Virginia Department of
Environmental Quality

Virginia Modeling Guideline for Air Quality Permits

July 2012 Office of Air Quality Assessments

Preface

The *Virginia Modeling Guideline for Air Quality Permits* presents current Virginia Department of Environmental Quality (VADEQ) air quality modeling guidance for estimating impacts from stationary sources of air pollution. It primarily addresses modeling issues for major stationary sources such as those subject to Prevention of Significant Deterioration (PSD) review, but may also apply in some cases to minor sources of air pollution. Recommendations in the *Virginia Modeling Guideline for Air Quality Permits* may not be applicable in all situations.

This guideline is intended to help permit applicants, air quality specialists, and others understand the VADEQ's expectations for the ambient air impact analysis and to prevent unnecessary delays in the permit process. It provides a starting point for modeling. To avoid misunderstandings, the reader should obtain the most recent version of this guideline from http://www.deq.virginia.gov/Programs/Air/AirQualityAssessments/DispersionModeling.aspx. In addition, the reader should also obtain current regulations and applicable U.S. Environmental Protection Agency (EPA) guidance.

This guideline is not intended to describe the implications of modeling results. Such implications are generally controlled by the permit rules or other relevant state and federal regulations, laws, and guidance. Nevertheless, this guideline contains incidental discussion of the effects of certain modeling results. Such discussion is for informational purposes only and shall not be construed to be authority defining the regulatory impact of any modeling result. For that, the reader should refer to the applicable rules and regulations.

The guideline is intended to promote technically sound and consistent modeling techniques, while encouraging the use of improved and more accurate techniques as they become available. The guideline helps permit applicants understand when modeling is warranted. It clarifies what modeling-related information and data should be included with a permit application. Supplemental guidance on specific technical issues and other modeling-related data and information, including checklists and meteorological data, are available at http://www.deq.virginia.gov/Programs/Air/AirQualityAssessments/DispersionModeling.aspx. If modeling procedures other than those recommended in Virginia and EPA guidance are used, there might be delays while the procedures are reviewed. In some cases, EPA approval may be necessary.

Disclaimer

This is only a guidance document. It does not have the force and effect of a rule and is not intended to supersede statutory/regulatory requirements or recommendations of the Commonwealth of Virginia or EPA. EPA models and guidance are available on the Internet at EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website at http://www.epa.gov/ttn/scram.[1] The Commonwealth of Virginia and the VADEQ make no warranties, expressed or implied, and assume no legal liability or responsibility for the accuracy or completeness of any information provided within this guideline or for its use.

[1] This SCRAM website is a source of information on atmospheric dispersion (air quality) models that support regulatory programs required by the federal Clean Air Act. Documentation and guidance for these computerized models are a major feature of this website.

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Definitions

Note: The following explanations of terms are included solely for the reader's convenience; they do not replace any full, formal definition in state or federal laws, rules, or regulations.

Air Pollutants - One or more air contaminants that are present in the outdoor atmosphere.

Air Quality Related Value(s) (AQRV) - Valued resources that could potentially be impacted by air pollutant emissions, including but not limited to: visibility, odor, flora, fauna, geological resources, archeological, historical, and other cultural resources; and soil and water resources.

Ambient Air - That portion of the atmosphere, external to buildings, to which the general public has access.

Class I Area - An area defined by Congress that is afforded the greatest degree of air quality protection. Class I areas are deemed to have special natural, scenic, or historic value. The PSD regulations provide special protection for Class I areas in which little deterioration of air quality is allowed. Increases in ambient concentrations of NO_2, SO_2, PM_{10}, and $PM_{2.5}$ must be below the PSD Class I increments.

Complex Terrain - Complex terrain is any terrain exceeding the height of the stack being modeled. This definition includes terrain that is commonly referred to as intermediate terrain, that is, those receptors between stack height and plume height.

Criteria Pollutant - A pollutant for which a national ambient air quality standard has been defined (SO_2, NO_2, PM_{10}, $PM_{2.5}$, Pb, CO, O_3).

Federal Land Manager(s) (FLM) - Agencies that administer the nation's Federal Class I areas including the U.S. Department of Agriculture Forest Service (USDA FS), the National Park Service (NPS), and the U.S. Fish and Wildlife Service (FWS).

Guideline on Air Quality Models - 40 CFR Part 51, Appendix W, recommends air quality modeling techniques that should be applied to State Implementation Plan (SIP) revisions for existing sources and to new source reviews, including Prevention of Significant Deterioration (PSD). It is intended for use by the EPA in judging the adequacy of modeling analyses performed by EPA, state and local agencies, and industry. The *Guideline* identifies those techniques and databases U.S. EPA considers acceptable. The reader is advised to obtain the most recent version of this reference from EPA's website.

Major Source (PSD Permitting) - The term major may refer to the total emissions at a stationary source or to a specific facility. For PSD review, once a site or project is major for one pollutant, all other pollutant emissions are compared to significance levels in 40 CFR 52.21(b)(23).

- A named major stationary source is any source belonging to a list of 28 source categories in 40 CFR 52.21(b)(1) which emits or has the potential to emit 100 tons per year (tpy) or more of any pollutant regulated by the Clean Air Act.
- A major stationary source is any source not belonging to the list of 28 source categories in 40 CFR 52.21(b)(1) that emits or has the potential to emit 250 tpy or more of any pollutant.

Major Modification - Used in the context of a PSD or NAA permitting action. The phrase “major modification” refers to a change in operation that results in a significant net increase of emissions for any pollutant for which a NAAQS has been issued. New sources at an existing major stationary source are treated as modifications to the major stationary source.

Minor Source - As used in this document, a minor source is any stationary source that is not defined as a major stationary source by 9 VAC 5-80-1615 C or 9 VAC 5-80-2010 C. The definition of minor source may vary based on the context in which it is used.

National Ambient Air Quality Standards (NAAQS) - The Federal Clean Air Act established two types of national ambient air quality standards. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings (40 CFR 50.2).

Nearby Source - A nearby source is any emission unit that causes a significant air pollutant concentration gradient in the vicinity of an applicant’s proposed new or modified facility.

Nonattainment **Area (NAA) -** An area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for a criteria pollutant.

North American Datum of 1927 (NAD27) - NAD27 is defined with an initial point at Meads Ranch, Kansas, and by the parameters of the Clarke 1866 ellipsoid. The location of features on most USGS topographic maps, including the definition of 7.5-minute quadrangle corners, is referenced to the NAD27.

North American Datum of 1983 (NAD83) - NAD83 is an Earth-centered datum and uses the Geodetic Reference System 1980 (GRS 80) ellipsoid. Please note that because the NAD83 surface deviates from the NAD27 surface, the position of a point based on the two reference datums will be different.

Other Background Sources - Other background sources include all sources of air pollution other than the source under review and those identified as nearby sources. Examples include area and mobile sources, natural sources, most minor sources, and distant major sources.

Receptor - A location where the public has access and could be exposed to an air contaminant (or pollutant) in the ambient air. Air quality models are used to estimate impacts at specific receptors. A receptor is a geographic location (point) at which the model calculates the impact (i.e., air pollutant concentration) from a source of air pollution. In practice, many receptors (i.e., a grid of receptors) are used to estimate air quality concentrations over the probable area of impact from a source. Each receptor has a unique geographic coordinate and elevation.

Significant Impact - A concentration in ambient air that exceeds a modeling significant impact level.

Universal Transverse Mercator (UTM) - The UTM system is a plane coordinate system that uses distances from a specified reference point as the basis for all locations. It is based on a transverse Mercator projection that divides the Earth's surface into zones that are 6 degrees of longitude wide and oriented to a meridian. Precise locations on the earth are described in terms of north-south (northing) and east-west (easting) distances, measured in meters from the origin of the appropriate UTM zone (Star and Estes, 1990).

World Geodetic System 1984 (WGS84) - The WGS84 datum was developed as a replacement for WGS72 by the military mapping community as a result of new and more accurate instrumentation and a more comprehensive control network of ground stations.

1 Introduction

The *Virginia Modeling Guideline for Air Quality Permits* has been developed by the Office of Air Quality Assessments (AQA) of the VADEQ to document air quality modeling procedures for air quality permit applications and other activities which require air quality impact modeling. It is assumed that the reader of this guideline has a basic knowledge of modeling theory and techniques. This guideline provides assistance to permit applicants required to perform modeling analyses to demonstrate that the air quality impacts from new and modified/existing sources protect public health, general welfare, and the natural environment. It also assists the VADEQ in expediting the permit review process and outlines additional modeling requirements specific to the VADEQ.

All estimates of ambient impacts required for a modeling analysis must be based on approved air quality models, databases, and other requirements generally approved by the EPA and specifically approved by the VADEQ. Case-by-case approval from EPA is typically required if an alternative model, as defined by *40 CFR Part 51, Appendix W - Guideline on Air Quality Models*, is proposed. The *Guideline on Air Quality Models (EPA, 2005)* is available at http://www.epa.gov/scram001/guidance_permit.htm.

The primary EPA modeling guideline is the *Guideline on Air Quality Models (EPA, 2005)*. There are many other EPA guidance documents, memos, and EPA model clearinghouse decisions that explain modeling procedures.

While the VADEQ has attempted to address as many issues as possible in this document, each modeling analysis is still treated on a case-by-case basis. Therefore, the applicant should work closely with the VADEQ throughout the project. All modeling submittals (e.g., input/output files, protocols, and reports) and correspondence (e.g., e-mails, letters) are required to be sent to both the AQA and the appropriate VADEQ regional office (i.e., Air Permit Manager) responsible for processing any permit application. The current VADEQ regional office contacts are located at http://www.deq.virginia.gov/Locations.aspx. The AQA contact information is provided in Appendix A. The applicant should verify that electronic mail with attachments is received by the VADEQ. Electronic mail with zip, executable, and some other types of attachments may be rejected by the VADEQ's electronic mail system.

For facilities subject to PSD, a pre-application meeting is required prior to submitting the modeling protocol and modeling analyses. The pre-application meeting is held to discuss project specifics with the appropriate VADEQ regional office and the AQA to identify project specific permitting and modeling requirements. If Class I area modeling is required, VADEQ will schedule a conference call with the appropriate Federal Land Managers (FLMs) to discuss these specific requirements.

1.1 Purpose of Air Dispersion Modeling

Air dispersion modeling is a tool utilized to predict impacts (air pollutant concentration levels) in ambient air based on emissions from one or more sources of air pollution. A variety of air quality models for use in air dispersion modeling have been developed for different pollution sources, meteorology, downwind distances, and other factors that affect how pollutants are dispersed in the atmosphere. In general, all of these models require information about the source being modeled and information about the meteorological conditions surrounding the source. A model uses this information to mathematically simulate the pollutant's downwind dispersion in order to derive estimates of concentration at a specified location (receptor). Some models simulate chemical transformations and removal processes that can occur along the transport path.

Air quality models[2] are used during the air quality permitting process to determine if a new or modified source will comply with applicable ambient air standards and other applicable regulatory requirements. Federal law requires that the VADEQ have legally enforceable procedures in place to prevent construction or modification of any source where the emissions from the projected activity would violate control strategies or interfere with attainment and maintenance of the National Ambient Air Quality Standards (NAAQS).[3]

The results from the air quality models are used by the VADEQ in their review of air quality permit applications. The model-predicted impacts are one of the many parameters considered in the technical review process. A model-predicted impact that exceeds an applicable ambient air standard may be used as the basis to modify permitted allowable emission rates, stack parameters, operating conditions, or to require State Implementation Plan review for criteria pollutants.

