New Jersey Department of Environmental Protection
Division of Air Quality

Technical Manual 1002

Guidance on Preparing an Air Quality Modeling Protocol

May 2021

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LIST OF ACRONYMS

The following are acronyms used in Technical Manual 1002.

amsl	Above mean sea level
APC	Air Pollution Control
AQRV	Air Quality Related Value
BID	Buoyancy-induced Dispersion
BPIPPRM	Building Profile Input Program with the Plume Rise Model
CAA	Clean Air Act
CFR	Code of Federal Regulations
CMSA	Consolidated Metropolitan Statistical Area
DAQ	Division of Air Quality
DEM	Digital Elevation Model
Department	New Jersey Department of Environmental Protection
FLM	Federal Land Manager
GEP	Good Engineering Practice
HAP	Hazardous Air Pollutant
ISC3	Industrial Source Complex (Version 3)
ISR	In-stack ratio
MCHISRS	Model Clearinghouse Information Storage and Retrieval System
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NJAAQS	New Jersey Ambient Air Quality Standard
NJDEP	New Jersey Department of Environmental Protection
NED	National Elevation Dataset
N.J.A.C.	New Jersey Administrative Code
NO_2	Nitrogen dioxide
NWS	National Weather Service
PM_{10}	Particulate matter having an aerodynamic diameter less than or equal to a nominal 10 micrometers
$PM_{2.5}$	Particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 micrometers
ppb	Parts per billion
ppm	Parts per million
PSD	Prevention Significant Deterioration
SCRAM	Support Center for Regulatory Atmospheric Modeling
SIA	Significant Impact Area
SMC	Significant Monitoring Concentration
SO_2	Sulfur dioxide
TEOM	Tapered element oscillating microbalance
TSP	Total Suspended Particulates
USEPA	United States Environmental Protection Agency
$\mu g/m^3$	Micrograms per cubic meter
USGS	United States Geological Survey

1.0 Introduction

1.1 Purpose of Document

Air dispersion modeling is the primary analytical tool for assessing air quality impacts from new or modified pollution sources when time, expenses and coverage limit the use of ambient air measurement. The New Jersey Department of Environmental Protection (NJDEP) Division of Air Quality (DAQ) has produced this Technical Manual (Manual) to provide modeling guidance for predicting the ambient air quality impact of emissions from stationary sources. This Manual addresses modeling issues for a wide range of source types and regulatory modeling requirements, such as Prevention of Significant Deterioration (PSD). It is intended for use by permit applicants and their consultants who need to conduct ambient impact analyses in support of air permit applications and other activities that require air quality impact modeling.

This Manual is not intended to describe the implications of modeling results. Such implications are generally controlled by relevant state and federal regulations, laws, and guidance documents. This Manual is not intended to provide an all-inclusive description of the requirements of a modeling analysis because each modeling analysis is unique. There can be many variations in source configuration and operating characteristics and differences in geography and climate from one modeling application to another. There is no one single model or methodology that can assess all the conceivable modeling situations. The purpose of this Manual is to provide a general framework for how the modeling analysis should be conducted, and to promote technically sound and consistent modeling techniques while encouraging the use of improved and more accurate techniques as they become available.

Individuals responsible for conducting the air quality impact analyses should, at a minimum, be familiar with the following United States Environmental Protection Agency (USEPA) documents:

- Appendix W to 40 CFR Part 51 – Guideline on Air Quality Models
- AERMOD Implementation Guide, EPA-454/B-16-013
- AERMOD User's Guide, EPA-454/B-16-011
- AERSURFACE User's Guide, EPA-454/B-08-001 (Revised 01/16/2013)
- AERMET User's Guide, EPA-454/B-16-010
- Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations), EPA-450/4-80-023R
- Additional guidance from the USEPA Support Center for Regulatory Atmospheric Modeling (SCRAM) at http://www.epa.gov/scram/ . Within SCRAM is the *Model Clearinghouse Information Storage and Retrieval System* (MCHISRS) at http://cfpub.epa.gov/oarweb/MCHISRS . It is a database of Model Clearinghouse

memoranda addressing the interpretation of modeling guidance for specific regulatory applications.

As stated above, each modeling analysis is unique. Therefore, applicants should work closely with the modeling staff at the Department to ensure that all modeling requirements are met. The contact phone number is (609) 292-6722. Additional information can be obtained from the air quality permit program's webpage: http://www.nj.gov/dep/aqpp/ . Note that the results of air dispersion modeling are used as inputs to risk assessment. New Jersey Technical Manual 1003 entitled "*Guidance on Preparing a Risk Assessment for Air Contaminant Emissions*" addresses the preparation of risk assessments and is available on the Department's webpage http://www.state.nj.us/dep/aqpp/techman.html .

1.2 Purpose of an Air Quality Impact Analysis

An air quality impact analysis is used to establish compliance with the National Ambient Air Quality Standards (NAAQS), the New Jersey Ambient Air Quality Standards (NJAAQS), and the PSD allowable increments. An air quality impact analysis may also be required for:

- Assessing whether a source is causing "air pollution," which is defined under New Jersey Administrative Code (N.J.A.C.) Title 7 Chapter 27 Subchapter 5 (7:27-5) as the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as are, or tend to be, injurious to human health or welfare, animal or plant life or property, or would unreasonably interfere with the enjoyment of life or property. This type of analysis usually involves a risk assessment (carcinogenic and non-carcinogenic health effects) or an odor impact evaluation (see Appendix C, Odor Modeling Procedures).

- Assessing Air Quality Related Values (AQRV), such as visibility, soils and vegetation impacts that would occur as a result of the source, and general commercial, residential, industrial and other growth associated with the source, as required by 40 CFR 52.21(o) of the PSD regulations. This analysis should not only address impact on visibility, soils and vegetation for the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge Class I area, but also evaluate impacts to Class II areas that have a significant commercial and recreational value.

2.0 Sources Requiring Air Quality Impact Analysis

2.1 New Jersey Regulations and Modeling Analysis

The New Jersey regulations that address the issue of air quality modeling are found in the N.J.A.C. 7:27-8 (Permits and Certificates for Minor Facilities and Major Facilities without an Operating Permit), 18 (Emission Offset Rules), and 22 (Operating Permits).

2.1.1 Title V Operating Permits

Most sources that will need to submit modeling analysis in support of their permit applications will be those sources requiring a Title V operating permit. N.J.A.C. 7:27-22.8 sets forth the requirements for submitting a modeling analysis for the following types of permit applications or modifications: (1) a new major source requesting an initial Title V permit; (2) a significant modification to an existing major facility; (3) or a minor modification to an existing major facility.

Though there are four scenarios listed in N.J.A.C. 7:27-22.8(a) that require modeling analysis as part of a Title V permit application or modification, only three of the principal concerns are described in more detail below.

1. 22.8(a)1 - The criteria for determining whether an application is subject to the PSD air quality impact analysis requirements can be found in 40 CFR Part 52.21(m). (Attainment)

2. 22.8(a)2 - An application is subject to the air quality impact analysis requirements set forth at N.J.A.C. 7:27-18.4 if it is proposing an emissions increase, based on potential to emit, that exceeds any of the major facility thresholds listed in Table 2-1 for at least one pollutant. An air quality impact analysis must be conducted for an existing major facility proposing a net emissions increase exceeding the thresholds listed in Table 2-2 below, as determined pursuant to N.J.A.C. 7:27-18.7. (Nonattainment)

   Additionally, Total Suspended Particulates (TSP) is not in Table 2-2 because the Department assumes that if the NAAQS for particulate matter equal to or less than 10 microns (PM_{10}) and the particulate matter equal to or less than 2.5 microns ($PM_{2.5}$) are met, then the TSP NJAAQS will also be met.

   The USEPA November 17, 2016 Memo titled Draft $PM_{2.5}$ Precursor Demonstration Guidance requires that sulfur dioxide (SO_2), oxides of nitrogen (NO_x), VOC, and ammonia must be evaluated in the development of all $PM_{2.5}$ nonattainment area State Implementation Plans. While New Jersey is currently attaining $PM_{2.5}$ NAAQS, the Department may require applicants to address VOC and ammonia as $PM_{2.5}$ precursors.

Table 2-1. Major Facility Thresholds

Air Contaminant	Threshold Value (tons/yr)
SO_2	100
SO_2 (as $PM_{2.5}$ precursor)	100[b]
TSP	100
PM_{10}	100
$PM_{2.5}$	100[a]
CO	100
NO_x	25
NO_x (as $PM_{2.5}$ precursor)	100[b]
VOC	25
Pb	10

a. This value reflects 40 CFR Part 51 Appendix S guidance.
b. Per revision to N.J.A.C. 7:27-18, adoption published in November 6, 2017 New Jersey Register.

Table 2-2. Significant Net Emissions Increase Thresholds

Air Contaminant	Significant Net Emissions Increase (tons/yr)
SO_2	40
SO_2 (as $PM_{2.5}$ precursor)	40[b]
PM_{10}	15
$PM_{2.5}$	10[a]
NO_x	25
NO_x (as $PM_{2.5}$ precursor)	40[b]
CO	100
Pb	0.6

a. This value reflects 40 CFR Part 51 Appendix S guidance.
b. Per revision to N.J.A.C. 7:27-18, adoption published in November 6, 2017 New Jersey Register.

3. 22.8(a)4 - New and modified sources at major facilities with operating permits may need to submit a health risk assessment if they emit certain contaminants regarded as air toxics. Air toxics are natural or man-made pollutants that when emitted into the air may cause an adverse health effect (see section 10.0 for health risk assessment modeling recommendations). The federal 1990 Clean Air Act (CAA) Amendments created a list of air toxics, called "hazardous air pollutants" or "HAPs", as well as regulations to limit HAP emissions. Air toxics that must be evaluated are listed on the NJDEP Division of Air Quality Risk Screening Worksheet (Worksheet), which can be accessed at http://www.state.nj.us/dep/aqpp/risk.html . The Worksheet evaluates HAPs, as well as other air toxics, such as hydrogen sulfide and ammonia. Sources that require further review per the Department's risk screening procedures must conduct air quality modeling, which applies site specific parameters to the assessment. The health risk screening procedures are described in New Jersey Technical Manual 1003 (*Guidance on Preparing a Risk Assessment for Air Contaminant Emissions*) and can be downloaded from the Department's air quality permitting program technical manual webpage at http://www.state.nj.us/dep/aqpp/techman.html .

2.1.2 Permits and Certificates for Minor Facilities and Major Facilities without an Operating Permit

The criteria for submission of a modeling analysis for minor facilities and major facilities without an operating permit are specified in N.J.A.C. 7:27-8.5 (Air Quality Impact Analysis). N.J.A.C. 7:27-8.5(a)1 and 2 are identical to the criteria for Title V operating permits set forth at N.J.A.C. 7:27-22.8(a)1 and 2, respectively. As is the case with N.J.A.C. 7:27-22.8(a)4, most sources affected by N.J.A.C. 7:27-8.5(b) will be those that require further review per the Department's risk screening procedure due to their emissions of air toxics, as listed in the Worksheet. N.J.A.C. 7:27-8.5(a)4 is a catchall condition for permit applications that the Department believes may cause or contribute to a violation of an ambient air quality standard or a PSD increment, or pose a threat to public health or welfare, but are not subject to modeling pursuant to any other criteria.

2.2 Sources That Must Conduct a Modeling Analysis

As required by 40 CFR Part 52, N.J.A.C. 7:27-8, and N.J.A.C. 7:27-22, an air quality modeling analysis must be conducted under the following scenarios:

1. Applications subject to PSD air quality impact analysis requirements per 40 CFR Part 52.21(m) (see Appendix A for more details).

2. Applications for a new major source or an existing minor source proposing an emission increase that exceeds the major source thresholds listed in Table 2-1 for at least one pollutant. An air quality impact analysis must be conducted for each pollutant whose proposed net emissions increase exceeds the thresholds listed in Table 2-2.

3. Applications for an existing major facility (allowable emissions above the levels in Table 2-1 for at least one pollutant) must conduct an air quality impact analysis for those pollutants whose proposed net emissions increase exceed the thresholds listed in Table 2-2.

4. Applicants that submit an APC permit where the Department's risk screening procedure indicates that further evaluation is required due to their emissions of air toxics.

5. The Department may request modeling in other unique circumstances. For instance, circumstances could involve a permit application at a new or existing major facility that the Department believes may cause or contribute to a violation of an ambient air quality standard or a PSD increment, or pose a threat to public health or welfare. For example, if a proposed increase in the hourly emission rate of a criteria pollutant is of sufficient magnitude that, in combination with the source's stack height, it may cause or contribute to a violation of a short-term ambient air quality standard or a PSD increment, modeling may be required even though the annual emissions increase may not be significant. Another example is a minor facility with insufficient annual emissions to meet the major facility threshold values in Table 2-1, but has a proposed emission increase and stack

parameters that suggest high air impacts. In this case, a new source proposing emissions of 80 tons per year of PM_{10} would likely need to be modeled.

2.3 Netting Analysis and the Requirements for Modeling

A netting analysis is sometimes performed pursuant to N.J.A.C. 7:27-18 when obtaining an air permit for a new or modified source. By accounting for creditable emissions reductions, the net emissions increase at a facility for a pollutant may be reduced below levels outlined in the Emissions Offset Rule. The methodology for calculating the net emissions increase at a facility is described in N.J.A.C. 7:27-18.7 (Determination of a net emissions increase or a significant net emissions increase).

A netting analysis can reduce the emissions increase at the facility below the significant net emissions increase threshold for which an air quality impact analysis is required. An exemption from performing a modeling analysis can be requested in such a situation. The exemption request may be denied if the Department believes that the reduction in ambient air concentrations from the emissions decrease will not be sufficient to prevent the proposed emissions increase from causing or contributing to a violation of an ambient air quality standard or a PSD increment, or posing a threat to public health or welfare. Proposed emission increases from a source located near complex terrain, near the property boundary line of the facility, in an area where elevated background air concentrations exist, or a stack subject to building downwash are examples of situations where a requested exemption from modeling may be denied.

While the air dispersion modeling is dependent upon the netting analysis as described by N.J.A.C. 7:27-18.7, it is a separate regulatory demonstration. When modeling a source for which a netting analysis has been conducted, an applicant should include not only the proposed emissions increases, but also the creditable emissions reductions at the source. Please note that the modeling of negative nitrogen dioxide (NO_2) emissions should only be done after consultation with the USEPA Regional Office to ensure that decreases are not overestimated.

3.0 Regulatory Requirements

The permit applicant must demonstrate compliance with the federal and the New Jersey air quality regulations. Below is a summary of the applicable regulatory requirements that are related to air quality modeling procedures and results.

3.1 National and New Jersey Ambient Air Quality Standards

3.1.1 National Ambient Air Quality Standards (NAAQS)

Congress enacted the 1970 Clean Air Act (CAA) to protect the health and welfare of the public from the adverse effects of air pollution. Subsequently, the USEPA established National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead (Pb). The NAAQS include both "primary" and "secondary" standards and are periodically updated to reflect the latest scientific findings. The primary standards are intended to protect human health with an adequate margin of safety; whereas the secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to materials or vegetation. Both the primary and the secondary standards must be addressed in the modeling evaluation. Table 3-1 "National Ambient Air Quality Standards" lists these primary and secondary standards.

Table 3-1. National Ambient Air Quality Standards

Pollutant	Averaging Period[a]	Primary NAAQS[b]	Secondary NAAQS[b]
NO_2	1-hour	100 ppb (188 $\mu g/m^3$)	---
	Annual	53 ppb (100 $\mu g/m^3$)	53 ppb (100 $\mu g/m^3$)
CO	1-hour	35 ppm (40,000 $\mu g/m^3$)	---
	8-hour	9 ppm (10,000 $\mu g/m^3$)	---
SO_2	1-hour	75 ppb (196 $\mu g/m^3$)	---
	3-hour	---	0.5 ppm (1,300 $\mu g/m^3$)
PM_{10}	24-hour	150 $\mu g/m^3$	150 $\mu g/m^3$
$PM_{2.5}$	24-hour	35 $\mu g/m^3$	35 $\mu g/m^3$
	annual	12 $\mu g/m^3$	15 $\mu g/m^3$
Ozone	8-hour	0.070 ppm	0.070 ppm
Lead	Rolling 3-month	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$

a. Short-term standards for 3-hour SO_2 and 1- and 8-hour CO are not to be exceeded more than once per year. The 3-month lead and annual NO_2 standards are never to be exceeded. The 1-hr NO_2 standard is the 98[th] percentile of the yearly distribution of 1-hour daily maximum concentrations averaged over 3 years. The 1-hr SO_2 standard is the 99[th] percentile of the yearly distribution of 1-hour daily maximum concentrations averaged over 3 years. The 24-hr PM_{10} standard is not to be exceeded more than once per year over 3 years. The 24-hr $PM_{2.5}$ standard is the 98[th] percentile of the maximum averaged over 3 years, and the annual $PM_{2.5}$ standards are annual means averaged over 3 years.

b. The actual form of each standard is listed first. The values in parentheses are approximations provided for convenience.

3.1.2 New Jersey Ambient Air Quality Standards (NJAAQS)

New Jersey Ambient Air Quality Standards (NJAAQS) are listed in Table 3-2. The differences between the New Jersey and the National standards are as follows:

- New Jersey maintains a 12-month and a 24-hour secondary standard for SO_2;
- New Jersey maintains 12-month and 24-hour primary and secondary standards for Total Suspended Particulates (TSP);
- New Jersey has no standards for $PM_{2.5}$ and PM_{10}; and
- New Jersey regulations specify its 3-hr, 8-hr, and 24-hr standards in terms of moving or non-overlapping running hourly averages, and its 3-month and 12-month standards in terms of moving or non-overlapping running monthly averages.

Table 3-2. New Jersey Ambient Air Quality Standards

Pollutant	Averaging Period[a]	Primary NJAAQS[b]	Secondary NJAAQS[b]
NO_2	12-Month	100 $\mu g/m^3$ (0.05 ppm)	100 $\mu g/m^3$ (0.05 ppm)
CO	1-hour	40 mg/m^3 (35 ppm)	40 mg/m^3 (35 ppm)
	8-hour	10 mg/m^3 (9 ppm)	10 mg/m^3 (9 ppm)
SO_2	3-hour	---	1,300 $\mu g/m^3$ (0.5 ppm)
	24-hour	365 $\mu g/m^3$ (0.14 ppm)	260 $\mu g/m^3$ (0.10 ppm)
	12-Month	80 $\mu g/m^3$ (0.03 ppm)	60 $\mu g/m^3$ (0.02 ppm)
TSP	24-hour	260 $\mu g/m^3$	150 $\mu g/m^3$
	12-Month	75 $\mu g/m^3$	60 $\mu g/m^3$
Ozone	1-hour	0.12 ppm	0.08 ppm
Lead	3-month	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$

a: All short-term (1-hr, 3-hr, 8-hr, and 24-hr) standards except ozone are not to be exceeded more than once per 12-month period. 3-month and 12-month standards are never to be exceeded. All averages are calculated as running or moving averages. The 12-month TSP standards are geometric means.

b: The actual form of each standard is listed first. The values in parentheses are approximations provided for convenience.

