AIR QUALITY IMPACT EVALUATION GUIDELINES IN VERMONT

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1.0 Introduction

An Air Quality Impact Evaluation (AQIE) is used to demonstrate whether a project will cause or contribute to violations of state and federal ambient air quality standards or significantly deteriorate existing air quality. A mathematical simulation or "model" attempts to replicate the effects of meteorology and topography on the transport and dispersion of air contaminants for a location or region. Air quality impact evaluations are unique to each application and require case-by-case consideration by the Air Quality & Climate Division (Division). Therefore, applicants are encouraged to work closely with the modeling staff at the Division to ensure all modeling criteria are met.

This document will provide guidance for conducting ambient air quality impact evaluations for both major and non-major sources of air contaminants in Vermont. In addition, guidance is provided for sources documenting compliance with Vermont's hazardous air contaminant rule, §5-261 of the *Vermont Air Pollution Control Regulations* (*Regulations*). The purpose of this document is to supplement other modeling guidance, specifically, the United States Environmental Protection Agency's (USEPA) *Guideline on Air Quality Models* (see Title 40 *Code of Federal Regulations* Part 51, Appendix W) for sources in the state of Vermont.

Appendix W recommends AERMOD as the primary air pollution dispersion modeling tool for predicting air quality impacts. The model and its associated processors are frequently updated, so applicants should regularly check EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website for the most recent version and information. An applicant must use the most recent version of AERMOD that coincides with the date that an administratively complete permit application is received by the Department.

Should a discrepancy arise between this document and state or federal laws, the laws govern the approach that must be used. Air quality modeling performed to satisfy requirements of the federal *Clean Air Act* is required to meet U.S. EPA's *Guidelines on Air Quality Models* as revised (see 40 CFR Part 51 Appendix W).

2.0 Applicability and Requirements

In Vermont, an air quality impact evaluation (AQIE) <u>must</u> be performed if any of the criteria listed in Section 2.1 are met. An AQIE <u>may</u> be required if any of the criteria listed in Section 2.2. are met.

If required, an AQIE would be expected to address the following regulatory requirements, as may be applicable: (1) National Ambient Air Quality Standards; (2) Prevention of Significant Deterioration increment; (3) for Class 1 areas the Federal Land Manager's Air Quality Related Values, and; (4) state air toxic Hazardous Ambient Air Standards. A discussion of these follows.

2.1 Mandatory Air Modeling

An AQIE must be performed for the following:

1. new major stationary sources and major modifications pursuant to the requirements of §5-502(4) of the *Regulations*. Please note that the major source threshold in Vermont is 50 tons per year of any air contaminant (with the exception of lead and greenhouse gasses), and the threshold for major modifications is defined by the *significant* thresholds defined in §5-101 of the *Regulations*. In certain situations, the owner or operator of a source may be required to perform additional analyses in order to quantify a project's expected impact on visibility, soils, vegetation, and Class I Wilderness areas or other "sensitive" areas;
2. pursuant to §5-406 of the *Regulations,* new minor stationary sources proposing allowable emissions greater than the *significant* thresholds defined in §5-101 of the *Regulations;* or
3. pursuant to §5-406 of the *Regulations,* existing stationary sources proposing a *modification* with emissions greater than the *significant* thresholds defined in §5-101 of the *Regulations.*

2.2 Discretionary Air Modeling

An AQIE may be required for the following:

1. sources subject to an air quality impact evaluation for hazardous air contaminants (HAC) as described in §5-261 of the *Regulations*; or
2. any source subject to §5-501 of the *Regulations* and requested by the Division to perform an air quality impact evaluation to demonstrate that operation of the proposed source will not directly or indirectly result in a violation of any ambient air quality standard (Table 1), interfere with attainment of an air quality standard, or violate any applicable Prevention of Significant Deterioration (PSD) increment (Table 2). The factors the Division will consider when making a determination include, but are not limited to:
    a. emission dispersion characteristics at or near the source (e.g. emission rate, stack configuration, heat of exhaust, building dimensions, nearby terrain, etc);
    b. ambient background concentration design value;
    c. proximity to sensitive receptors, Class I areas, ambient air boundaries, etc; and
    d. for sources subject to §5-261(2) of the *Regulations*, the degree of toxicity of the hazardous air contaminant.

2.3 National Ambient Air Quality Standards (NAAQS)

The USEPA established the NAAQS for six criteria pollutants; sulfur dioxide (SO_2), particulate matter (PM_{10}/$PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone (O_3), and lead (Pb), for the purposes of protecting human health from the adverse effects of air pollution under the 1970 Clean Air Act (CAA). The NAAQS are maximum air contaminant concentrations allowed in the ambient air and include both "primary" and "secondary" standards. The primary standards are intended to protect human health with an adequate margin of safety; whereas the secondary standards are intended to protect public welfare from any known or anticipated adverse effects associated with the presence of air pollutants, such as damage to buildings, crops or animals. Both the primary and secondary standards must be addressed in the modeling evaluation.

For new major sources or major modifications, a facility would be expected to compare the predicted impact from its entire emissions, plus those of other nearby sources as determined by the Division, in addition to representative background concentrations provided by the Division, to the respective NAAQS. If this modeling indicates an exceedance the NAAQS, the proposed source must demonstrate that its impacts are below the significance impact level at the affected receptors and therefore doesn’t cause or contribute to the exceedance of the NAAQS.

In Vermont, a new minor source or minor modification would generally not be required to include emissions from other nearby sources in its analysis, but the Division may require such inclusion on a case-by-case basis.

