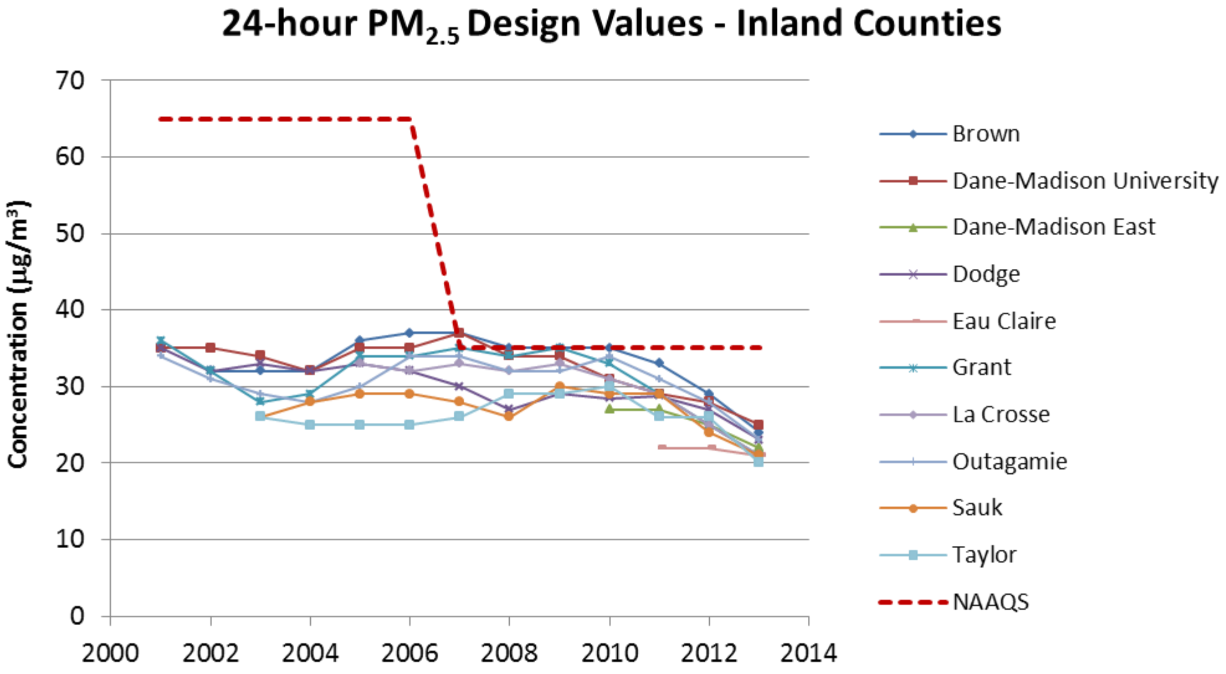


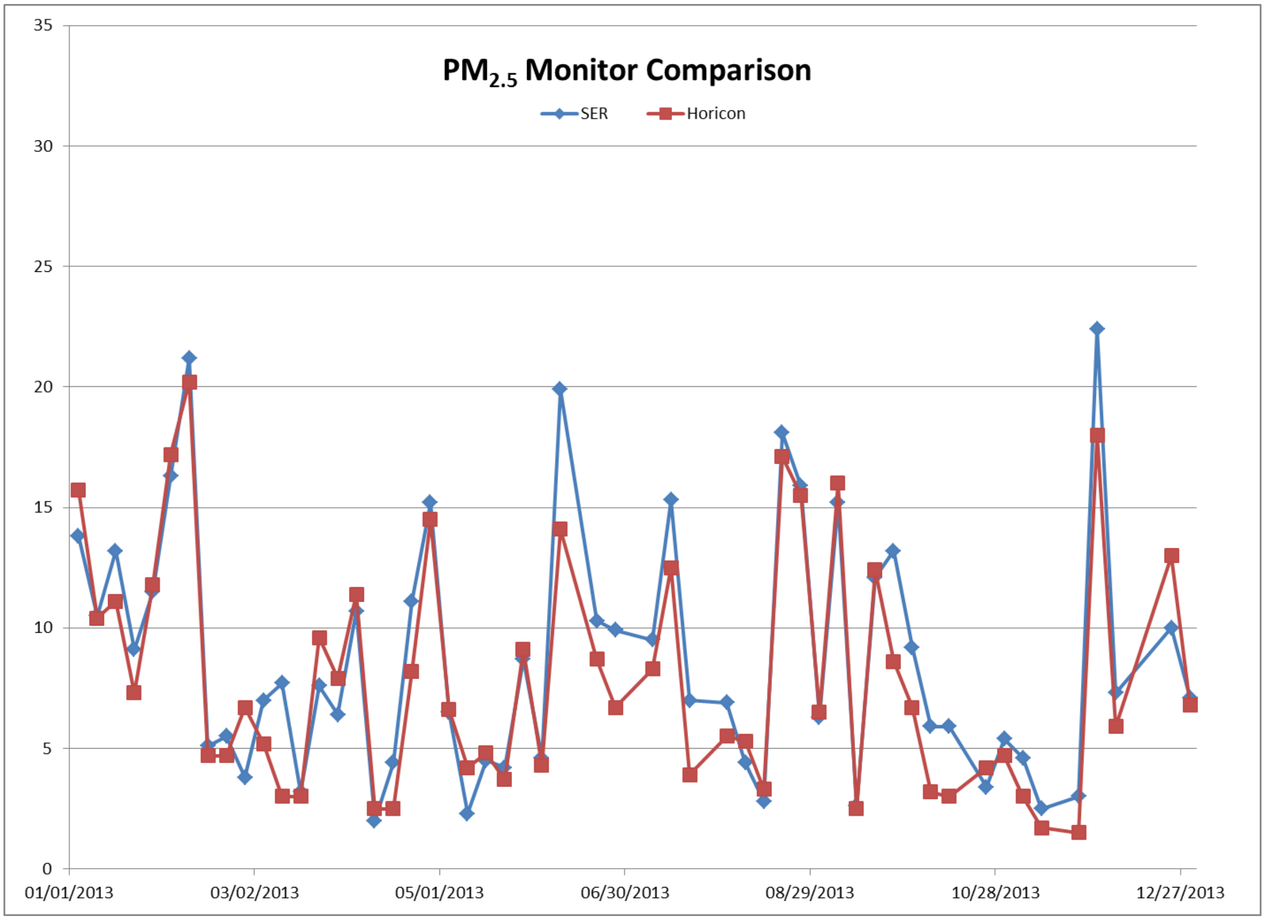
Figure 7b – Daily Wisconsin $PM_{2.5}$ Design Value Concentration



$PM_{2.5}$ concentrations are decreasing at all monitoring locations in Wisconsin, regardless of whether the site is rural and distant from large sources or urban and near major electric utilities. This trend indicates $PM_{2.5}$ from sources other than direct emissions have a profound effect on ambient concentrations.

This conclusion is confirmed by comparing the values between pairs of monitors. The filter based $PM_{2.5}$ federal reference method monitors at an urban location (SER – DNR Milwaukee Office) and a rural location (Horicon) were compared for days during 2013 where both sites were simultaneously measuring concentration. As shown in Figure 8, at neither site were concentrations near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. In addition, for the 54 common days, the correlation coefficient was 0.93, indicating strong correlation. When concentrations at Horicon increased, so did concentrations at SER Milwaukee, even though the monitors are ~73 kilometers apart. Since there are more sources of emission in a major city than outside the city, this indicates that larger scale regional factors such as long-range transport of emissions influence both monitors.

Figure 8 – $PM_{2.5}$ Monitor Comparison – Urban (SER) & Rural (Horicon)[9]
(Concentration in $\mu g/m^3$)



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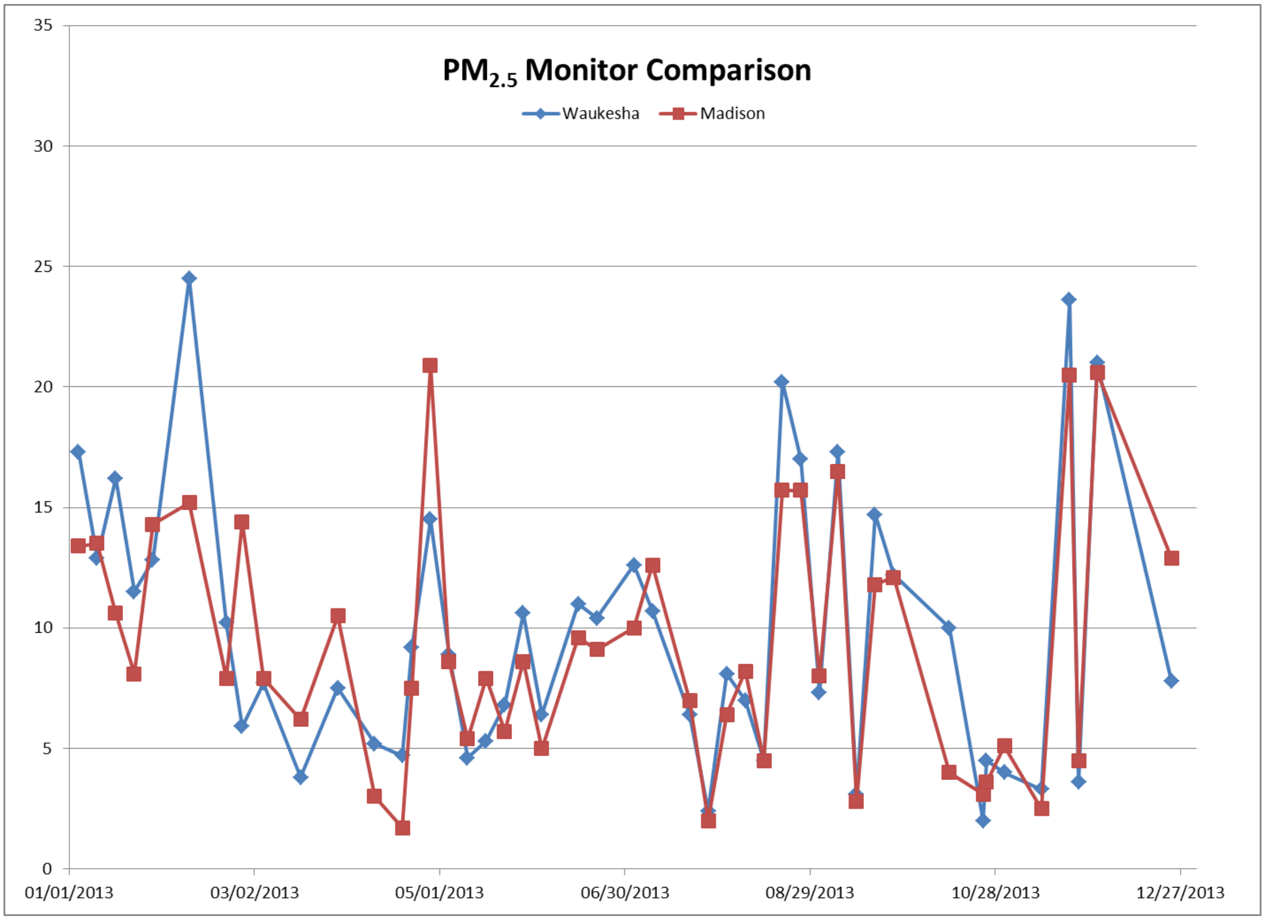
[9] http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