3.2 Modeling Recommendations for Individual Criteria Pollutants

3.2.1 Federal Recommendations:

Guidance on how to demonstrate compliance with the NAAQS is given in 40 CFR 51 Appendix W Section 9.2.3 (NAAQS and PSD Increments). The following is additional guidance on demonstrating NAAQS compliance for specific pollutants.

NO_2

The 1-hour NO_2 NAAQS is a probabilistic standard. Compliance is demonstrated as the 98th percentile of the 1-hour daily maximum concentration averaged over 3 years, which is equivalent to the 8th highest of the annual distribution of the daily maximum 1-hour concentrations averaged over five years. If three years of prognostic meteorological data are modeled, then the 8th highest of the annual distribution of the daily maximum 1-hour NO_2 concentrations is averaged over three years. And, finally, if one year of site-specific meteorological data is modeled, simply the 8th highest of the daily maximum 1-hour concentrations should be used for comparison to the NAAQS.

The following USEPA guidance memorandums provide additional information for demonstration with the 1-hour NO_2 standard: *Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard* (dated September 30, 2014), and *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard* (dated March 1, 2011).

Ozone and Secondarily Formed Particulate Matter

A modeling analysis showing compliance of an individual source with the ozone NAAQS is generally not required. Draft guidance for assessing secondary impacts was provided in the USEPA memorandum, *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under PSD Permitting Program* (dated December 2, 2016).

$PM_{2.5}$

Major $PM_{2.5}$ sources or major modifications (as defined by the USEPA) should follow the USEPA *Implementation of the New Source Review Program for Particulate Matter Less Than 2.5 Micrometers, Final Rule* (May 16, 2008 Federal Register) and 40 CFR Part 51, Appendix S, for nonattainment compliance demonstrations. Additional guidance for demonstrating compliance with the $PM_{2.5}$ NAAQS and PSD Increments is provided in the USEPA Memorandum *Guidance for $PM_{2.5}$ Permit Modeling* (dated May 20, 2014).

PM_{10}

The 24-hour PM_{10} NAAQS is a probabilistic standard. The standard is not to be exceeded more than once per year over an average of 3 years. When multiple years are modeled, they collectively represent a single period. Thus, if five years of NWS data are modeled, then the highest sixth highest concentration for the whole period becomes the design value.

SO_2

The 1-hour SO_2 NAAQS is a probabilistic standard. Compliance is demonstrated as the 99th percentile of the 1-hour daily maximum concentration averaged over 3 years, which is equivalent to the fourth highest of the annual distribution of daily maximum 1-hour concentrations averaged over five years. Just as in evaluating the 1-hour NO_2 impact concentrations, if three years of prognostic meteorological data are modeled, then the 4th highest of the annual distribution of the daily maximum 1-hour SO_2 concentrations is averaged over three years. And, finally, if one year of site-specific meteorological data is modeled, simply the 4th highest of the daily maximum 1-hour SO_2 concentrations should be used for comparison to the NAAQS.

The following USEPA guidance memorandums provide additional information for demonstration with the 1-hour SO_2 standard: *Guidance Concerning the Implementation of the 1-hour SO2 NAAQS for the Prevention of Significant Deterioration Program* (dated August 23, 2010), and *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard* (dated March 1, 2011).

Lead

On October 15, 2008, USEPA revised the lead NAAQS from 1.5 µg/m^3 based on calendar quarters to 0.15 µg/m^3 based on a rolling 3-month average.

3.2.2 New Jersey Recommendations:

Many of the NJAAQS are identical to the NAAQS. However, the New Jersey rules specify its 3-hr, 8-hr, and 24-hr standards in terms of moving or running hourly averages, and its 3-month and 12-month (annual) standards in terms of moving or running monthly averages. The NAAQS are defined in terms of blocked averages, both for short-term (24-hours or less) and annual averages. For example, when demonstrating compliance with a 24-hour NAAQS, pollutant concentrations are calculated from midnight to midnight the next day. When demonstrating compliance with a 24-hour NJAAQS, pollutant concentrations are calculated from midnight to midnight, from 1 a.m. to 1 a.m. the next day, from 2 a.m. to 2 a.m. the next day, etc.

Initially, compliance with the NJAAQS can be based on use of block averages (similar to the NAAQS). However, if the modeled impact based on blocked averages with representative background concentration added exceeds 90% of the NJAAQS, compliance must then be based on the running hourly and monthly averages for that pollutant and averaging time.

As with the ozone NAAQS, single-source ozone modeling to demonstrate compliance with the ozone NJAAQS usually is not required due to the lack of modeling tools. Modeling of a source's total suspended particulate (TSP) impact generally is not required because the Department assumes that if the PM_{10} and $PM_{2.5}$ NAAQS are met, then the TSP NJAAQS will also be met.

3.3 Prevention of Significant Deterioration (PSD) Increments

The proposed emission increases from all new or modified PSD applicable sources must not cause or contribute to an exceedance of a PSD allowable increment. The PSD allowable increments for Class I and Class II areas are listed in Table 3-3.

Table 3-3. PSD Allowable Increments

Pollutant	Averaging Period	Allowable Increments (µg/m^3)	
		Class I Area	Class II Area
SO_2	3-hr	25	512
	24-hr	5	91
	Annual	2	20
PM_{10}	24-hr	8	30
	Annual	4	17
$PM_{2.5}$	24-hr	2	9
	Annual	1	4
NO_2	Annual	2.5	25

For any averaging period, other than an annual period, the maximum predicted increase may exceed the allowable increment once per year at any one location. The federal guidance on how compliance with the PSD increments is determined is found in 40 CFR 51 Appendix W Section 9.2.3, NAAQS and PSD Increments. A discussion of the additional requirements in the air quality impact assessment for a PSD permit is presented in Appendix A**.**

4.0 Basic Steps of an Air Quality Impact Analysis

There are up to three major components in an air quality impact analysis – modeling protocols, preliminary (single-source) modeling, and multisource modeling analysis. Each component is described in the following sections.

4.1 Modeling Protocol

4.1.1 Preliminary (Single-Source) Modeling Protocol

In accordance with N.J.A.C. 7:27-8.5(d), 18.4(c), and 22.8(c), a modeling protocol must be submitted and approved in advance by the Department before the air quality impact analysis and/or a risk assessment is conducted. These regulations specify that the protocol address all relevant general and site-specific factors and how the air quality impact analysis and/or risk assessment will be conducted. N.J.A.C. 7:27-8.5(d), 18.4(c), and 22.8(c) all reference this document and Technical Manual 1003 (*Guidance on Preparing a Risk Assessment for Air Contaminant Emissions*) for guidance on preparing a modeling protocol.

The protocol should document in detail the methods the applicant proposes to conduct the modeling analysis and present the results. The protocol must be received and approved by the Department before a modeling analysis can be conducted and submitted. The Department will not accept a modeling analysis that was performed without a pre-approved protocol.

In general, a modeling protocol should contain the following information:

- Project Description, including a project overview, facility plot plan, emissions, stack parameters, and special operating and load scenarios, if necessary;

- Project Site Characteristics, including a land use analysis, attainment status, description of the local topography, a Good Engineering Practice (GEP) stack height analysis, and the meteorological data proposed for use in the modeling analysis;

- Regulatory Requirements, including a description of what federal and New Jersey regulations and guidelines apply to the proposed project;

- Proposed Air Quality Analysis, including the proposed air quality model selection and justification for use, screening analysis, and the proposed methods for refined modeling.

- Special Modeling Considerations, including the approach for addressing Class I area modeling, such as the effects on soils and vegetation/growth analysis, near field and long-range visibility, cooling tower modeling, coastal fumigation, health risk assessment, fugitive emissions, deposition and odor modeling (see Appendix C, Odor Modeling Procedures), if necessary;

- Establishing Background Air Quality, including justification of the background air quality monitoring data to be used in the analysis; and

- Presentation of Air Quality Modeling Results, including how maximum impacts, significant impact areas, and compliance with ambient air quality standards and PSD increments will be demonstrated.

Appendix B of this document contains a summary checklist that can be used to assess the completeness of an air quality modeling protocol and analysis. The Department recommends that this checklist be reviewed by the applicant before the documents are submitted to the Department. The modeling protocol should be submitted at the same time the air permit application is sent to the Department. The permit engineer assigned to the project should be informed that a modeling protocol has been submitted to the Department. The Department will not review protocols until an air permit application is received by the Department. Paper copies of modeling protocols and analyses should be sent to:

Chief, Air Quality Permitting
NJDEP, Division of Air Quality
P.O. Box 420 Mailcode 401-02
401 East State Street, 2nd Floor
Trenton, NJ 08625

4.1.2 Multisource Modeling Protocol

As discussed in Section 4.3 of this chapter, a multisource modeling analysis may be necessary if preliminary single-source modeling shows that the proposed source has a significant impact. In this situation, the applicant should submit an additional protocol known as a multisource modeling protocol. A multisource modeling protocol should be submitted and approved by the Department before an applicant conducts multisource modeling of nearby sources. The multisource modeling protocol should include how the multisource inventory was generated, information on the sources included in the multisource modeling, and the modeling methodology that would be employed in the multisource analysis. The same air quality models and meteorological data used in the preliminary (single-source) modeling of the proposed source are normally used for the multisource analysis.

4.2 Preliminary (Single-Source) Modeling Analysis

The preliminary modeling analysis evaluates only the emissions from proposed new sources, or the net emissions increase from a proposed modification.

Per PSD and New Source Review provisions in the 1990 Clean Air Act, one of the principal functions of the preliminary modeling analysis is to determine whether emissions from proposed new sources or the net emissions from a proposed modification will increase ambient concentrations of that pollutant by more than the significant impact levels listed in Table 4-1. The **highest** modeled pollutant concentration for each pollutant's NAAQS and NJAAQS averaging time is used to determine whether a source will have a significant impact, except for 1-hr NO_2, 1-hr SO_2, 24-hr $PM_{2.5}$, and annual $PM_{2.5}$, where at least a 3-year average of the modeled pollutant concentrations will be used to determine the significant impact.

When modeling a facility for which a netting analysis has been performed, the source's proposed emissions increases should be modeled first to determine if they will cause a significant impact. If pollutants and averaging times from the proposed emissions increase are predicted to have significant impact, additional refined modeling may be conducted to account for the effect of the creditable emissions reductions at the facility. In this modeling analysis, the proposed emissions increases should be modeled as positive emissions and the creditable emissions reductions at the facility modeled as negative emissions.

The possibility of a significant impact in a Class I area must also be examined if the source requires a PSD permit and is located within 100 kilometers (km) of a Class I area. In addition, if the source is located within a 100 km of Class I area, a Class I increment demonstrated must be included. PSD sources with large emissions that are located further than 100 km from a Class I Area may need to examine their impact on the Class I area; This determination is made on a case-by-case basis. Furthermore, all PSD source applicants should contact the Fish and Wildlife Office in Denver, Colorado to determine if special Air Quality Related Values Analysis is required for their new source or modification. Contact information is listed in Appendix A.

The only Class I area in or within 100 km of New Jersey is the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge (see Figure A-1). If refined modeling shows that the proposed PSD source has a significant impact in this Class I area, a multisource modeling analysis is necessary to determine PSD increment consumption at the Class I area and possible effects on its Air Quality Related Values (AQRVs). Further guidance on conducting a Class I visibility and other AQRVs analyses is given in Appendix A.

Table 4-1. Class I and Class II Area Significant Impact Levels

Pollutant	Averaging Period	Significant Impact Levels (µg/m^3)	
		Class I Area	Class II Area
SO_2	1-hour	---	7.8[a]
	3-hr	1.0	25
	24-hr	0.2	5
	Annual	0.1	1
NO_2	1-hour	---	10[b]
	Annual	0.1	1
CO	1-hr	---	2,000
	8-hr	---	500
$PM_{2.5}$[a]	24-hr	0.27[c]	1.2
	Annual	0.05[c]	0.2[d]
PM_{10}	24-hr	0.3	5
	Annual[e]	0.2	1
Pb[a]	3-month	---	0.01

a. Maximum of 5-year average 1st highest maximum concentration.

b. NESCAUM interim significance level as maximum 1st high concentration (April 21, 2010 document); USEPAhas recommended 4ppb (~7.5 µg/m^3) as maximum of 5-year average 1st highest maximum concentration.

c. Revised 24-hour and annual $PM_{2.5}$ Class I SIL per April 17, 2018 EPA guidance memo..

d. Revised annual $PM_{2.5}$ Class II SIL of 0.2 µg/m^3 per April 17, 2018 EPA guidance memo...

e. Annual PM_{10} SILs are listed because annual increments still required.

4.2.1 Prediction of Insignificant Impact

When the significant impact levels (SILs) for each applicable pollutant at each applicable averaging time are not exceeded, a multisource modeling analysis is usually not necessary. There are circumstances when the reviewing authority (e.g., NJDEP and/or USEPA) may require multisource modeling even if the predicted source impacts are less than the SILs (i.e., predicted total impacts are within a significant impact level value of the NAAQS, and specifically for $PM_{2.5}$ modeling). For PSD permits, the applicant is required to demonstrate that allowable PSD increments are not being consumed by way of multisource modeling. See Section 3.3 of this document for additional information. Please note that the applicant must always demonstrate compliance with the NAAQS and NJAAQS by adding the applicable background concentrations to the appropriate modeled concentrations.

4.2.2 Prediction of Significant Impact in Attainment Areas

If predicted impacts are above the significant impact levels in an attainment area, then a multisource modeling protocol as described in Section 4.1.2 and a multisource modeling analysis as described in Section 4.3 will be required, and the project's Significant Impact Area (SIA) must be calculated. The SIA is a circular area with a radius extending from the source to the most distant point where approved dispersion modeling predicts a significant ambient impact will occur. The SIA should be determined for each pollutant and averaging period that has been assigned a significant impact level.

4.2.3 Prediction of Significant Impact in Nonattainment Areas

The requirements of N.J.A.C. 7:27-18 (Emission Offset Rule) for Lowest Achievable Emission Rate (LAER) and emission offsets will apply to the emissions of a criteria pollutant if the facility is in an area that is in nonattainment for that criteria pollutant and the permit application is subject to N.J.A.C. 7:27-18 pursuant to N.J.A.C. 7:27-18.2 for that criteria pollutant (discussed in Section 2.1.1 and Tables 2-1 and 2-2 of this document). In addition, a permit application can be subject to the LAER and offset requirements of N.J.A.C. 7:27-18 for a given criteria pollutant when the facility is in an area that is in attainment for that criteria pollutant and the following occurs:

1. The permit application is subject to N.J.A.C. 7:27-18 for that criteria pollutant and the proposed net emissions increase would result in an increase in the ambient concentration of the criteria pollutant in an area that is in nonattainment for that criteria pollutant; and

2. The increase in the ambient concentration of the criteria pollutant is equal to or exceeds the significant air quality impact level specified in Table 4-2.

Thus, in some cases, the preliminary modeling analysis must include an evaluation of the permit application's proposed net emissions increase on any nearby nonattainment areas. All areas in the State are designated as attainment for NO_2, CO, TSP, $PM_{2.5}$, PM_{10}, and lead.

Table 4-2. Significant Air Quality Impact Levels for Increases in Ambient Air Concentrations in Nonattainment Areas*

Pollutant	Averaging Time				
	Annual	24-Hour	8-Hour	3-Hour	1-Hour
SO_2	1.0 µg/m^3	5 µg/m^3	-	25 µg/m^3	-
TSP	1.0 µg/m^3	5 µg/m^3	-	-	-
NO_2	1.0 µg/m^3	-	-	-	-
CO	-	-	500 µg/m^3	-	2000 µg/m^3
Pb	-	0.1 µg/m^3	-	-	-
PM-10	1.0 µg/m^3	5 µg/m^3	-	-	-

* Per N.J.A.C. 7:27-18.4

The following areas are currently designated as nonattainment areas for New Jersey for the following criteria pollutants:

<u>Ozone</u>
The entire state is classified as nonattainment for the 8-hr ozone standard (2008, 75 ppb), with the New York-Northern New Jersey-Connecticut area classified as moderate and the Philadelphia-Wilmington-Atlantic City area classified as marginal.

<u>SO_2</u>
New Jersey is classified as nonattainment with the 1971 SO_2 standard of 0.5 ppm for portions of Warren County that include the following: the Township of Belvidere, the Township of Harmony, portions of Liberty Township (south of UTM coordinate N4522 and west of UTM coordinate E505), portions of Mansfield Township (west of coordinate E505), the Township of Oxford, and the Township of White.

4.3 Multisource Modeling Analysis

When the impact from the proposed source or modification is significant in an attainment area, a comprehensive assessment of air quality is obtained by performing a multisource modeling analysis. The multisource modeling includes not only the facility obtaining the permit, but the contribution from other nearby major sources as well as representative air monitoring data. Those major sources that are located within or near the SIA of the proposed source or modification should be included in the multisource modeling analysis. As mentioned earlier, if the proposed source's air quality impact requires a multisource modeling, the applicant must submit a multisource modeling protocol for approval prior to performing the modeling analysis.

A major source is generally considered to be a facility with the potential to emit 100 or more tons per year of the subject pollutant (0.6 ton per year or more for lead) and is located within or near the SIA of the proposed source or modification. However, other sources with the potential to emit less than 100 tons per year may need to be included in the modeling if they are located within or near the SIA. For example, other sources emitting greater than 25 tons per year of NO_2 and located within the SIA should be investigated for multisource modeling if the applying source has a significant 1-hour NO_2 impact. For applicants requiring a PSD permit, "near" is considered to extend 10 to 20 km from the source(s) applying for a permit or modification. For non-PSD sources, "near" usually extends to at least 10 km beyond the SIA. Each modeling situation is unique; identification of nearby sources requires case-by-case professional judgement. The final multisource modeling inventory may not necessarily be limited by or inclusive of the sources initially investigated.

The applicant is responsible for developing the multisource modeling inventory. The multisource modeling analysis usually consists of two separate evaluations: an evaluation of the NAAQS and NJAAQS; as well as an evaluation of the PSD increments. Thus, two separate modeling inventories may need to be developed. The modeling inventory needs to include the emission units, emission rates, and stack parameters for each source included in the modeling analysis. Building parameters may have to be included if the Department believes the downwash effects are important in accurately predicting the source's contribution to the multisource impact. The Department will normally assist the applicant in identifying potential sources for inclusion in the modeling. For those sources identified as potential candidates for inclusion in the multisource modeling, a request can be made to the Department for a copy of their Title V Operating Permit. The allowable emission rates and stack parameters can be obtained from the Operating Permit. For proposed sources or modifications with significant impact areas that approach or extend into an adjacent state, a similar type of inventory must be obtained from that state as well. It is the responsibility of the applicant to obtain the necessary data from the other state(s).

To simplify multisource inventory development, the Department suggests initially modeling allowable emission rates. However, if necessary, modeling may account for actual operations for nearby sources when demonstrating NAAQS and PSD increment compliance. Additional details for developing an emission inventory are provided in the *Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches to Address Ozone and Fine Particulate Matter*, Federal Register, January 17, 2017. Consultation with the Department is recommended when developing emission inventories.