Table 1: National Ambient Air Quality Standards

Pollutant		Primary/Secondary	Averaging Time	Level [a,b]
Carbon Monoxide (CO)		primary	8 hours	9 ppm
			1 hour	35 ppm
Lead (Pb)		primary and secondary	Rolling 3 month average	0.15 μg/m^3
Nitrogen Dioxide (NO_2)		primary	1 hour	100 ppb
		primary and secondary	1 year	53 ppb
Ozone (O_3)		primary and secondary	8 hours	0.070 ppm
Particle Pollution (PM)	$PM_{2.5}$	primary	1 year	12.0 μg/m^3
		secondary	1 year	15.0 μg/m^3
		primary and secondary	24 hrs	35 μg/m^3
	PM_{10}	primary and secondary	24 hrs	150 μg/m^3
Sulfur Dioxide (SO_2)		primary	1 hour	75 ppb
		secondary	3 hours	0.5 ppm

[a.] ppm = parts per million, ppb = parts per billion, μg/m^3 = micrograms per cubic meter.

[b.] Short-term standards for 3-hour SO2 and 1- and 8-hour CO are not to be exceeded more than once per year. The 3-month lead and annual NO_2 standards are never to be exceeded. The 1-hr NO_2 standard is the 98th percentile of the yearly distribution of 1-hour daily maximum concentrations averaged over 3 years. The 1-hr SO_2 standard is the 99th percentile of the yearly distribution of 1-hour daily maximum concentrations averaged over 3 years. The 24-hr PM_{10} standard is not to be exceeded more than once per year over 3 years. The 24-hr $PM_{2.5}$ standard is the 98th percentile of the yearly distribution of the 24-hour maximum concentrations, averaged over 3 years, and the annual $PM_{2.5}$ standards are annual means averaged over 3 years.

2.4 Prevention of Significant Deterioration (PSD) Increments

Prevention of Significant Deterioration (PSD) applies to new major sources or major modifications at existing sources for pollutants where the area the source is located is in attainment or unclassifiable with the NAAQS and for which a respective PSD increment has been adopted. PSD increments are the amount of pollution an area is allowed to increase, while still preventing the air quality in clean areas from deteriorating to the maximum “ceiling” level set by the NAAQS. Each

PSD increment is assessed against a backdrop of the “baseline concentration” for that pollutant, which is the ambient concentration existing at the time the first complete PSD permit application affecting the area is submitted, called the “baseline date”. The PSD increment consumption is estimated from the modeled impact of the growth of all applicable emissions after the respective baseline dates. In Vermont, PSD increment limitations also applies to new or modified minor sources, although the source’s impact alone is generally compared to the entire increment and other increment consumption is not considered.

Vermont and the USEPA have adopted PSD increments for three classifications of geographical areas. Except for the Lye Brook Wilderness Area near Manchester, Vermont, all of Vermont is considered Class II. The Lye Brook Wilderness Area is classified as a Class I area. Class I areas are afforded greater protection under air pollution control laws in order to preserve their more pristine characteristics. Consequently, the PSD increments for Class I areas allow only a small degree of air quality deterioration, while Class II areas can accommodate moderate growth in emissions. There are currently no Class III areas in the U.S.

Table 2 provides the PSD increments for Class I and Class II areas in Vermont. Table 3 provides the baseline dates for each criteria pollutant in Vermont.

Table 2: Class I and Class II PSD Increments

Pollutant [a]	**Averaging Time [b]**	**Maximum Allowable Increment (µg/m^3) [c]**	
		Class I	**Class II**
$PM_{2.5}$	Annual	1	4
	24-hour	2	9
PM_{10}	Annual	4	17
	24-hour	8	30
SO_2	Annual	2	20
	24-hour	5	91
	3-hour	25	512
NO_2	Annual	2.5	25

[a] Increments have not yet been set for 1-hour SO_2 or 1-hour NO_2.

[b] The annual geometric mean concentration is not to exceed the annual PSD increment, while the 24-hour increments are not to be exceeded more than once per 24-hour period.

[c] µg/m^3 = micrograms per cubic meter.

Table 3: Baseline Dates

Pollutant	Baseline Date [a]	
TSP and PM_{10}	Major	January 6, 1975. No major sources in existence on the baseline date continue to operate today. Therefore, there are no major sources that consume increment.
	Trigger	August 7, 1977
	Minor	May 17, 1990. Date triggered by receipt of admin complete application AP-89-049 from OMYA (Verpol plant, Florence, VT) for installation of new equipment and two 3.8 MW gas turbines.
$PM_{2.5}$	Major	October 20, 2010. VT had no major sources of PM2.5 with actual emissions greater than 50 tpy in 2009-10. Only Ethan Allen Beecher Falls reported total PM emissions in excess of 50 tpy for 2009-2010, however the PM2.5 component was less than 50 tpy. Therefore there are no major sources that consume increment.
	Trigger	October 20, 2011
	Minor	December 29, 2011. Date triggered by receipt of admin complete application AP-11-038 from NSSEP for a 37 MW wood-fired power plant.
NO_2	Major	February 8, 1988. Three major source facilities were identified as being in operation on the baseline date: BED McNeil, FiberMark, and Simpson Paper. BED now operates a NOx control device and has lower emissions than on the baseline date. FiberMark has changed from No.6 fuel oil to natural gas and propane and now has lower NOx emissions than on the baseline date. Simpson is now closed. Therefore, there are no major sources that currently consume increment.
	Trigger	February 8, 1988
	Minor	September 14, 1989. Date triggered by receipt of admin complete application AP-88-008 from Arrowhead Cogen for a 28 MW gas turbine.
SO_2	Major	January 6, 1975. Five major source facilities were identified as being in operation on the baseline date: FiberMark, IBM, Kimberly Clark, Simpson Paper, and UVM. Kimberly Clark and Simpson Paper are now closed. FiberMark has switched from No.6 fuel oil to natural gas and propane and has lower SO2 emissions than on the baseline date. With the promulgation of ULSD sulfur in 2018 the other two operating facilities now have lower sulfur emissions than on the baseline date. Therefore, there are no major sources that currently consumer increment.
	Trigger	August 7, 1977
	Minor	February 27, 1980. Date triggered by receipt of admin complete application from BED McNeil for a 50 MW wood-fired power plant.