1.2 Overview of Modeling Protocols and Checklists

Modeling protocols and guidance checklists outline how a modeling analysis should be conducted and how the results should be presented. It is the VADEQ's goal to

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[2] Air quality models are computer codes for estimating ambient concentration levels (i.e., "impacts") from new and existing sources of air pollution. Models allow one to forecast future air quality levels from sources that have not been constructed. Models simulate in a simplified manner the complex behavior of emissions injected into the atmosphere. Such estimates can provide information on air quality impacts in an efficient and cost effective manner. Some models, such as "screening-level" models, are generally quick and easy to use. EPA models and guidance are available at http://www.epa.gov/ttn/scram.

[3] Pursuant to Section 110(a)(2)(C) of the federal Clean Air Act, the State Implementation Plan (SIP) needs to regulate the "*modification and construction of any stationary source within the areas covered by the plan as necessary to assure that national ambient air quality standards are achieved*." Similarly, 40 CFR 51.160 requires the State to have the authority to prohibit any construction or modification that would interfere with the attainment or maintenance of a national standard. This includes Prevention of Significant Deterioration (PSD) increments as well as NAAQS. See also 40 CFR 51.166.

expedite the permitting process through the use of these documents which are designed to clarify air quality modeling procedures before, rather than after, the technical work begins. Protocols should address relevant modeling requirements and recommendations from state/federal regulations and air quality modeling guidelines. The VADEQ does not wish to require permit applicants to use a specific modeling protocol format but instead has generated separate Class I and Class II area example checklists containing typical protocol elements as an aid in developing a modeling protocol for these areas. These checklists are provided in Appendix B.

Prior to commencing a refined modeling or PSD modeling analysis, the applicant must submit a modeling protocol to the AQA for approval. A copy is also required to be submitted to the appropriate VADEQ regional office processing the permit application. Additional copies may also be required to be submitted to EPA Region III and the appropriate FLMs depending on the project. The submittal of an electronic copy along with a hard copy is required. The electronic copy may be submitted on CD, DVD, or via electronic mail to the appropriate individuals. The applicant should verify that electronic mail with attachments is received by the VADEQ. Electronic mail with zip, executable, and some other types of attachments may be rejected by the VADEQ's electronic mail system. The VADEQ will generally not accept a refined modeling analysis without a pre-approved modeling protocol.

The applicant should allow 30 days for review of the protocol by the VADEQ. Upon review, the applicant will receive notification of the status of the modeling approach which may include the identification of any deficiencies and guidance on any outstanding issues. However, the applicant should understand that an approved modeling protocol does not necessarily limit the scope of the modeling that will be required to demonstrate compliance with applicable standards. As an example, additional modeling analyses not previously identified in a protocol may be required in order to address issues raised during the public comment period.

1.3 Overview of Modeling Reports

In general, the approved modeling protocol may serve as the basis of the modeling report. Please be sure the modeling report includes a discussion of each relevant issue listed in the applicable checklist in Appendix B and not previously addressed in the modeling protocol.

As with the modeling protocol, the submittal of an electronic copy and a hard copy of the modeling report to the AQA and VADEQ regional office is required. Additional copies of the report may also be required to be submitted to EPA Region III and the appropriate FLMs depending on the project.

Lastly, the submittal of all electronic modeling files, including model input and output files, model plot files, building downwash input and output files, meteorological data files, etc., necessary for VADEQ to reproduce the modeling results is required. Please submit the electronic copy of all modeling files on CD, DVD, USB drive, or other appropriate electronic storage media approved by the VADEQ.

2 Hierarchy of Modeling Methods

The complexity of the modeling analysis will vary widely based on the type of source being modeled as well as the size and location of the proposed project, existing air quality in the project area, proximity of nearby sources, and distance to sensitive areas. There are two basic levels of modeling that may be used to demonstrate compliance with ambient air standards and guidelines, screening and refined modeling. A simple modeling analysis might include the consideration of a single stack that could be considered using a screening model. A complex analysis can include multiple emission sources and would require a refined model to simulate ambient impacts.

2.1 Screening Modeling

The least complex form of modeling involves the use of a screening model. A screening model will produce estimates of regulatory design concentrations without the need for fully developed sets of meteorological and terrain data such as those used by a refined model. A screening model is designed to produce concentrations that are equal to or greater than the estimates produced by a refined model, and can be used to either verify compliance or determine that more detailed (i.e., refined) modeling is necessary.

AERSCREEN is the current EPA-recommended screening model. This model replaces SCREEN3 as the recommended screening model based on the *Guideline on Air Quality Models (EPA, 2005).* AERSCREEN is the single source screening version of AERMOD which is the current EPA-approved "preferred model" for refined dispersion modeling applications. The most recent version of AERSCREEN can be downloaded from EPA's SCRAM website at http://www.epa.gov/ttn/scram.

AERSCREEN generates a site-specific matrix of worst-case meteorological conditions using the meteorological data generator MAKEMET. Additionally, AERSCREEN incorporates the Plume Rise Model Enhancements (PRIME) downwash algorithms that are part of the AERMOD refined model and utilizes the Building Profile Input Program for PRIME (BPIP-PRIME) tool to provide a detailed analysis of downwash influences on a direction-specific basis. AERSCREEN also includes AERMOD's complex terrain algorithms and utilizes the AERMAP terrain processor to account for the actual terrain in the vicinity of the source on a direction-specific basis. Refer to the *AERSCREEN User's Guide (EPA-454/B-11-001, March 2011)* for additional information.

AERSCREEN calculates maximum 1-hour average concentrations and automatically provides impacts for other averaging periods using scaling ratios. The averaging period ratios currently implemented in AERSCREEN are as follows:

Table 2-1: Scaling Ratios for AERSCREEN

Averaging Period	AERSCREEN 1-Hour Concentration
3-hour	1.00
8-hour	0.90
24-hour	0.60
Annual	0.10

For area sources (rectangular and circular), the averaging factors are based on guidance in Section 4.5.4 of the EPA screening guidance document *Screening Procedures for Estimating the Air Quality Impact of Stationary Sources, Revised (EPA- 454/R-92-019, October 1992).* For area sources, the 3-hour, 8-hour, and 24-hour average concentrations are equal to the 1-hour average calculated by AERMOD in screening mode. No annual average concentration is calculated.

In general, AERSCREEN should produce concentrations that are equal to or greater than the estimates produced by AERMOD with a fully developed set of meteorological and terrain data.

In the event that the screening analysis indicates that the maximum predicted concentrations exceed an applicable ambient air quality standard, refined modeling or changes to the facility are necessary to reduce the modeled air quality impacts. Ambient air impacts can be lowered by reducing emissions, reducing hours of operation, adjusting stack parameters, etc. It is important to note that any adjustment in stack parameters (e.g., stack height) must not be considered a prohibited "dispersion technique" as defined in 9 VAC 5-10-20. If changes to the facility are not feasible, it may be necessary to refine the modeling results using a higher level of modeling sophistication.

2.2 Refined Modeling

Refined modeling may be used if the results of the screening analysis indicate that the maximum predicted concentrations from a source exceed an applicable ambient air quality standard. Before refined modeling is performed, the facility is required to submit a written modeling protocol that describes the methodology to be utilized in the analysis.

Refined models consist of analytical techniques that provide more detailed treatment of physical and chemical atmospheric processes. Refined models also require detailed input data and are designed to provide more accurate concentration estimates when compared to the more conservative screening models. The current EPA-approved "preferred model" for refined dispersion modeling applications (as defined in the *Guideline on Air Quality Models (EPA, 2005)*) is the most recent version of

AERMOD. A facility has the option to propose an alternative to the AERMOD model provided that the requirements for use of an alternative model (as defined in the *Guideline on Air Quality Models (EPA, 2005)*) are met. Approval for the use of an alternative model must occur prior to being used by the facility. The most recent version of AERMOD can be downloaded from EPA's SCRAM website at http://www.epa.gov/ttn/scram.

AERMOD should always be run in the regulatory default mode unless otherwise approved by VADEQ. In addition, commercial versions of this model that include user-friendly input interfaces are also acceptable if EPA has granted modeling equivalency.

Another example of a refined model is the CALPUFF modeling system which is most often used to assess impacts in Class I areas. CALPUFF incorporates more sophisticated physics and chemistry and requires more extensive data input than AERMOD. CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal.

CALPUFF can be applied on scales of tens to hundreds of kilometers. It is most often used for long range transport assessments (greater than 50 kilometers from the emission source). The model includes algorithms for sub-grid scale effects (such as terrain impingement), as well as longer range effects (such as pollutant removal due to wet scavenging and dry deposition, chemical transformation, and visibility effects of particulate matter concentrations). Additional information for the CALPUFF modeling system is available at EPA's SCRAM website at http://www.epa.gov/ttn/scram and the model developer's website at http://www.src.com/calpuff/calpuff1.htm.

3 Ambient Air Quality Analysis Applicability Determination

For new stationary sources and modifications not subject to PSD review under 9 VAC 5 Chapter 80, Article 8 or nonattainment area (NAA) review under 9 VAC 5 Chapter 80, Article 9 of the Commonwealth of Virginia Regulations for the Control and Abatement of Air Pollution (Regulations) (i.e., new minor sources and non-major modifications), an analysis to indicate the air quality impact from criteria and/or toxic pollutants from the proposed new source or modification may be required. The applicant should contact the appropriate VADEQ regional office for further information.

For major stationary sources requiring a preconstruction air quality permit (or air quality permit to construct and operate) in accordance with 9 VAC 5 Chapter 80, Article 8 and/or Article 9 of the Regulations, the applicant is frequently required to perform an analysis to quantify the air quality impact from the proposed new source or modification. The analysis must demonstrate that the proposed new source or modification does not cause or contribute to a violation of any applicable ambient air quality standard.

3.1 Attainment Areas

A determination of the impact on air quality from a new source or modification is applicable in all areas (“attainment, nonattainment, unclassifiable”). Therefore, modeling may sometimes be warranted for sources in attainment areas.

New major stationary sources and major modifications subject to 9 VAC 5 Chapter 80, Article 8 of the Regulations are required to submit various types of modeling and/or analysis along with their permit application. The application must include appropriate modeling and/or analysis to be ruled complete. Refer to 9 VAC 5-80-1715 of the Regulations for source impact analysis requirements.

With respect to ambient air standards, 9 VAC 5-80-1715 A of the Regulations requires that:

> “*The owner of the proposed source or modification shall demonstrate that allowable emission increases from the proposed source or modification, in conjunction with all other applicable emissions increases or reductions (including secondary emissions), would not cause or contribute to air pollution in violation of:*
>
> - *9 VAC 5-80-1715 A.1 - Any ambient air quality standard in any air quality control region; or*

- *9 VAC 5-80-1715 A.2 - Any applicable maximum allowable increase over the baseline concentration in any area"* (see Section 5.3).

Also, major stationary sources and major modifications are subject to additional requirements. See Sections 4 and 5 for more details.

3.2 Nonattainment Areas

A determination of the impact on air quality from a new source or modification is applicable in nonattainment areas. Therefore, modeling may sometimes be warranted for sources in nonattainment areas.