In cases where many nearby major sources have been identified, the applicant may propose screening techniques to limit the number of sources that are explicitly modeled. The multisource modeling protocol should discuss the methodology used to eliminate these sources from the analysis, such as concentration gradient modeling or adequate representation by background ambient monitoring. The permit applicant must adequately justify the exclusion of nearby sources from a multisource inventory. The applicant should obtain the Department's agreement on the methodology selected to remove sources from the inventory before submittal of the multisource inventory.

5.0 Model Selection

There are two levels of sophistication of models used in an air quality modeling analysis. The first level consists of relatively simple estimation techniques that generally use preset, worst-case meteorological conditions to provide conservative estimates of the air quality impact of a specific source, or source category. These are called screening techniques or screening models. The second level consists of those analytical techniques that provide more detailed treatment of physical and chemical atmospheric processes, require more detailed and precise input data, and provide more specialized concentration estimates. As a result, they provide a more refined and more accurate estimate of source impact and the effectiveness of control strategies. These are referred to as refined models.

Several factors must be considered in the model selection process. These factors include source type, pollutant averaging times that are to be addressed, the potential for aerodynamic building downwash affecting the emissions, nearby terrain features and the existence of complex terrain or complex wind flows, and the local urban/rural land use characteristics. The modeling protocol should specify the models selected, their version numbers, and a justification for their use in the air quality modeling analysis. The model options used in the analysis must be consistent with those recommended by USEPA and approved by the Department.

5.1 Screening Models

A screening modeling analysis is sometimes conducted for the following reasons: (1) to provide a preliminary indication of worst-case pollutant concentrations; (2) to identify the source's worst-case load or plant operating conditions that cause the highest ground-level concentrations; (3) to assist in delineating the appropriate receptor grid for detailed or refined modeling; (4) to determine a source's impacts during equipment startup and shutdown; and (5) to determine the impact of a source located in complex terrain for which no representative hourly meteorological data is available.

5.1.1 CTSCREEN Model

CTSCREEN can be used to obtain conservative, yet realistic, estimates for receptors located on terrain above stack height. CTSCREEN accounts for the three-dimensional nature of plume and terrain interaction and requires detailed terrain data representative of the modeling domain. CTSCREEN is the screening version of CTDMPLUS.

CTSCREEN is designed to execute a fixed matrix of meteorological values for wind speed, standard deviation of horizontal and vertical wind speeds, vertical potential temperature gradient, Monin-Obukhov length, mixing height as a function of terrain height, and wind directions for both neutral/stable conditions and unstable convective conditions. CTSCREEN is designed to address a single source scenario. Placement of receptors requires very careful attention when modeling in complex terrain. Often the highest concentrations are predicted to occur under very stable conditions, when the plume is near or impinges on the terrain.

5.1.2 AERSCREEN Model

AERSCREEN is the screening model whose algorithms are based on AERMOD. This model will produce estimates of regulatory design concentrations without the need for on-site or five years of National Weather Service (NWS) meteorological data and is designed to produce concentrations that are equal to or greater than the estimates produced by AERMOD with a fully developed set of meteorological and terrain data. It will make predictions in both simple and complex terrain for a single source.

5.2 Refined Models

Refined models are more complex than screening models and are used to address the impacts of both single and multiple sources. They require more detailed and precise input data than screening models, and use more complex calculations to provide more accurate estimates of pollutant concentrations.

5.2.1 AERMOD Model

AERMOD - An atmospheric dispersion model based on atmospheric boundary layer turbulence structure and scaling concepts, including treatment of multiple ground-level and elevated point, area and volume sources. It handles flat or complex terrain, rural or urban land use, and includes algorithms for building effects and plume penetration of inversions aloft. It uses Gaussian dispersion for stable atmospheric conditions (i.e., low turbulence) and non-Gaussian dispersion for unstable conditions (high turbulence). The model should be limited to plume transport distance of less than 50 km. This model was officially promulgated by the USEPA in 2005 to replace ISC3 as the preferred guideline model. Enhancements to AERMOD were included with the latest revisions to the Guideline on Air Quality Models published in the Federal Register Volume 82, Number 10, Tuesday, January 17, 2017.

The following are implemented when AERMOD's default option is selected: the elevated terrain algorithm that requires input of terrain height data, stack-tip downwash, the calms processing routines, the missing data processing routines, and a 4-hour half-life for exponential decay of SO_2 for urban sources. The regulatory default options should generally be used in the modeling analysis. However, use of the elevated terrain option that needs the input of terrain height data is not required in most New Jersey locations because of the flat terrain.

5.2.2 CALPUFF Model

CALPUFF - A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, chemical transformation of SO_2 and NO_x to sulfate and nitrate, and both dry and wet deposition. CALPUFF can be applied for long-range transport modeling (> 50 km) and in the near-field situations with complex wind fields such as in complex terrain or the coastline (i.e., sea-breeze). In keeping with the latest Appendix W changes, CALPUFF is no longer a preferred long range or complex terrain model.

5.2.3 CTDMPLUS Model

CTDMPLUS - A Complex Terrain Dispersion Model (CTDM) Plus algorithms for unstable situations (i.e., highly turbulent atmospheric conditions). It is a refined point source Gaussian air quality model for use in all stability conditions (i.e., all conditions of atmospheric turbulence) for complex terrain.

6.0 Project Description and Site Characteristics

It is essential that the air quality modeling protocol contain a description of the project and clearly describe the project site characteristics. This description should include a land survey, Good Engineering Practice (GEP) stack height analysis, urban/rural land use analysis, population estimates, and a discussion of the topography near the project. Each of these topics is discussed in more detail in the following subsections.

6.1 Project Overview

Description of the proposed source or modification should contain the following essential information:

- Type of facility (e.g., resource recovery facility, coal-fired power plant, sewage sludge incinerator, etc.);
- Size of the facility (e.g., waste input in pounds per hour or tons per day, megawatts, heat input in MMBTU/hr, etc.);
- Primary and secondary (if applicable) fuel type;
- Description of the facility equipment;
- Proposed control equipment;
- Proposed hours of operation;
- Pollutant emission rates (lbs/hr and tons/yr);
- Map with an appropriate scale indicating the location of the facility;
- Location of property line and fence line/ambient air boundaries (if applicable);
- Attainment status of all criteria pollutants and source location relative to nonattainment areas;
- Distance to the Brigantine Class I Area;
- Brief description of the area near the source in terms of land use, major geographic features, residential areas, etc.; and
- Topographical information: base elevation of the stack(s), closest terrain point above stack top, proximity of hilly terrain, whether the site is coastal or inland, how close the site is to the coast if within 20 km, the closest state border, and whether there are any

predominant features (i.e., high-rise structures, man-made hills, lakes, river valleys, etc.) in the vicinity.

6.2 Facility Plot Plan

A plot plan (also called land survey/site plan) of the facility property must be provided with the modeling protocol. The preparation and submittal of a plot plan to a regulatory agency in New Jersey is governed by the State Board of Professional Engineers and Land Surveyors and is codified in the New Jersey Administrative Code at Title 13, Chapter 40. **In accordance with N.J.A.C. 13:40-5.1 (J) (n), all land surveys, construction plans, and maps prepared to show topographic data or planimetric data and delineate property lines submitted to the Department must bear the signature and impression seal of the licensed land surveyor or professional engineer.** Thus, a full-size paper copy is required. Any plot plan submitted in the modeling protocol must show the facility's property line and the location of all sources and stacks that will be included in the modeling analysis. The plot plan shall also identify fences and other barriers, if any, which would deter public access.

The plot plan must be of sufficient detail (showing all building dimensions) to enable a determination of GEP formula stack height and the potential for building downwash considerations for stack heights less than GEP formula heights. The grade elevation and height above grade for each structure must be indicated as well as the stack base elevation. In complex cases where there are several existing structures or tiers which must be considered in the GEP analysis, photographs or three-dimensional sketches may also be required as additional documentation.

In summary, the applicant must provide a detailed plot plan of the site with the following information:

- Depiction of the site, drawn to scale (with the scale indicated), certified by a New Jersey professional engineer or land surveyor.

- An indication of true north. If plant north is shown on the plot plan, the relationship between true north and plant north must be provided.

- Location of: All proposed emission points (stacks, vents, etc.)
All buildings and structures on-site
The facility property line
The facility fence line (if any)

- Location of buildings and structures immediately adjacent to the applicant's property, if they are located near enough to the proposed emission points to potentially cause downwash effects.

- Base elevation, height, width, and length of all buildings and structures.

- Location of nearby residences and other sensitive receptors, such as hospitals, nursing homes, schools, and day care centers for those modeling analyses evaluating the health risk due to the emissions of air toxics. This information can be provided on separate figure(s).

Incomplete plot plans will not be accepted, and will be returned for correction. The plot plan must be in the form of a physical, paper copy. An electronic file will not be accepted. Contact the Department at 609-292-6722 if specific guidance is needed concerning the plot plan.

6.3 Good Engineering Practice (GEP) Stack Height Analysis

The use of stack height credit greater than GEP stack height or credit resulting from any other dispersion technique is prohibited in the development of emission limitations (40 CFR 51). If stacks for new or existing major sources are found to be less than the height defined by USEPA's refined formula for determining GEP height, the increased turbulence due to wake effects from the nearby building structures should be determined.

A GEP stack height analysis shall be conducted in accordance with the USEPA stack height regulation (40 CFR 51) and the *Guideline for Determination of Good Engineering Practice Stack Height* (USEPA, 1985). The formula for the GEP stack height, as defined by the USEPA guidelines, is listed below:

$$H_{GEP} = H_b + 1.5\ L$$

where: H_{GEP} is formula GEP stack height;
H_b is the height of adjacent or nearby building; and
L is the lesser of the height and the maximum projected width of adjacent or nearby building, i.e., the critical dimension

A stack is considered close enough to a building to be affected by downwash if it is located within 5L, or five times the lesser dimension of the building in any wind direction.

The GEP Stack height analysis must identify all buildings on and off site with the potential to cause aerodynamic downwash of emissions from the stack. According to the *Guideline for Determination of Good Engineering Practice Stack Height*, the analysis need only consider buildings within 0.8 kilometer or 5L from the stack, whichever is less. For each stack, a table shall be provided with the following data for each building (or tier):

a. Building height (relative to stack base elevation);
b. Maximum projected building width;
c. Distance from the stack;
d. 5L distance; and
e. Calculated formula GEP stack height.

In the table, identify the building which gives the greatest formula GEP stack height. In addition to the GEP stack height table, a table with coordinates must be provided for all stacks and each corner of any structure (or structure tiers) that are within 5L of the stack. Indicate whether there are any unusual structures, such as hyperbolic cooling towers or lattice work.

The USEPA's Building Profile Input Program with the Plume Rise Model Enhancements (BPIPPRM) is used to derive the parameters necessary to simulate directional dependent aerodynamic downwash in the model. The output from BPIPPRM can help to complete the GEP stack height table described above. Output from this program must not be used as a substitute for the GEP stack height table. Accurate input to the GEP stack height software program is vital. The Department will verify the information provided in the GEP stack height table with the facility plot plan. Input/output files from the BPIPPRM program should be submitted to the Department in electronic format with the protocol.

Neither proposed nor modified sources may employ dispersion techniques (as defined in 40 CFR 51.100(hh)) or seek to increase the height of an existing stack unless the provisions in 40 CFR 51.100(kk)2 are met. If the height of the stack is above both the calculated formula GEP height and the *de minimus* GEP height of 65 meters, the higher of either the calculated GEP height or 65 meters (not the actual stack height) must be used in the modeling to demonstrate compliance with ambient air quality standards. Exceptions are sometimes made for modeling to be used in health risk assessments. Before modeling a stack height above GEP, the applicant should consult with the Department.

6.4 Urban/Rural Determination

It is important to determine whether a source is in an urban or rural dispersion environment. Urban areas have more turbulence in the atmosphere than rural locations due to their larger surface roughness length and the nighttime convective boundary layer associated with urban heat islands. AERMOD has two keyword switches for turning on the urban mode: the URBANOPT keyword on the CO pathway and the URBANSRC keyword on the SO pathway. AERMOD enhances the turbulence for urban nighttime conditions more than what would be expected at adjacent rural locations. In addition, AERMOD uses population estimates as a surrogate to define the magnitude of the differential heating caused by the urban heat island effect.

Sources located in an area defined by population or land use as urban should be modeled using the urban mode. For non-population oriented urban areas, or areas influenced by both population and industrial activity, the user will need to estimate an equivalent population to adequately account for the combined effects of industrialized areas and populated areas with the modeling domain. Selection of the appropriate population for these applications should be determined in consultation with the Department and/or USEPA.

Sources located in areas defined as rural should be modeled using the rural dispersion parameters. For tall stacks located adjacent to small or moderate-sized urban areas, the effective plume height may extend above the urban boundary layer and, therefore, rural coefficients may be considered. For analysis of whole urban complexes, the entire area should be modeled as an urban region if most of the sources are in areas classified as urban. Buoyancy-induced dispersion (BID), as identified by Pasquill, is included in the preferred models and should be used where buoyant sources, e.g., sources involving fuel combustion, are involved.

In some situations, professional judgment must also be used in classifying a site as urban or rural. For example, Auer's land use analysis may result in a rural designation when a source is in a heavily urbanized area next to a large body of water. At such a site, there are strong arguments that an urban designation is more appropriate. In these and other cases where the urban/rural determination is borderline, consult with the Department to determine the mode under which to model the subject source(s). The two methods for determining whether a source should be modeled as urban or rural are described in the following two sections. Of the two methods, the land use procedure is considered more definitive.

6.4.1 Land Use Analysis

Section 7.2.1.1 of the USEPA *Guideline on Air Quality Models* provides the basis for determining the urban/rural status of a source. For most applications, the Land Use Procedure described in Section 7.2.3(c) is sufficient for determining the urban/rural status.

Table 6-1. Identification and Classification of Land Use

Type	Use and Structures	Vegetation
I1	Heavy Industrial: Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; < 5% vegetation
I2	Light-moderate industrial: Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost total absent; <5% vegetation
C1	Commercial: Office and apartment buildings, hotels; > 10 story heights, flat roofs	Limited grass and trees; < 15% vegetation
R1	Common residential: Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; > 70% vegetation
R2	Compact residential: Single, some multiple, family dwelling with close spacing; generally < 2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; < 30% vegetation
R3	Compact residential: Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ash pits, no driveways	Limited lawn sizes, old established shade trees: < 35% vegetation
R4	Estate residential: Expansive family dwelling on multi-acre tracts	Abundant grass lawns and lightly wooded; > 95% vegetation
A1	Metropolitan natural: Major municipal, state, or federal parks, golf courses, cemeteries, campuses, occasional single-story structures	Nearly total grass and lightly wooded; > 95% vegetation
A2	Agricultural rural	Local crops (e.g., corn, soybean); > 95% vegetation
A3	Undeveloped: Uncultivated; wasteland	Mostly wild grasses and weeds, lightly wooded; > 90% vegetation
A4	Undeveloped rural	Heavily wooded; > 95% vegetation
A5	Water surfaces: Rivers, lakes	

1978: Correlation of Land Use and Cover with Meteorological Anomalies. *Journal of Applied meteorology*, 17, 636-643.

To perform the land use procedure: (1) Classify the land use within the total area circumscribed by a 3-kilometer radius circle about the source using the meteorological land use typing scheme shown in Table 6-1 (Auer, 1978); (2) If land use types I1, I2, C1, R2, and R3 account for 50% or more of the total area, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients. Use the latest available United States Geological Survey (USGS) National Land Cover Data (NLCD) to identify and correlate the land cover classifications to the Auer land use type. Figure 6-1 provides an example of the interrelationship between the USGS NLCD classifications and the Auer methodology.

Figure 6-1. Correlation of USGS Land Cover Classifications with Auer Land Use Types

USGS Classifications

Auer Land Use Types

Type	Use and Structures	Vegetation
I1	Heavy Industrial: Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; < 5% vegetation
I2	Light-moderate industrial: Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost total absent; <5% vegetation
C1	Commercial: Office and apartment buildings, hotels; > 10 story heights, flat roofs	Limited grass and trees; < 15% vegetation
R1	Common residential: Single family dwelling with normal easements; generally one story, pitched roof structures; frequent driveways	Abundant grass lawns and light-moderately wooded; > 70% vegetation
R2	Compact residential: Single, some multiple, family dwelling with close spacing; generally < 2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; < 30% vegetation
R3	Compact residential: Old multi-family dwellings with close (<2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ash pits, no driveways	Limited lawn sizes, old established shade trees: < 35% vegetation

USGS Land Cover	Auer Land Use Type
23: Developed, Medium Intensity	R2: Compact Residential – Single R3: Compact Residential – Old Multi-family
24: Developed, High Intensity	I1: Heavy Industrial I2: Light-Moderate Industrial C1: Commercial

If land cover data is later than 1992, supplemental canopy and impervious surface data should be included. Major roadways and clover leaf interchanges should be identified as urban land use areas. Unless the source is in an area that is distinctly urban or rural, the land use analysis should provide the percentage of each land use type from the Auer scheme and the total percentages for urban versus rural. In some circumstances, such as when an area is undergoing rapid development, county or local planning board maps may be required to support land use classification.

6.4.2 Population Density Procedure

Population Density Procedure: (1) Compute the average population density, p, per square kilometer for the surrounding area; (2) If p is greater than 750 people/km^2, use urban dispersion coefficients; otherwise use rural dispersion coefficients. The selection of either urban or rural dispersion coefficients can become difficult in adjacent urban areas and across areas of suburban sprawl. Population density should be used with caution and should not be applied to highly industrialized areas. In this circumstance, the population density may be low, but the area is sufficiently built-up so that the urban land use criteria would be satisfied.

The AERMOD model requires population data when sources are in urban areas. Guidance on determining the population of the urban area can be found in USEPA's *AERMOD Implementation Guide*. According to this document, if a source is in a relatively isolated urban area, the published census data corresponding to the Metropolitan Statistical Area (MSA) for that location can be used. When the urban area is located next to other urban areas or corridors, it is necessary to identify the area of population that will contribute to the urban heat island that will affect the modeled sources' plume. USEPA does not recommend the use of population based on the Consolidated MSA (CSMA) for applications within urban corridors as this may overestimate the urban heat island effect. When an MSA cannot be clearly identified, it is recommended that the extent of the area where the population density exceeds 750 people per square kilometer be determined. The combined population within the defined area should be input to the AERMOD model. USEPA suggests using gridded population values based on census block or block group data.

The applicant must include a section in the protocol describing the methodology and data used to derive the population estimate. In situations where the population cannot be clearly determined, consult with the Department.

6.5 Topography

In terms of an air quality modeling analysis, the topography in the region of a source is defined as being simple terrain for land features that are below stack top, or being intermediate/complex terrain for land features that are above stack top. Terrain must be considered in the model selection process. The USEPA recommended model for regulatory applications (AERMOD) has been formulated to produce valid design concentrations in both simple and intermediate/complex terrains.