[a] For discussion of baseline dates, see FR June 6, 2007. Any increase in actual emissions stemming from a modification (major or minor mod) at an identified major source (see table) after the major source baseline date would consume increment. Any increase in actual emissions at any source after the minor source baseline date, whether associated with a mod or not, would consume increment. Actual emissions from any unidentified major source and all minor sources prior to the minor source baseline date are excluded. Mobile source emission increases also consume increment after the minor source baseline date, although we would likely determine such emissions are insignificant. The increment consumption is the difference between actual emissions on the base line date and current actual emissions.

2.4.1 Provisions for Class I Areas and Federal Land Managers

The possibility of a significant impact in a Class I area must also be examined if the source requires a PSD permit or, per §5-501(5) of the *Regulations*: if it is a minor source locating within 10 km of a Class I area. In addition to the more stringent Class I PSD increment, a source may need to demonstrate compliance with any Air Quality Related Values (AQRVs) established by the Class I Federal Land Manager (FLM). Applicants should follow the procedures set forth in the 2010 FLAG (Federal Land Managers' Air Quality Related Values Work Group, https://www.nps.gov/subjects/air/permitresources.htm). A facility needs to work directly with the FLM for this demonstration. The Division will notify the relevant FLM of all PSD permit applications within 30 days of receipt of the application, and at least 60 days before any public hearings on the application. If the Division receives advance notification prior to submission of a PSD permit application, the FLM will be notified within 30 days of the advance notification.

The following is for informational purposes. To help identify if a new project is potentially large enough to represent a risk to the air quality of Class 1 area, the FLM often uses a screening tool referred to as "Q/d". The Q/d screening tool is intended to only be used for projects that are further than 50 km from a Class 1 area. If the calculated Q/d is less than 10, the project is not anticipated to adversely affect the Class 1 area.

d = the distance (km) from the proposed project to the Class 1 area,

Q = [SO_2 + NO_X + PM_{10} + H_2SO_4] and has the units of tons/year.

For each pollutant the tons/year calculation is based on the maximum 24-hour emission rate * 365 days. Note that if a project has a very high short-term emission rate, but has an annual cap such as 99 tons/year, do not use 99 as the value to represent the tons/yr emission rate when calculating Q/d.

Federal Land Manager for Lye Brook Wilderness Area

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2.5 Vermont Hazardous Ambient Air Standards (HAAS)

The Vermont Hazardous Ambient Air Standards (HAAS) are the highest acceptable concentrations in the ambient air of any Hazardous Air Contaminant (HAC). HACs are divided into three categories. Category I HACs are known or suspected carcinogens and the HAAS for each Category I HAC is set at a level estimated to correspond to an excess lifetime carcinogenic risk of one in one million assuming continual inhalation exposure. Category II HACs are believed to cause chronic systemic toxicity due to long-term exposure, and Category III HACs are believed to cause short-term irritant effects. For both Category II and III effects, it is generally believed that there is some level of exposure below which no adverse health effects are likely to occur. Due to variation of the actual threshold level from individual to individual, assessment of such compounds focuses on estimating a population threshold level. The Category II and Category III HAAS are set to a level estimated to correspond to such a threshold based on continual inhalation exposure. The averaging periods for Category I and II HACs are annual average concentrations, while the averaging period for Category III HACs is a 24-hr average.

The requirements of §5-261 of the *Regulations* will apply to any source with proposed or actual emissions of HACs above the threshold emission rate specified in the rule, or Action Level (AL). An AQIE may be required to demonstrate that resulting HAC impacts from the source, and any nearby interactive sources, are below the HAAS. The HAAS and associated ALs are provided in Appendix C of the *Regulations.*

In accordance with §5-261(3) of the *Regulations,* the following factors will be taken into consideration to determine if such an AQIE is warranted:

a. The degree of toxicity of the air contaminant and emission rate;
b. The proximity of the source to residences, population centers and other sensitive human receptors; and
c. Emission dispersion characteristics at or near the source, taking in account the physical location of the source to surrounding buildings and terrain.

3.0 General Modeling Considerations

The AQIE is used to determine the potential ambient pollutant concentrations that may exist once a project is operating or to evaluate an existing source. To estimate potential impacts, source related data, meteorological data, and receptor data are input into the dispersion model.

3.1 Source Related Data

The following source related parameters are required for all primary and interactive sources included in the modeling:

- Stack Parameters (elevation, stack height, diameter, exit temperature, exit velocity, and discharge configuration);
- Emission Rates, both short term and long term;
- Building Dimensions (scaled maps and drawings including building profile drawing);
- Location Map and Site Plan (indicating location of any nearby roads or landmarks, location of fence line, and stack locations);

3.1.1 Good Engineering Practice (GEP) Stack Height Analysis

Proper stack height is critical in achieving good dispersion of air contaminants. If the stack is too low, the air contaminants that are released may be trapped in the wake zone of nearby obstructions (structures or terrain features) and may be brought down to ground level in the immediate vicinity of the release point (down-wash). This situation causes high concentrations and may pose a health threat.