Monitors even further apart also show the same temporal correlation. For example, the filter-based $PM_{2.5}$ monitors at Cleveland Avenue in Waukesha and University Avenue in Madison (~95 km apart) were compared for days during 2013 where both were simultaneously taking samples. Note that concentrations at both locations were never close to the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. Also, for the 47 common days between these pairs, the correlation coefficient was 0.84, indicating strong correlation. As shown in Figure 9, values at both monitors increased and decreased in a similar fashion, even though they are far apart. Since the concentration trend is very similar between the monitoring sites this indicates that larger scale regional factors such as long-range transport of emissions influence both monitors.

Figure 9 – $PM_{2.5}$ Monitor Comparison – Waukesha and Madison (University Ave)[10]
(Concentration in $\mu g/m^3$)



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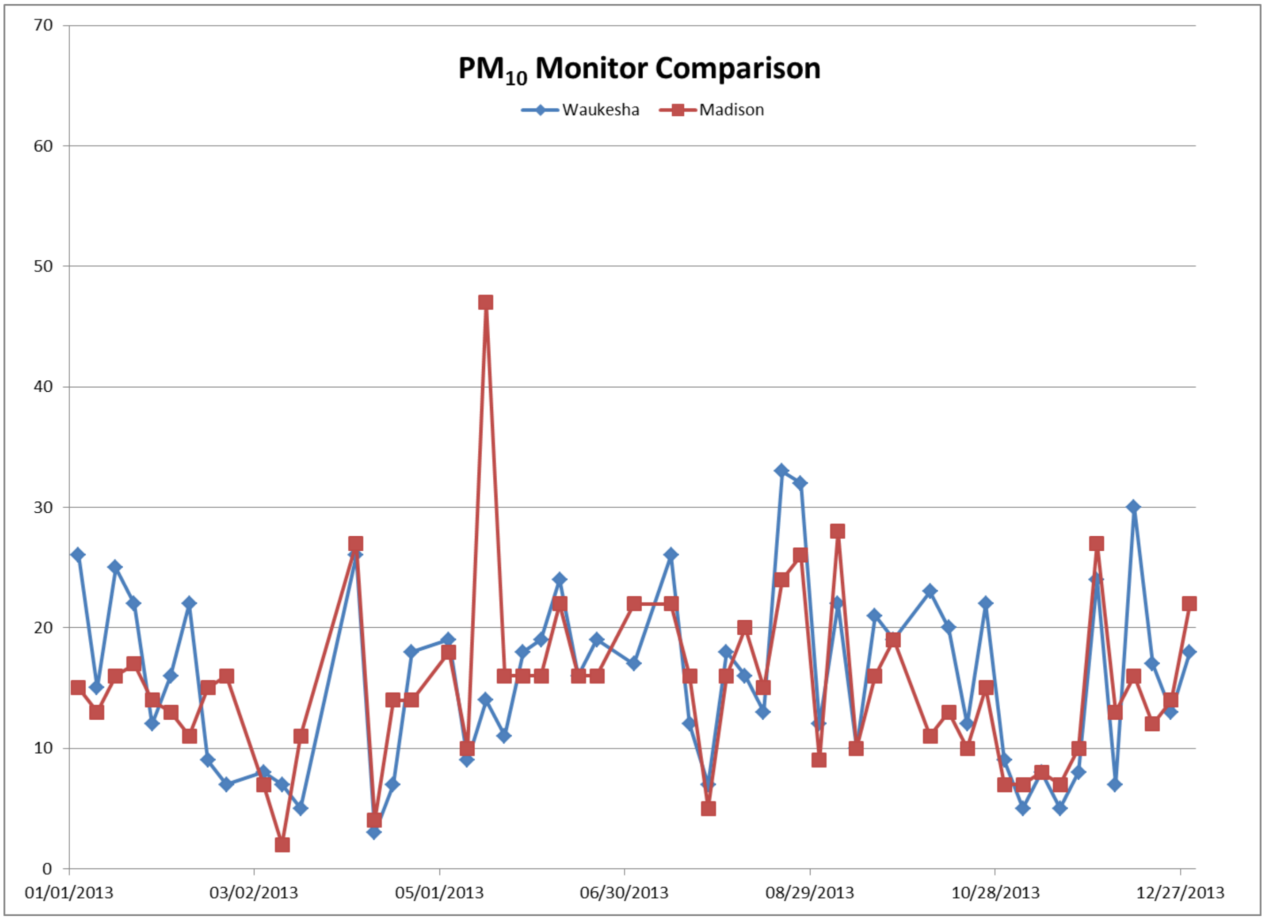
[10] http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

The difference between fine and coarse particulate is revealed by examining the correlation between pairs of PM_{10} monitors. For PM_{10} concentrations at Waukesha and University Avenue in Madison (54 days) the correlation coefficient was 0.56 or one-third lower than the $PM_{2.5}$ correlation. In comparison to the $PM_{2.5}$ graph in Figure 9, PM_{10} concentrations at Waukesha did not always increase similarly to concentrations in Madison, although in both cases the values were well below the 24-hr PM_{10} standard (150 micrograms per cubic meter). Therefore, ambient PM_{10} concentrations act differently than ambient $PM_{2.5}$ concentrations and are influenced by different factors.

Figure 10 – PM_{10} Monitor Comparison – Waukesha & Madison (University Ave)[11]
(Concentration in $\mu g/m^3$)



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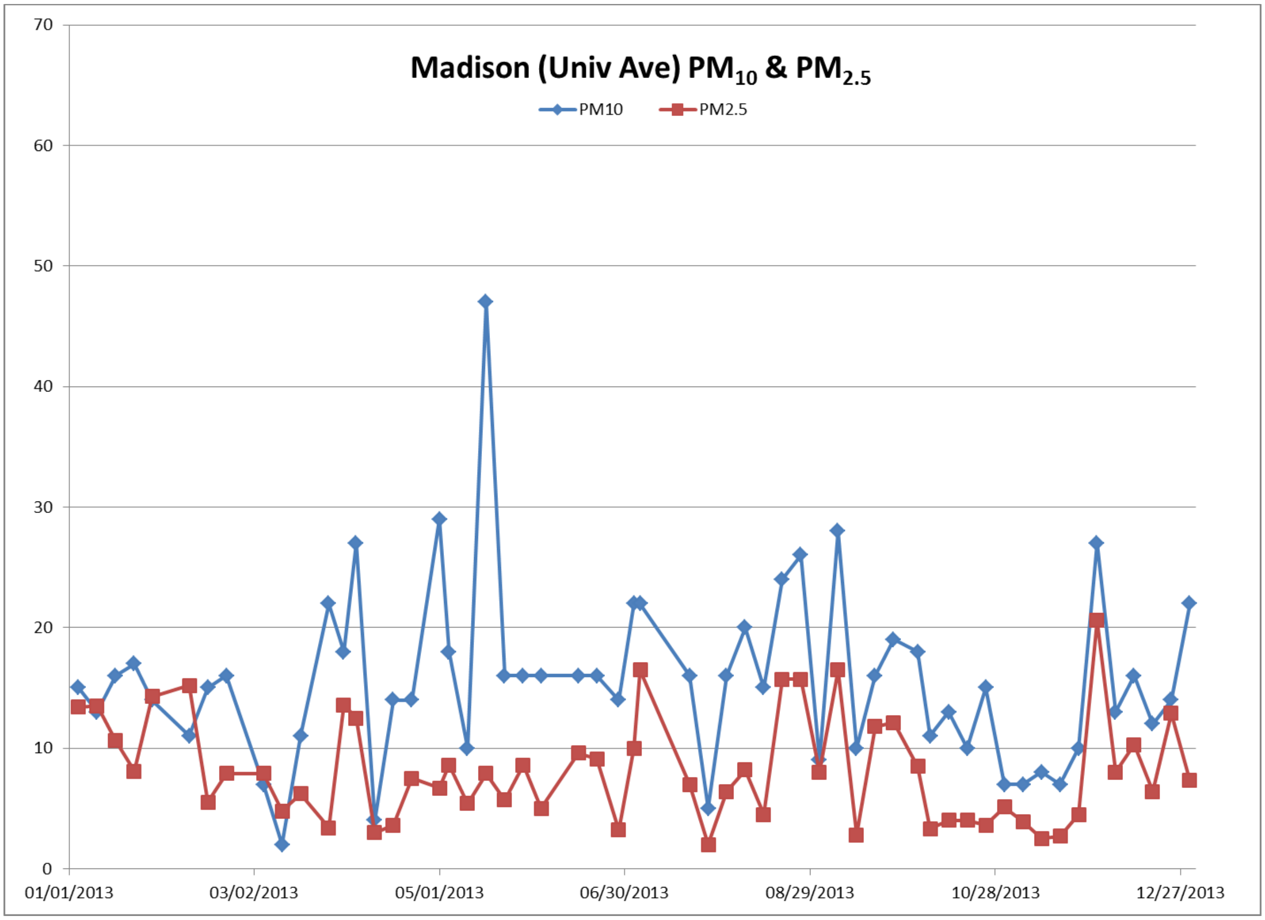
[11] http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