When AERMOD is used in the regulatory default mode, AERMOD calculates the total concentration as the weighted sum of 2 plume states: a horizontal plume state and a terrain-responding plume state. In the horizontal plume state, the plume height is determined by the release height and plume rise. Impingement occurs if terrain rises to the elevation of the plume. In the terrain-responding plume state, the plume follows the terrain. Under certain conditions such as gently sloping terrain, AERMOD may underestimate concentrations. Because of this, the Department may require that the model be run with non-default parameters. This will be determined on a case by case basis. Most locations in New Jersey can be modeled as flat (simple) terrain.

AERMAP requires either Digital Elevation Model (DEM) data or National Elevation Dataset (NED) to process the terrain. The Department requires the use of 10-meter or 30-meter resolution data. A detailed discussion on the use of DEM and NED data in AERMAP is contained in Section 4.3 of the *AERMOD Implementation Guide*. The size of the modeling domain should be discussed and all DEM/NED files used in the analysis and should be submitted with the modeling protocol.

7.0 Emissions and Source Data

7.1 Emissions

Allowable emissions from the source must be specified on both the annual (tons/year) and hourly (lbs/hour) basis. Often a source will have more than one operating scenario. Each operating scenario may have its own lbs/hour allowable emission rate and stack parameters. Therefore, each operating scenario may need to be evaluated to determine which will cause the highest impacts used to demonstrate compliance with the NAAQS, NJAAQS, and PSD increments. For example, if a boiler uses natural gas as primary fuel and diesel as backup fuel, then the fuel which produces the highest impact for each pollutant and pollutant-specific averaging period should be used to show compliance.

Other examples include the variation in operating loads (Section 7.1.1) and the variation of emission rates and stack parameters that occur with ambient temperature in simple and combined-cycle turbines. As the density of air entering the turbine increases (colder temperatures), the mass of air flowing through the turbine increases as does the turbine output power, gas flow, and mass emissions. It is reasonable to calculate annual emissions and stack parameters at a representative annual average temperature, but short-term emissions and stack parameters should be calculated using reasonable minimum and maximum temperatures that can be expected at the site.

Table 7-1 specifies how the allowable emission rates of the proposed or modified source applying for a permit should be calculated. The information in this table is taken from the proposed major new or modified source portion of Table 8-2 in USEPA's *Guideline on Air Quality Models*. When modeling a proposed modification to a source, only the net change in emissions need to be modeled to determine whether the modification will have a significant impact on air quality (see Section 2.3 of this technical manual). Except for federally enforceable permit demonstrations, emissions from emergency generators and fire pumps are generally not included in the air quality impact modeling analysis.

Table 7-1. Point Source Emission Input Data for NAAQS Compliance Demonstration

Averaging Time	Emission Limit (lb/MMBtu)[1]	Operating Level (MMBtu/hr)[1]	Operating Factor (e.g., hr/yr, hr/day)
Annual and quarterly	Maximum allowable emission limit or federally enforceable permit limit	Design capacity or federally enforceable permit condition	Continuous operation (i.e., 8760 hrs/yr)[2]
Short Term (<= 24 hrs)	Maximum allowable emission limit or federally enforceable permit limit	Design capacity or federally enforceable permit condition[3]	Continuous operation, i.e., all hours of each time period under consideration (for all hours of the meteorological data base)[2]

1 Terminology applicable to fuel burning sources; analogous terminology (e.g., lb/throughput) may be used for other types of sources.

2 If operation does not occur for all hours of the time period of consideration (e.g., 3 or 24-hours) and the source operation is constrained by a federally enforceable permit condition, an appropriate adjustment to the modeled emission rate may be made (e.g., if operation is only 8 a.m. to 4 p.m. each day, only these

hours will be modeled with emissions from the source. Modeled emissions should not be averaged across non-operating time periods.

3 Operating levels such as 50% and 75% of capacity should also be modeled to determine the load causing the highest concentration.

7.1.1 Partial Load and Startup/Shutdown Emissions

The operating scenario analysis may include an evaluation of the various operating loads for an emission unit or source(s). Because emission rate, exit velocity, and temperature may vary as a function of operating load or condition, modeling is required to determine which load has the potential for the highest ambient impact. At a minimum, the emission unit should be modeled using the design capacity (100% load), or any higher load rates if it can be operated at those higher rates. Sources that operate for appreciable amounts of time at loads less than the design capacity require an analysis at partial loads, such as 50% and 75%, to identify the operating conditions that cause the maximum ground-level concentrations. It should be noted that while emissions and stack flow rates are relatively linear with load for boilers, emissions and stack flows for combustion turbines are not linear with load. Engineering data should be submitted by the applicant to define turbine low load emissions and flow data. In general, load analysis is required only for larger emission units operating for significant amounts of time at less than 100% load. Applicants should describe their proposed partial-load approach and assumptions in the modeling protocol. If an operating load is evaluated as worst-case in the air dispersion demonstration, it must be included as an operating scenario in the permit requirements

A modeling analysis of short-term air quality impact during source startup/shutdown is required when the applicant details special emission limits during these time periods. Startup/shutdown modeling may also be requested if these conditions coincide with a very low stack exit velocity or temperature.

7.1.2 Fugitive Emissions

Fugitive emissions from a facility are those emissions that are not captured and released through a stack or active vent. A proposed source must model the impact of its fugitive emissions unless the release height, emission rate, or distance to the property line is such that minimal air quality impacts would result. A few examples of fugitive emission sources are coal piles, paved and unpaved roads, and gaseous emissions from landfills. Fugitive emissions are usually modeled as area or volume sources. All fugitive emission calculations and modeling assumptions should be discussed in detail and referenced in the modeling protocol.

7.2 Types of Emission Sources

7.2.1 Point Sources

Point sources include emission units that exhaust through stacks, chimneys, exhaust fans, or vents. The required input data include emission rate, stack height, stack inside diameter, stack exit temperature, and stack exit velocity. The base elevation of the stack should be based upon local topographic data. The stack location in Universal Transverse Mercator (UTM) coordinates must also be provided. If a value of 0.0 is input for the exit temperature, AERMOD will adjust the exit temperature for each hour to reflect the ambient temperature.

7.2.2 Area Sources

Area sources are identified as sources with low level or ground level releases with minimal thermal or momentum plume rise, and include material storage piles, lagoons and other low-lying sources. In AERMOD, individual area sources may be represented as rectangles with aspect ratios (length/width) of up to 10 to 1. Rectangles may be rotated in a clockwise (positive angle value) or counterclockwise (negative angle value) direction, relative to a north-south orientation. The rotation angle and the location of the source are specified relative to the location of the southwest corner of the source. Irregular shaped sources may be represented by a series of smaller rectangles, or a polygon. The modeling of area sources is discussed in detail in Section 3.3.2.3 of the AERMOD User's Guide.

The emission rate for the area source is expressed as grams per second per meter squared ($g/sec/m^2$). In addition to the emission rate, release height (h), physical dimensions and orientation of the area source, the applicant may optionally provide the initial vertical dimension of the area source plume.

Area sources are not affected by the building downwash algorithms in the models. Additionally, elevated terrain is not considered when modeling impacts from area sources. AERMOD treats area sources as if in flat terrain, even if elevated receptors are incorporated.

7.2.3 Volume Sources

Volume sources are sources that have initial dispersion prior to release, such as building roof vents and conveyor belts. Volume sources can also be used to characterize the mobile emissions associated with construction activities. The modeling of volume sources is discussed in Section 3.3.2.2 of the AERMOD User's Guide. The location of the volume source is specified relative to the location of the center of the source. Volume sources are characterized by volume emission rate gram per second (g/s), emission release height, initial lateral dimension (σy_O), and initial vertical dimension (σz_O). The release height is the height of the center of where most of the plume is emitted from (i.e., the center of the initial volume).

For buoyant sources, such as engine emissions associated with construction/yard activities, assume that the volume height equals the plume height under annual average (or period average) conditions. The initial lateral and vertical dimensions represent one standard deviation of the plume. Therefore, the initial dimensions can be smaller than the release height.

The initial lateral dimension is calculated differently depending on whether the source is a single volume source or a line source. The initial vertical dimension is calculated differently depending on the emission release height and the presence of buildings. USEPA's suggested procedures for estimating σy_O and σz_O are listed in Table 7-2. Like area sources, volume sources are not affected by the building downwash algorithms in the models.

Table 7-2. Suggested Procedures for Estimating σy_O and σz_O *

Type of Source	Procedure for Obtaining Initial Dimension
(a) Initial Lateral Dimensions (σy_O)	
Single Volume Source	σy_O = length of side divided by 4.3
Line Source Represented by Adjacent Volume Sources	σy_O = length of side divided by 2.15
Line Source Represented by Separated Volume Sources	σy_O = center to center distance divided by 2.15
(b) Initial Vertical Dimensions (σz_O)	
Surface-Based Source	σz_O = vertical dimension of source divided by 2.15
Elevated Source on or Adjacent to a Building	σz_O = building height divided by 2.15
Elevated Source not on or Adjacent to a Building	σz_O = vertical dimension of source divided by 4.3

* Per Section 3.3.2.2 of User's Guide for the AMS/EPA Regulatory Model – AERMOD EPA-454/B-03-001, USEPA, Research Triangle Park, North Carolina, September 2004.

7.2.4 Roadways and Line Sources

Line sources are sources that may be represented as a series of volume or area sources, such as roads, runways, or conveyor belts. Near ground level sources may be modeled using a series of area sources. As mentioned earlier, in AERMOD individual area sources may be represented as rectangles with aspect ratios (length/width) of up to 10 to 1. Line sources with an initial plume depth, such as a conveyor belt or rail line, may be modeled as a series of volume sources. The number of line sources required to represent the source, N, is calculated as the length of the line source divided by its width.

In the case of a long and narrow line source such as a rail line, it may not be practical to divide the source into N volume sources. It is acceptable to approximate the representation of the line source by placing a smaller number of volume sources at equal intervals along the line source. In general, the spacing between individual volume sources should not be greater than twice the width of the line source. However, a larger spacing can be used if the ratio of the minimum source-receptor separation and the spacing between individual volume sources is greater than about 3. The total line source emission rate is divided equally among the individual volumes used to represent the line source, unless there is a known spatial variation in emissions.

The impact of particulate emissions from vehicle traffic (e.g., road dust), in which an initial wake behind the vehicle is created, should be characterized using multiple volume or area sources. The number of volume sources, N, should be calculated as described above. The vertical dimension of the source used in the calculation of σz_O is typically equivalent to the height of the vehicles generating the emissions, commonly 1.5 to 3.0 meters.

7.2.5 Flares

Unlike enclosed flares, open flares are unique point sources as they do not have a defined stack exit diameter. For modeling, it is necessary to compute equivalent emission parameters, i.e. adjusted values of temperature, stack height and "stack" inside diameter. AERMOD does not have a source category for flares, and therefore, needs to have the adjustments made by the modeler. The approach is as follows:

1. Compute the adjustment to stack height (H in meters) as a function of total heat release Q (in MMBtu/hr):

$$H_{equivalent} = H_{actual} + 0.944(Q)^{0.478}$$

[Note: 1) some flares are rated in calories per second and the conversion factor is 14.3 Btu/hr for every cal/s; and 2) the adjustment is to account for flame length and assumes the flame is tilted 45-degrees from the vertical.]

2. Assume a temperature of 1,273 degrees Kelvin (K);

3. Assume an exit velocity of 20 meters/second; and

4. Assume an effective stack diameter d_{eff} of,

$$d_{eff} = 0.1755(Q)^{0.5} \text{ meters.}$$

Equivalent diameter is applicable for both vertical and horizontal flares since it is back calculated from a buoyancy flux assumption. Buoyancy flux is not a function of flare orientation. Therefore, the equation can be used for both horizontal and vertical flare orientations.

This method pertains to the “typical” flare, and will be more or less accurate depending on various parameters of the flare in question, such as heat content and molecular weight of the fuel, velocity of the uncombusted fuel/air mixture, presence of steam for soot control, etc. This method may not be applicable to every situation; therefore, the applicant may submit their own properly documented method to the Department for review and approval. Flares may be modeled with AERSCREEN or AERMOD in screen mode.

8.0 Establish Background Air Quality Concentrations

Background air quality concentrations are an essential part of the total air quality concentrations to be considered in assessing source impacts. Background air quality includes pollutant concentrations due to: (1) natural sources; (2) nearby sources that were not included in the modeling analysis; and (3) distant sources (e.g., long-range transport).

Air monitoring data used in the background determination should be representative of the area of interest (i.e., it should characterize the existing concentrations expected at locations of predicted maximum impacts). For short-term standards, the diurnal or seasonal patterns of the air quality monitoring data may differ significantly from the patterns associated with the modeled concentrations. When this occurs, it may be appropriate to pair the air quality monitoring data in a temporal manner that reflects these patterns (e.g., pairing by season and/or hour of day). An applicant's determination of the appropriate background concentrations must be consistent with USEPA modeling guidance and justified in the modeling protocol.

8.1 Sources of Background Air Quality Data

There are generally two ways to obtain background air quality concentrations: through an on-site air quality monitoring network; or through a monitoring network operated by government agencies. In most cases, monitoring data collected by either the Department or a neighboring state is used to establish background concentrations. If monitoring data is obtained from an air monitoring network other than the Department's, the data must be shown to meet the Department's air monitoring quality assurance requirements for representativeness, completeness, precision, and accuracy.

When possible, an applicant must select a monitor upwind of the existing sources included in the modeling to avoid double-counting the impact from these sources. In some instances, such as a multisource modeling analysis, a different background monitor will need to be used than that proposed in the single-source modeling analysis. Additional guidance can be obtained from Appendix W to 40 CFR 51 – Guideline on Air Quality Models.

Modeling protocols must specify the monitors selected as representative of background air concentrations, justify their selections, and list the pollutant concentrations that will be used in the analysis. Unless instructed otherwise by the Department and regardless of the anticipated significance or insignificance of the source, the applicant must include a discussion of background data in the protocol.

In 2015, the Department maintained over 37 monitoring sites in its continuous and manual monitoring networks. The continuous monitoring network consists of sites that measure CO, NO_x, O_3, SO_2, and meteorological data by automated instruments (not all pollutants are measured at all sites). In addition, the continuous monitoring network has real time $PM_{2.5}$ (TEOM) monitors. Nonetheless, the data from the $PM_{2.5}$ real-time analyzer cannot be used for comparison to the NAAQS or as background for modeling because it is not a USEPA approved 24-hour manual samplers.

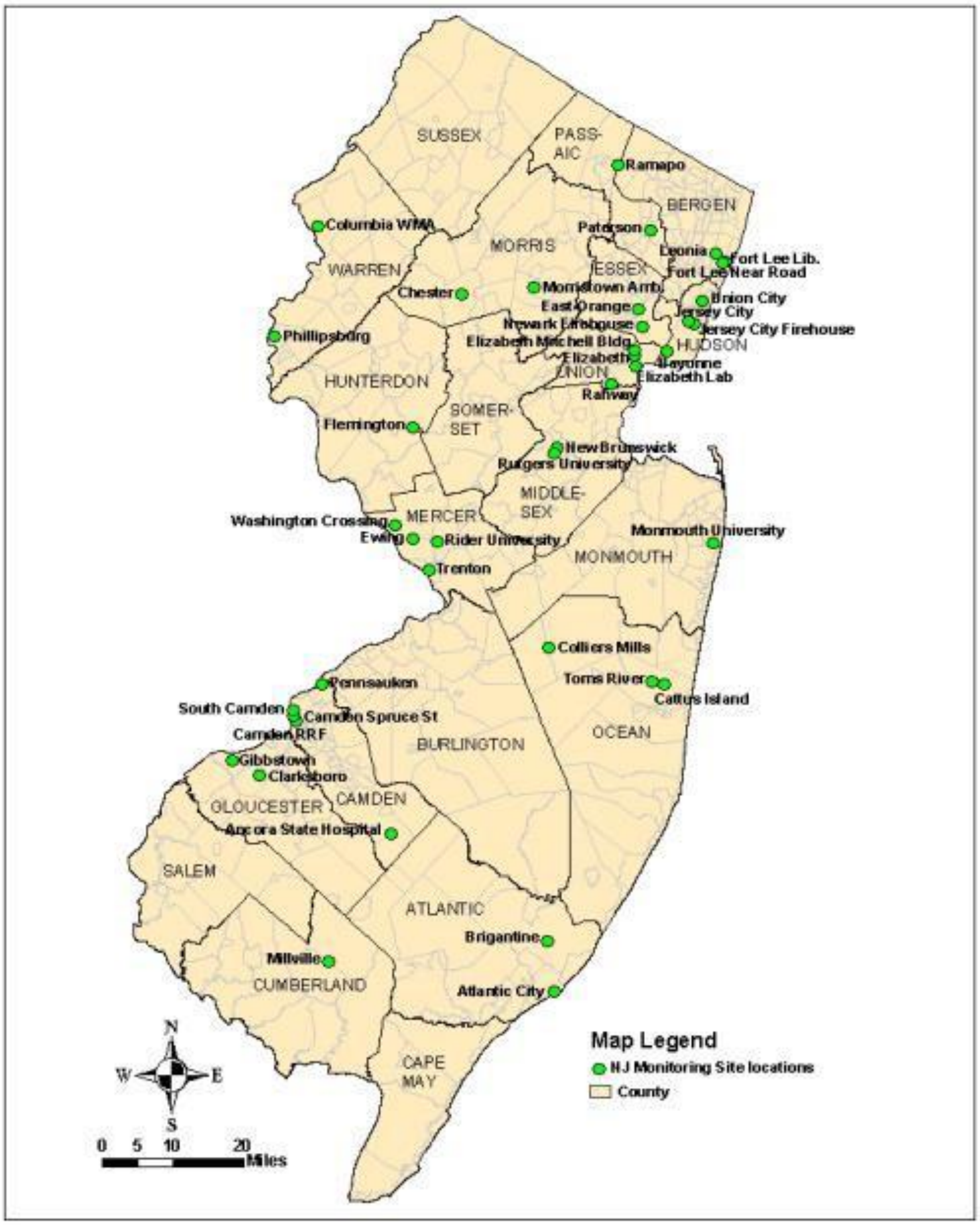
Table 8-1. List of Pollutants Monitored at Each Site

Monitoring Site	NO_x	SO_2	CO	O_3	$PM_{2.5}$	PM_{10}
Ancora State Hospital				x		
Atlantic City					x	
Bayonne	x	x		x		
Brigantine		x		x	x	
Camden Spruce Street	x	x	x	x	x	x
Camden-RRF						x
Chester	x	x		x	x	
Clarksboro / Gibbstown [a]				x	x [a]	
Colliers Mills				x		
Columbia WMA	x	x		x	x	
East Orange	x [b]		x [b]			
Elizabeth		x	x			
Elizabeth Lab	x	x	x		x	
Elizabeth-Mitchell Building					x[b]	
Flemington				x		
Fort Lee Near Road	x		x			
Fort Lee-Library					x	
Jersey City-Firehouse					x	x
Jersey City	x	x	x			
Leonia				x		
Millville	x			x		
Monmouth University				x		
Morristown-Ambulance Squad					x	
New Brunswick					x [c]	
Newark Firehouse	x	x	x	x	x	
Paterson					x	
Pennsauken					x	
Phillipsburg					x	
Rahway					x	
Ramapo				x		
Rider University				x		
Rutgers University	x			x		
Toms River					x	
Trenton					x	
Union City					x	
Washington Crossing					x	

a. Gibbstown $PM_{2.5}$ monitor relocated 7 kilometers east to nearby Clarksboro monitoring site during 2017.
b. Discontinued in 2016.
c. New Brunswick $PM_{2.5}$ speciation monitor relocated to nearby Rutgers University monitoring site in 2016.

