Division of Air Pollution Control
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Engineering Guide #69: Air Dispersion Modeling Guidance

This engineering guide provides responses to frequently asked modeling questions to develop a basis for consistent application of modeling methods and techniques. Although many projects will require case-specific responses, this document is designed to aid in understanding the framework of permit modeling in Ohio such that permitting personnel, regulated entities and the public will have an understanding of expected outcomes and approaches to modeling for many applications. The answers in this document do not reflect a rule or regulation, are not intended to be treated as a rule or regulation and are subject to change[1]. If you have additional questions on modeling or comments on this guide, contact the Division of Air Pollution Control at (614) 644-2270.

[1] This Engineering Guide is not binding, does not have the force and effect of law, is not a "rule" as defined in section 119.01(C) of the Revised Code, and is not a "policy" as defined in section 3745.30(A)(1) of the Revised Code.

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Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
AIRS	Aerometric Information Retrieval System
AQRV	Air Quality Related Values
ARM2	Ambient Ratio Method Version 2
BACT	Best Available Control Technology
BPIPPRM	Building Profile Input Program for PRIME
CAA	Clean Air Act
CAMx	Comprehensive Air Quality Model with Extensions
CMAQ	Community Multiscale Air Quality
DAPC	Division of Air Pollution Control
DEM	Digital Elevation Model
DO/LAA	District Office/Local Air Agency
EIS	Emission Inventory System
FLAG	Federal Land Managers' Air Quality Values Work Group
FLM	Federal Land Managers
GAII	Generally Acceptable Incremental Impact
GEP	Good Engineering Practice
ISC	Industrial Source Complex
ISR	In-stack Ratio
LAER	Lowest Achievable Emissions Rate
MACT	Maximum Achievable Control Technology
MAGLC	Maximum Acceptable Ground-Level Concentration
MCH	Modeling Clearinghouse
MMIF	Mesoscale Model Interface
NAAQS	National Ambient Air Quality Standards
NED	National Elevation Dataset
NSR	New Source Review
OAC	Ohio Administrative Code
OLM	Ozone Limiting Method
ORC	Ohio Revised Code
PRIME	Plume Rise Model Enhancements
PSD	Prevention of Significant Deterioration
PTI	Permit-to-Install
PTIO	Permit-to-Install and Operate
PVMRM	Plume Volume Molar Ratio Method
SCICHEM	Second-order Closure Integrated Puff Model with Chemistry
SCRAM	Support Center for Regulatory Air Models
SER	Significant Emission Rate
SIA	Significant Impact Area
SIL	Significant Impact Level
SIP	State Implementation Plan
SMC	Significant Monitoring Concentration
TLV	Threshold Limit Value
USGS	United States Geological Service

Abbreviations

ADJ_U*	adjust u* option where u* is surface friction velocity
AERMET	AERMOD meteorological preprocessor
AERMINUTE	1-minute ASOS wind data pre-processor for AERMET
AERMAP	terrain pre-processor for AERMOD
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AERSCREEN	screening-level air quality model based on AERMOD
AERSURFACE	surface characteristic pre-processor for AERMET
Guideline	40 CFR Appendix W to Part 51 – Guideline on Air Quality Models (82 FR 5182)
H_2SO_4	sulfuric acid mist
$\mu g/m^3$	micrograms per cubic meter
NO_2	nitrogen dioxide
NO_x	oxides of nitrogen
Ohio EPA	Ohio Environmental Protection Agency
$PM_{2.5}$	particulate matter with aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with aerodynamic diameter less than or equal to 10 microns
SCREEN3	screening version of the ISC3 model
SO_2	sulfur dioxide

General FAQ

Question 1. What are Ohio EPA air quality modeling requirements?

Where applicable, Ohio EPA is consistent with the Guideline[2] and supplementary guidance. These resources do not address every detail of problems that confront modelers, who may require a case-specific response. Air dispersion modeling helps demonstrate and predict the relationship between a source or sources and effects on ambient air quality. Modeling is often necessary to demonstrate that a project[3] will:

1) not cause or significantly contribute to ambient concentrations in excess of either of the federally-mandated NAAQS or PSD increments;
2) comply with Ohio EPA's policy of no new source consuming more than one half of the available PSD increment[4]; and/or
3) not cause an exceedance of a MAGLC for air toxics[5].