9 VAC 5 Chapter 80, Article 9 of the Regulations refers to the concept of reasonable further progress (RFP) for sources located in nonattainment areas. If emissions from a new source or modification would prevent a NAA from coming into compliance with the applicable ambient air quality standard by the applicable date in the implementation plan, then the source impairs RFP.[4]

New major stationary sources and major modifications subject to 9 VAC 5 Chapter 80, Article 9 of the Regulations (NAA rules) may be required to submit various types of modeling and/or analysis along with their permit application. The application may need to include appropriate modeling and/or analysis to be ruled complete.

In nonattainment areas, 9 VAC 5 Chapter 80, Article 9 of the Regulations contains a number of requirements for obtaining a permit. Refer to 9 VAC 5 Chapter 80, Article 9 of the Regulations for details. A few of the requirements follow:

- *Offsets must represent reasonable further progress towards attainment of the applicable ambient air quality standard when considered in connection with other new and existing sources of emissions.*

- *Offsets meeting the requirements of 9 VAC 5 Chapter 80, Article 9 of the Regulations may also be obtained from existing sources outside the nonattainment area if the applicant demonstrates:*

    - *The other area has an equal or higher nonattainment classification than the area in which the source is located; and*

[4] 9 VAC 5 Chapter 80, Article 9 of the Regulations defines reasonable further progress as "*the annual incremental reductions in emissions of a given air pollutant (including substantial reductions in the early years following approval or promulgation of an implementation plan and regular reductions thereafter) which are sufficient in the judgment of the board to provide for attainment of the applicable ambient air quality standard by the attainment date prescribed in the implementation plan for such area.*"

- *Emissions from such other area contribute to a violation of the ambient air quality standard in the nonattainment area in which the source is located.*

3.3 Major Stationary Sources Within 10 Kilometers of Class I Areas

Modeling should be performed for any emissions rate at a new PSD major stationary source or net emissions increase associated with a modification at an existing PSD major stationary source located within 10 kilometers (6.2 miles) of a federal Class I area to determine if the maximum 24-hour average impact of the regulated pollutant in the Class I area is equal to or greater than 1.0 micrograms per cubic meter ($\mu g/m^3$). If the 24-hour impact is equal to or greater than 1.0 $\mu g/m^3$, the emissions rate associated with the new major stationary source or the net emissions increase associated with a modification at an existing major stationary source is considered significant. As a result, the regulated pollutant for the new major stationary source or the modification, which would constitute a major modification, would be subject to PSD review under 9 VAC 5 Chapter 80, Article 8.

The Class I significance level of 1.0 $\mu g/m^3$ on a 24-hour basis is only intended to determine if the rate of emissions of any regulated pollutant from a proposed new or modified major stationary source located within 10 kilometers of a Class I area is considered to be significant. It should not be used to determine if the impact in a Class I area is significant. Refer to Section 4 to determine if the impact is significant.

3.4 PSD Criteria Pollutant Modeling Thresholds

The criteria pollutant modeling thresholds specified in this section apply to new stationary sources and modifications subject to PSD review under 9 VAC 5 Chapter 80, Article 8.

For a given pollutant, modeling is warranted if the annual (tons per year) requested emission rate for a new source or the facility-wide net emissions increase for a modification is equal to or greater than the applicable emission threshold in Table 3-1. If the requested emission rate and/or the facility-wide net emissions increase is below the applicable threshold, modeling is usually not warranted.

Table 3-1: PSD Criteria Pollutant Modeling Thresholds

Pollutant	Requested Emission Rate from a New Source or Facility-Wide Net Emissions Increase from a Modification (tons per year)
Carbon Monoxide (CO)	100
Nitrogen Oxides (NO_X)	40
Sulfur Dioxide (SO_2)	40
Particulate Matter ≤ 10 µm (PM_{10})	15
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	10
Lead (Pb)	0.6

Ozone producing compounds such as volatile organic compounds (VOC) and non-methane organic compounds (NMOC) are not typically required to be modeled using dispersion models. However, there may be limited circumstances where an individual source may be modeled using a photochemical model to evaluate the effects of emissions on ozone formation (e.g., source apportionment modeling).

Lastly, it is important to note that lead compounds are also modeled for toxic air pollutants in addition to elemental lead.

3.5 Toxic Air Pollutants

New major stationary sources and major modifications subject to PSD may be required to conduct an ambient air quality impact analysis for toxic air pollutants pursuant to 9 VAC 5 Chapter 60, Article 5 of the Regulations. Any analysis required pursuant to 9 VAC 5-60-300 et seq must demonstrate compliance with the applicable significant ambient air concentration(s) (SAAC) for each toxic pollutant emitted by the proposed facility that exceeds its exempt emission rate(s). The list of toxic air pollutants and their applicable exempt emission rate(s) and SAAC(s) is provided in Appendix C. Please check with the VADEQ to verify the information in Appendix C is current.

4 The Preliminary Analysis for Ambient Air Quality Standards and PSD Increments

If a modeling analysis is warranted (see Section 3), the VADEQ usually recommends that a preliminary analysis (also referred to as a significant impact analysis) be conducted to help determine the scope of the modeling analysis. According to the *Guideline on Air Quality Models (EPA, 2005)*, the significance of a source's spatial and temporal contribution to a modeled violation should be considered when deciding if a source causes or contributes to a violation of ambient air quality standards.

The dispersion modeling analysis usually involves two distinct phases (EPA, 1990). The first phase is the preliminary analysis which is also referred to as a significant impact analysis. The preliminary analysis determines if the applicant can forego further air quality analysis for a particular pollutant with respect to Virginia Ambient Air Quality Standards, NAAQS, and PSD increments. Since the Virginia Ambient Air Quality Standards are the same as the NAAQS, NAAQS will be used hereafter in this document to refer to both sets of standards. The second phase is the full impact analysis for the NAAQS and applicable PSD increments; it is sometimes referred to as the air quality impact analysis or the cumulative impact analysis.[5] The full impact analysis involves a more comprehensive assessment of air quality impacts. It is discussed in Section 5.

In the preliminary analysis for a given pollutant and averaging period, the modeled concentration at each receptor in ambient air is determined in accordance with the *Guideline on Air Quality Models (EPA, 2005*) and other applicable EPA guidance (EPA, 2010a, EPA, 2010b, EPA, 2010c, and EPA, 2011) and then compared to the significant impact levels (SILs) in Table 4-1 for Class I areas and Table 4-2 for Class II areas. Impacts from nearby and other background sources, including background concentrations, are not considered in the preliminary analysis. If the modeled concentration is below the applicable SIL for each pollutant and averaging period, no further analysis is typically required. The source is considered to have an insignificant impact. For example, if the modeled concentrations are less than the SILs in Table 4-2, a compliance demonstration for NAAQS (NAAQS analysis) is not required. For major stationary sources subject to PSD, a Class I or Class II PSD increment analysis is not required if the impacts are less than the SILs in Table 4-1 and Table 4-2, respectively; however, other analysis requirements of the PSD rules must nevertheless be addressed (see Section 5). If the impact is equal to or greater than the SIL, the source or modification has a significant impact in ambient air and the next phase of analysis, a full impact analysis, is required (see Section 5).

The preliminary analysis should be used to determine the extent of the significant impact area (SIA) of the proposed project. The SIA is a circular area with a radius that extends from the source to the most distant point where the modeling predicts concentrations equal

[5] Federal land managers sometime use the phrase "cumulative impact analysis" to refer to the air quality related values (AQRV) analysis, visibility analysis, and other analyses.

to the SIL. Initially, the SIA is determined for every relevant averaging time for a particular pollutant. The final SIA for that pollutant is the largest of the areas determined for that pollutant. Additionally, the facility-only impacts may determine if the applicant is required to conduct pre-construction air quality monitoring (see Section 5.2.1).

4.1 Significant Impact Levels for Class I PSD Increments

The Class I PSD increment SILs in Table 4-1 are only used for major stationary sources subject to PSD located within 300 kilometers of a federal Class I area. Figure 4-1 shows the federal Class I areas that are within approximately 300 kilometers of Virginia. The Class I PSD increment SILs presented for all pollutants, except for $PM_{2.5}$, are based on the EPA proposal from 1996.[6] The SILs for $PM_{2.5}$ are from EPA's October 20, 2010 final rule *Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers ($PM_{2.5}$) – Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC).*[7] The SILs in Table 4-1 are only intended for the Class I PSD increment analysis. They were not developed to determine if there would be significant impacts to air quality related values (AQRVs), including visibility, within the Class I areas.

Table 4-1: Significant Impact Levels for Class I[a] PSD Increments

Pollutant	Averaging Period	Significant Impact Level (SIL) ($\mu g/m^3$)
Sulfur Dioxide (SO_2)	1-hour	[b]
	3-hour	1.0[c]
	24-hour	0.2[c]
	Annual	0.1[c]
Particulate Matter ≤ 10 µm (PM_{10})	24-hour	0.3[c]
	Annual	0.2[c]
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	24-hour	0.07[d]
	Annual	0.06[d]
Nitrogen Dioxide (NO_2)	1-hour	[b]
	Annual	0.1[c]

[a] Class I areas within 300 kilometers of Virginia are shown in Figure 4-1.
[b] No Class I SIL has been defined for this averaging period.
[c] Federal Register: July 23, 1996 (Volume 61, Number 142), Proposed Rules, Pages 38249-38344.
[d] Federal Register: October 20, 2010 (Volume 75, Number 202), Rules and Regulations, Pages 64863-64907.

[6] Federal Register: July 23, 1996 (Volume 61, Number 142), Proposed Rules, Pages 38249-38344.

[7] Federal Register: October 20, 2010 (Volume 75, Number 202), Rules and Regulations, Pages 64863-64907.

4.2 Significant Impact Levels for NAAQS and Class II PSD Increments

The SILs in Table 4-2 are used to determine if a NAAQS and Class II PSD increment analysis are required. The 1-hour NO_2 and SO_2 SILs are EPA-recommended interim SILs that VADEQ considers appropriate and should be used by applicants until EPA promulgates a 1-hour SIL for NO_2 and SO_2 via rulemaking. The SILs for $PM_{2.5}$ are from EPA's October 20, 2010 final rule *Prevention of Significant Deterioration (PSD) for Particulate Matter Less Than 2.5 Micrometers ($PM_{2.5}$) – Increments, Significant Impact Levels (SILs) and Significant Monitoring Concentration (SMC).*[8] The remaining SILs presented are listed in 9 VAC 5-80-1715.

Table 4-2: Significant Impact Levels for NAAQS and Class II[a] PSD Increment Analyses

Pollutant	Averaging Period	Significant Impact Level (SIL) (µg/m^3)
Nitrogen Dioxide (NO_2)	1-hour	7.5[b]
	Annual	1
Carbon Monoxide (CO)	1-hour	2,000
	8-hour	500
Sulfur Dioxide (SO_2)	1-hour	7.86[c]
	3-hour	25
	24-hour	5
	Annual	1
Particulate Matter ≤ 10 µm (PM_{10})	24-hour	5
	Annual	1
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	24-hour	1.2[d]
	Annual	0.3[d]

[a] All areas of Virginia are designated as Class II except for the areas shown in Figure 5-1.
[b] Interim SIL from EPA Memorandum from Stephen D. Page, "Guidance Concerning the Implementation of the 1-hour NO_2 NAAQS for the Prevention of Significant Deterioration Program," June 29, 2010.
[c] Interim SIL from EPA Memorandum from Stephen D. Page, "Guidance Concerning the Implementation of the 1-hour SO_2 NAAQS for the Prevention of Significant Deterioration Program," August 23, 2010.
[d] Federal Register: October 20, 2010 (Volume 75, Number 202), Rules and Regulations, Pages 64863-64907.