Yearly summaries of air quality data collected by NJDEP are available as Air Quality Reports. These reports can be accessed easily at the following website: http://www.njaqinow.net/. These reports also contain information on the address and description of each monitoring site in the NJDEP ambient air quality monitoring network. Air pollutants monitored at each monitoring site are listed in Table 8-1. A map showing the locations of the ambient air monitoring sites is contained in Figure 8-1. Further information can be obtained by calling (609) 292-0138.

Figure 8-1. 2014 New Jersey Air Monitoring Sites



8.2 Use of Background Values in the Modeling Analysis

Unless air quality data collected from a source specific network are used, the latest three years of monitoring data should be used irrespective of the meteorological data period used in the dispersion modeling. Further refinement of these background air quality values such as those techniques discussed in Section 8.3 of EPA's Appendix W to 40 CFR 51 – *Guideline on Air Quality Models* will be considered by NJDEP on a case-by-case basis.

8.2.1 Deterministic NAAQS and NJAAQS

All NAAQS and NJAAQS not specifically discussed in Section 8.2.2 are deterministic.

First-Tier
The highest, second-highest short-term concentrations from the selected representative monitor should be used as the background concentration for the short-term deterministic NAAQS (24 hours or less). For long-term deterministic NAAQS and NJAAQS, the maximum value monitored over three years should be used as background.

Second-Tier
If an applicant believes a background based on second-high values is too high, a second-tier technical analysis may be made that demonstrates the first-tier value could not reasonably be assumed to occur at the same time/place as the modeled design value. In this situation, an alternative background value may be proposed with justification. The proposal is subject to NJDEP approval.

8.2.2 Statistical Based NAAQS

8.2.2.1 1-Hour NO_2

The 1-hour NO_2 standard is based on the 3-year average of the 98^{th}-percentile of the annual distribution of daily maximum 1-hour concentrations. Use of background monitoring data in a 1-hour NO_2 NAAQS demonstration is discussed in detail in the USEPA memo "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard" (March 1, 2011).

First-Tier
The first-tier background technique is defined by USEPA as the 98^{th}-percentile of the annual distribution of daily maximum 1-hour values averaged across three years of data from a representative monitor. That value would be equivalent to the 8^{th} highest daily 1-hour value over a 365-day monitoring period. The latest three years of monitoring data should be used irrespective of the meteorological data period used in the dispersion modeling. Normally, the Department accepts first-tier 1-hour NO_2 background values without further justification.

Second-Tier

The second-tier background technique uses a 3-year year average of the 98th-percentile of the available background concentrations grouped into subsets by the four seasons (quarterly) and/or the 24 hours-of-day. The various options of defining a second-tier background include:

- 2nd-highest 1-hour value from each of the **four seasonal (or quarterly) distributions** should be used to represent the 98th-percentile.

- 3rd-highest 1-hour value for **each season and hour-of-day combinations** should be used to represent the 98th-percentile.

- 8th-highest 1-hour value should be used to represent the 98th-percentile for **hour-of-day background when the entire year is used (not seasonal)**.

- 1st-highest values for more detailed temporal pairing, such as season by hour-of day and day-of-week or month by hour-of-day.

Because the 1-hour NO_2 NAAQS is based on the annual distribution of daily maximum 1-hour values, the diurnal and seasonal patterns of ambient impacts could play a significant role in determining the most appropriate method for combining modeled and monitored concentrations. For example, if the daily maximum 1-hour impacts associated with the project emissions generally occur under nighttime stable conditions whereas maximum monitored concentrations occur during daytime convective conditions, pairing modeled and monitored concentrations based on hour of day should provide a more appropriate estimate of cumulative impacts than the first-tier method that ignores this diurnal pattern. The applicant's use of a second-tier analysis in these situations will be subject to NJDEP approval.

8.2.2.2 1-Hour SO_2

The 1-hour SO_2 standard is based on the 3-year average of the 99th-percentile of the annual distribution of daily maximum 1-hour concentrations. Use of background monitoring data in a 1-hour SO_2 NAAQS demonstration is also discussed on pages 17 - 21 of the USEPA memo "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-Hour NO_2 National Ambient Air Quality Standard" (March 1, 2011).

First-Tier

The "first-tier" background technique is defined by USEPA as the 99th-percentile of the annual distribution of daily maximum 1-hour values averaged across the three years of data from a representative monitor. That value would be equivalent to the 4th highest daily 1-hour value over a 365-day monitoring period. The latest three years of monitoring data should be used irrespective of the meteorological data period used in the dispersion modeling. Normally, the Department accepts first-tier 1-hour SO_2 background values without further justification.

Second-Tier

The "second-tier" background technique is to use a 3-year average of the 99^{th}-percentile of the available background concentrations grouped into subsets by the four seasons (quarterly) or the 24 hours-of-day. The various options of defining a second-tier of SO_2 background include:

- highest 1-hour value from each **four seasonal (or quarterly) distributions** should be used to represent the 99^{th}-percentile; or

- 4^{th}-highest 1-hour value should be used to represent the 99^{th}-percentile for **hour-of-day background when the entire year is used (not seasonal)**.

Unlike NO_2, there is no significant atmospheric chemistry involved in the formations of SO_2. Therefore, there may be less variation in the diurnal and seasonal monitored values than that of the 1-hour NO_2. However, an examination of the diurnal and seasonal patterns of peak 1-hour SO_2 modeled impacts may show that they occur at different times during the day and/or year than peak monitored values. In this case, use of a second-tier background may be appropriate. The applicant's use of a second-tier analysis will be subject to Department approval.

8.2.2.3 24-Hour and Annual $PM_{2.5}$

The 24-hour $PM_{2.5}$ NAAQS is based on the 3-year average of the 98^{th}-percentile of the annual distribution of 24-hour average concentrations. The annual $PM_{2.5}$ NAAQS is based on a 3-year average of annual $PM_{2.5}$ concentrations. Use of background monitoring data in a $PM_{2.5}$ NAAQS demonstration is discussed in detail on pages 56-63 of the USEPA document "Guidance for $PM_{2.5}$ Permit Modeling" (May 2014), EPA-44-/B-14-001. This document can be found at: https://www3.epa.gov/ttn/scram/guidance/guide/Guidance_for_PM25_Permit_Modeling.pdf

First-Tier (24-Hour)

The "first-tier" background technique is defined as the 98^{th}-percentile of the annual distribution of daily maximum 1-hour values averaged across the three years of data from a representative monitor. The latest three years of monitoring data should be used irrespective of the meteorological data period used in the dispersion modeling. Normally, the Department accepts first-tier 24-hour $PM_{2.5}$ background values without further justification.

Second-Tier (24-Hour)

The second-tier background technique uses a 3-year year average of the 24-hour 98^{th}-percentile of the available background concentrations grouped into subsets by the four seasons (quarterly). Seasonally-varying monitored background components are likely to be more important factors for the 24-hour $PM_{2.5}$ NAAQS than the annual $PM_{2.5}$ NAAQS. The methods of defining a second-tier background include:

- 2^{nd}-highest 24-hour $PM_{2.5}$ value from each **seasonal (or quarterly) distributions** should be used to represent the 98^{th}-percentile when monitoring every day; or

- 3^{rd}-highest 24-hour $PM_{2.5}$ value from each **seasonal (or quarterly) distributions** should be used to represent the 98^{th}-percentile when monitoring one in three days.

There can be situations where daily background $PM_{2.5}$ levels are substantially higher on average during the summer months as compared to the winter months, or vice-versa. If the modeled 24-hour $PM_{2.5}$ impact is greater in the season of lower background values, then use of a second-tier background may be appropriate. The Department advises applicants to evaluate when model predictions of 24-hour $PM_{2.5}$ impacts and $PM_{2.5}$ background levels peak throughout the year before embarking on a second-tier modeling analysis. The applicant's use of a second-tier analysis will be subject to Department approval.

9.0 Receptor Network and Meteorological Data

9.1 Receptor Network

Receptor locations used in refined modeling should be of sufficient density to enable the identification of the highest concentrations and possible exceedances of an ambient air quality standard or a PSD increment. The design of a receptor network should emphasize the receptor resolution and location, not the total number of receptors. The selection of receptor locations should take into consideration the topography, the climatology, monitor sites, and the results of the initial screening procedures.

The Department recommends that, at a minimum, receptors should include a Cartesian Grid with receptors spaced as follows:

- 25 m along the facility fence line (if applicable), or property line in the case of risk assessment modeling;
- 50 m extending from the property line/fence line to 0.5 km;
- 100 m extending from 0.5 km to 1.5 km;
- 250 m extending from 1.5 km to 3 km; and
- 500 m extending from 3 km to 5 km.

The applicant must ensure that receptors appropriately include all publicly accessible locations (i.e., ambient air). If concentrations are not decreasing clearly near the edge of the receptor grid, additional receptors should be added. Fine grids (50 m) should be placed over the area(s) of maximum concentration to ensure that the true maximum concentration is identified. Tall buildings with balconies or other elevated open-air locations that could be occupied for extended periods must also be included in the AAQS analysis. These locations should be modeled as “flag pole” receptors.

In a multisource modeling analysis, receptors only need to be placed in the SIA. Receptors of interest are the following:

1. location of the maximum concentration predicted from the multisource modeling analysis of other nearby major sources;
2. location of maximum impact from the proposed source; and
3. location of the maximum impact of the combined effect of the nearby sources and the proposed source.

The proper location of receptors when modeling the Brigantine Class I area impact is discussed in Appendix A.

9.2 Ambient Air

The air quality modeling analysis must be performed in all locations of “ambient air”, which has been defined by USEPA as “that portion of the atmosphere, external to buildings, to which the general public has access” (40 CFR 50.1(e)). Public access to the facility’s property must be restricted by a physical barrier such as a fence or river with signage along the riverbank. If no physical barrier exists, receptors shall be placed both on and off the facility's property when conducting an air quality impact analysis for compliance demonstration of a NAAQS, NJAAQS, or a PSD increment. If a physical barrier exists, receptors shall be placed along and outside of the physical barrier when conducting an air quality impact analysis for compliance demonstration of a NAAQS, NJAAQS, or a PSD increment.

As a general policy when conducting modeling for risk assessment, receptors are only placed along and outside of a facility's property line regardless of public access. There is an exception to this policy when there is the potential for short-term health impacts on the facility's property and significant public presence may occur (e.g. park or recreation structures located on the facility's property).

In situations involving leasing arrangements where a source is located on land leased to them by another source, applicants should apply the guidance contained in the June 22, 2007 USEPA memorandum entitled: *Interpretation of "Ambient Air" In Situations Involving Leased Land Under the Regulations for Prevention of Significant Deterioration (PSD).*

9.3 Meteorological Data

The protocol should describe and justify the use of all meteorological data that will be used in the modeling analysis. The representativeness of meteorological data is not only a function of proximity, but other factors, such as nearby terrain.

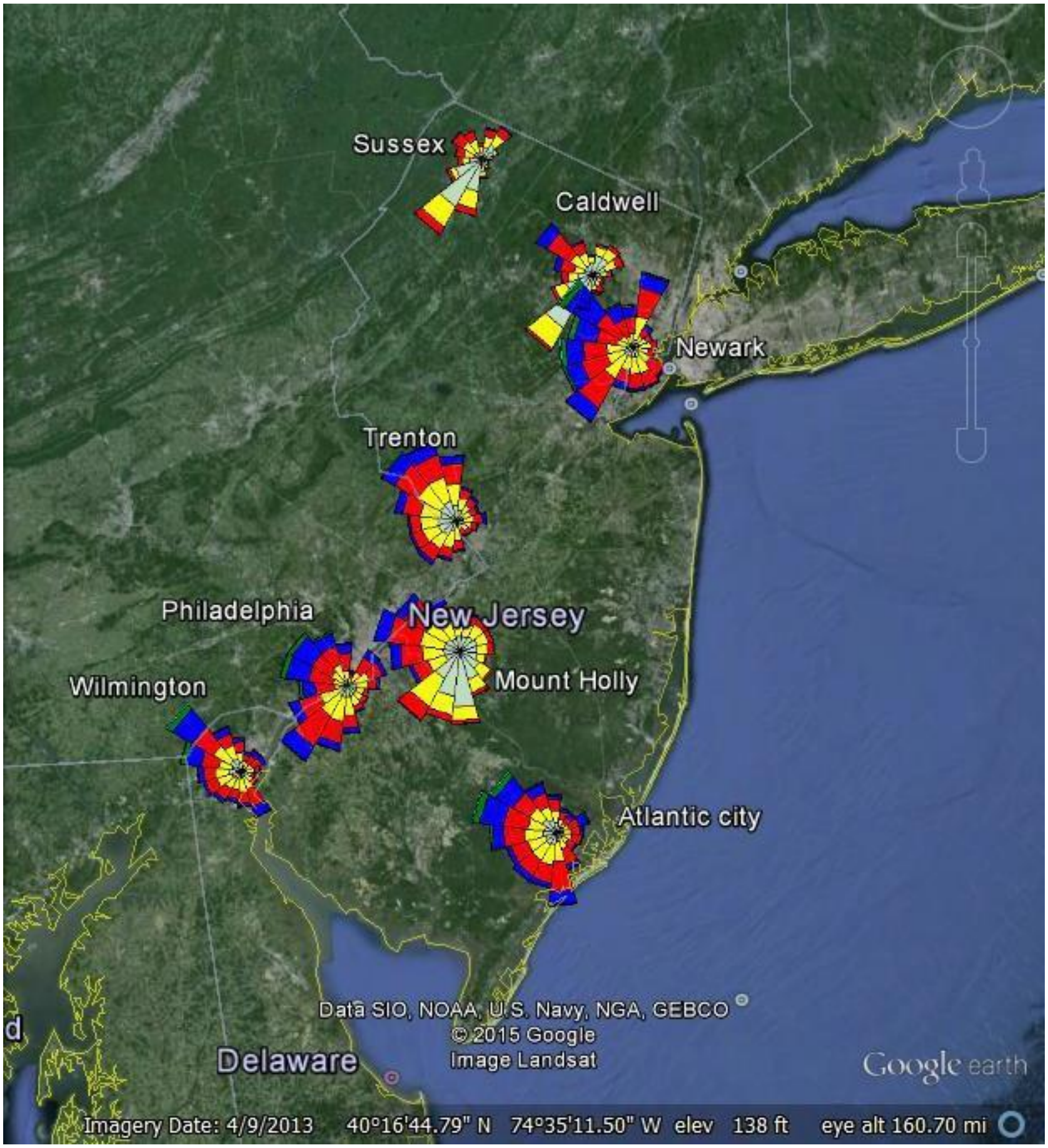
Five years of representative National Weather Service (NWS) meteorological data, at least three complete years of prognostic meteorological data, or at least one year of on-site meteorological data should be used when estimating concentrations with an air quality model. When using NWS data for air modeling, the Department prefers consecutive years from the most recent, readily available 5-year period. The Department has processed meteorological data sets for use by permit applicants when performing air dispersion modeling analyses. The use of standardized meteorological data sets eliminates the need for each applicant to undertake the resource-intensive effort of generating this meteorological data on their own. The most recent 2-minute Automated Surface Observing System (ASOS) meteorological data have been processed using EPA's latest meteorological processors and guidance.

The Department maintains five-year AERMET data sets for eight NWS station locations. The stations locations are: Atlantic City, NJ. Caldwell, NJ, Mount Holly, NJ. Newark, NJ, Philadelphia, Pennsylvania, Sussex, NJ, Trenton, NJ, and Wilmington, Delaware. Table 9-1 provides the location in decimal degrees, elevation in meters, anemometer height in meters, and upper air data pairing for each meteorological station. Note that the Profile Base elevation that should be input to AERMOD is the base elevation of the station as listed in Table 9-1. These data sets are available to the general public upon request. The applicant should consult with the Department for the proper AERMET data to use as input to the AERMOD model. Figure 9-1 shows a small-scale wind rose of the dominant wind direction for each station at its spatial location relative to New Jersey's borders.

Table 9-1. ASOS Meteorological Stations for Use in New Jersey Air Dispersion Modeling Analyses

Surface Station	Latitude (degrees)	Longitude (degrees)	Base Elevation amsl (m)	Anemometer Height (m)	Upper Air Station
Atlantic City	39.4520	74.5670	18.0	7.92	Brookhaven, NY
Caldwell	40.8764	74.2828	53.0	7.92	Brookhaven, NY
Mount Holly	39.9407	74.8407	16.0	10.0	Sterling, VA
Newark	40.6828	74.1693	3.0	10.0	Brookhaven, NY
Philadelphia	39.8733	75.2268	8.5	7.92	Sterling, VA
Sussex	41.1993	74.6260	128.0	10.0	Albany, NY
Trenton	40.2768	74.8156	64.9	7.92	Sterling, VA
Wilmington	39.6744	75.6056	24.4	10.0	Sterling, VA

Figure 9-1. Location of ASOS Meteorological Stations Processed for use in Air Dispersion Modeling Analyses in the State of New Jersey



10.0 Health Risk Assessments and Other Special Modeling Considerations

Some special modeling considerations that may need to be addressed by both PSD and non-PSD sources include, but are not limited to: modeling for a risk assessment, atmospheric deposition, cooling tower modeling, coastal fumigation modeling, fugitive emissions, start-up/shutdown impacts, and modeling of other nearby major sources. This section addresses some of these special requirements and contains a brief discussion of running averages and block averages and their relation to NAAQS, NJAAQS, and PSD increments. When applicable, the applicant should address each of these topics in the protocol details of its modeling analysis.

10.1 Health Risk Assessment

Air toxics are natural or man-made pollutants that, when emitted into the air, may cause an adverse health effect. The federal 1990 CAA Amendments created a list of air toxics, called “hazardous air pollutants” or “HAPs”, as well as regulations to limit HAP emissions. The air toxics list generally excludes “criteria pollutants,” that is, those for which NAAQS or NJAAQS have been established. The exception to this is lead, which is a criteria pollutant and is also considered to be an air toxic because of its ability to cause significant adverse health impact at very low exposures. “Lead compounds” are included in USEPA’s HAP list, as are many specific VOCs, which fall under the VOC pollutant category, and specific heavy metals, which are included in the particulate matter criteria pollutant category.

Health risk assessments are required for all source operations that emit air toxics above its reporting threshold for which the Department has designated an inhalation unit risk factor (URF) or a reference concentration (RfC). The risk assessment shall also include any air toxic emitted below the reporting threshold that is included in the permit. The majority of health risk assessments are conducted using the Department’s screening tools. However, under certain situations, a refined health risk assessment will be required for either a single source operation, multiple source operations, or on a facility-wide basis. These refined risk assessments may require the submittal of an air quality modeling and risk assessment protocol. The atmospheric dispersion modeling techniques used in a refined health risk assessment should generally follow the guidance outlined in this document. This section contains additional guidance specific to performing a refined risk assessment. The Department’s webpage, http://www.state.nj.us/dep/aqpp/risk.html, contains a listing of air toxics for which the Department has published URF or RfC and other important information concerning risk assessment procedures. As with an air quality analysis, an air quality modeling and risk assessment protocol must be approved by the Department before an applicant submits the health risk assessment.