If a project's potential-to-emit or net emissions increase[6] for a pollutant is considered significant[7], the new or modified source or sources must be evaluated to estimate the maximum incremental impact. SERs are identified in Table 3 of this guide. New or modified sources with nonexempt emissions of air toxics must be evaluated to determine maximum impact of these emissions for comparison against the MAGLC as required by procedures in division (F)(4) of section 3704.03 of Ohio Revised Code.

Where a project includes both emission increases and decreases, generally restricted to a contemporaneous 5- or 10-year period, the net increase should be modeled[8]. Ohio EPA must approve netting emissions prior to modeling review.

Modeling shall be based on information including, but not limited to, emission control devices or methods, operational restrictions, stack parameters, and emission dispersion devices or methods that may affect ground-level concentrations, either individually or in combination. If there are several sources in the same project, combined peak impact must be evaluated.

Question 2. Will Ohio EPA perform air dispersion modeling for my facility?

No, each owner/operator is responsible for conducting and submitting permit modeling analysis when required, and Ohio EPA is responsible for reviewing for reproducibility, completeness, applicability, and

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[2] This guidance uses the term "the Guideline" to mean U.S. EPA Guideline on Air Quality Models (Appendix W of 40 CFR Part 51). Acronyms and abbreviations referenced in two or more questions, or otherwise widely applied in permitting and modeling, are defined in the Acronyms and Abbreviations front matter and are not spelled out in the questions and responses.

[3] "Air contaminant source project" as defined in Ohio Administrative Code 3745-31-01(J)

[4] One half the increment is the effective goal for all new source modeling of criteria pollutants, regardless of the size or location of the new source. Question 19 and Question 20 in this guide provides more information on this policy.

[5] References to "toxics" or "air toxics" in this document refer to regulated toxic air contaminants listed in Ohio Administrative Code rule 3745-114-01. The section Air toxics in this guide has more information on air toxics modeling. Please refer to Ohio EPA, DAPC Engineering Guide 70 "Air Toxics Analysis" for further guidance. Available at: epa.ohio.gov/portals/27/engineer/eguides/Guide70Final20170509.pdf

[6] Net emissions increase is defined in Ohio Administrative Code 3745-31-01(VVV).

[7] Significant is defined in Ohio Administrative Code 3745-31-01(VVVVV)(1).

[8] Question 8 provides more detail on what emission rates should be modeled.

protectiveness or impact. Please contact your DO/LAA for more information.

Question 3. What sources require "state-only" modeling?

Throughout this guide, the term "state-only" is used to refer to facilities that require modeling for protection against Ohio's MAGLC for air toxics[5] and GAII[9] for criteria and other pollutants. Moreover, any owner/operator of a facility where emissions increase exceeds the SERs shown in Table 3 that may not otherwise be required to submit modeling for federal programs is considered to have a state-only modeling project.

Question 4. What air quality models are recommended or required?

Size and complexity of source(s), receptor network details, toxicity and reactivity of emissions, regulatory purpose, and other factors influence whether a screening or refined model should be employed. Screening models provide conservative estimates of air quality impacts based on simplified assumptions of model inputs. Output from a screening model may demonstrate protection of health and environment or warrant more sophisticated refined modeling. Except in certain circumstances, the most recent version of a model is necessary. Terrain and building downwash must be included.

Most models discussed in the Guideline are available for public download at the U.S. EPA SCRAM website[10]. The SCRAM website also contains users' manuals, ancillary programs, meteorological data, and supplementary model application guidance. Any changes made to existing packages require a showing of equivalency. Meteorological data for Ohio sources and an electronic version of this engineering guide are available on the Ohio EPA DAPC website[11, 12].

Screening models:
AERSCREEN is the U.S. EPA recommended screening model for most applications with all types of terrain and downwash applications. AERSCREEN is the required screening model for all NAAQS and PSD projects or any modeling analyses performed in fulfillment of a federal requirement[13]. SCREEN3 modeling may be submitted to Ohio EPA for state-only modeling.

While conversion factors for averaging times other than 1-hour are calculated and provided in AERSCREEN output, conversion factors shown in the table on the following page must be applied by the user to convert short-term estimates in SCREEN3.