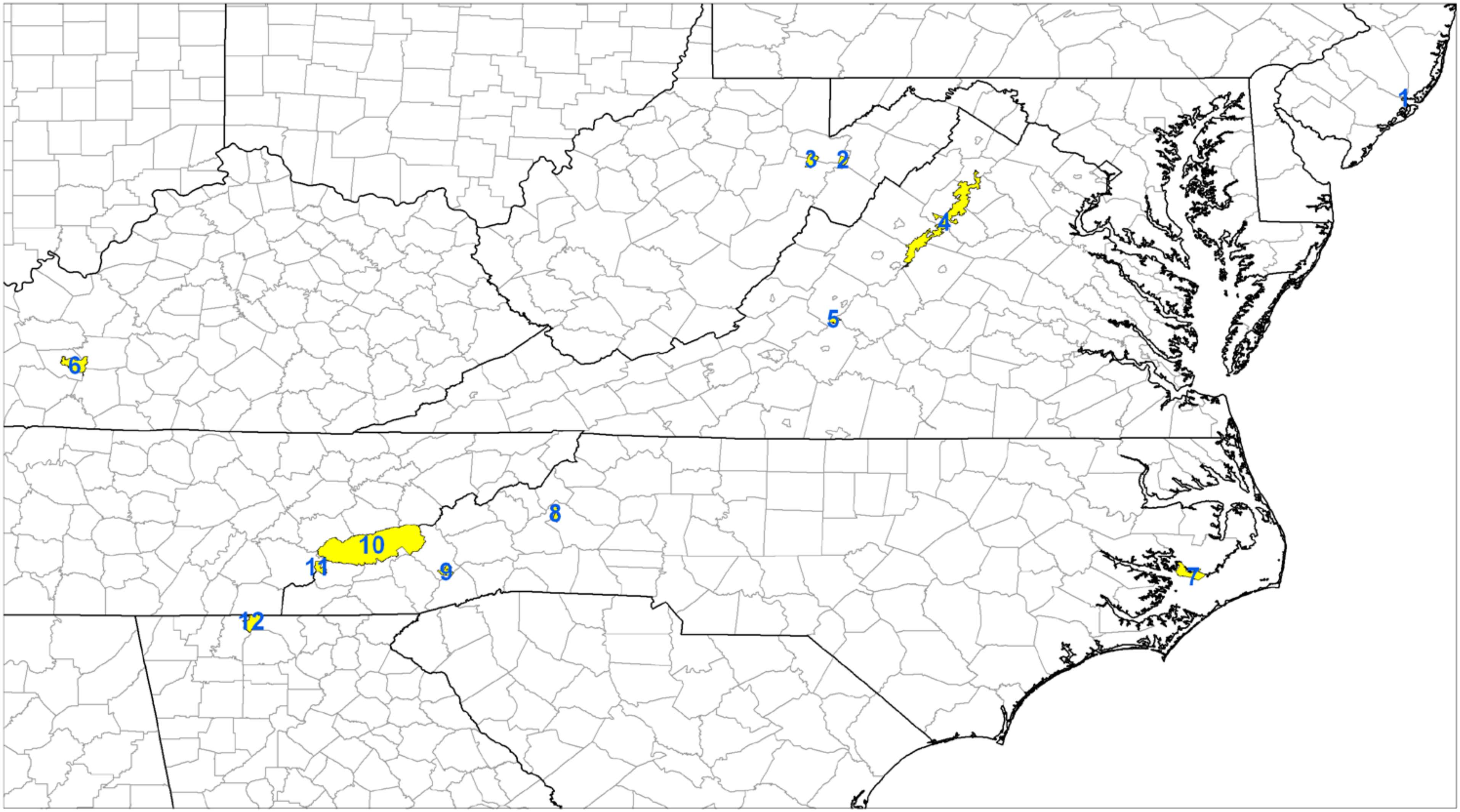
[8] Federal Register: October 20, 2010 (Volume 75, Number 202), Rules and Regulations, Pages 64863-64907.

4.3 Emission Rates in the Preliminary Analysis

For a new source, the requested emission rates, requested operating rates, or the maximum design rates (after controls) and quantifiable fugitive emissions should be modeled in the preliminary analysis. Emergency equipment such as generators should also be included unless the applicant can provide an adequate technical justification to exclude these units. It may be necessary to establish an enforceable permit condition if the requested emission or operating rate used in the modeling is less than the maximum design rate for a specific unit. For modifications, the facility-wide net emissions increase should be modeled in the preliminary analysis.

Major stationary sources do not need to include emissions from the commercial, residential, and industrial growth analysis in the preliminary analysis. The growth analysis is a separate additional impact analysis required under PSD (see Section 5.4.3).

Figure 4-1: Class I Areas Within 300 Kilometers of Virginia



- 1. Brigantine Wilderness Area
- 2. Dolly Sods Wilderness Area
- 3. Otter Creek Wilderness Area
- 4. Shenandoah National Park
- 5. James River Face Wilderness Area
- 6. Mammoth Cave National Park
- 7. Swanquarter Wilderness Area
- 8. Linville Gorge Wilderness Area
- 9. Shining Rock Wilderness Area
- 10. Great Smoky Mountains National Park
- 11. Joyce Kilmer-Slickrock Wilderness Area
- 12. Cohutta Wilderness Area

5 Full Impact Analysis for New Major Stationary Sources and Major Modifications

The components of the major stationary source or major modification full impact analysis vary depending on the applicable regulatory requirements. This section discusses various aspects of the full impact analysis. As discussed in Section 6.1, the VADEQ requires applicants to submit modeling protocols.

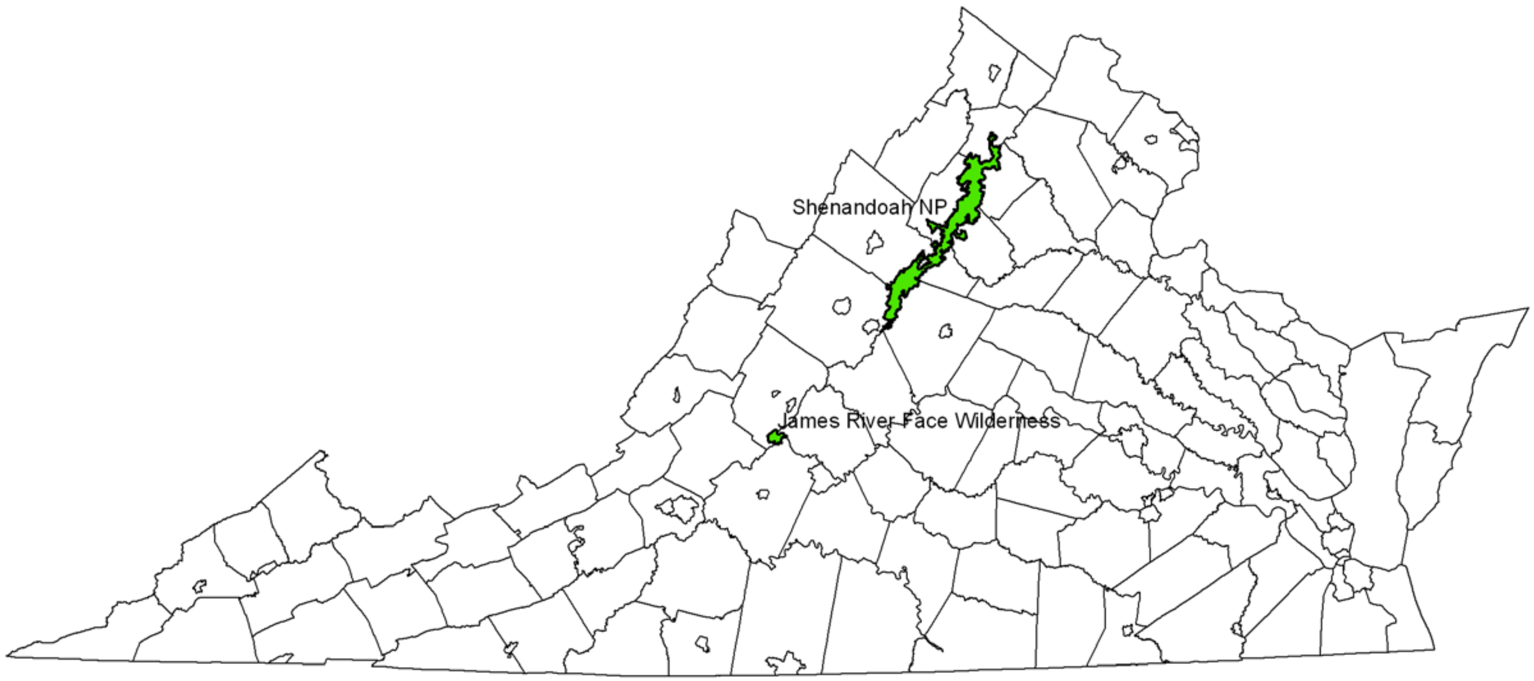
All areas of Virginia are classified as Class II with the exception of the two federal Class I areas which are shown in Figure 5-1. Class I areas have the greatest protection from air quality deterioration; Class III areas have the least protection; however, there are no Class III areas in Virginia. In addition to demonstrating compliance with ambient air quality standards (Section 5.1), major stationary source permit applicants must demonstrate that they will not cause or contribute to a violation of PSD increments (Sections 5.3 and 5.5.1). Major stationary sources located within nonattainment areas are subject to additional requirements (Section 3.2).

As a first step in the air quality analysis, the VADEQ recommends a preliminary analysis (Section 4) to determine if a full impact analysis for the NAAQS and PSD increments is warranted.

Major stationary sources are required by regulation to submit an additional impact analysis to address potential impairment to visibility, soils, and vegetation from the source or modification under review and from associated growth (see Section 5.4). In addition, regulations require that applicants submit an analysis of impairment to AQRVs, including visibility, in affected Class I areas (see Section 5.5.2).

PSD applicants should also consult with the VADEQ to determine if there will be any pre-construction ambient monitoring requirements (see Section 5.2).

Figure 5-1: Virginia Class I Areas



5.1 NAAQS Analysis

The federal Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of sensitive populations such as people with asthma, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. The NAAQS are listed in Table 5-1.

Units of measure for the standards are parts per billion (ppb) by volume, parts per million (ppm) by volume, and micrograms per cubic meter of air (µg/m^3).