In addition to the requirements outlined in this document, an air quality impact analysis that includes a health risk assessment must also include:

1. For each air toxic included on the Department's URF list: the maximum predicted long-term (chronic) average concentration and its location, the applicable URF, and the calculated incremental cancer risk (source impact times the URF); and

2. For each air toxic included on the Department's RfC list: the maximum predicted long-term or short-term (acute) average concentration and its location, the RfC, and the calculated hazard quotient (source impact divided by the RfC).

In a refined risk assessment, chronic health risks should be calculated based on a five-year average (43,800 hours) concentration. For calculating acute health risks, the maximum air toxic specific short-term concentration modeled (not highest, second-high) should be used.

For chronic health risks, the emission rate modeled should be based on the air toxic tons per year emission rate listed in the permit application. For air toxics with acute health effects, the maximum pound per hour emission rate listed in the permit must be used. The use of annualized hourly emissions to evaluate acute health effects should only be used in the case of fugitive emissions or tank emissions.

If the air quality modeling protocol is only evaluating air toxic emissions, under certain situations, the use of the AERMOD non-default control option (FLAT) may be appropriate. This option ignores receptor elevations and stack-base elevation and assumes flat terrain. This option will be approved on a case-by-case determination.

In addition to providing incremental cancer risk and hazard quotients at the point of maximum impact, health risks at the sensitive receptor with the greatest predicted impact also need to be provided. For health risk assessments, sensitive receptors can include, but are not limited to: residents of occupied homes, hospitals, schools, and parks. Generally, cancer risks and hazard quotients need only be calculated at and beyond the applicant's property line. However, if the general public has access to the property, the Department may require estimates of the short-term hazard quotient be made for facility on-site receptors.

The predicted cancer risk and hazard quotient will be compared to the Department's Risk Guidelines for Air Toxics listed in Table 10-1 below. The type of action the applicant may need to take when this guideline value is exceeded will depend on the location, frequency, and magnitude of the exceedances. For more information on the Department's Risk Guidelines for Air Toxics and the Risk Management Committee, consult Technical Manual 1003 "*Guidance on Preparing a Risk Assessment for Air Contaminant Emissions*."

Table 10-1. Risk Guidelines for Air Toxics

Cancer Risk Guidelines for Individual Sources	
Risk ≤ 1 in a million ($1x10^{-6}$)	Negligible risk
1 in a million < Risk < 100 in a million	Case-by-case review by Risk Management Committee
Risk ≥ 100 in a million ($1x10^{-4}$)	Unacceptable risk
Facility-Wide Cancer Risk Guidelines	
Risk ≤ 10 in a million ($1x10^{-5}$)	Negligible risk
10 in a million < Risk < 1000 in a million	Case-by-case review by Risk Management Committee
Risk ≥ 1000 in a million ($1x10^{-3}$)	Unacceptable risk
Non-cancer Risk Guidelines for All Sources	
Hazard Quotient ≤ 1	Negligible risk
Hazard Quotient > 1	Case-by-case review by Risk Management Committee

10.2 Cooling Towers

In the permitting of facilities with wet or wet/dry cooling towers, the Department may require modeling of the cooling tower plumes to determine their potential for causing fogging and icing of nearby highways. In addition, the cooling towers must be included in the air quality modeling when their PM_{10} emissions exceed 1 lb/hr. Details on how the particulate emission rate is calculated and what assumptions are made must be included in the modeling protocol and analysis. Cooling towers are normally modeled as a series of point sources, with each cell in the cooling tower associated with a diameter, exit temperature, and exit velocity. Often, cooling towers are subject to downwash effects from the cooling tower structure itself. The PM_{10} and $PM_{2.5}$ concentrations due to cooling tower emissions should be added to those caused by other sources at the facility.

10.3 Coastal Fumigation

Fumigation occurs when a plume that was originally emitted into a stable layer is mixed rapidly to ground-level when unstable air below the plume reaches plume level. The well-mixed, unstable air, which develops as air coming from the ocean is heated over land, is known as the thermal internal boundary layer (TIBL). Sources with tall stacks that are in an area designated as rural and within 3 km of a large body of water must address coastal fumigation in their modeling analysis. Other sources located beyond 3 km may also need to examine their coastal fumigation impacts if the Department believes such an analysis is warranted. Three point source models capable of simulating coastal fumigation are AERSCREEN, CALPUFF, and the Shoreline Dispersion Model.

10.4 Proximity to Major Sources

In special cases where a proposed source will be near an existing major source, the Department may require a modeling analysis of emissions from the proposed source along with emissions from the existing source, even if the predicted impacts of the proposed source are insignificant. This type of analysis is usually required in response to, or in anticipation of, concerns on the part of the public and the need to show that the ambient air quality standards will be met in the area surrounding the proposed source.

10.5 Use of Running Averages and Block Averages

There are two methods of calculating pollutant concentration averages, running averages and block averages. The time when the block average begins and when it ends is specifically defined and never varies. For example, all 24-hour averages are calculated from midnight to midnight, annual averages are calculated from January 1 through December 31, and 3-hour averages are calculated from midnight (12 p.m.) to 3 a.m., 3 a.m. to 6 a.m., etc. Conversely, running averages (sometimes called moving averages) have no set time when they must begin and end. A 24-hour average can begin at 3 a.m. one day and run to 3 a.m. the next day. Running annual averages can occur over any consecutive 12-month period (e.g. April 1 through March 31, October 1 through September 30).

As mentioned in Section 3.1.2, New Jersey's 3-hour, 8-hour, and 24-hour ambient air quality standards are defined in terms of running hourly averages, and its 3-month and 12-month ambient air quality standards are defined in terms of running monthly averages. However, all NAAQS, PSD increments, and the ambient air quality standards of all states surrounding New Jersey are defined in terms of block averages. It should be noted that New Jersey has no AAQS for PM_{10} or $PM_{2.5}$.

To help avoid confusion in the execution and presentation of the modeling results, the Department recommends the following:

> Initially, calculate all short-term impacts in terms of block averages. Quarterly and annual concentrations can also be determined as block averages. These values should be used to determine whether the proposed source has a significant impact. After adding background and the impact of other sources (if multisource modeling was conducted), if the total concentration is greater than 90% of the NJAAQS, then running averages should be calculated.

10.6 Nitrogen Oxide to Nitrogen Dioxide Conversion

Approximately 90% of NO_x emissions from a combustion source are emitted in the form of nitrogen oxide (NO). The rate at which NO will convert to NO_2 in the atmosphere will be a function of the background levels of ozone and other oxidizing agents.

Compliance demonstrations with NO_2 annual average NAAQS and NJAAQS, the 1-hour NO_2 NAAQS, and the NO_2 PSD increment in near-field modeling (source-to-receptor distances less than about 50 km) can be done following the tiers described in Section 4.2.3.4 of USEPA's *Revised Guideline on Air Quality Models*.

Tier 1 - Assume 100% conversion of NO_x emissions to NO_2.
(assume NO_2 emission rate = NO_x emission rate)

Tier 2 - The Ambient Ratio Method 2 (ARM2) is based on an empirically derived equation from hourly NO_2 and NO_x concentrations measured at 580 monitors across the country for more than 10 years. ARM2 uses the ratio provided by the equation to convert AERMOD's modeled NO_x concentrations to NO_2 concentrations. The specific ratio applied will be a function of the modeled NO_x concentration. For example, as the predicted NO_x concentration increases, the ARM2 NO_2/NO_x ratio may decrease.

The default minimum and maximum NO_2/NO_x ratios are set at 50% and 90%, respectively. The minimum NO_2/NO_x ratio is representative of the modeled source's in-stack NO_2/NO_x ratio. An alternative NO_2/NO_x value may be applied based on the source's in-stack emissions ratios, with the minimum value reflecting the source's in-stack NO_2/NO_x ratio. Consultation with the Department is required for the use of an alternate ARM2 factor. Adequate demonstration of a source's in-stack ratio (ISR) is required, and the submission of stack test data to USEPA's ISR database may be required as part of the documentation process.

The factors to consider on whether ARM2 should be used are listed below. There are no absolute guidelines regarding these factors. Each factor may be cited in a weight of evidence evaluation.

1. The specific ratio applied will be function of the modeled NO_x concentration; as the predicted NO_x concentration increases, the ARM2 NO_2/NO_x ratio may decrease.
2. ARM2 will tend to be conservative if there is a short travel time from the stack to the location of maximum modeled NO_x impacts.
3. ARM2 will tend to be conservative if the maximum 1-hour NO_x impacts are predicted to occur at night during winter months, when background ozone is generally low. The Department can provide maximum hourly concentrations for different monitoring stations throughout New Jersey.
4. The use of ARM2 is likely conservative if background NO_2 is generally low (11 to 16 $\mu g/m^3$) and the primary source has a Tier 1 modeled NO_x impact of less than 380 $\mu g/m^3$ (200 ppb).
5. If the NO_2/NO_x ISR for the source is less than 0.5, then ARM2 will tend to be conservative in predicting NO_2 impacts.
6. If the ISR is higher than 0.5, ARM2 may still possibly be used if the minimum ambient NO_2/NO_x ratio input is above the 0.5 default minimum value.
7. In areas with high background ozone, use of ARM2 is likely conservative if the primary source has a Tier 1 modeled NO_x impact of less than 282 $\mu g/m^3$ (150 ppb).
8. In areas with low background ozone, use of ARM2 is likely conservative if the primary source has a Tier 1 modeled NO_x impact of less than 376 $\mu g/m^3$ (200 ppb).
9. Sensitivity tests suggest ARM2 may underestimate actual NO_2/NO_x ratios when hourly ozone concentrations are greater than 80-90 ppb. The September 30, 2014 USEPA

clarification memo recommends caution when applying ARM2 if there are more than 7 days with hourly ozone above 80-90 ppb.

Tier 3 - This tier involves using the Ozone Limiting Method (OLM) or the Plume Volume Molar Ratio Method (PVMRM) algorithms in AERMOD. Consultation with the USEPA Regional Office is required for this level of evaluation.

As with Tier 2, the default minimum and maximum NO_2/NO_x ratios are set at 50% and 90%, respectively. With sufficient supporting data, an alternative minimum NO_2/NO_x ratio may be proposed based on the source's, or a similar source's measured ISR. When conducting a multisource modeling analysis, the NO_2/NO_x ISR recommended for distant sources is 0.2.

Some factors to consider when applying a Tier 3 methodology are listed below.

1. Both PVMRM and OLM require the use of hourly ozone data. Ozone monitoring locations in New Jersey are listed in Table 8-1.
2. Normally, only one ozone background monitor is used, however, AERMOD includes the option to specify multiple background files based on geographic relation to the source and modeling domain.
3. OLM works best for large groups of sources, area sources, and near-surface releases. For most cases, the OLMGROUP ALL option is recommended.
4. PVMRM works best for relatively isolated and elevated point sources.

The Department recommends 100% NO to NO_2 conversion for long-range transport modeling (e.g., source-to-receptor distances greater than about 50 km).

10.7 Treatment of Horizontal Stacks and Rain Caps

For horizontal stacks or rain caps present on a point source stack, the vertical momentum component of the exit velocity is effectively removed. Consequentially, a unique approach may be needed to characterize these stacks. The approach varies by model, as discussed below.

AERMOD: For capped and horizontal stacks that are NOT subject to building downwash influences, a simple screening approach (Model Clearinghouse Memo from J. Tikvart to K. Eng, dated 7/9/93) can be applied. This approach uses an effective stack diameter to maintain the flow rate, and hence the buoyancy, of the plume, while suppressing plume momentum by setting the exit velocity to 0.01 m/s. To appropriately account for stack-tip downwash, the user should first apply the non-default option of no stack-tip downwash (i.e., NOSTD keyword). Then, for capped stacks, the stack release height should be reduced by three actual stack diameters to account for the maximum stack-tip downwash adjustment while no adjustment to release height should be made for horizontal releases.

Capped and horizontal stacks that are subject to building downwash should not be modeled using an effective stack diameter to simulate the lack of vertical momentum. The problem is that the PRIME algorithms use the stack diameter to define the initial plume radius which, in turn, is used to solve conservation laws. The user should input the actual stack diameter and exit temperature but set the exit velocity to a nominally low value, such as 0.01 m/s. This approach will have the desired effect of restricting the vertical flow while avoiding the mass conservation problem inherent with the effective diameter approach. The approach suggested here will most likely result in a lower plume height, and therefore, will provide a conservative estimate of impacts. Also, since PRIME does not explicitly consider stack-tip downwash, no adjustments to stack height should be made.

The latest version of AERMOD has incorporated the above adjustments for horizontal discharge and rain cap stacks as a Beta option to the model inputs.

11.0 Air Quality Modeling Results

Results of the air quality dispersion modeling analysis are discussed in this section.

11.1 Modeling Submitted in Support of a New Jersey Air Permit Application

Air quality dispersion modeling for the proposals made by a facility must clearly show that emissions of criteria pollutants will not cause or significantly contribute to an exceedance of any NAAQS or NJAAQS, and emissions of air toxics will not cause an unacceptable health risk. The modeling results section of the analysis must contain the following essential information:

1. The location and magnitude of maximum predicted impacts for each modeled criteria pollutant and air toxic for each applicable averaging time;

2. A comparison of the maximum predicted impact for criteria pollutants to defined significant impact levels (Table 4-1) for each criteria pollutant modeled;

3. For any proposed source with a predicted insignificant impact for criteria pollutants, a comparison of the appropriate predicted impact with monitored background concentration added to applicable state and federal air quality standards;

4. For any proposed source with a predicted significant impact for criteria pollutants, a comparison of the total impact (the combination of the proposed source impact, the impact of other existing nearby major sources, and the monitored background concentration) to applicable state and federal air quality standards; and

5. The results of any additional analyses performed such as a risk assessment or cooling tower analysis.

In addition, PSD permit air quality evaluation should include a modeling comparison to PSD increments. The highest long-term average concentrations and the highest, second-high short-term average concentrations may be used to determine compliance with NAAQS, NJAAQS, and PSD Class II increments when five years of off-site or at least one year of on-site meteorological data are used in the modeling analysis. Guidance on demonstrating compliance with the $PM_{2.5}$ and PM_{10} NAAQS is contained at the following webpage, http://www.nj.gov/dep/aqpp/permitguide.html, and Section 3.2.1 of this document, respectively.

11.2 PSD Permit Applications

In addition to the demonstration required in Section 11.1 above, for PSD permit applications, the air quality dispersion modeling analysis must also provide the following additional information:

1. A comparison of the predicted impacts to the PSD Class II increments for each pollutant for which the proposed source is PSD applicable;

2. An analysis of the effect of the proposed source on soil and vegetation in the impacted area and a growth analysis;

3. For any PSD source within 100 km of the Brigantine Class I area, the Department will normally require a comparison of the predicted impacts to the PSD Class I increments. For a proposed source with predicted significant impacts at the Brigantine Class I area, the modeled impact of other PSD increment consuming sources must be included; and

4. For any PSD source within 300 km from the Brigantine Class I area, the FLM for the Brigantine Class I area (U.S. Fish and Wildlife Service) will, on a case-by-case basis, require an evaluation of the proposed project's impact on the Brigantine's Air Quality Related Values (AQRVs). AQRVs include visibility and atmospheric deposition of sulfur and nitrogen.

11.3 Documentation

Copies of model input and output files should be provided with the modeling submittals. The Department strongly recommends that modeling protocols and analyses be presented in loose leaf format in a binder so that additions or revisions can be made easily. If this is not done, both minor and major revisions will require resubmittal of the entire document.

Applicants are reminded that all impact assessments are public information (except process information marked confidential as defined in N.J.A.C.7:27-1.11) and that major permit applications frequently undergo extra examination during public hearing/comment processes. Acronyms and abbreviations should be defined, tables and figures should be clearly labeled, and excess technical jargon should be avoided.

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APPENDIX A

Additional Issues for PSD Affected New or Modified Sources

This Appendix provides a brief discussion of the additional issues a Prevention of Significant Deterioration (PSD) affected source must address. Further details concerning PSD regulations may be found in the Federal Register (45 FR 52676, August 7, 1980) and in the Code of Federal Regulations (40 CFR 52.21).

A.1 Pre-application Air Quality Monitoring

For any criteria pollutant that the applicant proposes to emit in significant amounts (see Table 2-1), continuous ambient monitoring data may be required as part of the air quality analysis. If, however, either (1) the predicted ambient impact, i.e., the highest modeled concentration for the applicable averaging time, caused by the proposed significant emissions increase (or significant net emissions increase), or (2) the existing ambient pollutant concentrations, are less than the prescribed significant monitoring concentrations (SMC) (see Table A-1), the Department has discretionary authority to exempt an applicant from this air quality monitoring requirement. The Department will also exempt a source from pre-application monitoring if it believes air quality in the area is adequately represented by existing monitors. Information on PSD monitoring can be found in *Ambient Monitoring Guidelines for PSD* (EPA-450/4-87-007), 1987.

Table A-1. Significant Monitoring Concentrations

Pollutant	Air Quality Concentration and Averaging Time ($\mu g/m^3$)
CO	575 (8-hr)
NO_2	14 (annual)
SO_2	13 (24-hr)
TSP	10 (24-hr)
PM_{10}	10 (24-hr)
$PM_{2.5}$	0*
Ozone	A
Lead	0.1 (3-month)
Asbestos	b
Beryllium	0.001 (24-hr)
Mercury	0.25 (24-hr)
Vinyl Chloride	15 (24-hr)
Fluorides	0.25 (24-hr)
Sulfuric acid mist	b
Total reduced sulfur (including H_2S)	b
Reduced sulfur (including H_2S)	b
Hydrogen sulfide	0.2 (1-hr)

A: No significant air quality concentration for ozone monitoring has been established. Instead, applicants with a net emission increase of 100 tons/yr or more of VOCs or NOx subject to PSD would be required to perform an ambient impact analysis, including pre-application monitoring data.
b: Acceptable monitoring techniques may not be available at this time. Monitoring requirements for this pollutant should be discussed with the Bureau.

*On January 22, 2013, the U.S. Court of Appeals for the D.C. Circuit vacated and remanded the PSD rules regarding Significant Impact Levels (SIL) under 52.21(k)(2) and SMC for fine particulate matter ($PM_{2.5}$). With respect to SMC, the Court precluded USEPA from using the $PM_{2.5}$ SMC to exempt permit applicants from the requirement to compile preconstruction monitoring data.