Good engineering practice (GEP) stack height is defined as the height necessary to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies or wakes which may be created by the source themselves, nearby structures or nearby terrain obstacles. If a stack is below the GEP height, then the plume entrainment must be considered by incorporating proper downwash algorithms, such as the Building Profile Input Program (BPIP) into the dispersion models. However, if the stack height meets GEP, then entrainment within the wake of nearby obstructions is unlikely and need not be considered in the dispersion modeling.

In some situations, the existing stack may be higher than the GEP stack height calculated using the GEP equation which appears below. In Vermont, <u>no credit is given for the height extending above the "calculated" GEP stack height</u>. Also, no "credit" can be taken for dispersion techniques, as defined in Title 40 *Code of Federal Regulations* (40 *CFR* 51.164), which may extend the plume above the GEP calculated height. The Division may allow an air contaminant source to take credit in its air quality impact evaluation for reheating its exhaust so long as the exhaust first passes through an air pollution control device. In order to apply this credit, the source must in fact install and operate an exhaust reheater to achieve the gas temperature specified in the analysis. Operation of the reheater and control device must be incorporated as an "enforceable" permit condition.

GEP is determined using the procedures outlined in U.S. EPAs *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document For The Stack Height Regulations), Revised*. Office of Air Quality Planning and Standards, Research Triangle Park, NC. EPA Publication No. EPA-450/4-80-023R. June 1985. (NTIS No. PB 85-225241).

GEP is calculated using the following equation:

Equation 1: GEP Stack Height Formula

The GEP stack height formula is: Hg = H + 1.5*L	
Where;	**Hg is the GEP stack height measured from ground level elevation at the base of the stack,**
	H 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).

A GEP analysis shall be conducted for all structures within 5*L (with L being the terrain feature height) of each stack following the procedures outlined in *Guideline for Determination of Good Engineering Practice Stack Height*. The structure that results in the largest GEP stack height for each stack should be identified as the critical or "controlling tier" for that stack. Also note that terrain features that are located within 5*L of a stack can cause wake effects and should be considered on a case-by case basis.

3.1.2 Horizontal Stacks and Rain Caps

In dispersion modeling, the exit velocity in the upward vertical direction is required. Many stacks have non-vertical discharges (horizontal or downward) or have rain caps which change the outlet velocity from vertical to horizontal. In order to model these stacks properly in AERMOD, the POINTHOR and POINTCAP keywords should be used for horizontal or capped stacks, respectively.

Please refer to the Division's Stack Height and Rain Guard Guidance webpage for more information on acceptable stack configurations in Vermont.

3.1.3 Emission Rates

The emission rate for the modeled source must reflect the maximum allowable emissions; as expressed by permit condition, emission standard, regulation, or other enforceable condition; for each applicable averaging period dependent upon the ambient standard to be used in the compliance comparison (e.g., annual, 3-month, 24-hour, 8-hour, 3-hour, 1-hour).

The operating scenario that causes the maximum ground level concentration must be determined for the "primary" source. This may require modeling more than one operating scenario (e.g., 100%, 75%, and 50% of maximum operating load or rate). The highest load or rate does not always correlate to the greatest impacts. If the source will not operate at variable loads or if a source is incorporated into the analysis as an "included" source in an interactive modeling study, then the load analysis is not typically necessary. The owner or operator of a source should have the Division determine whether the proposed operating scenario is considered representative. A discussion of the load analysis must be included with any reported results. For PSD modeling, baseline actual emission rates (both annual and short-term) must be specified for SO_2, NO_2, TSP, and PM_{10}.

For new sources or sources that have not been assigned an emission limit, the emission rate may be derived from published emission factors (see *Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources. AP-42, 5th Edition, January 1995*. Office of Air Quality Planning and Standards, Research Triangle Park, NC.), approved stack test data, manufacturer's test data, material balance, or other engineering methods approved on a case-by-case basis. For emission rates other than those permitted, all calculations and assumptions must be provided along with the analysis. For sources using backup fuels, the fuel that produces the highest emission rate for each pollutant should be used when determining emission rates for modeling.

For existing sources that are proposing to install a new device the emits criteria pollutants or HACs, all other existing permitted sources at the facility must also be modeled.

3.1.4 Fugitive Emissions

Fugitive emissions are emissions that are not vented directly from a stack or vent, such as open pits or lagoons, paved or unpaved roads, landfills, etc. The fact that the emissions do not vent directly through a stack or vent does not preclude them from a modeling analysis. They are typically modelled as area or volume sources in AERMOD. In situations where fugitive emissions are significant, the Division should be consulted to determine how these emissions should be characterized in the modeling analysis.

3.2 Meteorological Data

Meteorological data is used for refined modeling and is processed through AERMOD's meteorological pre-processor, called AERMET. AERMET combines surface and upper-air weather observations with surface characteristics to produce dispersion parameters for input to AERMOD in the form of .SFC and .PFL files. The applicant should confer with the Division to determine which of the available AERMET data sets will be most representative of the meteorological conditions at the project location. The Division will provide the AERMET files for AERMOD modeling for the proposed project.