Table 5-1: NAAQS and PSD Significant Monitoring Concentrations

Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	PSD Significant Monitoring Concentration[a]
Nitrogen Dioxide (NO_2)	1-hour[b]	100 ppb (188 µg/m^3)	NA	NA
	Annual[c]	0.053 ppm (100 µg/m^3)	0.053 ppm (100 µg/m^3)	14 µg/m^3
Carbon Monoxide (CO)	1-hour[d]	35 ppm (40,000 µg/m^3)	NA	NA
	8-hour[d]	9 ppm (10,000 µg/m^3)	NA	575 µg/m^3
Sulfur Dioxide (SO_2)	1-hour[e]	75 ppb (196.5 µg/m^3)	NA	NA
	3-hour[d]	NA	0.5 ppm (1,300 µg/m^3)	NA
	24-hour[d]	0.14 ppm (365 µg/m^3)	NA	13 µg/m^3
	Annual[c]	0.03 ppm (80 µg/m^3)	NA	NA
Ozone (O_3)	8-hour[f]	0.075 ppm	0.075 ppm	100 tons/yr VOCs
Particulate Matter ≤ 10 µm (PM_{10})	24-hour[g]	150 µg/m^3	150 µg/m^3	10 µg/m^3
	Annual	Revoked	Revoked	NA

Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS	PSD Significant Monitoring Concentration[a]
Particulate Matter ≤ 2.5 µm ($PM_{2.5}$)	24-hour[h]	35 µg/m^3	35 µg/m^3	4 µg/m^3
	Annual[i]	15 µg/m^3	15 µg/m^3	NA
Lead (Pb)[j]	Rolling 3-Month[c]	0.15 µg/m^3	0.15 µg/m^3	NA
	Calendar Quarter	NA	NA	0.1 µg/m^3
Fluorides	24-hour	NA	NA	0.25 µg/m^3
Total Reduced Sulfur	1-hour	NA	NA	10 µg/m^3
Hydrogen Sulfide	1-hour	NA	NA	0.2 µg/m^3
Reduced Sulfur Compounds	1-hour	NA	NA	10 µg/m^3

[a] The significant monitoring concentrations (de minimis levels) apply only to new sources and modifications subject to PSD review (see 9 VAC 5-80-1695).

[b] To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb.

[c] Never to be exceeded.

[d] Not to be exceeded more than once per calendar year.

[e] Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

[f] Final rule signed March 12, 2008. To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

[g] Not to be exceeded more than once per year on average over 3 years.

[h] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3.

[i] To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m^3.

[j] Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

5.1.1 Modeling Recommendations for Individual Criteria Pollutants

While this section is intended for sources located in attainment or unclassified areas of Virginia, it may, in some cases, be used by sources located in nonattainment areas; however, sources in nonattainment areas should read Section 3.2 first.

In a compliance demonstration, the applicable design concentration must be calculated. This is done within the model or by using a post-processor (see Sections 6.2.1, 6.2.2, and 6.2.3).

5.1.1.1 Carbon Monoxide

Compliance demonstrations should address both the 1-hour and 8-hour NAAQS.

5.1.1.2 Lead

Compliance should be demonstrated with the rolling 3-month average NAAQS. EPA changed the calculation method for the averaging time to use to a rolling 3-month period with a maximum (not-to-be-exceeded) form, evaluated over a three-year period. This replaces the previous approach of using calendar quarters.

5.1.1.3 Nitrogen Dioxide

Compliance demonstrations should address both the 1-hour and annual NAAQS. Refer to the *Guideline on Air Quality Models (EPA, 2005)* and other relevant EPA guidance (EPA, 2010b and EPA, 2011) for methods that may be used to determine how much NO_X exists as NO_2 in the atmosphere at a given receptor.

5.1.1.4 Ozone

In general, accurate and cost effective methods for modeling ozone impacts from individual stationary point sources are not available. Therefore, ozone modeling is not routinely requested for construction permits.

5.1.1.5 PM_{10}

Compliance demonstrations should address the 24-hour NAAQS.

5.1.1.6 $PM_{2.5}$

Compliance should be demonstrated with the 24-hour and annual NAAQS.

5.1.1.7 Sulfur Dioxide

Compliance demonstrations should address the 1-hour, 3-hour, 24-hour, and annual NAAQS. The 24-hour and annual standards remain in effect until one year after an area is designated for the 2010 standard.

5.1.2 NAAQS Analysis Compliance Demonstration

For new major stationary sources and major modifications, the compliance demonstration for the NAAQS includes:

i. The estimated (i.e., modeled) impact for the new source or modification (see Section 5.1.3);

ii. A representative ambient monitored background concentration (see Section 5.1.5);

iii. The estimated impacts from additional sources explicitly included in the model such as:

1. Existing sources at the facility under review (see Section 5.1.4);

2. Existing nearby and other background sources (see Section 5.1.4);

3. Proposed nearby sources (this includes those which have received PSD permits but are not yet in operation and others that have submitted complete PSD applications to a reviewing agency, but have not yet been issued permits; it may also include any large new minor sources that have received permits, but are not yet in operation).

iv. If appropriate, the estimated impacts from growth in residential, commercial, and industrial sources associated with, but not part of, the proposed source. See EPA guidance for more detailed recommendations (EPA, 1990).

5.1.3 NAAQS Emission Inventory for the PROPOSED Source or Modification

This section only applies to the proposed new source or modification. It does not apply to existing stationary sources. For emissions from existing stationary sources, use the procedures in Section 5.1.4.

The emissions estimates used in modeling should be consistent with EPA recommendations in Table 8-2 of the *Guideline on Air Quality Models (EPA, 2005)* and other applicable EPA guidance. In general, this means that, for the NAAQS analysis, the design capacity or federally enforceable emission limit (e.g., the allowable emission rate) should be modeled for the source under review. If the model is to be used to establish emission limits for a source, refer to EPA guidance.

According to the *Guideline on Air Quality Models (EPA, 2005)*, the load or operating condition that causes maximum ground-level concentrations should be established. As a minimum, the source should be modeled using the design capacity (100 percent load). If a source operates at greater than design capacity for periods that could result in violations of the NAAQS or PSD increments, this load should be modeled. Where the source operates at substantially less than design capacity, and the changes in the stack parameters associated with the operating conditions could lead to higher ground level concentrations, loads such as 25, 50, and 75 percent of capacity should also be modeled. A range of operating conditions should be considered in screening analyses; the load causing the highest concentration, in addition to the design load, should be included in refined modeling.

Permit conditions may be proposed based on the information used in the modeling. For example, if the operating level is limited or if the modeling uses a restricted operating schedule (i.e., less than 24 hours per day), the operating conditions may become permit conditions, if appropriate, to protect standards.

5.1.4 NAAQS Emission Inventory for EXISTING Nearby and Other Background Sources (Cumulative Analyses)

The recommendations in this section only apply to existing sources. The emissions could be from existing sources at the facility under review or from completely separate facilities. For emissions from the new source or modification under review, use the procedures in Section 5.1.3.

In this document, the terms nearby sources and other background sources can be used to refer to existing sources at the facility under review and to existing off-site sources. That is, the terms include stationary sources except the new source or modification under permit review. Air quality impacts from nearby and other background sources should be considered in the NAAQS analysis.

Specifically, EPA recommends that, at a minimum, nearby sources be explicitly modeled as part of the NAAQS analysis. A nearby source is a source that causes a significant concentration gradient in the vicinity of a new or modified source. Background sources may be accounted for by using an appropriate ambient background concentration (i.e., see Section 8.2.3 of the *Guideline on Air Quality Models (EPA, 2005)*) or, if a suitable ambient background concentration is not available, by application of a model.

The emissions estimates used in modeling nearby and other background sources should be consistent with EPA recommendations in Table 8-2 of the *Guideline on Air Quality Models (EPA, 2005)* and other applicable EPA guidance. Table 8-2 recommends that actual or design capacity operating levels, whichever is greater, or federally enforceable permit limits should be used for all nearby sources. That is, allowable emission rates should be used.

The VADEQ does not recommend a specific objective procedure for determining which nearby sources should be explicitly modeled in the analysis. The procedure used to select nearby sources to model should be based on professional judgment considering local conditions such as topography, meteorology, dispersion characteristics, availability of ambient monitoring data, existing air quality, and other relevant factors and determined, in consultation with the VADEQ, on a case-by-case basis. VADEQ approval of the sources selected for the NAAQS inventory is recommended prior to modeling.

In some cases, sources from neighboring states may be required. The applicant is responsible for obtaining this data and verifying any missing data with the other states. In addition, it is the applicant's responsibility to ensure the adequacy of all source inventory data.

5.1.5 Background Concentrations for NAAQS Analyses

In general, the background concentration is intended to account for sources not explicitly included in the modeling. According to Section 8.2.1 of the *Guideline on Air Quality Models (EPA, 2005)*, "*Background concentrations are an essential part of the total air quality concentration to be considered in determining source impacts. Background air quality includes pollutant concentrations due to: (1) Natural sources; (2) nearby sources other than the one(s) currently under consideration; and (3) unidentified sources. Typically, air quality data should be used to establish background concentrations in the vicinity of the source(s) under consideration. The monitoring network used for background concentrations should conform to the same quality assurance and* *other requirements as those networks established for PSD purposes. An appropriate data validation procedure should be applied to the data prior to use. If the source is not isolated, it may be necessary to use a multi-source model to establish the impact of nearby sources…Background concentrations should be determined for each critical (concentration) averaging time*."

The applicant should consult with VADEQ to determine if representative ambient background air quality data exists. Existing ambient data may be used in circumstances where VADEQ determines that these data are representative and can establish the attainment status of the area immediately surrounding the proposed facility.

5.2 Pre- and Post-Construction Monitoring Analysis

The VADEQ should be contacted as early as possible to discuss the need to conduct pre-construction monitoring. If monitoring is proposed or required, a monitoring plan consistent with applicable EPA monitoring guidance should be submitted for approval.

If the proposed emission rate from a new source or the net emissions increase from a modification is significant for a given pollutant, as defined by 9 VAC 5 Chapter 80, Article 8 of the Regulations, the estimated impact from the new source or modification should be compared to the significant monitoring concentration (SMC) (see Table 5-1 or 9 VAC 5-80-1695 of the Regulations).

5.2.1 Pre-Construction Monitoring Analysis

Pre-construction monitoring may be required on a case-by-case basis. The requirement for pre-construction monitoring can be met in the following ways:

i. Existing ambient data may be used if VADEQ determines that these data are representative and can establish the attainment status of a particular region.

ii. Establish a site-specific monitoring network.

PSD does not require that an applicant perform ambient monitoring prior to submittal of an application if adequate monitoring data is already available to perform the required air quality analyses. As stated by EPA in the draft *New Source Review Workshop Manual (EPA, 1990*), the PSD regulations require an applicant "to provide an ambient air quality analysis that may include pre-construction monitoring data, and in some instances post-construction monitoring data, for any pollutant proposed to be emitted in significant amounts."

If the estimated impacts from the proposed source or modification are below the applicable SMC, the facility may propose to be exempt from pre-construction monitoring subject to VADEQ review and approval. Alternatively, if the facility cannot be exempted from the pre-construction monitoring requirements based on estimated impacts, the applicant may propose use of existing monitoring data.

If existing monitoring data is determined not to be representative for the location of the proposed source or modification, the applicant is required to establish a site-specific monitoring network. Permit applicants should be aware that the timeline for submitting a PSD application could be affected by the requirement to collect ambient data. For example, if the collection of site-specific meteorological data is required, at least a full year of data must be collected. For air quality data, at least a full year of data is typically required, although as little as four months of data may be allowed in some circumstances. The VADEQ must approve ambient data for use before the permit application can be ruled complete.

5.2.2 Post-Construction Monitoring Analysis

As part of the permit review process for new major stationary sources and major modifications, the VADEQ will determine if post-construction monitoring is necessary.[9]

5.3 PSD Increment Analysis

The air quality analysis for new and modified sources subject to PSD must demonstrate compliance with the applicable PSD increments shown in Table 5-2. This section is not intended to provide a comprehensive overview of PSD increment consumption; for that, refer to other relevant EPA guidance documents (e.g., EPA, 1990).

Increment consumption is calculated on an hour-by-hour and receptor-by-receptor basis. That is, the consumption of PSD increment by one particular source does not necessarily preclude similar increment consumption by another nearby source if the consumption occurs at a different time and/or at a different location (e.g., receptor). Refer to Section 6.2 for more information about the design value that should be used to determine compliance with applicable PSD increments.