The difference between fine and coarse particulate is further revealed by examining the correlation between PM_{10} and $PM_{2.5}$ at the same monitor. For concentrations at the University Avenue monitor in Madison (57 days) the correlation coefficient between PM_{10} and $PM_{2.5}$ was 0.49, lower than the correlation of PM_{10} between Madison and Waukesha, and lower than the correlation of $PM_{2.5}$ between Madison and Waukesha. Although there are some days where PM_{10} increases along with $PM_{2.5}$, the values of PM_{10} can change more measurably and more quickly than values of $PM_{2.5}$.

Figure 11 – PM_{10} to $PM_{2.5}$ Comparison – Madison (University Ave)[12]
(Concentration in $\mu g/m^3$)



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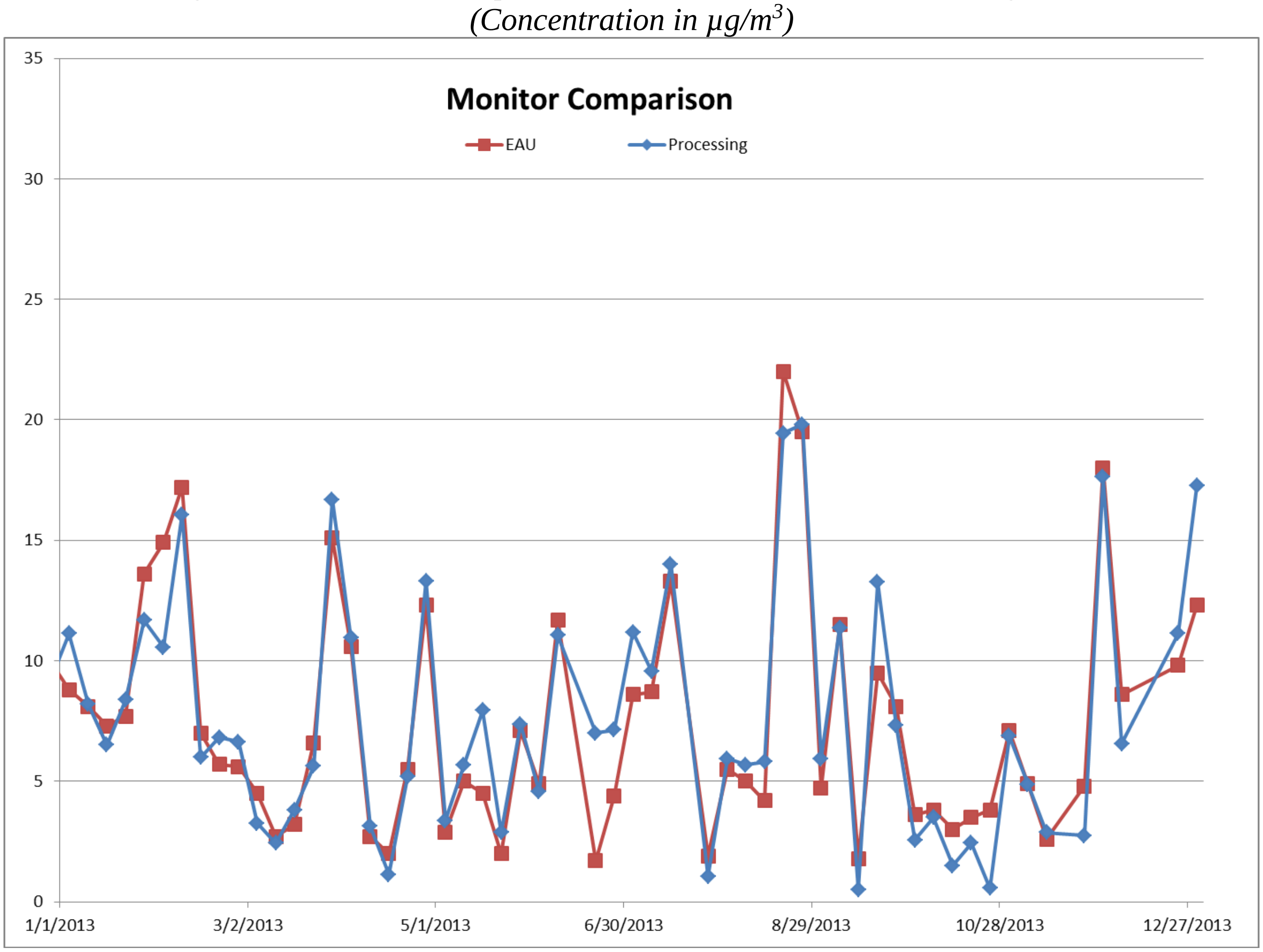
[12] http://www.epa.gov/airquality/airdata (accessed Jun 25, 2014)

As further evidence, ambient monitoring was performed adjacent to a sand processing plant and affiliated sand mine in western Wisconsin (refer to *Assessment of Community Exposure to Ambient Respriable Crystalline Silica near Frac Sand Processing Facilities, Richards, J. and Brozell, T., Atmosphere 2015, 6, 960-982*). The monitors were located in the area expected to have the highest ambient concentrations from a directly emitted pollutant – within the property of the facilities. The filter-based data collected was fine particles with aerodynamic diameter of 4 micrometers (PM_4). By definition, this data will contain all the $PM_{2.5}$, including secondarily formed $PM_{2.5}$, and particles between 2.5 micrometers and 4 micrometers in diameter, so the PM_4 data should have higher concentrations than ambient $PM_{2.5}$ data.

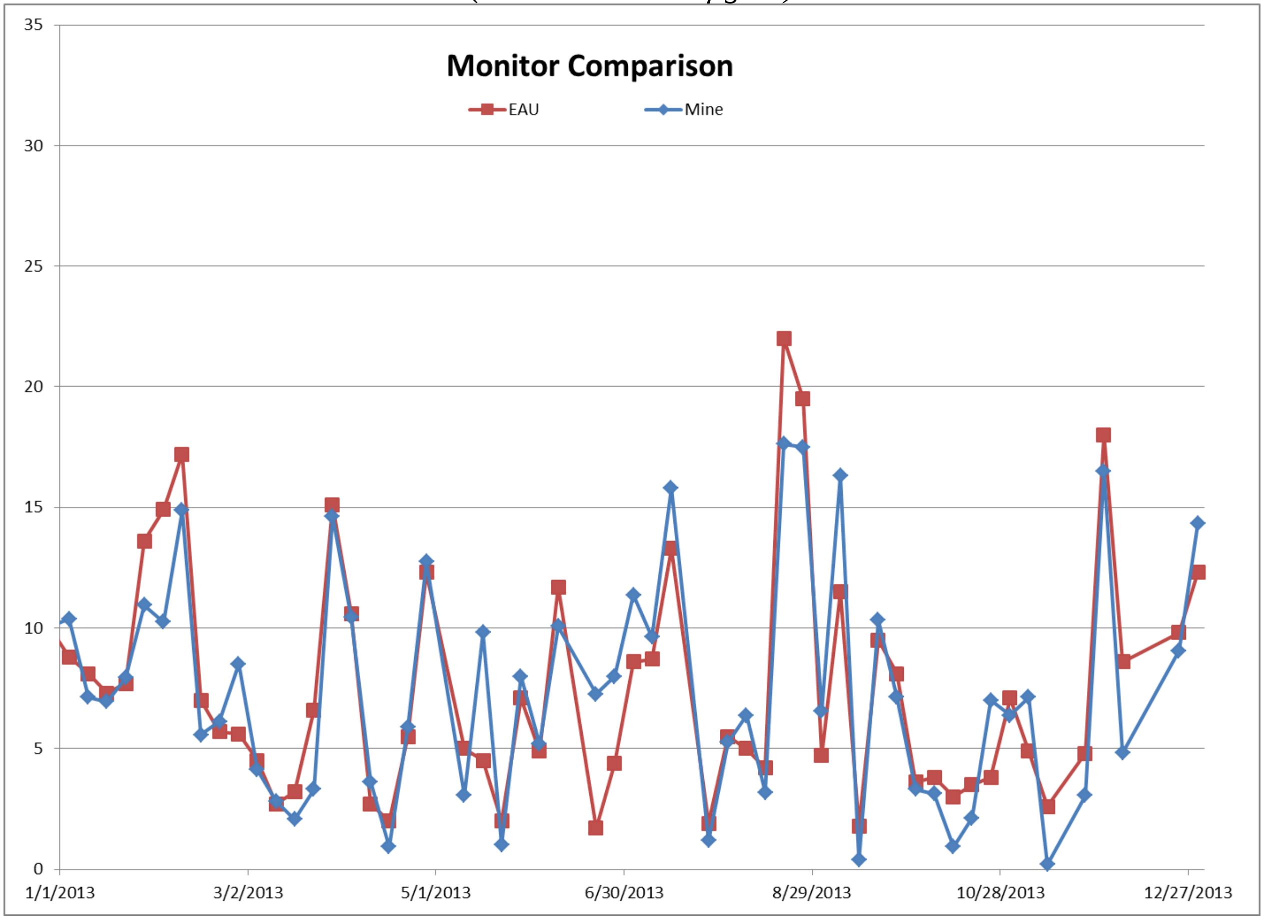
Comparing the facility-adjacent PM_4 monitoring data with Wisconsin $PM_{2.5}$ monitoring data confirms that sources other than direct emissions have a profound effect on ambient concentrations. The filter based $PM_{2.5}$ federal reference method monitored concentrations at Eau Claire (EAU) are compared to filter based PM_4 concentrations measured at the processing plant. As shown in Figure 12 no concentrations were near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. In addition, the correlation coefficient between the PM_4 data collected at the processing plant and the Eau Claire $PM_{2.5}$ data is 0.93, indicating strong correlation. When concentrations at the processing plant monitor increased, so did concentrations in Eau Claire even though the monitors are 23 kilometers apart.