Subsequently, on March 4, 2013, USEPA issued a guidance document "Circuit Court Decision on $PM_{2.5}$ Significant Impact Levels and Significant Monitoring Concentration Questions and Answers." This document is meant to address issues that have resulted from the January 22, 2013 court decision. On page 2, the USEPA provides the following guidance on the statutory requirement to compile preconstruction monitoring data:

> Accordingly, all applicants requesting a federal PSD permit, including those having already applied for but have not yet received the permit, should submit ambient $PM_{2.5}$ monitoring data in accordance with the Clean Air Act requirements whenever either direct $PM_{2.5}$ or any $PM_{2.5}$ precursor is emitted in a significant amount. In lieu of applicants setting out $PM_{2.5}$ monitors to collect ambient data, applicants may submit $PM_{2.5}$ ambient data collected from existing monitoring networks when the permitting authority deems such data to be representative of the air quality in the area of concern for the year preceding receipt of the application.

Although the court's decision related specifically to $PM_{2.5}$, the decision can be interpreted to also preclude the use of SMCs to exempt from monitoring for the other PSD affected pollutants. Therefore, a waiver to the ambient air monitoring requirement cannot be granted based just on the SMC.

A.2 Post-construction Air Quality Monitoring

Post-construction monitoring may be required when there are valid reasons, such as (1) when the NAAQS are threatened, and (2) when there are uncertainties in the databases for modeling.

A.3 PSD Baseline Trigger Date

The PSD increments are the maximum allowable increase in ambient pollutant concentrations that can occur above the applicable baseline concentrations. The following emission changes must be used to calculate available increment. Sources that should be included in increment modeling are those within the SIA and may also include sources up to 50 km beyond the SIA.

1. The actual emissions increases (or decreases) after the Major Source Baseline Date that are associated with construction at a major source. The major source Baseline Dates are as follows:

SO_2 and PM_{10} - August 6, 1975
NO_2 - February 8, 1988
$PM_{2.5}$ - October 20, 2010

2. The actual emission increases (or decreases) at any stationary source permitted after the Minor Source Baseline Date (listed below).

3. Allowable emissions from PSD sources (including secondary and fugitive emissions) which have submitted a PSD application prior to the date of application by the proposed source. If the source is an existing PSD source and has been in operation for more than two years, actual emissions may be used.

4. Actual emission increases from general area growth.

5. Changes in emissions due to State Implementation Plan (SIP) revisions.

For short-term averaging periods, the difference between the current maximum actual emissions and the maximum actual emissions as of the applicable baseline date are modeled. The maximum actual emissions are the highest occurrence or an upper percentile value for that averaging period during the previous two years of operation. For the annual averaging period, the difference between the current average actual emissions and the average actual emissions as of the applicable baseline date are modeled. In both cases, the average actual emissions are calculated as the average over the previous two-year period.

Many facilities do not have the necessary records to support the calculation of the change in actual emissions since the applicable baseline date. Therefore, as a conservative approach, allowable emissions can be used as a screening techniques. This approach assumes no changes in emissions after the major source baseline date. As another alternative, the Department recommends that the first level of the increment analysis be accomplished using the actual emissions from the previous two years for all emission sources included in the analysis. If this approach results in predicted concentrations above the applicable PSD increment, then the difference in actual emissions can be determined for the emission unit(s) contributing to the exceedances and the model rerun. This approach eliminates the need to calculate the difference in actual emissions for all increment consuming sources.

If the change in actual emissions included a change in stack parameters, then the stack parameters and emission rates associated with both the baseline case and the current case are input into the same model run, with the baseline case modeled as negative emissions and the current case modeled as positive emissions, each with the appropriate stack parameters.

The Department will assist all PSD applicants with their increment analysis by providing air quality monitoring data on file, parameters for existing sources located in the State, and modeling analyses developed in support of SIP revisions, when available. It is the responsibility of the applicant to obtain details on specific permits from Department's files and to obtain necessary data from any other state(s) or agency(s).

The Department currently has no policy that limits the amount of short-term or long-term increment one source can consume. However, to allow for future economic development, permit applicants are discouraged from proposing emissions increases that will consume most or all the available PSD increment in an area. Note that increment expansion is allowed only from sources that existed at the time of the baseline date, and the expansion must be attributed to actual emissions.

The PSD increment major source baseline date is a fixed date found in the regulation associated with the specific criteria pollutant. The minor source baseline concentration is the concentration of a pollutant after the first complete PSD permit application affecting the area was received. That date is referred to as the PSD "Minor Source Baseline Date." To demonstrate compliance with PSD increment levels, the area that will be impacted by the project must first be defined and then the amount of increment available in that area must be calculated by modeling all sources in that area permitted after the minor source baseline date. The following PSD minor source baseline dates have been established in New Jersey:

1. New Jersey Portion of the New York - New Jersey - Connecticut Interstate Air Quality Control Region (Bergen, Essex, Hudson, Middlesex, Monmouth, Morris, Passaic, Somerset, and Union Counties)

SO_2	November 3, 1977	(Exxon)
PM_{10}	November 15, 1978	(GAF)
$PM_{2.5}$	September 4, 2013	(Attainment status)

2. New Jersey Portion of the Metropolitan Philadelphia Interstate Air Quality Control Region (Burlington, Camden, Gloucester, Mercer, and Salem Counties)

SO_2	October 6, 1977	(Seaview Petroleum)
PM_{10}	July 18, 1979	(BF Goodrich)
$PM_{2.5}$	January 13, 2014	(West Deptford Energy)

3. New Jersey Portion of the Northeast Pennsylvania Upper Delaware Valley Interstate Air Quality Control Region (Hunterdon, Sussex, and Warren Counties)

SO_2	November 21, 1980	(Hoffmann LaRoche)
PM_{10}	September 20, 1978	(Hoffmann LaRoche)
$PM_{2.5}$	No trigger date to include minor sources	

4. New Jersey Intrastate Air Quality Control Region (Atlantic, Cape May, Cumberland, and Ocean Counties)

SO_2	November 17, 1988	(CNG Lakewood)
PM_{10}	November 17, 1988	(CNG Lakewood)

$PM_{2.5}$	April 16, 2014	(Ocean Peaking Power)

The PSD minor source baseline date for NO_2 is February 8, 1988 for all areas of New Jersey. It corresponds to the date on which the increments for NO_2 were first proposed in the Federal Register, Volume 53, Number 25, February 8, 1988. Also note that sources may consume increment in neighboring states but they cannot trigger the minor source baseline date for increment analysis in the neighboring state.

A.4 Additional Impact Analysis - Growth

This analysis is an estimate of the projected residential, commercial, and industrial growth that will occur because of the PSD project and an estimate of the air emissions associated with this growth. Air contaminant emissions associated with any new growth predicted to result from the proposed project and the air emissions from the proposed PSD project are modeled together. The applicable background values are added to the resulting modeled concentrations and the results compared with the applicable NAAQS and PSD increments.

Often the new residential, commercial, and industrial growth estimated to occur because of the PSD project is negligible. In this case, further modeling analyses for growth are not necessary.

A.5 Additional Impact Analysis - Soils and Vegetation

The purpose of the soils and vegetation analysis, required by 40 CFR 52.21(o), is to assess the impact of the project emissions on areas of commercial or recreational value. For some pollutants and monitoring intervals, the NAAQS or the NJAAQS provide sufficient protection against damage to vegetation. However, these air quality standards may not adequately protect many commercially grown crops in New Jersey that are classified as sensitive vegetation. Therefore, the Department requires additional screening for SO_2 at the 3-hour and 12-month intervals. This screening values are adopted from Table 3.1 of the USEPA document *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078) and are shown in Table A-2. Note that the SO_2 averaging times are the same for the demonstrating compliance with NJAAQS, and therefore will not require additional modeling.

Table A-2. Soils and Vegetation Screening Values

Pollutant	Averaging Period	Screening Value (μg/m^3)[a]
SO_2	3-hour	786
	Annual	18

a. The screening value is based on the sensitive vegetation screening value in the USEPA document 450/2-81-078. This value should be compared to the maximum average ambient air concentration plus background for the specified averaging period.

If the emission impact is greater than the screening criteria in Table A-1, the applicant should follow USEPA guidance in the *New Source Review Workshop Manual* (USEPA 1990) to assess potential impacts on vegetation. This includes:

a) Create an inventory of soils and vegetation with commercial or recreational value in the impact area (e.g., crops and parks). This may be available from conservation groups, state agencies, and universities;
b) Review peer-reviewed scientific literature to determine the concentration level (for appropriate averaging times) of SO_2 that would be harmful to each type of vegetation in the area of impact; and
c) Discuss the nature of the harm and its spatial extent in the modeling report. This analysis should evaluate the predicted concentrations associated with the averaging periods addressed in the applicable vegetation impact studies.

Depending on the potential impacts to vegetation information, the applicant may be asked to provide an additional analysis that follows the seven-step process outlined in USEPA document 450/2-81-078 for estimating the impact from annual soil deposition and the subsequent uptake of pollutants by plants and animals.

A.6 Class I Area Impact Analysis

All areas of the United States are classified as Class I, II, or III PSD areas. Class I areas are generally national parks and wilderness areas; Class II areas allow for moderate growth and represent most areas of the country; and Class III are designated as areas that intend to foster extensive industrial development. The classifications and associate increment values are codified at 40 CFR 51.166 and 40 CFR 52.21.

The entire State of New Jersey is designated as a Class II PSD area except for the Brigantine Wilderness in the Brigantine Division of the Edwin B. Forsythe National Wildlife Refuge (formerly the Brigantine National Wildlife Refuge), which is a Class I PSD area.

The USEPA is to be informed of all permit applications related to major stationary source or major modifications per 40 CFR 51.166(p). If a major stationary source or major source modification is proposed that results in a predicted impact concentration greater than 1 µg/m^3 on a 24-hour basis within 10 km of a Class I area, then the source is PSD affected for that pollutant. For a proposed PSD source or modification located within 50 km of the Brigantine Class I area, the applicant must conduct a modeling analysis of the source's impact at the Class I area. A proposed PSD source or modification between 50 and 300 km of this Class I area may be required to evaluate its Class I area impact on a case-by-case basis. The Federal Land Manager (FLM) is to be provided written notice of any permit application for any proposed major stationary source or major modification within 300 km of a Class I Area per 40 CFR 52.21(p). The FLM normally determines the level of analysis required beyond the items outlined in this section of the guidance document. The Department may require a Class I increment analysis of sources closer than 100 km from the Brigantine Class I area even when not required by the FLM.

The basic procedures that should be used in a Class I area analysis can be found in the following documents:

- *Federal Land Managers Air Quality Related Values Workgroup Phase I Report* (FLAG, 2000), *Federal Land Managers' Air Quality Related Values Work Group (FLAG) Phase I Report – Revised (2010)* NPS/NRPC/NRR – 2010/232 https://www.nature.nps.gov/air/pubs/pdf/flag/FLAG_2010.pdf

- *Interagency Workgroup on Air Quality Modeling Phase 3 Summary Report: Long Range Transport and Air Quality Related Values* (EPA-454/P-15-003 July 2015) https://www3.epa.gov/ttn/scram/11thmodconf/IWAQM3_LRT_Report-07152015.pdf
- *Reassessment of the Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report: Revisions to Phase 2 Recommendations* (EPA-454/R-16-007 December 2016), and, https://www3.epa.gov/ttn/scram/appendix_w/2016/IWAQM_Phase2_Reassessment_2016.pdf
- *Technical Support Document (TSD) for AERMOD-Based Assessments of Long-Range Transport Impacts for Primary Pollutants* (EPA-454/B-16-007 December, 2016). https://www3.epa.gov/ttn/scram/appendix_w/2016/AppW_LRT_TSD.pdf

The FLM's permit review process consists of three main analyses:

- An air quality analysis to ensure that the pollutant levels do not exceed NAAQS and PSD increments;
- An AQRV analysis to ensure that the Class I area air quality related values are not adversely affected by the proposed emissions; and
- A Best Available Control Technology (BACT) analysis to ensure that the emission increases from the proposed facility are minimized using appropriate pollution control equipment.

The FLM for the Brigantine Class I area is the United States Fish and Wildlife Service (F&WS). Catherine Collins is currently the F&WS permitting lead on PSD applications affecting the Brigantine Class I area. Contact information is listed below.

Federal Land Manager
US Fish and Wildlife Service
National Wildlife Refuge System
Branch of Air Quality
7333 West Jefferson Ave., Suite 375
Lakewood, Colorado 80235-2017
(303) 914-3804
Catherine_Collins@fws.gov or aq_permits@fws.gov

Guidance on Class I area modeling issues may be obtained from Tim Allen of the F&WS (303-914-3802, Tim_Allen@fws.gov). Contacts from the local F&WS office are: Wendy Walsh at 609-382-5274, and Alicia Protus at 609-382-5266.

A.6.1 Class I PSD Increments

As discussed in USEPA's *Guideline on Air Quality Models*, the type of modeling conducted to predict PSD increment consumption at the Brigantine Class I area will depend on the location of the source. Those sources located within 50 km will use a steady-state model such as AERMOD in their modeling analysis. If the source is greater than 50 km from the Class I area, impacts can be conservatively predicted at an arc of receptors 50 kilometers from the source in the radial direction of the Brigantine Wilderness Area. Any additional long range transport modeling should be investigated in consultation with the Department and the USEPA Regional Office.

Table A-3. PSD Class I Significant Impact Levels and PSD Increments

Pollutant	Averaging Period	Class I Significant Impact Levels (μg/m^3)	Class I PSD Increments (μg/m^3)
SO_2	3-hr	1.0	25
	24-hr	0.2	5
	Annual	0.1	2
$PM_{2.5}$	24-hr	0.27[a]	2
	Annual	0.05[a]	1
PM_{10}	24-hr	0.3	8
	Annual	0.2	4
NO_2	Annual	0.1	2.5

a) Revised 24-hour and annual $PM_{2.5}$ Class I SIL per April 17, 2018 EPA guidance memo..

The Class I significant impact levels, as well as the Class I PSD increments are listed in Table A-3. For sources modeling PM_{10}, sulfate and nitrate formed during plume transport to the Class I area should be added to the predicted impact due to direct PM_{10} emissions. A PSD project whose proposed impact exceeds the Class I significant impact levels at the Brigantine Class I area must conduct a multisource modeling analysis to determine cumulative increment consumption.

A.6.2 Class I Area Air Quality Related Values (AQRVs)

In addition to the PSD increments, there are requirements for the protection of various Class I area resources that might be affected by air pollution. These "air quality related values", or "AQRVs", include visibility, vegetation, lakes and streams, soils, fish, and animals. Pursuant to the CAA, FLMs have an affirmative responsibility to protect AQRVs. Among the Brigantine Class I area's AQRVs of interest to the FLM are visibility, the impact of sulfur/nitrogen deposition on soils and water quality, and ozone damage to sensitive vegetation. The FLM's recommendations on how the applicant should assess its impact on Class I areas are found in the FLAG documents. Below is a brief summary of the AQRV issues.

A.6.2.a Visibility Impairment Analysis

Visibility in important natural areas is protected under several provisions of the CAA. Visibility impairment is caused by light scattering and light absorption associated with particles and gases in the atmosphere. In most areas of the country, light scattering by $PM_{2.5}$ is the most significant component of visibility impairment. The key components of $PM_{2.5}$ contributing to visibility impairment include sulfates, nitrates, organic carbon, elemental carbon, and crustal material. In 1999, USEPA issued revisions to the regulations to address visibility impairment in the form of regional haze, which is caused by numerous, diverse sources. The Federal Land Managers' Air

Quality Related Values Work Group (FLAG) visibility modeling recommendations are divided into distinct sections to address requirements for near field plumes compared to a background, and for long-range transport of plumes and aggregation of plumes that affect a vista.

The visibility impairment analysis should evaluate both the impacts to the immediate area affected by the source emissions, and the impacts from chemical transformation and long-range transport of source emissions to nearby Class I areas. Any proposed PSD source or modification located within 300 km of the Brigantine Class I area, for which the FLM has requested a Class I evaluation must address its visibility impact at the Class I area. If the source is located within 50 km of the Brigantine Class I area, a method of assessing the source's visibility impact due to coherent plumes should be used. Applicants should first model their potential plume impacts using the USEPA's screening model, VISCREEN, or, if the next level of analysis is called for, the USEPA's PLUVUE II. Both models use steady-state, Gaussian-based plume dispersion techniques to calculate one-hour concentrations within an elevated plume. These two models calculate the change in the color difference index (ΔE) and contrast between the plume and the viewing background. Values of ΔE and plume contrast are based on the concentrations of $PM_{2.5}$ (including sulfates), NO_2, and the geometry of the observer, target, plume, and the position of the sun. PLUVUE II also allows consideration of the effects of secondarily formed sulfates.

A.6.2.b Atmospheric Deposition Analysis

Emissions of nitrogen, sulfur, mercury and other secondary pollutants, can, in sensitive ecosystems, change soil and water characteristics and the biodiversity of the ecosystem. To address the relationship between deposition and ecosystem effects, the FLMs have developed estimates of critical loads. A critical load is defined as "A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge."

Deposition of sulfur and nitrogen has the potential to affect terrestrial, freshwater, and estuarine ecosystems on FLM lands. The FLM has identified, where possible, AQRVs sensitive to deposition of sulfur and nitrogen on FLM lands and the critical loads associated with those AQRVs. A proponent of a source of new emissions with the potential to contribute to sulfur or nitrogen deposition in a FLM area should consult with the FLM to determine what analyses are needed to assess AQRV effects. The FLM may request a deposition impact analysis as summarized below.

1. Estimate the current deposition rate to the FLM area. A list of monitoring sites providing data to characterize deposition in FLM areas is included on the respective agencies websites.