In Vermont, upper-air sounding data from Albany, NY are used with Automated Surface Observing System (ASOS) station data that should be representative of the location being modeled. The meteorological data files contain the five (5) most recent, consecutive years of both ASOS hourly observations and upper-air soundings. In addition to the area-specific meteorological data files, the base elevations for these sites are needed as input to run AERMOD. Table 4 provides this additional data.

Table 4: Vermont ASOS Station Information

Station Location	Station Identifier	Lat/Long	Elevation (m)	5 Digit WBAN ID (ASOS ID)	ISHD	Anemometer Height (m)	Ice-Free Wind Date
Burlington	BTV	44.46822/ -73.14988	101	14742	726170 -14742	7.92	2002-09-24
Montpelier	MPV	44.20503/ -72.56545	337	94705	726145 -94705	7.92	2005-10-27
Morrisville	MVL	44.53280/ -72.61523	224	54771	726114 -54771	7.92	2005-11-07
Springfield	VSF	43.34212/ -72.52130	173	54740	726115 -54740	7.92	2005-11-07
Bennington	DDH	42.89351/ -73.24876	241	54781	726166 -54781	10.05	2005-11-07

If at least one year of on-site meteorological data is available, this should be used only in consultation with the Division to ensure that all relevant data and processing requirements are met.

3.3 Receptors

The receptor grid is important in determining the maximum impact from a source. The grid should be placed so that the location of the maximum concentration for which the general public has access can be determined. Therefore, receptors may be required within the source's property line to evaluate cavity and wake regions if the general public is not restricted from gaining access to the area. Public facilities such as K-12 schools, college campuses and hospitals and any facility in which the general public has access must have receptors on their property. At these types of facilities, a 20 m spacing is recommended on the facility property excluding buildings. The boundary of ambient air is discussed in Section 3.3.1 Ambient Air.

Rectangular receptor networks are the most widely applied form of receptor network and should be centered at the source. The Division discourages the use of polar receptor grids because of the gaps in coverage between radials, especially with increasing distance from the center point. The receptor grid to be used in the refined analysis should be approved by the Division prior to beginning the refined modeling analysis.

For non-major sources, it is recommended that receptors be placed along the ambient air boundary at a 20-meter spacing, and should extend outward for a distance of 1,000 meters from the center of the grid. From 1,000 meters to 2,000 meters, the receptor grid should not exceed 100-meter spacing. From 2,000 meters to 5,000 meters, receptor spacing should not exceed 250 meters. From 5,000 to 10,000 meters, receptor spacing should not exceed 500 meters. Beyond 10,000 meters from the center of the grid, receptor spacing should not exceed 1,000 meters. Depending on the circumstances, such as an impact evaluation for a hazardous air contaminant source, it may be necessary to reduce receptor spacing to 50 meters near points of maximum impact.

Major sources must first establish the impacts along the ambient air boundary. Receptors should then be placed out far enough to determine maximum ambient concentrations, as well as the extent of the significant impact area. The maximum grid spacing should follow the same criteria for non-major sources. However, a fine grid spacing may be required to locate the general areas of maximum ambient impact and the extent of the SIA.

In all cases, discrete receptors should be located at sensitive receptor locations (e.g., schools, hospitals, day care facilities, Environmental Justice communities, etc.), and at the closest terrain point at an elevation equivalent to stack top. Receptors should be placed in all "sensitive terrain" areas and Class I areas if within the SIA. Sensitive terrain areas are geographical areas where the elevation is 2,500 feet above mean sea level or greater.

Receptor elevation should be included for all receptors by using the AERMAP processor (or equivalent). AERMAP uses digital elevation model (DEM) data to calculate terrain elevations for use in AERMOD. DEM data is available upon request from the Division or can be downloaded from the USGS here: https://www.mrlc.gov/viewerjs/

All receptors located in Vermont should be considered rural for the purposes of running AERMOD.

3.3.1 Ambient Air

On December 2, 2019, the U.S. EPA released the Revised Policy on Exclusions from “Ambient Air”. In this guidance, the U.S. EPA clarified and revised previous guidance described in a 1980 letter from the EPA Administrator Douglas Costle to Senator Jennings Randolph. In the 1980 letter, the definition of areas to be excluded from ambient air was an area owned or operated by the stationary source in which the general public was excluded by means of a fence or other physical barrier. In the December 2019 revised guidance, the definition of areas to be excluded from ambient air was revised to mean “the atmosphere over land owned or controlled by the stationary source may be excluded from ambient air where the source employs measures, which may include physical barriers, that are effective in precluding access to the land by the general public”.

Historically, the Division interpreted the boundary of ambient air to mean the locations over land in which the public is precluded access by means of a fence, wall, or other physical barrier. In light of more recent U.S. EPA guidance, the Division will also consider barriers, physical or otherwise, that preclude access by the general public. These measures should be explained in the modeling protocol if the applicant wishes to exclude receptors from the property. The modeling protocol, including the receptor grid, shall be reviewed, and approved by the Division on a case-by-case basis.

3.4 Modeling Protocol

A pre-application modeling protocol is required for all Air Quality Impact Evaluations, and shall be reviewed by the Division prior to commencement of the evaluation. A protocol should include the following information:

Table 5: Modeling Protocol Information

Criteria	Description
1.	A diagram of the site including building dimensions location of existing and proposed exhaust stacks, locations of building air intake vents, associated structures, property boundaries, and all pertinent UTM coordinates.
2.	A list of the building in criteria 1 including dimensions (heights, widths, lengths).
3.	A diagram showing property boundaries, distances to adjacent property and description of adjacent property use. Include a scale and true north arrow.
4.	Discussion of reasons for proposing a model other than AERMOD.
5.	Stack parameters and emission rates for each source.
6.	Discussion of receptor locations.
7.	Discussion of PSD baseline dates and sources for interactive modeling.