Figure 12 – Monitor Comparison – Eau Claire & Sand Processing Plant
(Concentration in $\mu g/m^3$)



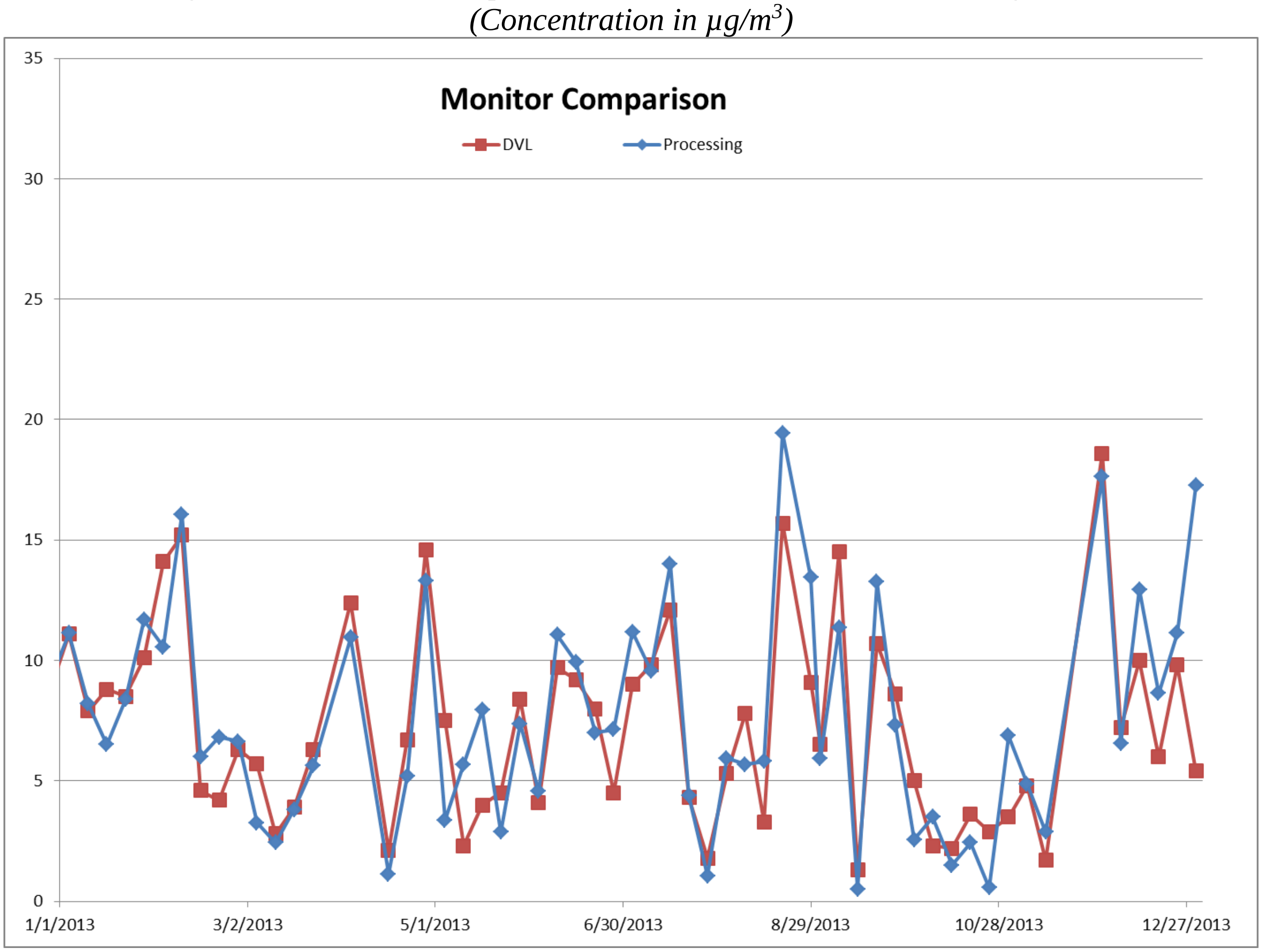
The filter based $PM_{2.5}$ federal reference method monitor at Eau Claire (EAU) was also compared to filter based PM_4 concentrations measured at the sand mine. As shown in Figure 13 no concentrations were near the 24-hour $PM_{2.5}$ standard of 35 micrograms per cubic meter. The correlation coefficient between the PM_4 data collected at the sand mine and the Eau Claire $PM_{2.5}$ data is 0.89, indicating strong correlation. When concentrations at the mine increased, so did concentrations in Eau Claire even though the monitors are 37 kilometers apart.

Figure 13 – Monitor Comparison – Eau Claire & Sand Mine
(Concentration in µg/m^3)



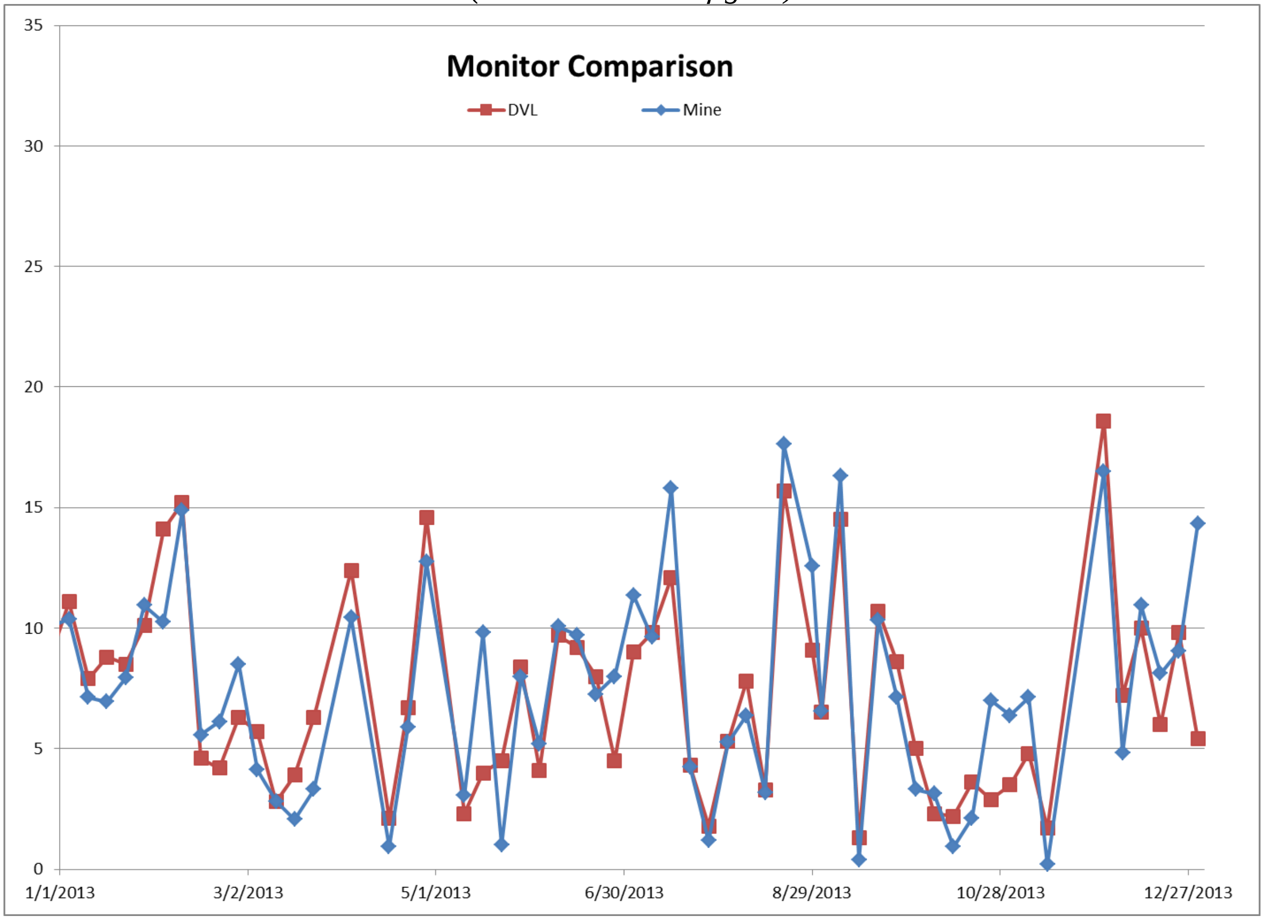
Monitors even further apart show the same temporal correlation. The filter based $PM_{2.5}$ federal reference monitor at Devils Lake (DVL) were compared to the filter based PM_4 concentrations at the processing plant. As shown in Figure 14, no concentrations were near the 24-hour PM2.5 standard, and the correlation coefficient is 0.84, even though the monitors are about 130 kilometers apart.