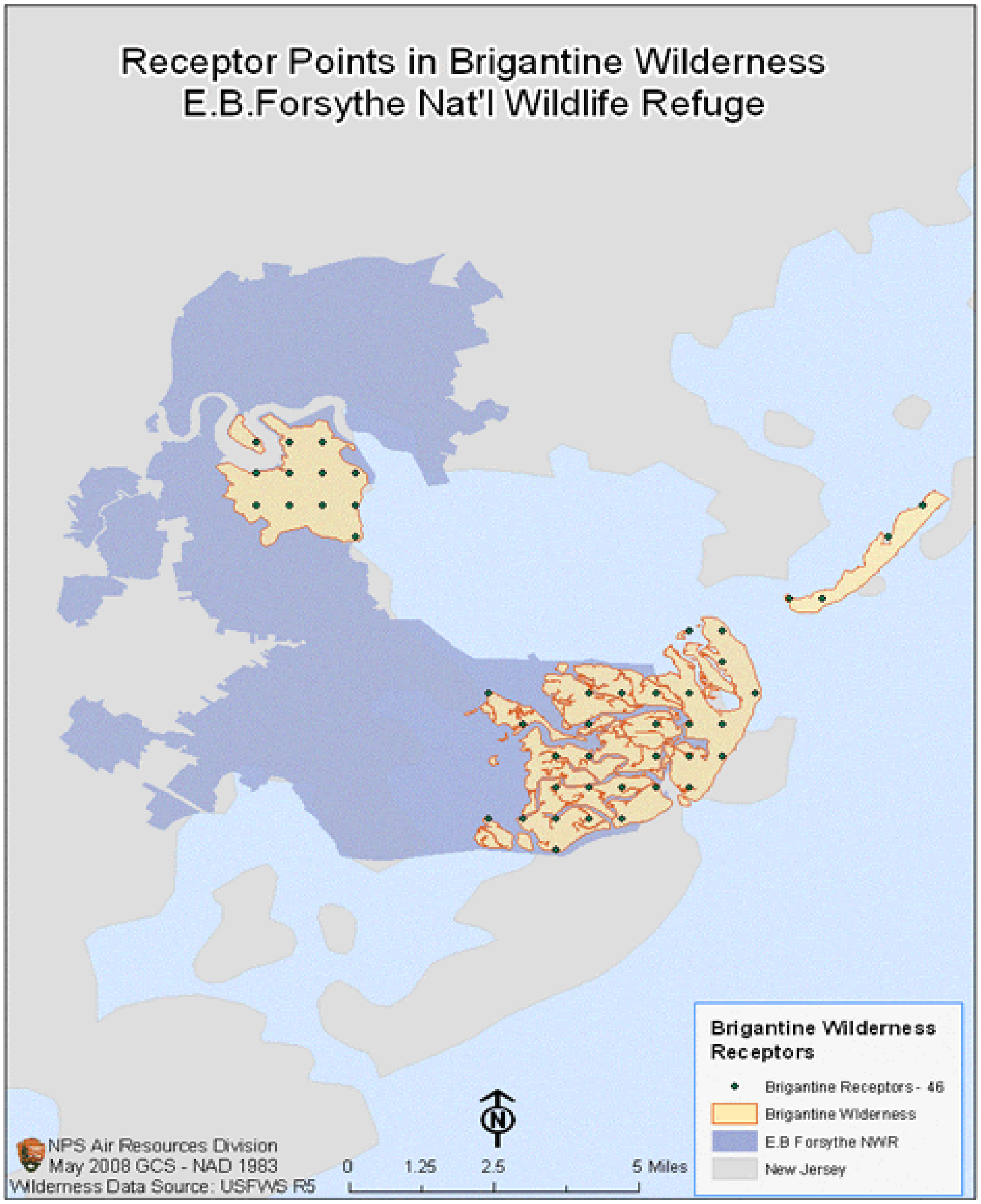
2. Estimate the future deposition rate by adding the existing rate, the new emissions' contribution to deposition, the contribution of sources permitted but not yet operating, and then subtracting the credit for enforceable emissions reductions. Modeling of new, reduced, and permitted but not yet operating emissions' contribution to deposition should be conducted following current USEPA modeling guidance.

3. Compare the future deposition rate with the recommended screening criteria (*e.g.*, critical load, concern threshold, or screening level value) for the affected FLM area.

A.6.3 Class I Required Receptors

When conducting a Class I impact analysis, the impact at 44 pre-selected receptors at the Brigantine Class I area must be evaluated. A listing of the latitude, longitude, and height above sea-level of these sensitive receptors can be downloaded at the following webpage: http://www.nature.nps.gov/air/Maps/Receptors/index.cfm. Figure A-1 shows the location of these receptors on a map.

Figure A-1. Required Receptor Locations in Brigantine Division of the E.B. Forsythe National Wildlife Refuge



APPENDIX B

Example Air Quality Analysis Checklist

This checklist recommends a standardized set of data and a standard basic level of analysis needed for modeling submittals. The checklist implies a level of detail required to assess compliance with the PSD increments, the NAAQS, and the NJAAQS. Individual cases may require more or less information and the reviewing authority should be consulted at an early stage in the development of a data base for a modeling analysis.

At pre-application meetings between the applicant and the reviewing authority, this checklist should assist the participants as they work to develop a consensus on the data base, modeling techniques and overall technical approach prior to the actual analyses. By reaching agreement on these items prior to submission of the applicant's modeling, applicants may reduce the chances of a misunderstanding concerning the final results and the need for additional analyses.

1. Source location map(s) showing location with respect to:
    - Urban areas
    - PSD Class I areas
    - Potential environmental justice areas
    - Nonattainment areas
    - Topographic features (terrain, lakes, river valleys, etc.)
    - Other major existing sources
    - State/local/on-site air quality monitoring locations
    - Plant layout on a topographic map covering a 1 km radius of the source with information sufficient to determine GEP stack heights

2. Information on urban/rural characteristics:
    - Land use within 3 km of source classified per Auer (1978): Correlation of land use and cover with meteorological anomalies, *J. Appl. Meteor.*, **17**: 636-643
    - Population (total and density)
    - Based on current guidance determination of whether the area should be addressed using urban or rural modeling methodology

3. Criteria and hazardous air pollutant emissions and operating/design parameters for proposed major sources:
    - Allowable annual emission rates (tons/yr) and operating rates
    - Maximum design load short-term emission rate (lbs/hr)
    - Associated emissions/stack characteristics as a function of load for maximum, average, and minimum operating conditions. Screening analyses may be employed to determine the constraining load condition (e.g., 50%, 75%, or 100% load) to be relied upon in the short-term modeling analysis.
      - location (UTM's)
      - height of stack (ft or m) and grade level above MSL
      - stack exit diameter (ft or m)

- exit velocity (m/s)
- exit temperature (Kelvin/°F)

- Area source emissions (rates, size of area, height of area source)
- Location and dimensions of buildings (shown on plot plan)
  - to determine GEP stack height
  - to determine potential building downwash for stack heights less than GEP
- Associated parameters
  - boiler size (megawatts, pounds/hr. steam, fuel consumption, etc.)
  - boiler parameters (% excess air, boiler type, type of fuel, etc.)
  - operating conditions (pollutant content in fuel, hours of operation, startup and shut down emissions, capacity factor, % load for winter, summer, etc.)
  - pollutant control equipment parameters (design efficiency, operation record, e.g., can it be bypassed? etc.)

4. Air quality monitoring data:
   - Proposed monitors that will be used to represent background air quality.
   - Justification for their selection, and the latest three years of measurements from the selected monitors

5. Meteorological data:
   - Five consecutive years of representative sequential hourly National Weather Service (NWS) data, or one or more years of hourly sequential on-site data

6. Air quality modeling analyses:
   - Model the 1 to 5 years for which data are available with a recommended model or model demonstrated to be acceptable on a case-by-case basis
     - urban dispersion coefficients for urban areas
     - rural dispersion coefficients for rural areas
   - Evaluate downwash if stack height is less than GEP
   - Define worst case meteorology
   - Determine background and document method (long-term and short-term)
   - Provide topographic map(s) of receptor network with respect to location of all sources
   - Follow current guidance on selection of receptor sites for refined analysis
   - Include receptor terrain heights (if applicable) used in analysis
   - Determine extent of significant impact; provide maps
   - Define areas of maximum and highest, second-highest impacts due to applicant source (long-term and short-term)
   - NAAQS & PSD emissions inventories (if applicable)

7. Comparison with acceptable air quality thresholds:
   - NAAQS and NJAAQS
   - PSD increments
   - Emission offset impacts if nonattainment
   - Department health risk criteria

APPENDIX C

Odor Modeling Procedures

C.1 Odor Modeling Procedures

The mechanisms of odorant dispersion in the atmosphere are the same as the dispersion of other pollutants. However, there are some special issues that must be considered when attempting to quantify a source's odor impact with dispersion modeling. Among them are determining the emission rates of the odor-producing pollutants (odorants), the high degree of subjectivity in the perception and intensity of odors, the short time period over which odors are observed, and the enhancing or masking of odors by the combinations of odorants. In addition, there are no dispersion models or modeling techniques recommended by the USEPA for odor modeling.

N.J.A.C. 7:27-5 (Prohibition of Air Pollutants) states that a source shall not emit air contaminants in such quantities and duration as to unreasonably interfere with the enjoyment of life or property. Therefore, the Department does on occasion need to evaluate or review modeling of new or modified sources capable of causing odor problems. In addition, odor modeling may be required of a new, reconstructed, or modified municipal wastewater/sludge handling or treatment facility. Although there is no USEPA guidance on the issue, there have been several scientific studies and technical papers written about odor modeling. The Department has reviewed the available literature and has developed guidance for assessing a source's odor impact with dispersion modeling. Predictions made in an odor modeling analysis following this guidance would only be considered an indication of the future odor impact of the source, not the definitive answer. It should be considered a tool in setting either a dilution-to-threshold (D/T) odor emission limit or pound per hour pollutant specific emission rate for the source.

C.2 Odor Modeling Techniques

The Department currently recommends two methods to model odor impact. The method selected will be a function of the number of odor-producing pollutants emitted from the source. Regardless of the method used, the analysis must provide predictions of maximum odor impact at sensitive receptors near the source. Sensitive receptors include, but are not limited to, residents of occupied homes and residential areas, employees and customers at industrial, commercial, or government establishments, schools, hospitals, and visitors at a recreational public place such as park or playground. Submittal of predicted odor frequency tables also provides useful information in the review of a source's odor impacts. As with other air quality impact analyses, the Department requires that a protocol be submitted and approved before the odor modeling analysis is conducted.

C.3 Sources that Emit One Primary Odor Producing Pollutant

In this situation, the interaction of pollutants masking or enhancing a perceived odor should be minimal. Therefore, the odor producing pollutant can be modeled by entering the pollutant's emission rate in grams per second into the selected model. The model's predicted concentration (in mass per volume, $\mu g/m^3$) can then be compared to the pollutant's specific odor threshold.

C.4 Sources that Emit Several Odor Producing Pollutants

When there are numerous pollutants being emitted from a source, there is a much higher potential for interactions where various odorants may mask or enhance a perceived odor. Therefore, a dilution to threshold (D/T) approach to quantifying odors should be used in the analysis. D/T is dimensionless and is a measure of how many volumes of odor-free air must be added to a sample of contaminated air in order to reduce its odor level below the detection level. The odor emission rate of the source is expressed as the product of the D/T in air directly emitted by the source and the volume flow rate. To obtain the correct magnitude of D/T, the model selected should be set to predict g/m^3, not $\mu g/m^3$.

In the measurement of a source's D/T emission rate, the odorous air sample from the source is diluted with equal volumes of odor-free air until an odor is no longer perceptible. For example, an odorous air sample that was diluted with 100 volumes of odor-free air to reach the 50% odor perceptibility would have an odor level of 100 D/T.

C.5 Conversion of 1-Hour Modeled Concentrations to Short-term Averages

An odor modeling analysis can be conducted with either a puff (fluctuating plume) model or one of the standard Gaussian models recommended by the USEPA such as the AERMOD model. If a puff type model such as TRC's Odor Model or USEPA's INPUFF model is used, no conversion is necessary because short-term D/T values or pollutant concentrations will be predicted by the model. However, if a model such as AERMOD is used, the predicted one-hour D/T or pollutant concentration needs to be converted to short-term peak value of 5 minutes or less.

Review of the available literature indicates the relationship between a 1-hour concentration and a short-term peak concentration such as a five-minute average is a function of meteorology (principally atmospheric stability), the release height of emissions, the distance from the source to receptor, building downwash, and surface roughness. In the paper *A Conversion Scheme for ISC Model In Odor Modeling* (Samuel S. Cha, Zhenjia Li, and Karen E. Brown, 1992. AQMA 85th Meeting, 92-153.02), a technique was developed for converting 1-hour concentrations to 5-second concentrations for point sources. Conclusions reached in the paper indicate that the peak/mean ratios depend on the meteorological condition, the type of source and the receptor location. A summary of their results for point sources with a 20-meter plume height and a 40-meter plume height is given in Table C-1. The paper *Odor Modeling - Why and How* (Duffee, R.A., M. A. O'Brien, and M. Ostojic, 1989. AWMA Specialty Conference) compares 1-hour ISCST predictions to the instantaneous predictions of the INPUFF model. When modeling an area source during stable conditions, a relatively constant conversion ratio of approximately 7 was found at receptor distances of 0.8 km, 1.6 km, and 2.4 km.

Table C-1. Conversion Factors for Peak-To-Mean Ratio

Distance (m)	B Stability: Wind Speed: 2 m/s (4.5 mi/hr)	D Stability: Wind Speed: 6 m/s (13.4 mi/hr)	E Stability: Wind Speed: 2 m/s (4.5 mi/hr)
Case I: Point Source Plume Height = 40 Meters			
100	45.0	6.0	8.3
200	38.5	7.3	8.3
300	23.2	8.5	10.1
400	16.1	10.2	10.9
600	12.8	12.4	12.7
800	12.6	13.3	13.1
1,000 (0.62 mi)	12.4	10.2	15.6
Case II: Point Source Plume Height = 20 Meters			
100	36.0	6.0	5.6
200	14.7	9.7	7.8
300	11.6	12.6	10.9
400	11.0	10.3	12.6
600	10.8	7.4	10.9
800	10.6	6.7	8.4
1,000 (0.62 mi)	10.4	6.6	7.3

Though often too simplistic, another method of converting values to shorter averaging times is the power law relationship. The following is an example of using the power law to convert a 1-hour concentration or D/T value to a five-minute average:

$$C_p = C_m (t_m/t_p)^{0.2}$$

where: C_p = 5-minute average concentration or D/T
C_m = 1-hour average concentration or D/T
t_p = 5 minutes
t_m = 60 minutes

An applicant planning to conduct odor modeling with a model similar to ISC3 or AERMOD can suggest the use of a conversion ratio based on the above discussion or propose their own. The Department will review the proposed conversion ratios in the modeling protocol before they are approved for use in the analysis.

C.6 Odor Modeling Results

Once short-term pollutant concentrations are calculated, they must be compared to odor detection and complaint levels. Odor detectability, or the odor threshold, is usually defined as the point at which 50% of a given population will perceive an odor. Table C-2 lists some of the published odor detection levels of pollutants that often cause odor problems. Odor complaint levels are usually 2 to 3 times higher than the odor threshold levels. The Connecticut Department of Environmental Protection odor limits given in Table C-2 are considered nuisance levels. Applicable odor detection and complaint levels for odor producing emissions from a proposed source should be discussed in the modeling protocol.

Based on the results of the modeling, a D/T emission limit at the source is set which ensures offsite D/T values will be at an acceptable level. Odor-causing compound(s) from a new, reconstructed, or modified source should have an odor intensity of less than 5 D/T at the sensitive receptor with the highest impact. Once the D/T emission limit is set for a facility, it can later be verified by source testing when the facility is built.

Table C-2. Published Odor Thresholds

Odorant	Odor Threshold[a] (μg/m^3)	Odor Limit[b] (μg/m^3)	Odor Threshold[c] (μg/m^3)	Odor Detection[d] (μg/m^3)
Acetaldehyde	120	---	90	90
Ammonia	---	---	3,615	3,700
Carbon Disulfide	---	---	342	3,900
Dimethyl Disulfide	---	---	---	66
Dimethyl Sulfide	---	---	---	51
Hydrogen Sulfide	---	6.3	11.3	5.5
Methyl Mercaptan	---	2.2	3.4	2.4
Phenol	230	461	153	500
Styrene	640	638	1,360	1,300
Trimethyl Amine	---	---	1.1	6

a. Geometric mean of all odor threshold detection levels in literature reviewed by authors, values from *Reference Guide to Odor Thresholds for HAPS Listed in the Clean Air Act Amendments of 1990* (Draft), 1991, TRC Environmental Consultants.

b. Connecticut DEP - 15-minute average of concentration considered a nuisance.

c. Geometric mean of all odor threshold detection levels in literature reviewed by authors: "Odor as an Aid to Chemical Safety: Odor Thresholds Compared with TLV and Volatilities for 214 Industrial Chemicals in Air and Water Dilution" from *Journal of Applied Toxicology* Vol. 3 No. 6, 1983.

d. Represents the 50% detection level: "The Odor Impact Model" from *Journal of Air and Waste Management* Vol. 41 No. 10, October 1991.

C.7 Odor Testing

I. Introduction

The purpose of this document is to provide guidance in the use of odor panel testing to determine dilutions-to-threshold (D/T) levels. This document should not be considered as a substitute for a complete testing protocol, which must be source specific. All sampling and analysis shall be performed in accordance with the approved protocol. Unapproved deviation from the protocol is not acceptable and will be justification to require repetition of the test project.

II. Test Method

The D/T will be determined at the source emission point using ASTM Method E679-91, Standard Practice for Determination of Odor and Taste Thresholds By a Forced-Choice Ascending Concentration Series Method of Limits.

III. Sampling

1. Samples should be collected into tedlar bags using a sampling line made of an odor-free, chemically inert and non-reactive material, such as teflon. If sulfur compounds are suspected to be present, the tedlar bag should not have a stainless steel valve. The sampling train must allow for the transfer of the gas through the sample line directly into the bag without going through any sources of potential contamination, such as pumps or rotometers. The evacuated container sampling procedure listed in EPA Reference Method 18, Section 7.1.1, is recommended. Alternatives must be approved by the Department's Emission Measurement Section, which can be contacted at 609-984-3443.

2. A new tedlar bag is required for each sample. Bags should be pre-purged with carbon filtered air for 48 hours to remove background odors prior to being used for sampling. New sampling line tubing should be used for each sample and the line should be as short as practical.

3. The sample line and bag should be pre-conditioned by filling the bag with the odorous sample and then emptying the bag.

4. The sampling location must be approved by the Department's Emission Measurement Section.

5. Sampling should be 5-minute grab samples, unless otherwise approved. The number of samples required will be determined in the source specific protocol. In general, sampling will be required under worst case operating conditions. At least one sample will be a duplicate, where the two evacuated containers used to fill the tedlar bags will be manifolded by a tee fitting to a common pump. The goal for the duplicate sample is agreement within +20% of the original, analyzed by the same odor panel on the same day. One field blank sample of odor free air should be collected for each day of sampling.

6. The tester is responsible for collecting a sufficient volume; however, in general, a 10-liter sample should be sufficient.

7. Once collected, samples should be maintained at ambient temperatures and protected from direct contact with the sun. If condensed moisture is expected in the sample bags under these conditions, the tester must address this issue, either through pre-dilution with odor-free air so that there is no visible moisture, or by other approved means. If pre-dilution is utilized, the results will have to be adjusted by the dilution factor.

IV. Analysis

1. Analysis will be done with an odor panel by means of a forced choice triangular dynamic dilution olfactometer. The odor panel should consist of a minimum of 8 panelists. The greater the number of panelists, the greater the accuracy of the odor determination. Panelists should be trained and screened for their ability to smell the odors of interest. Individuals with normal sensitivity should be selected as panelists.

2. Samples should be analyzed within 8 hours of sample collection when possible; however, sample

holding time may not exceed 24 hours under any situation.

3. The olfactometer should be constructed of odor-free materials. In addition, parts that come into direct contact with the sample must also be chemically inert and non-reactive and must also have the ability to be purged or cleaned quickly to make them odor-free in case of contamination. The sample should be directly interfaced with the olfactometer, with the connection being as short as possible and made of the same materials listed above.

4. The dilution air, olfactometer-to-subject interface and presentation method should be as described in the Guidelines for Odor Sampling and Measurement by Dynamic Dilution Olfactometry document (revised Draft May 1993) of the AWMA EE-6 Subcommittee on the Standardization of Odor Measurement. Air flow per sniff port should be established at 8 liters per minute (lpm), with a minimum acceptable flow rate of 6 lpm.