4.0 Modeling Analysis

Any person conducting an AQIE in Vermont should first consult the U.S. EPA's *Guideline on Air Quality Models* (Appendix W to 40 CFR Part 51) to ensure the most up-to-date version of AERMOD is used in accordance with the regulations. https://www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models#aermod

If any additional models are needed to address other concerns, such as visibility, mobile source impacts, reactive plumes, and long-range transport, then first contact the Division to discuss the project. Use of any additional models must be included in the modeling protocol and approved by the Division before use. This information is available on the U.S. EPA's Support Center for Regulatory Air Models (SCRAM) website at www.epa.gov/scram.

4.1 Screening Analysis

AERSCREEN is the preferred regulatory screening model for conservatively estimating air quality impacts up to 50 km from a single source. However, the inputs required to run AERSCREEN are virtually identical to those required to run AERMOD, except for meteorological data. Due to meteorological data being readily available from the Division, it is recommended to use AERMOD for all permit modeling, including determination of the SIA as described in Section 4.3.1 Prediction of Significant Impact Area.

4.2 Refined Modeling Analysis

Refined modeling is required for all sources subject to the applicability requirements discussed in Section 2.0 Applicability and Requirements. The latest version of AERMOD is the preferred model to predict ambient air quality impacts and determine compliance with NAAQS, PSD increments, and the Vermont HAAS. If the highest maximum predicted concentrations are less than the Significant Impact Levels (SILs) listed in Table 6, generally no further analysis is required.

For predicted concentrations above the SILs, the Division should be consulted to determine what, if any, interactive sources need to be included in the analysis. The combined impacts of the subject source and any interactive sources must be added to the appropriate background concentrations for a comparison to the NAAQS. Impacts from interactive sources as well as the subject source must also be evaluated against the PSD increments. Background concentrations are not added to the predicted impacts for evaluation against the PSD increments; however, baseline concentrations existing at the baseline dates listed in Table 3 must be accounted for. This is accomplished by modeling the existing baseline source(s) at a negative emission rate to represent baseline contributions.

4.3 Significant Impact Levels (SILs)

Significant Impact Levels (SILs) can be used to evaluate whether emissions from a proposed new or modifying source may cause or contribute to a violation of the NAAQS or PSD increment, therefore requiring a cumulative impact analysis including background concentrations and potential nearby sources. A cumulative impact analysis is required when impacts from a new or modified stationary source's emissions result in an increase of ambient concentration greater than or equal to the SIL values listed in Table 6.

Table 6 provides SILs for Class I and Class II areas.

Table 6: Class I and Class II Area Significant Impact Levels

Pollutant	Averaging Period	Significant Impact Levels ($\mu g/m^3$)	
		Class I Area	Class II Area
SO_2	1-hr	-	7.8 [a]
	3-hr	1.0	25
	24-hr	0.2	5
	Annual	0.1	1
NO_2	1-hr	-	7.5 [b]
	Annual	0.1	1
CO	1-hr	-	2,000
	8-hr	-	500
$PM_{2.5}$ [a]	24-hr	0.27 [c]	1.2 [c]
	Annual	0.05 [c]	0.2 [c]
PM_{10}	24-hr	0.32	5
	Annual [e]	0.16	1

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

b. NESCAUM interim significance level as maximum 1st high concentration (May 30, 2013 letter); USEPA has recommended 4ppb (~7.5 $\mu g/m^3$) as maximum of 5-year average 1st highest maximum concentration.

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

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

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

4.3.1 Prediction of Significant Impact Area

If predicted impacts are above the SILs in an attainment area, then a cumulative impact analysis must be performed at described in Section 4.3.2 , and the project's Significant Impact Area (SIA) must be calculated. The SIA is a circular area with a radius extending from the source to the most distant point where approved dispersion modeling predicts a significant ambient impact will occur. The SIA should be determined for each pollutant and averaging period that has been assigned a significant impact level.

When the SILs for each applicable pollutant at each applicable averaging time are not exceeded, a cumulative impact analysis is usually not necessary. For Major NSR/PSD permits, however, a cumulative impact analysis is always required to demonstrate that allowable PSD increments are not being consumed. There are other circumstances when the reviewing authority may require a cumulative impact analysis modeling even if predicted impacts are less that the SILs, such as if there are other sources within 50 km that may cause a significant concentration gradient between the source and ambient background monitor.

4.3.2 Cumulative Impact Analysis

For new and modified sources with impacts greater than the SILs, the SIA must be calculated as described in Section 4.3.1 Prediction of Significant Impact Area. All sources meeting the criteria shown below that are not adequately represented by an ambient monitor should be modeled as interactive sources using actual temporally representative emission rates, in accordance with 40 CFR Appendix W Sections 9.2.3(d) and 8.3. Sources may choose to use permitted allowable emissions from nearby sources, which can be an appropriately conservative emissions value for such sources if actual temporally representative actual emissions profiles are not readily available. Additional sources may also be required on a case-by-case basis at the discretion of the Division.

a. Nearby sources located within the SIA with actual emissions greater than the following significant emission rates:

i. CO: 50 tons/yr

ii. NOx: 40 tons/yr

iii. SO2: 40 tons/yr

iv. PM10: 15 tons/yr

v. PM2.5: 10 tons/yr

b. Nearby sources located within 20 km of the proposed source that have actual emissions greater than 50 tons/yr of any singular criteria pollutant.

c. Nearby sources located within 50 km of the proposed source that have actual emissions greater than 500 tons/yr of any singular criteria pollutant.