Figure 14 – Monitor Comparison – Devils Lake & Sand Processing Plant (Concentration in $\mu g/m^3$)



The filter based $PM_{2.5}$ federal reference monitor at Devils Lake (DVL) were also compared to the filter based PM_4 concentrations at the sand mine. As shown in Figure 15, no concentrations were near the 24-hour PM2.5 standard, and the correlation coefficient is 0.86, even though the monitors are about 145 kilometers apart.

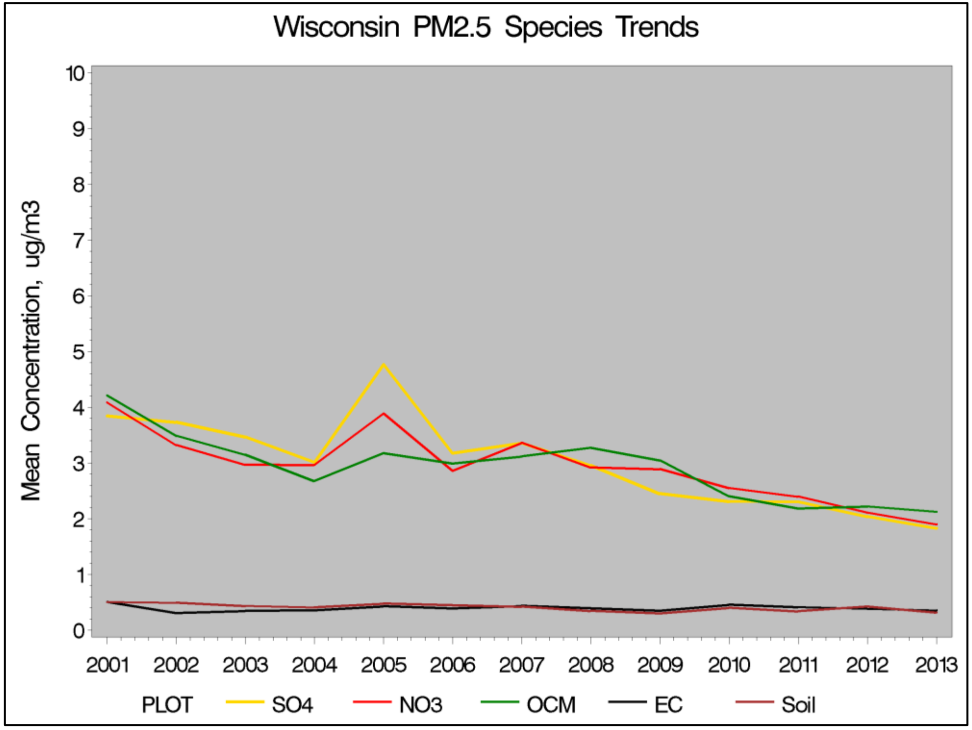
Figure 15 – Monitor Comparison – Devils Lake & Sand Mine (Concentration in µg/m^3)



Detailed examination of fine particles captured using speciation monitors reveals that the mean concentrations of the sulfate, nitrate, and organic carbon components of $PM_{2.5}$ have decreased. Sulfates, nitrates, and organic carbon are all formed secondarily in the atmosphere from precursor pollutants. Of the reported components, elemental carbon is correlated to directly emitted $PM_{2.5}$ from fuel combustion. Concentrations of elemental carbon have essentially held steady at very low levels and this trend does not correspond to the decrease in ambient $PM_{2.5}$. The distribution of component contributions demonstrates that emissions of primary, direct $PM_{2.5}$ have minimal impact upon ambient air concentrations.

Figure 16 obtained from the Lake Michigan Air Directors Consortium (LADCO) provides detail on the species with the largest contribution to ambient concentrations. As approximated from the plot, in 2009, measured average nitrate concentrations were ~2.9 ug/m^3 as compared to ~1.9 ug/m^3 in 2013. Average measured sulfates dropped from ~2.4 ug/m^3 in 2009 to ~1.8 ug/m^3 in 2013; average organic carbon went from ~3.1 ug/m^3 in 2009 to ~2.2 ug/m^3 in 2013.

Figure 16 – $PM_{2.5}$ Species Trends for Wisconsin Speciation Monitors[13]



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[13] May 9, 2014 email from Donna Kenski – LADCO to John Roth - WDNR

The reduction in sulfate, nitrate, and organic carbon correspond to reductions in NO_x and SO_2 emissions from improvements in engine efficiency and reductions in sulfur content of fuels (Tier 2 Emission Standards for Vehicles and Gasoline Sulfur Standards; Heavy-Duty Diesel Engine Rule; & Nonroad Large Spark Ignition Engine and Recreational Engine Standards). The reduction in ambient concentration is also consistent with regression analysis performed by the Lake Michigan Air Directors Consortium (LADCO). The 2010 update *Summary of CART Analysis for PM2.5 Meteorologically Adjusted Trends* states, "Trends in all eight urban areas were consistently downward; these results appear to show that nationwide emission reductions of SO_2 and NO_x in recent years have had a measurable impact on $PM_{2.5}$."

SUMMARY

- This analysis demonstrates that direct emissions of $PM_{2.5}$ from any individual stack or source have little influence on ambient concentrations of $PM_{2.5}$ and therefore $PM_{2.5}$ emissions from any individual stack or source do not cause or exacerbate violation of any $PM_{2.5}$ increment or standard. In summary:

- Emissions of $PM_{2.5}$ derive from different sources than those of PM_{10} and therefore $PM_{2.5}$ emissions cannot be characterized simply as a subset of total particulate matter.

- Emissions of $PM_{2.5}$ have long lifetimes in the atmosphere and travel long distances from the emission source thus becoming well-mixed in ambient air.

- National emissions estimates of $PM_{2.5}$ from direct sources have remained steady from year-to-year, yet monitored concentrations have steadily decreased at both rural and urban locations bolstering the conclusion that directly emitted $PM_{2.5}$ is not affecting monitored concentrations of the pollutant.

- Both national and Wisconsin emission estimates of the $PM_{2.5}$ precursors SO_2 and NO_x from direct sources have decreased year-to-year, similar to $PM_{2.5}$ monitored concentrations.

- The true level of direct, primary $PM_{2.5}$ emissions may be at least nine times lower than previously reported due to errors in stack testing methods that were used to develop emission factors.

- Concentrations of ambient $PM_{2.5}$, as measured by monitors in Wisconsin, are below the NAAQS and continue to steadily decrease with time.

- All of Wisconsin is considered in attainment for both the 24-hour and annual NAAQS for $PM_{2.5}$ due to the steady decrease of ambient levels of $PM_{2.5}$ as monitored by DNR's air monitoring network.

- Comparison of ambient $PM_{2.5}$ concentrations from monitors both in close proximity of each other and far apart show strong correlations, indicating that broad regional factors, such as weather patterns and long-range transport from distant sources, have a greater effect on ambient air than direct emissions from stationary sources.

- Comparison of concentrations from monitors within sand facilities to either nearby or distant Wisconsin ambient monitors also show strong correlations, further indicating that broad regional factors have a greater effect on ambient air than direct emissions from stationary sources.

- Examination of component substances captured by $PM_{2.5}$ speciation monitors illustrates that concentration of elemental carbon (corresponding to directly emitted $PM_{2.5}$ from fuel combustion) are not a major contributor to ambient $PM_{2.5}$ concentrations and are not increasing.

- Sulfate, nitrate, and organic carbon, produced by secondary reactions in the atmosphere, comprise most of the ambient $PM_{2.5}$ in Wisconsin.

- Decreased concentrations of ambient $PM_{2.5}$ correlate to national technology improvements such as fuel efficiency and reductions in sulfur content of fuels for both industry and mobile sources.

CONCLUSION

Use of dispersion modeling in order to approve air permit applications for direct sources of fine particulate ($PM_{2.5}$) is not appropriate for demonstrating that the emissions from the source do not cause or exacerbate a violation of the air quality standards for $PM_{2.5}$. Reductions in ambient air concentrations of pollutants such as ozone and $PM_{2.5}$ are influenced by regional factors such as weather patterns, long-range transport from distant sources, and secondary formation.

Ambient concentrations of $PM_{2.5}$ have decreased over time due to reductions in concentrations of sulfate, nitrate, and organic carbon. Reductions in concentrations of sulfate, nitrate, and organic carbon are due to national technology improvements, increases in mobile source fuel efficiency, and reductions in the sulfur content of fuels, leading to reductions in emission of SO_2 and NO_x. The trend in ambient concentrations of $PM_{2.5}$ does not correlate to trends in concentrations of elemental carbon, and so do not correlate to direct, industrial $PM_{2.5}$ emissions.

Therefore, the WDNR concludes that direct emissions of $PM_{2.5}$ from a single, direct stationary source will not cause or exacerbate violation of any $PM_{2.5}$ air quality standard or increment. For existing sources, minor new sources, and minor modifications of sources dispersion modeling of $PM_{2.5}$ is not necessary to demonstrate whether the emissions from the source cause or exacerbate a violation of the air quality standard for $PM_{2.5}$ and will no longer be performed for this purpose. Wisconsin will continue to regulate emissions of NO_x and SO_2 and will follow USEPA guidance on assessing the impact of direct $PM_{2.5}$ and secondarily formed $PM_{2.5}$ under the Prevention of Significant Deterioration permit program.