[9] 40 CFR Part 51.166(v)(2) states that the source "shall...conduct ambient air monitoring as the reviewing authority determines is necessary...." In addition, the draft New Source Review Workshop Manual (EPA, 1990) suggests that post-construction monitoring "be done when there is a valid reason, such as (1) when the NAAQS are threatened, and (2) when there are uncertainties in the data bases for modeling."

All changes in emissions and related parameters[10] after the minor source baseline date may affect PSD increment consumption or expansion.[11] In addition, modifications at major stationary sources after the major source baseline date also may affect increment consumption. Refer to EPA guidance (e.g., EPA, 1990) for procedures.

Table 5-2: PSD Increments

Pollutant	Averaging Period	Class I Increment ($\mu g/m^3$)	Class II Increment ($\mu g/m^3$)	Class III Increment ($\mu g/m^3$)
Nitrogen Dioxide (NO_2)	1-hour	[a]	[a]	[a]
	Annual[b]	2.5	25	50
Sulfur Dioxide (SO_2)	1-hour	[a]	[a]	[a]
	3-hour[c]	25	512	700
	24-hour[c]	5	91	182
	Annual[b]	2	20	40
Particulate Matter ≤ 10 μm (PM_{10})	24-hour[c]	8	30	60
	Annual[b]	4	17	34
Particulate Matter ≤ 2.5 μm ($PM_{2.5}$)[d]	24-hour[c]	2	9	18
	Annual[b]	1	4	8

[a] No PSD increments have been defined for this averaging period.
[b] Never to be exceeded.
[c] Not to be exceeded more than once per year.
[d] Effective October 20, 2011.

EPA guidance (EPA, 1990) provides details regarding the major source baseline dates, trigger dates, and minor source baseline dates. The major source baseline dates and trigger dates are fixed dates. The major source baseline dates are January 6, 1975 for particulate matter (PM) and PM_{10}, January 6, 1975 for SO_2, February 8, 1988 for NO_2, and October 20, 2010 for $PM_{2.5}$. The trigger dates are August 7, 1977 for PM and PM_{10}, August 7, 1977 for SO_2, February 8, 1988 for NO_2, and October 20, 2011 for $PM_{2.5}$.

In contrast, the minor source baseline dates vary for each county and independent city in Virginia. The minor source baseline date is the earliest date after the trigger date on which a complete PSD application is received by the permit-reviewing agency. In addition, the minor source baseline date for a particular pollutant is triggered by a PSD applicant only if the proposed increase in emissions of that pollutant is significant. As a result, the minor

[10] "The creditable increase of an existing stack height or the application of any other creditable dispersion technique may affect increment consumption or expansion in the same manner as an actual emissions increase or decrease. That is, the effects that a change in the effective stack height would have on ground level pollutant concentrations generally should be factored into the increment analysis." (EPA, 1990)

[11] A PSD increment is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. The baseline concentration is defined for each pollutant and, in general, is the ambient concentration existing at the time of the first complete PSD permit application affecting the area (EPA, 1990).

source baseline date for different pollutants need not be the same in a particular area. Appendix D contains a figure that shows each county and independent city in Virginia. It also contains a table listing the counties and independent cities in Virginia and the applicable pollutant(s) where the minor source baseline date(s) has been established. Please check with the VADEQ to verify the minor source baseline dates in Appendix D are current.

5.3.1 PSD Increment Emissions Inventory for the PROPOSED Source

This section only applies to the proposed new source or modification. It does not apply to existing emissions. For emissions from existing stationary sources, use the procedures in Section 5.3.2.

The emissions estimates used in modeling should be consistent with EPA recommendations in Table 8-2 of the *Guideline on Air Quality Models (EPA, 2005)* and other applicable EPA guidance. In general, the design capacity or federally enforceable emission limit (e.g., the allowable emission rate) should be modeled for the source under review.

The main difference between the NAAQS and PSD increment inventory is in the way nearby and other background sources are treated. Refer to Section 5.3.2 for details.

5.3.2 PSD Increment Emissions Inventory for EXISTING Nearby and Other Background Sources

The recommendations in this section only apply to existing sources. The emissions could be from existing sources at the facility under review or from completely separate facilities. For the new source or modification under review, use the inventory procedures in Section 5.3.1.

The terms nearby sources and other background sources can be used to refer to existing sources at the facility under review and to existing off-site sources. That is, the terms include stationary sources except the new source or modification under permit review. Air quality impacts from nearby and other background sources should be considered in the PSD increment analysis.

The main difference between the NAAQS and PSD increment inventory is that the PSD increment inventory uses actual emissions for all sources except for the new source or modification under permit review (One exception, of course, would be for recently permitted PSD sources that are not yet operating). In addition, not all NAAQS sources are increment consuming. In fact, the number of increment-consuming sources will depend on the how much growth has occurred since the applicable major and minor source baseline dates.

Like the NAAQS inventory, the methods to estimate emissions for the PSD increment inventory should be consistent with Table 8-2 of the *Guideline on Air Quality Models (EPA, 2005)* and other applicable EPA guidance.

In general, the amount of PSD increment that has been consumed or expanded in a PSD baseline area is determined from the emissions increases and decreases that have occurred since the applicable baseline dates. The focus of increment consumption/expansion modeling is to calculate the concentration change attributable to increment consuming or expanding emissions. Emissions increases that consume a portion of the applicable increment are, in general, all those emissions NOT accounted for in the baseline concentration and specifically include:

- Actual emissions increases occurring after the major source baseline date, which are associated with a new major stationary source and physical changes or changes in the method of operation (i.e., construction) at an existing major stationary source.

- Actual emissions increases at ANY (i.e., new or existing) source occurring after the minor source baseline date.

The procedure used to select sources for the PSD increment inventory should be based on professional judgment considering local conditions such as topography, meteorology, dispersion characteristics, availability of ambient monitoring data, existing air quality and other relevant factors and determined, in consultation with the VADEQ, on a case-by-case basis. VADEQ approval of the sources selected for the PSD increment inventory is recommended prior to modeling.

5.3.3 Background Concentrations for PSD Increment Analyses

VADEQ does not typically recommend the use of a background concentration to account for increment consumption due to the difficulty in determining which portion of the background is from increment-consuming sources. Nevertheless, there may be situations where a statistical analysis or review of trends in ambient air quality data would be useful to quantify local or regional changes in air quality since the relevant baseline dates.

5.4 Additional Impact Analysis

For new major stationary sources and major modifications subject to PSD, an additional impact analysis is required (see 9 VAC 5-80-1755 of the Regulations). This analysis assesses the impacts from the new source or modification under review on visibility, soils and vegetation, and the potential for and impact of associated industrial, commercial, and residential growth.

The additional impact analysis can be done using qualitative[12] or quantitative[13] methods. The level of analysis depends on the situation and the likelihood that there could be some type of impairment.

5.4.1 Visibility Analysis

An analysis of impairment to visibility in Class II areas should be addressed in the permit application (see 9 VAC 5-80-1755 of the Regulations).

According to EPA guidance (EPA, 1990), "*in the visibility impairment analysis, the applicant is especially concerned with impacts that occur within the impact area of the proposed new source or modification. Note that the visibility analysis required here is distinct from the Class I area visibility analysis requirement. The suggested components of a good visibility impairment analysis are:*

- *A determination of the visual quality of the area,*
- *An initial screening of emission sources to assess the possibility of visibility impairment, and*
- *If warranted, a more in-depth analysis involving computer models*."

Refer to EPA guidance for more specific recommendations. The focus of the Class I visibility analysis is on assessing visibility impacts within a Class I area. The focus of the Class II visibility analysis is on sensitive views (also referred to as vistas) outside of Class I areas.

The applicant is responsible for evaluating whether any sensitive Class II views exist within the SIA of the new major stationary source or major modification that would require a visibility impairment analysis. If there are, the analysis approach should be determined on a case-by-case basis in consultation with the VADEQ. If modeling is warranted, the modeling procedures for the sensitive Class II views are usually based on techniques similar to those used for Class I visibility assessments.

The VADEQ does not have specific thresholds or criteria for determining when there is impairment to a Class II view. Impairment determinations are

[12] A *qualitative* determination is one that is made without regard to quantity. That is, it does not involve a numerical estimate of the impact. Instead, it relies on descriptive generalized statements. For example, qualitative arguments are justifiable in situations where, based on professional judgment, it is reasonable to assume there will not be impairment.

[13] A *quantitative* determination is one that involves a numerical "estimate" of the air pollutant concentration in ambient air.

made on a case-by-case basis considering a number of factors including the geographic extent, intensity, duration, frequency, and time of modeled visibility impairment. Other factors such as interference with a visitor's visual experience, correlations between time of impairment with natural conditions that reduce visibility, and other criteria might be considered. Finally, limitations of the modeling system are considered. For example, results from a screening-level model do not carry as much weight as results from a refined model. The ability of the modeling system to properly account for relevant atmospheric chemistry and meteorology is also considered.

5.4.2 Soils and Vegetation Analysis

9 VAC 5-80-1755 of the Regulations states that the owner should provide an analysis of impairment to soils and vegetation. Only vegetation with commercial or recreational value should be addressed. EPA's guidance states that, for most soils and vegetation, ambient concentrations of criteria pollutants below the secondary NAAQS) will not result in harmful effects. Nevertheless, the secondary NAAQS may not adequately protect certain sensitive vegetation and soils. As recommended in EPA guidance, new sources or modifications subject to PSD should:

i. Provide an inventory of soils and vegetation with commercial or recreational value in the vicinity of the facility (e.g., crops);

ii. Review peer-reviewed scientific literature, including but not limited to, the document *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils and Animals* (EPA, 1980), to determine the concentration level (for appropriate averaging times) of regulated pollutants that would be harmful to vegetation. If no information is available in the literature, assume the secondary NAAQS is protective if one exists for the regulated pollutant under review. If modeling has been done, compare modeled impacts to the secondary NAAQS and to other levels of concern identified through a literature search. If the potential impact is determined to be harmful, discuss the nature of the harm and its spatial extent in the modeling report.

5.4.3 Growth Analysis

The purpose of the growth analysis is to quantify how much new growth is likely to occur to support the source or modification under review and then to estimate the emissions which will result from that associated growth. An assessment of the amount of residential growth the proposed source will bring to the area is necessary. The amount of residential growth will depend on the size of the available work force, the number of new employees, and the availability of housing in the area. Associated commercial and industrial growth consists of new sources providing goods and services to the new employees and to the proposed source itself. Other growth is all growth not covered by the preceding, including construction-related activities and mobile sources (e.g., permanent and temporary, truck traffic).

5.5 Class I Area Impact Analysis

Current modeling guidance provided by the FLMs recommends that new major stationary sources and major modifications subject to PSD and located within 300 kilometers of a federal Class I area perform a modeling analysis to assess the ambient air quality impacts for NAAQS, Class I PSD increments, and AQRVs (e.g., visibility and acid deposition). The FLMs are provided reviewing authority for Class I areas that may be affected by emissions from a proposed source by the PSD regulations and are specifically charged with protecting the AQRVs within the Class I areas. As a result, it is recommended the applicant work closely with the affected FLM(s) during the PSD permitting process.