Source parameters and emission rates to be used in interactive modeling are available from the Division upon request. The Division must be consulted before submitting modeling to determine the sources, and the source parameters, based on Table 8-2 of Appendix W. If the SIA extends beyond the Vermont state line, the applicant must obtain source information from the neighboring state in which significant impacts were predicted. This information must be reviewed and approved by the Division in the modeling protocol prior to beginning the refined analysis.

4.4 Background Concentrations

The monitored design concentrations to be added to modeled results are calculated based on 3-year average concentrations. These values are updated yearly by the Division and available on its website: https://dec.vermont.gov/air-quality/permits/construction/background-data. There may be situations where the short-term averages need to be more refined as detailed in Sections 5.4.1 1-Hour NO_2 NAAQS Background Concentrations and 5.5.1 1-Hour SO_2 NAAQS Background Concentrations.

4.5 Hazardous Air Contaminant Demonstration

Sources that emit HACs above their respective Action Level found in Appendix C of the *Regulations* may be required to demonstrate compliance with the HAAS for those contaminants. Category I and II HACs are evaluated based on an annual averaging period while Category III HACs are evaluated based on a 24-hour averaging period. The maximum predicted impacts for each averaging period (annual and 24-hr) are then compared to the respective HAAS for each HAC. In general, background concentrations for HACs are not available, but interactive sources may be required to be included in the analysis for Category II and III HACs if non-zero impacts are predicted near another permitted source of the same HACs. For multi-source HAAS compliance demonstrations, the source’s impacts, plus any additional interactive source’s impacts, must be below the HAAS. Note that per §5-261(5), Cat I HACs are only modeled for the facility’s emissions (no interactive modeling of nearby facilities or including any available ambient air background data).

The source’s impacts may pose an air quality concern if the results indicate that the HAAS is exceeded. Should this occur, the source must abate emissions to a greater degree such that the analysis demonstrates compliance with the HAAS, or the Permit will be denied.

5.0 Special Modeling Considerations

For sources subject to 5-502 of the *Regulations* and the Federal PSD program, three additional analyses must be performed to address the following: growth, soils & vegetation, and visibility. Applicants demonstrating compliance with short-term NO_2 and SO_2 NAAQs, or that emit precursor pollutants which may produce secondary formation of $PM_{2.5}$ and ozone also require additional techniques. These approaches are discussed in the following sections.

5.1 Growth

For PSD increment modeling, the applicant may be required to evaluate area-wide emissions growth on increment consumption. The Division and EPA Region 1 should be consulted to determine the assumptions and methodologies that will be used in the growth analysis, especially when modeled concentrations approach the available increments.

5.2 Soils & Vegetation

In accordance with Vermont's *State Implementation Plan*, impacts on vegetation, soils, and an assessment of secondary growth will be conducted through procedures established in Title 10, Chapter 151, *Vermont Statutes Annotated*. Section 6081 of this law requires the review and issuance of an Act 250 Land Use Permit for all significant changes in land use throughout the state. This section includes all secondary growth and all development of a nature likely to impact soils and vegetation through emissions to the ambient air.

Guidance related to this analysis are provided "A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals" (EPA, December 12, 1980). The Division and EPA Region 1 should be consulted to determine the assumptions and methodologies used in the soils and vegetation analysis.

5.3 Visibility

Sources located within 300 km of a Class I area and subject to the federal PSD program are required to consult with the Federal Land Manager for each Class 1 area to determine if a visibility assessment is required. If required, this typically involves using a 3-tiered approach. A plume visual impact screening tool (VISCREEN) is used for levels one and two, while a detailed plume visual impact analysis (PLUVUE II) is used as a more sophisticated plume visibility model for level three of the evaluation.

In accordance with §5-502(4)(d) the proposed source must demonstrate that the increase in allowable emissions will not cause an *adverse impact on visibility*, or interfere with *reasonable progress toward remedying of existing man-made visibility impairment*, in any sensitive area.

The applicant will use the same tools noted above for Class 1 areas to establish that the project does not cause an *adverse impact on visibility* at the Vermont sensitive area which is closest to the proposed project.

To avoid interfering with *reasonable progress toward remedying of existing man-made visibility impairment*, any proposed source installing fuel burning equipment with a heat input greater than 100 MMBtu/hr must have an annual average SO_2 emission rate less than or equal to 1.2 lb SO_2/MMBtu heat input.

5.4 1-Hour NO_2 NAAQS Compliance Demonstration

In 2010, the U.S. EPA promulgated the 1-hour NO_2 NAAQS. Due to the increased stringency and complex chemical transformations that occur as facilities emit NOx, which becomes NO_2 in the atmosphere, the U.S. EPA has approved a three-tiered approach to modeling NO_2 impacts from point sources.

- Tier 1 assumes full conversion of NOx to NO_2. This approach is the most conservative and resulting concentrations are compared directly to the NAAQS. If predicted concentrations, plus applicable background concentrations, exceed the NAAQS, the analysis proceeds to Tier 2.
- Tier 2 uses the Ambient Ratio Method 2 (ARM2) approach that was embedded into AERMOD. The maximum average concentration derived in the Tier 1 estimate is multiplied by an in-stack NO_2/NOx factor. The national minimum and maximum in-stack ratios are 0.5 and 0.9, respectively. If concentrations still exceed the NAAQS, the analysis proceeds to Tier 3.
- Tier 3 uses one of two options: the Plume Volume Molar Ratio Method (PVMRM), and the Ozone Limiting Method (OLM). Both methods require the use of in-stack ratios. The U.S. EPA has established a generally accepted ratio of 0.5 for the primary source and any nearby interactive source, and 0.2 for distant sources (greater than 1-3km away). Use of either of these methods requires consultation with the Division and EPA Region 1.