This report serves as the WDNR determination pursuant to s. 285.63(1)(b), Wis. Stats and is consistent with the determination made for other pollutants, such as ozone.

APPENDIX C – NO_2 Technical Support Document

Air Quality Dispersion Modeling of Industrial Stationary Sources on Ambient NO_2 Concentrations In Wisconsin

March 2018

Wisconsin Department of Natural Resources
Air Management Program
P.O. Box 7921
Madison, WI 53707

BACKGROUND

The annual NO_2 NAAQS was promulgated in 1971 to protect against respiratory disease in children. In subsequent reviews of the standard in 1985 and 1996, the annual standard was retained without revision. During the most recent review of the NO_2 NAAQS in 2010, it was determined that the annual standard alone was not sufficient to protect public health from effects that could occur following short-term exposures to ambient NO_2. The state of Wisconsin published changes on August 1, 2016, to Ch. NR 404, Wis. Adm. Code, including the 1-hour standard for NO_2, to align with the NAAQS established by U.S. EPA in February 2010. The annual NO_2 NAAQS remains applicable.

When a NAAQS is established, both federal and state air pollution permit programs must show that the source does not cause or contribute (or exacerbate) a violation of the standard. Compliance with any ambient air quality standard is primarily demonstrated by either monitoring or modeling. When using monitors, sampling equipment collects a sample of ambient air where concentrations are expected to be elevated relative to the standard. Dispersion modeling uses mathematical models to calculate ambient air concentrations based on the conditions entered in the model and summarizes the results following the form of the standard. Compliance with the 1-hour NO_2 standard is shown when the multi-year average of the 98th percentile daily maximum hour is at or below 100 parts per billion, or 188 micrograms per cubic meter ($\mu g/m^3$).

Most NO_x emissions are in the form of nitrogen oxide (NO) with direct in-stack emissions of NO_2 typically making up less than 10 percent of the total NO_x emissions. Ambient concentrations of NO_2 are influenced by emissions of NO_2, but are primarily affected by the conversion of NO to NO_2. The conversion occurs within minutes during daytime through reaction with ozone (O_3). NO_2 can also be broken down by sunlight to reform NO, creating new O_3 in the process.

During the 2010 review of the NO_2 NAAQS, the potential for adverse health effects following exposure to elevated NO_2 concentrations around major roads was particularly noted by U.S. EPA, while the impact of NO_x emissions from industrial, stationary sources was not mentioned. The U.S. EPA review of nationwide monitoring data indicated that NO_2 impacts are highest at sampling sites nearest to a roadway. The U.S. EPA made revisions to the ambient air monitoring and reporting requirements to focus on ambient concentrations of NO_2 near major roadways.

NO_x EMISSIONS DATA

NO_x emissions originate from a variety of sources. According to U.S. EPA, in the review of the primary NAAQS for NO_2 (75 FR 6474), the top emitters of NO_x are on-road mobile sources, followed by electric generation units and non-road mobile sources.

Emission estimates of NO_x for Wisconsin mirror the national distribution and trends. Based on the most recent National Emissions Inventory (NEI), Table 1 lists the categories that accounted for 90 percent of NO_x emissions in Wisconsin in 2011[14].

Table 1 – Wisconsin Emission Distribution from NEI 2011

Wisconsin NO_x Source Categories Ratio to State Total			
Mobile On Road non-Diesel	22.6%	Locomotives	4.33%
Mobile On Road Diesel	21.7%	Mobile Non-Road	3.98%
*Electric Generation Coal	10.5%	*Industrial/Commercial Nat'l Gas	3.26%
Mobile Non Road Diesel	10.3%	Residential Natural Gas	2.18%
Biogenics	5.87%	*Commercial Fuel Oil	1.92%
*Industrial Boiler Coal	4.55%	*Industrial Processes	1.75%

* Source types regulated under Wisconsin stationary source air permitting programs

According to the NEI, less than 25 percent of all NO_x emissions in Wisconsin are emitted by sources regulated by the state's stationary source permit programs, with the majority of stationary emissions occurring due to the combustion of coal. The distribution of NO_x emissions across a variety of sources correlates to the U.S. EPA implementation for 1-hour NO_2, and supports the focus on near-road (mobile source) impacts.

Industrial NO_x emissions have been trending steadily downward due to emission controls, energy efficiency, and new technologies, as illustrated in Figure 1.

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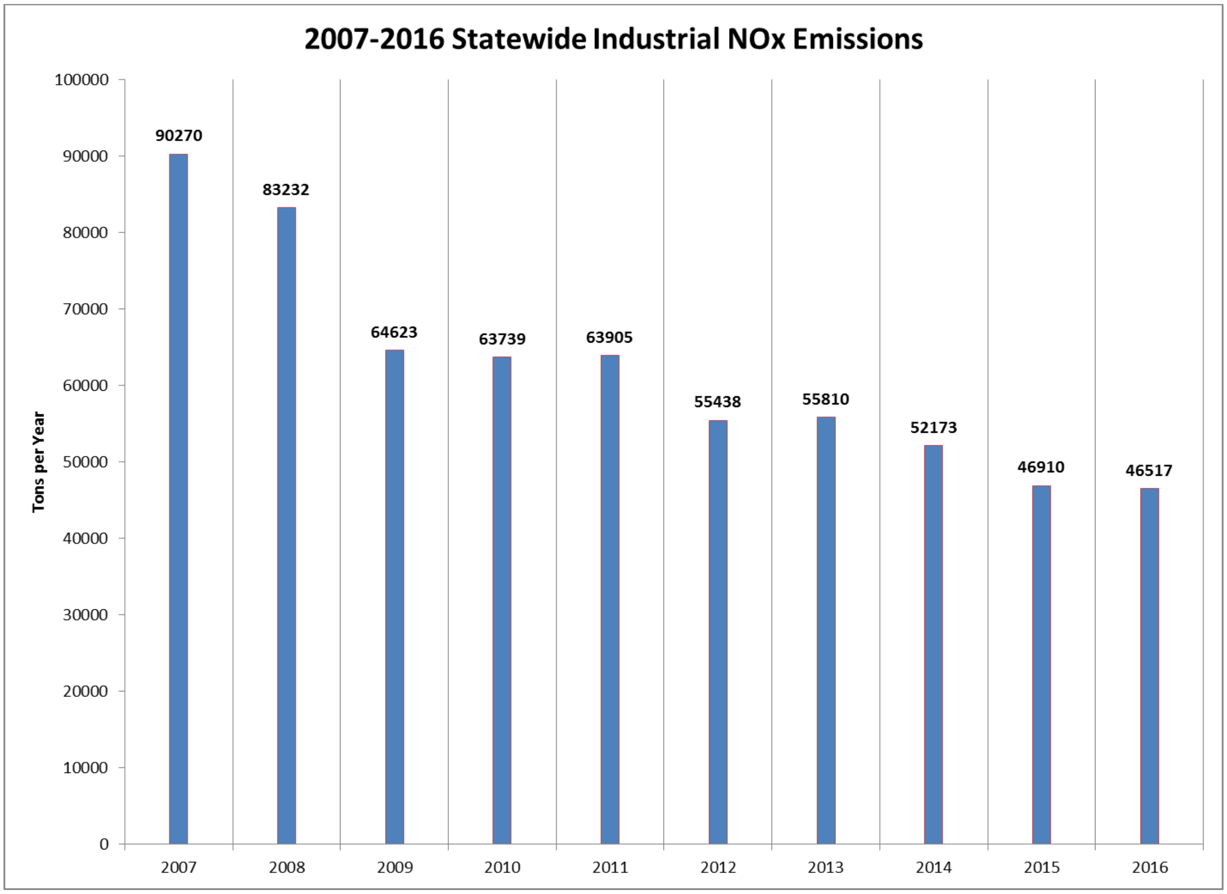
[14] National Emissions Inventory (https://www.epa.gov/air-emissions-inventories)

Figure 1 – Wisconsin Reported Annual Industrial NO_x Emissions



Nationally, emissions of NO_x from all sources have also been decreasing. Per U.S. EPA (75 FR 6474), this downward trend is expected to continue due to implementation of mobile source emission standards, national NO_x reductions from the interstate and transport rules for major point sources, and implementation of the 2015 ozone NAAQS. These emission reductions correlate to the reduction in measured NO_2 concentrations. As the 1-hour NO_2 NAAQS is currently being met across the country, future compliance with the standard is likely.

NO_2 MONITORING DATA AND TRENDS

In all parts of Wisconsin, Minnesota, Michigan, Iowa and Illinois, ambient air concentrations currently meet the 1-hour NO_2 NAAQS of 100 ppb, as shown in Table 2, including rural locations, urban locations, and locations near major roadways.

Table 2 – Regional 1-Hour NO_2 Concentration[15]

98th Percentile Daily Maximum Hour Concentration (ppb) in 2016					
Site ID	**State**	**Value (ppb)**	**Site ID**	**State**	**Value (ppb)**
Chicago	Illinois	58	Detroit	Michigan	44
Chicago	Illinois	61	Wayne Cty	Michigan	40
Schiller Park	Illinois	56	Livonia	Michigan	41
Cicero	Illinois	55	Detroit	Michigan	42
Northbrook	Illinois	40	Detroit	Michigan	50
East St. Louis	Illinois	34	Blaine	Minnesota	39
Des Moines	Iowa	33	Rosemount	Minnesota	32
Des Moines	Iowa	29	Inver Grove	Minnesota	26
Davenport	Iowa	30	Lakeville	Minnesota	39
Van Buren Cty	Iowa	8	Minneapolis	Minnesota	43
Lansing	Michigan	38	Manitowoc	Wisconsin	5
Missaukee Cty	Michigan	9	(SER) Milwaukee	Wisconsin	49
Detroit	Michigan	42	(Near Road) Milwaukee	Wisconsin	48

As shown in Table 2, ambient NO_2 concentrations are measured at three locations in Wisconsin, with one monitor in Manitowoc County and two monitors in Milwaukee. The monitor in Manitowoc County measures NO_2 in conjunction with ambient ozone concentrations. The monitors in Milwaukee measure where both mobile source NO_x emissions and NO_2 concentrations are highest in Wisconsin, a site near Interstate Highway 94.