The Federal Land Managers' Air Quality Related Values Work Group (FLAG) was formed (1) to develop a more consistent and objective approach for the Federal Land Managers (FLMs), i.e., National Park Service, U.S. Fish and Wildlife Service, and U.S. Department of Agriculture Forest Service, to evaluate air pollution effects on their AQRVs and (2) to provide State permitting authorities and potential permit applicants consistency on how to assess the impacts of new and existing sources on AQRVs. The FLAG effort focuses on the effects of the air pollutants that could affect the health and status of resources in areas managed by the three agencies, primarily such pollutants as ozone, particulate matter, nitrogen dioxide, sulfur dioxide, nitrates, and sulfates.

Based on knowledge gained and regulatory developments since FLAG 2000, the FLMs made certain revisions. The revised report (FLAG 2010) reflects those changes. However, it is important to emphasize that this revision contains certain changes to update specific information and data, but retains much of the background and general information contained in FLAG 2000. The applicant is encouraged to stay informed on the latest FLAG developments at http://www.nature.nps.gov/air/Permits/flag/index.cfm.

5.5.1 Class I PSD Increment Analysis

The increment analysis for an affected Class I area includes not only emissions from the proposed source but also increment-consuming emissions from other sources located within 300 kilometers of the affected federal Class I area. For emissions from the proposed source and other increment-consuming sources to be included in the Class I PSD increment analysis, use the inventory procedures in Sections 5.3.1 and 5.3.2, respectively.

5.5.2 Class I AQRVs and Visibility Analysis

The AQRV analysis is required as part of a PSD modeling exercise to estimate potential changes in special attributes such as visibility and acid deposition in federal Class I areas. The goal of the Class I impact analysis is to determine if the projected changes to AQRVs are acceptable for a given Class I area. The decision to issue a permit is the responsibility of VADEQ. A permit application can be denied if a proposed source would impair visibility or other AQRVs in a Class I area. It is important to note that the determination of impairment is done on a case-by-case basis. In the case of visibility, this determination will be made based on the magnitude, number of occurrences, time of year, and if such changes would affect a visitor's experience in the area.

In general, the elements of the Class I AQRV analysis are determined on a case-by-case basis. As recommended in Section 6.1, a protocol should be submitted to the AQA, the appropriate VADEQ regional office, EPA Region III, and each affected FLM.

6 Model Selection and Application

All estimates of ambient concentrations shall be based on applicable EPA-approved air quality models, databases, and other requirements generally approved by the EPA and specifically approved by the VADEQ. Model selection and application should be consistent with the *Guideline on Air Quality Models (EPA, 2005*) and associated guidance (e.g., EPA, 1990). EPA models, user's guides, guidance, and modeling-related memos and information are available from EPA's SCRAM website (http://www.epa.gov/ttn/scram).

To avoid unnecessary delays in the permit process, applicants and/or their consultants should discuss model and database selections with the VADEQ and are required to submit a modeling protocol for approval prior to submittal of the modeling results. Section 6.1 provides details on the protocol submittal requirements.

Procedures and models other than those recommended by EPA or in this guideline may be approved on a case-by-case basis if there is sufficient technical justification; however, EPA approval is required. Refer to EPA guidance for use of alternative models.

If a non-EPA-approved model is proposed, the nature and requirements of such a model should be outlined to the VADEQ at a pre-application meeting. The permit application will be deemed incomplete until there has been a public hearing on the proposed model and written approval of the EPA has been received (see 9 VAC 5-80-1725 of the Regulations).

The most recent version of EPA-approved models should be used for all modeling analyses.

For Class I area modeling, the VADEQ generally supports the use of models and modeling techniques recommended by the FLMs. Section 5.5 provides further details on the availability and location of the FLMs' Class I modeling guidance. In addition, recommendations for the Class I analysis may vary from one area to another. Therefore, the applicant is encouraged to work closely with the VADEQ and FLMs to determine the appropriate Class I modeling methodology.

6.1 Modeling Protocols

The protocol is the primary mechanism by which all affected parties such as the applicant, the VADEQ, EPA, and FLMs reach agreement on a modeling approach. The protocol development process is intended to minimize the chances of misunderstandings and to avoid delays in the permit process. It explains in detail how a modeling analysis will be performed, how the results will be presented, and how compliance with applicable requirements will be demonstrated. VADEQ prefers a separate modeling protocol for the Class I area modeling analysis and the Class II area modeling analysis. Separate Class I and Class II example checklists containing typical modeling protocol elements are provided in Appendix B. This list does not address all possible components of a protocol. Case-by-case judgments should be used to decide if additional aspects of the analysis should be included in the protocol or if certain elements are not necessary in a given situation.

It is important to note an applicant must submit a modeling protocol to the AQA for approval prior to commencing a refined modeling or PSD analysis. A copy is also required to be submitted to the appropriate VADEQ regional office processing the permit application. The VADEQ will not accept a refined modeling analysis without a pre-approved modeling protocol. The submittal of an electronic copy and a hard copy of the protocol to the VADEQ is required. Additional copies may also be required to be submitted to EPA Region III and the appropriate FLMs depending on the project. Electronic copies may be submitted on appropriate media such as a CD, DVD, or USB drive or via electronic mail. The applicant should verify that electronic mail with attachments is received by the VADEQ. Electronic mail with zip, executable, and some other types of attachments may be rejected by the VADEQ's electronic mail system.

6.2 Design Concentrations for Comparison to Standards and Increments

Refer to the *Guideline on Air Quality Models (EPA, 2005)* (e.g., Sections 7.2.1.1, 10.1, and 10.2.3) and other applicable EPA guidance (EPA, 2010a, EPA, 2010b, EPA, 2010c, and EPA, 2011) to decide if the *highest* or *highest, second-highest* or some other concentration value should be used in the NAAQS, PSD increment, and similar compliance demonstrations. The *design concentration*, as it is sometimes called, is calculated directly by the model or by using a post-processor.

For the significant impact analysis (see Section 4), the modeled concentration should be determined in accordance with the *Guideline on Air Quality Models (EPA, 2005*) and other applicable EPA guidance (EPA, 2010a, EPA, 2010b, EPA, 2010c, and EPA, 2011).

6.2.1 CO, SO_2, Pb, and NO_2 Design Concentrations

According to Section 10.2.3.2 of the *Guideline on Air Quality Models (EPA, 2005)*, "*for new or modified sources predicted to have a significant ambient impact and to be located in areas designated attainment or unclassifiable for the SO_2, Pb, NO_2, or CO NAAQS, the demonstration as to whether the source will cause or contribute to an air quality violation should be based on: (1) The highest estimated annual average concentration determined from annual averages of individual years; or (2) the highest, second-highest estimated concentration for averaging times of 24-hours or less; and (3) the significance of the spatial and temporal contribution to any modeled violation.*" For Pb, EPA changed the calculation method for the averaging time to use to a rolling 3-month period. The highest estimated quarterly average concentration should be used as the design concentration.

Therefore, regardless of the number of years of meteorological data used, compliance with short-term standards, except for the 1-hour averaging period for SO_2 and NO_2, is based on the *highest, second-highest* modeled concentration. That is, at each receptor, the highest concentration value is ignored; instead, compliance is based on the *second-highest* value. For the annual standards, the highest annual average value would be used for each year. It is not acceptable to use *period* averages for several years, for example, to estimate the annual concentration for comparison to standards based on annual averaging periods.

Compliance with the 1-hour NO_2 NAAQS is based on a comparison of the1-hour NO_2 modeled design concentration to the standard. The 1-hour NO_2 modeled design concentration refers to the highest of the 5-year averages of the 98^{th}-percentile (8^{th}-highest) of the annual distribution of daily maximum 1-hour values predicted at each receptor based on five (5) years of National Weather Service meteorological data or the highest of the multiyear averages of the 98^{th}-percentile (8^{th}-highest) of the annual distribution of daily maximum 1- hour values predicted at each receptor based on one or more complete years (up to five (5) years) of site-specific meteorological data.

Compliance with the 1-hour SO_2 NAAQS is based on a comparison of the1-hour SO_2 modeled design concentration to the standard. The 1-hour SO_2 modeled design concentration refers to the highest of the 5-year averages of the 99^{th}-percentile (4^{th}-highest) of the annual distribution of daily maximum 1-hour values predicted at each receptor based on five (5) years of National Weather Service meteorological data or the highest of the multiyear averages of the 99^{th}-percentile (4^{th}-highest) of the annual distribution of daily maximum 1- hour values predicted at each receptor based on one or more complete years (up to five (5) years) of site-specific meteorological data.

6.2.2 PM_{10} Design Concentration

According to Section 10.2.3.2 of the *Guideline on Air Quality Models (EPA, 2005)*, "*for new or modified sources predicted to have a significant ambient impact in areas designated attainment or unclassifiable for the PM-10 NAAQS, the demonstration of whether or not the source will cause or contribute to an air quality violation should be based on sufficient data to show whether: (1) The projected 24-hour average concentrations will exceed the 24-hour NAAQS more than once per year, on average;...and (3) the source contributes significantly, in a temporal and spatial sense, to any modeled violation.*"

If five (5) years of meteorological data were used in the model, for example, the design value (i.e., the value to compare to the standard) for the 24-hour standard would be the *highest, sixth-highest* concentration estimate over the entire 5-year period. That is, at each receptor, the five highest concentration values would be ignored. Compliance would be based on the sixth-high value.

6.2.3 $PM_{2.5}$ Design Concentrations

The 24-hour $PM_{2.5}$ modeled design concentration is the highest of the multiyear averages of the maximum modeled 24-hour average $PM_{2.5}$ concentrations predicted at each receptor based on the number of years of meteorological data.

The annual $PM_{2.5}$ modeled design concentration is the highest of the multiyear averages of the maximum modeled annual average $PM_{2.5}$ concentrations predicted at each receptor based on the number of years of meteorological data.

6.3 Receptor Networks

The approach to creating a receptor network varies with the goals of the modeling study. Case-by-case professional judgment should be used. Factors such as topography, density of nearby sources, meteorology, and requirements of the selected model should be considered when selecting receptors. In general, the network should be consistent with EPA's recommendations. It should extend far enough to define the SIA for the source or modification under review. For elevated point sources, it is sometimes useful to initially use a simple screening-level model to help determine how far out to extend the receptor network.

If the concentration gradient is increasing at the edge of the network, the network should be extended. The VADEQ generally considers a *fine* receptor grid to have receptor spacing of 50 meters or less. A *coarse* receptor grid usually refers to receptor spacing greater than 50 meters.

While source-specific issues such as expected plume rise and topography should be considered when deciding if the following recommendations are appropriate, the following recommendations often provide a good starting point:

a. Up to 1 kilometer – grid with 50-meter receptor spacing;
b. From 1 to 3 kilometers – grid with 100-meter spacing;
c. From 3 to 10 kilometers – grid with 250-meter spacing;
d. Beyond 10 kilometers – grid with 500-meter spacing;
e. Along fence line or property boundary – 25-meter receptor spacing;
f. Discrete receptors for sensitive nearby sites (e.g., residences, schools);
g. If the modeled maximum from the facility under review (or the maximum in an *air quality impact analysis* such as a NAAQS analysis) occurs in a *coarse* receptor grid, additional modeling should be performed with a fine grid to find the maximum concentration;

h. Additional fine receptor grids or discrete receptors may be necessary in complex terrain or sensitive areas to clearly define the area of maximum impact.

The modeling analysis should evaluate all locations that are considered ambient air. An exemption from ambient air is available only for the atmosphere over land owned or controlled by the source and to which public access is precluded by a fence or other physical barriers, including a security guard, when the plant is in operation. Refer to EPA memos[14] on this subject (e.g., EPA, 1984, EPA, 1986, EPA, 1987a, EPA, 1987b, EPA, 1987d, EPA, 1989).