These approaches are detailed in the following memoranda released by the U.S. EPA:

- Applicability of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, June 28, 2010,
- Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard, March 1, 2011,
- Clarification on the Use of AERMOD Dispersion Modeling for Demonstrating Compliance with the NO_2 National Ambient Air Quality Standard, September 30, 2014.

5.4.1 1-Hour NO_2 NAAQS Background Concentrations

The background concentrations for the 1-hour NO_2 standard is based on the most recently available three-year averages of 98th percentile background concentrations by season and hour of day. The approach is detailed in EPA's March 1, 2011 guidance "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO2 National Ambient Air Quality Standard". For Tier 1 demonstrations, the use of uniform monitored background concentrations is acceptable without further justification; however, this approach may be overly conservative.

5.5 1-Hour SO_2 NAAQS Compliance Demonstration

In 2010, the U.S. EPA promulgated to 1-Hour SO_2 NAAQS. Although SO_2 does not encounter the same atmospheric transformation as NO_2, and therefore does not require the same three-tiered screening approach, the procedure for including background concentrations are similar to those employed for 1-hour NO_2. The following U.S. EPA memorandum is applicable to the 1-hour SO_2 standard:

- Applicability of Appendix W Modeling Guidance for the 1-hour SO_2 National Ambient Air Quality Standard, August 23, 2010

5.5.1 1-Hour SO_2 NAAQS Background Concentrations

The background concentrations for the 1-hour SO_2 standard is based on the most recently available three-year averages of 99^{th} percentile background concentrations by season and hour of day.

5.6 Secondary $PM_{2.5}$ Formation

For new sources and modifications that are major sources of $PM_{2.5}$, NOx, and SO_2, secondary formation of $PM_{2.5}$ must be evaluated by photochemical modeling. The U.S. EPA has released the following memoranda for the evaluation of secondarily formed $PM_{2.5}$:

- Appendix W Section 5.0, *Models for Ozone and Secondarily Formed Particulate Matter*
- Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program, April 30, 2019
- Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program, April 17, 2018
- Use of Photochemical Grid Models for Single-Source Ozone and secondary $PM_{2.5}$ impacts for Permit Program Related Assessments and for NAAQS Attainment Demonstrations for Ozone, $PM_{2.5}$ and Regional Haze, August 4, 2017
- Guidance for $PM_{2.5}$ Permit Modeling, May 20, 2014

The Division and EPA Region 1 must be consulted prior to performing a secondary $PM_{2.5}$ assessment.

Please note that as of the drafting of this guidance document, EPA is developing and will soon publish final guidance for the treatment of $PM_{2.5}$ and Ozone in permit modeling in 2021. The draft version of this guidance was issued on March 16, 2020 and is available on the EPA's SCRAM Website.

- DRAFT Guidance Ozone and Fine Particulate Matter Permit Modeling, February 10, 2020

5.7 Secondary Ozone Formation

Vermont is located within the Ozone Transport Corridor (OTC); therefore, all applicants proposing allowable emissions of NOx in excess of one-hundred (100) tons per year or fifty (50) tons per year of VOCs must complete non-attainment new source review (NNSR) for ozone. Ozone secondary formation modeling is not required under NNSR. Applicants proposing between fifty and one-hundred tons per year of NOx shall be subject to Vermont major source permitting pursuant to §5-502.

5.8 Intermittent Sources

Compliance demonstrations for the 1-hour NO_2 and 1-hour SO_2 shall include sources that are assumed to be operated relatively continuously or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. If the applicant wishes to exclude emissions from intermittent sources, such as emergency generators or startup/shutdown scenarios, then justification for such exclusion shall be provided in the modeling protocol and approved by the Division on a case-by-case basis. Applicants may also choose to take a limit on operating hours, or number of startup/shutdown periods, as an enforceable permit condition in order to classify a source as intermittent for modeling purposes. The Division will approve such proposal on a case-by-case basis, and consider such factors as the dispersion characteristics of the source, emission rates, distance to sensitive receptors, etc., when making its decision.

6.0 Reporting

The Division recommends that the air quality impact evaluation final report include the following at a minimum.

Table 7: Modeling Report Information

Criteria	Description
1.	Executive summary including abstract of results and statement of compliance.
2.	GEP stack height analysis
3.	Maps showing location of source(s) with overlays describing significant impact areas, if any, receptor grid overlays, north arrow, scale, and appropriate UTM coordinates. Locate receptors where high concentrations were predicted, and sensitive receptors.
4.	Plant description including a key to abbreviations used to describe equipment and stacks.
5.	A description of the modeling methodology used (inputs, model selection, options, receptor grid, etc.).
6.	Clear presentation of all assumptions made in the evaluation.
7.	Modeling results (raw input/output attached as appendix). Concentration output tables should list the maximum impact depending on the pollutant/averaging period.
8.	Modeling results in tabular summary relative to acceptable air quality levels.
9.	Model and preprocessor input and output data files including the meteorological data used in the modeling (zipped or compressed files).
10.	Background concentration data used.
11.	Input data for any other nearby sources included in the evaluation.