The location of monitors near major roadways and in urban areas provides worst case information because mobile sources are the primary source of NO_x emissions that contribute to ambient NO_2 concentrations according to U.S. EPA. One of the monitor locations in Table 2 is at the Wisconsin DNR Southeast Region (SER) headquarters in Milwaukee, at the intersection of Dr. Martin Luther King Jr. Drive and North Avenue. As noted in Table 2, the measured NO_2 concentration in this area (49 ppb) is

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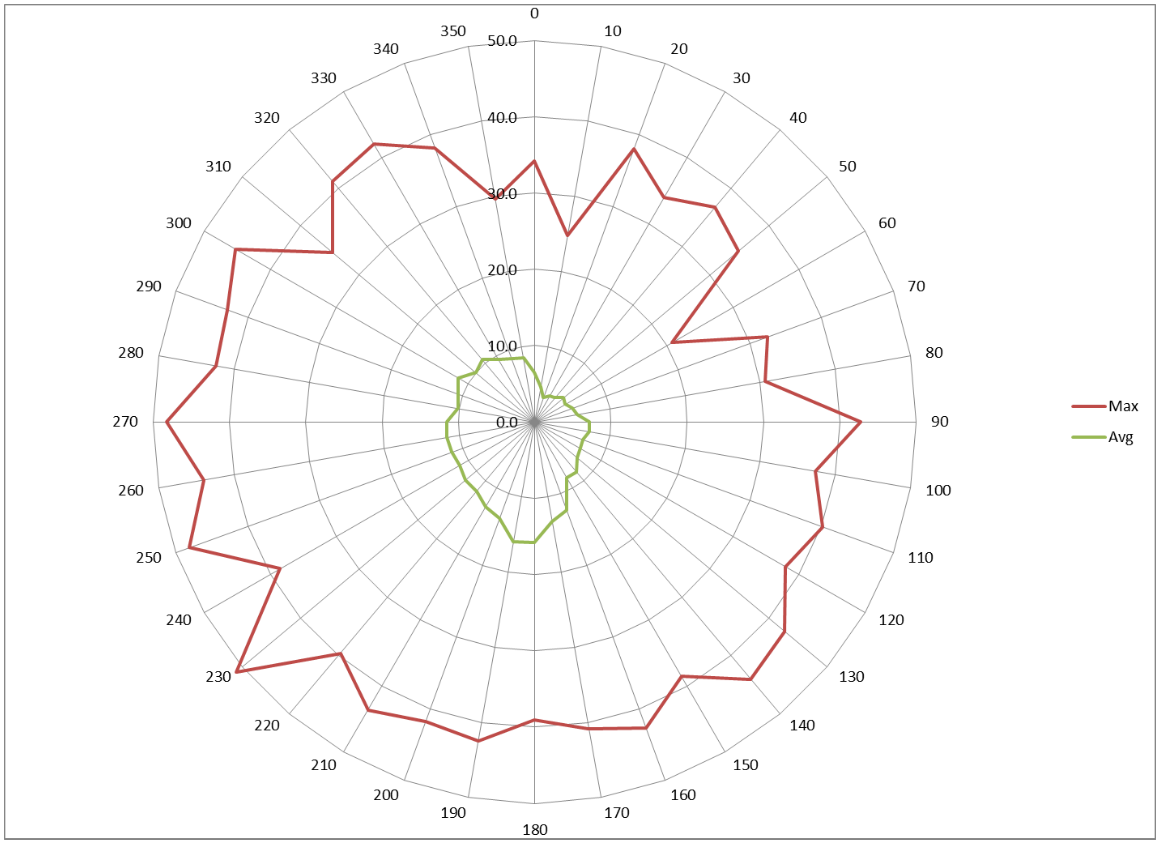
[15] http://www.epa.gov/airquality/airdata (accessed November 10, 2017)

well below the 1-hour NAAQS (100 ppb). The area around the monitor is residential with commercial areas further away. The SER monitor is located about 500 meters east of Interstate Highway 43 (I-43) and 3.5 kilometers north-northeast of the WE Energies Valley Power Plant, a major fossil fuel fired facility with large quantities of NO_x emissions. The twin stacks of the Valley plant are taller than surrounding buildings, so the impact of the emissions is expected to be observed several kilometers from the facility.

NO_x emissions from the WE Energies Valley facility in calendar year 2015 were reported at 1,113,849 pounds. Due to the large quantity of NO_x emissions from this facility, hourly wind direction data from General Mitchell International Airport was matched with the hourly monitored NO_2 concentrations at the SER monitor to determine the impact of the NO_x emissions from WE Energies. Both maximum and average monitored concentrations were determined for each 10-degree wind sector (36 sectors total), and plotted in Figure 1. Maximum concentrations are shown in red and average concentrations are shown in green.

Figure 1 – DNR SER 2015 Measured NO_2 Concentrations by Wind Direction

(North to Top of Figure)



Maximum concentrations of NO_2 (red) are representative of hourly NO_2 values. Higher maximum concentrations occurred with westerly wind directions (190-330 degrees). These directions correspond to the location of roadway NO_x emissions from I-43. The 1-hour NO_2 data shows no increase of peak hourly concentrations in the south-southwesterly direction (190 degrees), which corresponds to the WE Energies Valley location in comparison to the SER monitor. This supports U.S. EPA's conclusion that NO_x emissions from mobile sources are the primary contributor to ambient 1-hour NO_2 concentrations.

Average concentrations of NO_2 (green) are representative of annual NO_2 values. Higher average concentrations occurred within a narrow range of south-southwesterly winds (180-190 degrees), which corresponds to the direction of WE Energies Valley facility. These increased average NO_2 concentrations show the Valley plant impacts the monitor, but also supports the validity of examining the impact of NO_x emissions from industrial stationary sources only on a longer time frame, such as for comparison to the annual NO_2 NAAQS.

Nationwide, ambient NO_2 monitored concentrations have been steadily and consistently decreasing over time. Figure 2 presents the nationwide trend from 1980 through 2013, as reported by U.S. EPA in the Report on the Environment[16]. The downward trend in concentration began before the 1-hour NO_2 NAAQS was enacted in 2010 and is associated with improvements in mobile source and industrial technology.

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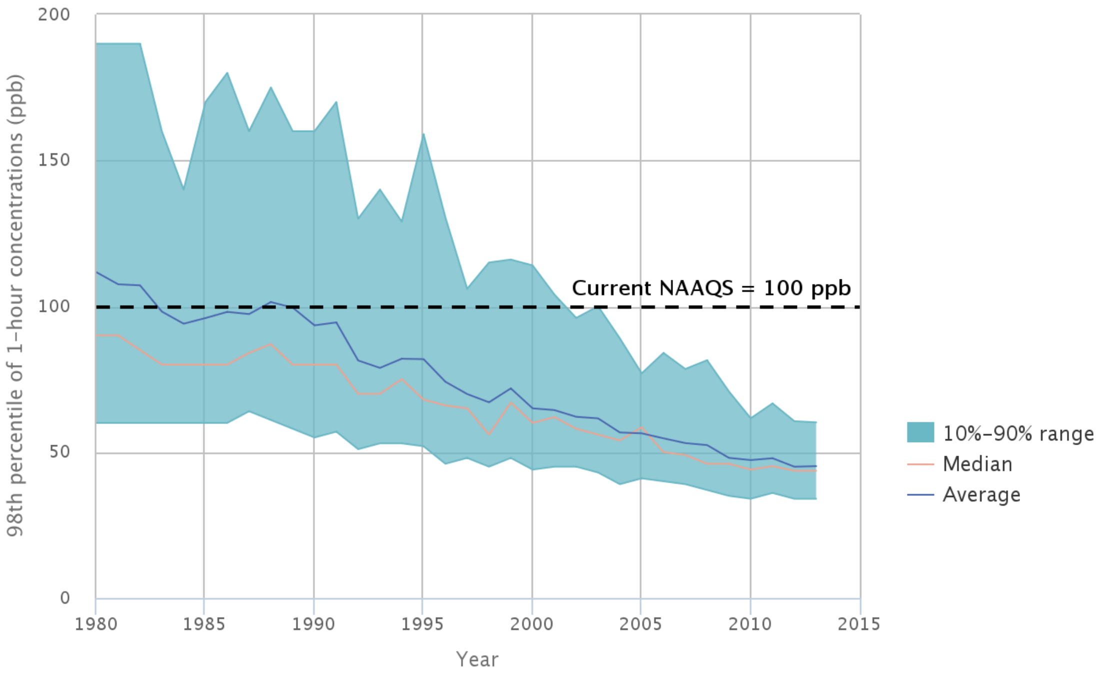
[16] U.S. EPA Report on the Environment (http://www.epa.gov/roe)

Figure 2 – Nationwide 1-Hour NO_2 Ambient Concentrations 1980-2013



The current 1-hour NO2 NAAQS was established in 2010 and is shown to provide context for the magnitude of pollutant concentrations. No 1-hour NO2 NAAQS existed prior to 2010 (U.S. EPA, 2014b).