6.4 Elevation Data for Sources and Receptors

Terrain can have an effect on the modeling results. Therefore, terrain elevations for sources and receptors and elevation data that convey the features of the surrounding terrain should be used in the modeling analysis. Terrain elevation data produced by the U.S. Geological Survey (USGS) or other equivalent data should be used. It is usually best to extract the elevation data from the same database to avoid discontinuities. Additional terrain information for applicants proposing to use AERMOD is contained in the latest version of the *AERMOD Implementation Guide (EPA, 2009)* which is available at http://www.epa.gov/scram001/dispersion_prefrec.htm#aermod.

The applicant should be aware of the datum of the terrain elevation data and maintain consistency throughout the modeling process. All receptor, building, and source locations must be in UTM coordinates and must originate in, or be converted to, the same horizontal datum.

Large-scale modeling (e.g., CALPUFF) may require use of a Lambert Conformal Conic (LCC) projection system. If a LCC projection system is used, the corresponding UTM or latitude and longitude coordinates for any LCC coordinates presented in the modeling report are required to be included in the report.

6.5 Good Engineering Practice Stack Height

New and modified major stationary sources are subject to EPA's general stack height regulations, which include Good Engineering Practice (GEP) stack height requirements, promulgated at Title 40, Part 51 of the Code of Federal Regulations (40 CFR 51). As defined by the regulations, the GEP stack height is calculated as the greater of 65 meters (measured from the ground level elevation at the base of the stack) or the height resulting from the formula presented below. Therefore, a GEP stack height analysis should be performed based on the design of the new or modified

[14] Internet links to these EPA memos can be found in the Reference section of this document on page 54.

major stationary source to determine the potential for building-induced aerodynamic downwash for all modeled stacks. The analysis procedures described in EPA's *Guidelines for Determination of Good Engineering Practice Stack Height (EPA, 1985)* and the stack height regulations (40 CFR 51) should be used.

The GEP formula stack height is based on the observed phenomena of disturbed atmospheric flow in the immediate vicinity of a structure resulting in higher ground level concentrations at a closer proximity to the structure than would otherwise occur. It identifies the minimum stack height at which significant aerodynamic downwash is avoided. The GEP stack height can be calculated (in meters) as follows:

$$H_{GEP} = H_B + 1.5L$$

Where:

- H_{GEP} is the GEP stack height, measured from the ground level elevation at the base of the stack;
- H_B is the height of nearby structure(s), measured from the ground level elevation at the base of the stack; and
- L is the lesser dimension (height or projected width) of nearby structure(s)

For a squat structure, i.e., height less than projected width, the formula reduces to:

$$H_{GEP} = 2.5H_B$$

Both the height and width of the structure are determined from the frontal area of the structure projected onto a plane perpendicular to the direction of the wind. In all instances, the GEP stack height is based on the plane projections of any nearby structure which results in the greatest justifiable height. For purposes of the GEP analysis, nearby refers to the "sphere of influence", defined as five times the height or width of the structure, whichever is less, downwind from the trailing edge of the structure.

The applicant should include downwash effects in the modeling analysis for all modeled stacks. Due to the complexity of the GEP guidance, EPA has developed computer programs for calculating downwash parameters for use with refined dispersion models. The most current downwash program is the Building Profile Input Program – Plume Rise Model Enhancements, otherwise referred to as the BPIP-PRIME downwash algorithm. This algorithm is incorporated into AERMOD for determining the impact of downwash on ambient concentrations and AERMOD uses it to determine refined concentration estimates.

6.6 Meteorological Data

To determine if representative meteorological data are available for the area under consideration, the applicant should consult with the VADEQ. If an applicant proposes to use available meteorological data, a detailed meteorological analysis submitted to the VADEQ for review may be required. The meteorological analysis should explain how meteorological data from this location is representative of the meteorological patterns around the facility. This may include the character and complexity of the terrain in the source surroundings and between the source and the meteorological monitoring or observing site, the proximity of the meteorological monitoring site to the source, instrumentation and exposure of the meteorological monitoring site, and the quality, completeness, and period of record of the meteorological data. The applicant should discuss the differences/similarities in topography and climatology (especially wind patterns and mixing heights) between the two locations.

In addition, applicants proposing to use AERMOD are required to address the elements contained in the latest version of the *AERMOD Implementation Guide (EPA, 2009)* which is available at http://www.epa.gov/scram001/dispersion_prefrec.htm#aermod. These elements include, but are not limited to, a sensitivity analysis of land use parameters (i.e., surface roughness, Bowen ratio, and albedo).

If it is determined that representative meteorological data are not available, it will be necessary for the applicant to collect at least one (1) year of site-specific data. Meteorological data should be collected, processed, and applied in ways that are consistent with the *Guideline on Air Quality Models (EPA, 2005), Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA, 2000), Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD) (EPA, 1987c),* and model user's guides. Any source intending to collect site-specific data should contact the VADEQ prior to establishing a monitoring program in order to ensure that EPA and VADEQ requirements for the collection of site-specific meteorological data are met.

Raw surface and upper air meteorological data that is used as input to air quality models are available in a number of formats. The applicant should contact the VADEQ to determine the availability of these data. Although the VADEQ may be able to assist in obtaining the raw meteorological data, the applicant is ultimately responsible for obtaining these data.

In addition, the VADEQ suggests that applicants proposing to use AERMOD append the raw surface and upper air meteorological data that are reported in Greenwich Mean Time (GMT) and require a time adjustment (e.g., 5 hours for the Eastern U.S. time zone) by adding day 1 of the following year prior to processing the data using AERMET, the meteorological data preprocessor for AERMOD. Appending the data will generally eliminate the missing data messages generated by AERMET during the processing of several end of the day hours for the last day (i.e., December 31) of a particular year.

The applicant should contact the VADEQ to discuss the requirements for processing raw meteorological data into a model-ready format. In certain cases, VADEQ may prefer to process these data and provide them to the applicant. Recommendations for processing meteorological data to be used as input to AERMOD are also contained in the latest version of the *AERMOD Implementation Guide (EPA, 2009).*

Prior to use, meteorological data should be approved by the VADEQ. This should be completed as part of the modeling protocol review. To prevent unnecessary delays during the permit review process, applicants and/or their consultants are required to submit meteorological and ambient air monitoring data to the VADEQ prior to the submission of modeling. Per regulatory requirements, for PSD applications where the VADEQ has required pre-construction meteorological monitoring, the permit application will not be ruled complete until the data has been submitted to the VADEQ and approved (see Section 5.2).

As stated in Section 8.3.1.2 of the *Guideline on Air Quality Models (EPA, 2005),* five (5) years of National Weather Service data or at least one (1) year of site-specific data should be used. If more than one year of site-specific data exists, multiple years (up to five years) should be used.

For Class I areas located more than 50 kilometers and less than 300 kilometers from the proposed facility, modeling using the latest EPA-approved version of the CALPUFF modeling system is typically required. Meteorological data that has been processed through the CALMET program for direct input to CALPUFF is often available from VADEQ or the FLMs upon request. It is strongly recommended that the applicant use these pre-approved data for Class I modeling exercises.

6.7 Land-Use Classification

The classification of the land use in the vicinity of air pollution sources is necessary because dispersion rates differ between urban and rural areas. In general, urban areas have greater rates of dispersion because of increased turbulent mixing and buoyancy-induced mixing. The turbulent mixing results from the combination of greater surface roughness caused by more buildings and structures, and greater amounts of heat released from concrete and similar surfaces.

The recommendations in the *Guideline on Air Quality Models (EPA, 2005*) are required to be followed for all modeling analyses. Additionally, applicants proposing to use AERMOD are required to determine if the area surrounding the facility is urban or rural in accordance with the latest version of the *AERMOD Implementation Guide (EPA, 2009).*

6.8 Consistency in Geographic Coordinates

Geographic coordinates are often used in modeling. Whenever possible, the datum upon which geographic coordinates are based should be provided. For example, potentially significant discontinuities in coordinates for sources and receptors may occur if some Universal Transverse Mercator (UTM) coordinates are based on the North American Datum of 1927 (NAD27) while others are based on the North American Datum of 1983 (NAD83). Often, site surveys are performed using GPS systems that are based upon the World Geodetic System 1984 **(**WGS84) while UTMs might be based upon a NAD27 topographic map. Therefore, a coordinate conversion should be performed when appropriate so that receptors, source locations, and other coordinates reference a consistent system.

7 Submittal and Review of Air Quality Modeling

A separate narrative air quality modeling report describing the modeling performed for the facility is required to be submitted for the Class I area analysis and the Class II area analysis. The level of detail of the report will depend on the complexity of the modeling analysis and the situation(s) in question. The report for any modeling analysis usually includes the list of data and information presented in Appendix B. Examples of tables that may be used for presenting the results of the modeling analysis in the report are provided in Appendix E. If the data and/or information are not provided and cannot be provided upon request in a timely manner, the review may be delayed. In addition, if data cannot be provided in a suitable format, additional staff time may be necessary for data-processing tasks.

All modeling submittals (e.g., input/output files, protocols and reports) and correspondence (e.g., e-mails, letters) are required to be sent to both the AQA and the appropriate VADEQ regional office (i.e., Air Permit Manager) responsible for processing any permit application. The current VADEQ regional office contacts are located at http://www.deq.virginia.gov/Locations.aspx. The AQA contact information is provided in Appendix A. The applicant should verify that electronic mail with attachments is received by the VADEQ. Electronic mail with zip, executable, and some other types of attachments may be rejected by the VADEQ's electronic mail system.

In addition, for new major stationary sources and major modifications subject to PSD, a copy of all modeling submittals and correspondence are often required to be sent by the applicant to the EPA Region III modeling contact listed in Appendix A.

Additionally, Class I area modeling submittals and correspondence must be sent to the FLMs responsible for the Class I areas within 300 kilometers of the proposed facility. The FLM contacts are provided in Appendix A.

The VADEQ will review the modeling submittals to ensure that the analysis was performed in a manner consistent with EPA and VADEQ guidance and requirements. Should additional information be required to complete the review, the VADEQ will notify the applicant. If oversights, errors, or questionable assumptions and/or methods are found during the review process, the VADEQ will work with the applicant to resolve the modeling-related issue(s). Depending on the ramifications of the modeling-related issue(s), it may be necessary for the applicant to redo the analysis.

The FLM role during the modeling submittal review process generally consists of considering whether emissions from a new major stationary source or major modification may have an adverse impact on the AQRVs in a Class I area, including visibility and acid deposition, and providing comments to VADEQ. The FLM of a Class I area has an affirmative responsibility to protect the AQRVs for that area which may be adversely affected by air pollution. When the Class I area modeling analysis demonstrates that the new major stationary source or major modification would not cause or contribute to an applicable Class I PSD increment violation but the FLM determines that the emissions from the source would have an adverse impact on the AQRVs, the burden of proof is on the FLM to demonstrate their case to the satisfaction of VADEQ pursuant to Section 165 of the Clean Air Act. Conversely, if it is demonstrated through the Class I area modeling analysis that the emissions would cause or contribute to an applicable Class I PSD increment violation, the burden of proof is on the applicant to demonstrate to the FLM that the proposed source would have no adverse impact on the AQRV(s). In either case, the permit may not be issued if an adverse impact is identified.

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