Coverage: 29 monitoring sites in 24 counties nationwide (out of a total of 308 sites measuring NO2 in 2013) that have sufficient data to assess NO2 trends since 1980.

Information on the statistical significance of the trends in this exhibit is not currently available. For more information about uncertainty, variability, and statistical analysis, view the technical documentation for this indicator.

Data source: U.S. EPA, 2014a

MODELING INFORMATION

Dispersion modeling of NO_x emissions is complicated by the conversion of NO_x into NO_2, particularly for short timeframes. The regulatory dispersion model is a statistical treatment of the spreading of a plume and does not contain the equations to explicitly calculate the minute-by-minute conversion of NO_x into NO_2. The regulatory dispersion model calculates the dispersion of NO_x emissions and multiplies by a scalar to calculate the approximate level of NO_2 in the atmosphere.

The U.S. EPA has created three separate screening tiers to calculate NO_2 concentrations from modeled NO_x emissions. Each subsequent tier accounts for increasingly complex calculations, but as noted in the January 17, 2017 *Guideline on Air Quality Models*, U.S. EPA does not specifically recommend any one tier over another[17]. Use of each tier can result in different NO_2 modeled concentrations relative to one another, yet, despite numerous changes to the Tier 2 and Tier 3 conversion methods, U.S. EPA has not removed any conversion method or provided a recommendation on a preferred tier. This illustrates the uncertainty in how the dispersion model accounts for the conversion of NO_x to NO_2[18].

To demonstrate the effect of the NO_x-to-NO_2 screening conversion on modeled concentrations, the department modeled a small boiler using all conversion treatments No other parameters or meteorological data were changed. Assuming the maximum emission scenario, the model concentration results varied from 37.2 ppb up to 87.3 ppb for the various conversion options. This small unit would be expected to operate at a variety of emission scenarios. The lowest impact from any scenario and any conversion treatment is 22 ppb, almost four times lower than the highest impact. When including other emission sources and background concentrations, it is possible to find modeled concentrations that both exceed and never exceed the 1-hour NO_2 NAAQS, which leads to the conclusion that dispersion modeling produces no substantive evidence in this scenario and other techniques should be examined.

There is an element of uncertainty associated with any model. This uncertainty is in addition to the uncertainty inherent in modeling NO_x to NO_2 conversion. As stated in Section 4 of U.S. EPA's January 2017 *Guideline*, "Models…estimate concentrations at specific sites that represent an ensemble average of numerous repetitions of the same event." The 2017 *Guideline* continues, "The irreducible uncertainty associated with models… may be… as much as +/- 50 percent. Reducible uncertainties can be on a similar scale." "Errors of 5 to 10 degrees in the measured wind direction can result in concentration errors of 20 to 70 percent for a particular time and location." The *Guideline* does assert that the uncertainties do not indicate that the modeled concentration does not occur, "only that the precise time and locations are in doubt. But, as a screening tool, the tiered conversion options are designed to produce high modeled concentrations relative to actual conditions in addition to the model uncertainty.

Emission sources, such as space heaters, small boilers, engine testing, and drying ovens, typically operate (or cycle) for only a few minutes per hour, but dispersion modeling is based on continuous release of emissions for a full hour. Considering the uncertainty expressed by U.S. EPA, as well as the inherent conservatism of screening treatments, modeled concentrations for these small non-continuous emission sources based on maximum hourly emission limits will overestimate the true impact of these sources. Adding to this dispersion model uncertainty is the uncertainty in the conversion of NO_x emissions to NO_2 for a specific time and location, as well as the multi-year nature of the standard. It is highly unlikely that the precise conditions required to produce high NO_2

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[17] Revisions to the Guideline on Air Quality Models, 82FR5182 (Jan 17, 2017)

[18] Id.

concentrations will occur frequently enough to produce single year exceedances, and even less likely to produce multi-year violations of the 1-hour NO_2 NAAQS. Due to the multi-year, probabilistic nature of the standard, and due to the cycling nature of operation of the processes, these small units are unlikely to cause or exacerbate a violation (i.e. multi-year exceedances) of the 1-hour NO_2 NAAQS and therefore do not need to be explicitly modeled.

The U.S. EPA, in the March 1, 2011 *Clarification Regarding Modeling Guidance for the 1-hour NO_2 NAAQS*, began addressing intermittent emissions units, such as emergency generators and startup/shutdown operations. As stated, "The intermittent nature of the… emissions associated with emergency generators…, when coupled with the probabilistic form of the standard, could result in modeled impacts being significantly higher than actual impacts…" To mitigate this, U.S. EPA recommended, "…that compliance demonstrations for the 1-hour NO_2 NAAQS be based on emission scenarios that can logically be assumed to be continuous or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations." Based on this recommendation, Wisconsin DNR developed an intermittent source modeling policy that does not explicitly model emergency generators or emergency backup fuel. In the 2011 *Clarification* memo, U.S. EPA offered that an averaged emission rate could be modeled for the intermittent source, but in light of the range of modeled impacts from the different conversion options, this would produce no substantive evidence of impact.

For those sources that are not considered intermittent, such as the small boiler example presented earlier, the nature of how air pollution control permits are prepared also results in an unrepresentative modeled impact. Rather than examine the specific operating scenarios of the unit, the rated capacity of the equipment is used to establish the maximum emission rate, regardless of how often (or even if) it occurs. For smaller sources and sources intended to be operated in a fluctuating manner, this conservatism, on top of the limitations on the model NO_x-to-NO_2 conversion and the dispersion model uncertainty, results in no substantial evidence for whether a source will cause or exacerbate a violation of the 1-hour NO_2 NAAQS. This does not imply that all emissions from these types of processes are intermittent, but that modeling NO_x emissions against the 1-hour NO_2 standard does not result in information sufficient to make a regulatory finding of the impact to ambient air.

Non-Modeling Approach for 1-hour NO_2 NAAQS

While uncertainty in dispersion models exists for all pollutants, the impact of NO_x emissions on the 1-hour NO_2 NAAQS is more uncertain due to the unpredictability of NO_x-to-NO_2 conversion and the short time frame of the standard compared to the varying nature of emissions from small sources of NO_x. Since modeled results can be both below and above the NAAQS, regulatory dispersion modeling results in no substantial evidence of whether these types of sources will cause or exacerbate a violation of the 1-hour NO_2 NAAQS. Examining ambient monitor data and the categorical breakdown of emissions of NO_x, and considering the probabilistic nature of the 1-hour NO_2 NAAQS, small sources of NO_x emissions are highly unlikely to result in emission scenarios that occur frequently enough to cause or exacerbate a multi-year violation of the 1-hour NO_2 NAAQS.

Large emission sources, such as electric utility boilers, are more likely to operate steadily over an hour and over an entire year. Considering that these large units are at facilities that contribute 10 to 15 percent of the Wisconsin NO_x emissions, Wisconsin DNR will use model concentrations to determine whether the source will cause or exacerbate a multi-year violation of the 1-hour NO_2 NAAQS. Instead of establishing the difference between large and small NO_x emitters using reported emissions, Wisconsin DNR will consider a facility to be a large source if the source operates a combustion unit with a maximum heat input of 250 mmBTU/hr.

Approach for Annual NO_2 NAAQS

An annual averaged emission rate also eliminates one of the inherent uncertainties in modeling impact. Any emission source, including those that cycle, can be analyzed with annual averaged emission rates to produce representative annual modeled concentrations in comparison to the annual NO_2 NAAQS (100 $\mu g/m^3$). This approach is consistent with the long-standing Wisconsin DNR procedures to assess the impact of NO_x emissions on the annual NO_2 NAAQS.

Increment Consumption

Increment concentrations are defined under the federal and state Prevention of Significant Deterioration (PSD) regulations to represent ambient air impacts that do not significantly deteriorate air quality in the area. Proposed sources requesting PSD permits under Chapter NR 405, Wis. Adm. Code must have a demonstrated impact less than the increment concentration for pollutants above the PSD thresholds. In addition, after a major PSD construction permit application has been deemed complete, any subsequent increase of emissions within the county must also have a demonstrated impact less than the increment concentration for each respective pollutant.

Increment concentration standards are established by federal and state rule, separate from the NAAQS. They are not directly affected by changes or deletions of ambient air standards. For NO_2, the annual increment standard remains (25 $\mu g/m^3$), and will continue to be addressed as necessary. This includes establishing new baseline counties where PSD permit applications are received, and modeling the impact of proposed emissions in comparison to the annual increment.

SUMMARY

All portions of the United States are currently in attainment with the 1-hour NO_2 NAAQS. Wisconsin, Minnesota, Iowa, and Illinois have monitored NO_2 concentrations of less than 70 percent of the 1-hour NAAQS, including the heavily populated Chicago metropolitan area. Trends in air quality monitoring indicate a decrease in ambient NO_2 concentrations that correlates to a decrease in total NO_x emissions, both in Wisconsin and nationally. This decrease is associated with improvements in mobile source and industrial technology.

For a short-term standard of a chemically active pollutant, air quality dispersion modeling based upon maximum hourly emission limits might not be informative or accurate for smaller sources or sources intended to be used in a fluctuating manner. Multiple factors, including the distribution of NO_x emissions from mobile and stationary sources, the nature of industrial emissions, and the atmospheric chemistry of NO_2, indicate that a weight of evidence method is a more sensible approach to predicting the impact of NO_x emissions on ambient 1-hour NO_2 air quality. The weight of evidence, including the downward emission trends, downward concentration trends and the current state and national NO_2 monitoring data, is used to determine that NO_x emissions from small or fluctuating sources do not cause or exacerbate a violation of the 1-hour NO_2 NAAQS.