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[9] Ohio's Generally Acceptable Incremental Impacts are discussed in Question 19.

[10] U.S. EPA. "Air quality dispersion modeling – Preferred and recommended models." www.epa.gov/scram/air-quality-dispersion-modeling-preferred-and-recommended-models

[11] Ohio EPA. "AERMET output files for AERMOD model input." epa.ohio.gov/dapc/model/modeling/metfiles.aspx

[12] Ohio EPA. "Engineering Guide #69: Air dispersion modeling guidance." epa.ohio.gov/portals/27/engineer/eguides/guide69.pdf

[13] U.S. EPA. (April 11, 2011). "Clarification memorandum on AERSCREEN as the recommended screening model." www3.epa.gov/ttn/scram/guidance/clarification/20110411_AERSCREEN_Release_Memo.pdf

Conversion Factors (SCREEN3 only)

	Desired Averaging Period						
Model Output	1-hr	3-hr	8-hr	24-hr	Month	Quarter	Annual
Simple*	1	0.9	0.7	0.4	0.18	0.13	0.08
Complex*	1	0.7	0.5	0.15			0.03

*U.S. EPA has recommended separate conversion factors for simple terrain and complex terrain in SCREEN3.

Additional guidance on AERSCREEN is provided in Appendix A in this guide.

Whereas most routine releases, even of heavy compounds, will have similar density to air from dilution, screening evaluations of emergency release scenarios or sources emitting 'light' or 'heavy' plumes may use one of the commercially available toxic release models to determine if ambient impacts exceed the applicable MAGLC.

Refined models:
AERMOD is the preferred refined model for regulatory applications in all types of terrain and for aerodynamic building downwash using representative meteorological data in the regulatory default modes. Several commercial versions of AERMOD have been granted model equivalency by U.S. EPA. While deposition is available as an option in AERMOD, its application should be evaluated by Ohio EPA on a case-by-case basis. For refined air toxics analyses, the same procedures used for criteria pollutants are used to determine ambient concentrations. (ISC is no longer accepted by Ohio EPA.)

Chemical transport models:
As indicated in Question 23, if you believe chemical transport modeling may be necessary, discuss with the Ohio EPA air quality modeling unit as early as possible when developing a protocol. Current U.S. EPA guidance indicates that photochemical grid modeling will only be required for the largest sources. Do not initiate this type of analysis without consulting air modeling staff at DAPC.

U.S. EPA recommends models that simulate atmospheric chemical transformations, e.g. CAMx and CMAQ, where a more refined tier 2 analysis for ozone or secondary $PM_{2.5}$ may be necessary. Reduced-form models, e.g., SCICHEM, reflect underlying atmospheric science with reduced computational resources of complex, numerical photochemical or Lagrangian models and may be appropriate in such cases. U.S. EPA has issued a clarification memorandum[14] to the effect that CAMx and CMAQ for PSD compliance do not require formal alternative model approval via the MCH. A modeling protocol, however, is required to approve model selection and use. As indicated in Question 23, if you believe chemical transport modeling may be necessary, discuss with the Ohio EPA air quality modeling unit as early as possible when developing a protocol.

Question 5. Can screening models be used for more than one source?

Yes, screening models can be used to conservatively estimate maximum modeled concentrations from more than one source even though they are designed as single-source models. One of these approaches is generally adequate for screening purposes:

[14] U.S. EPA. (August 4, 2017). "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." https://www3.epa.gov/ttn/scram/guidance/clarification/20170804-Photochemical_Grid_Model_Clarification_Memo.pdf

1) Model each source individually; sum the maximum modeled concentrations (as though occurring at the same receptor); and compare to the applicable standard; or
2) Model combined emissions from a single source closest to the fence line using the worst-case stack flow parameters of the group[15]. One method for merged parameters is described in EPA guidance on screening procedures[16].

Consult your DO/LAA to discuss alternative approaches, if necessary.

Question 6. When is a Class I Modeling Analysis required?

Protection of Class I areas is the responsibility of FLMs, including permit application reviews for adverse impacts on AQRVs[17]. The FLAG report[18] provides guidance on evaluating air pollution effects on public AQRVs in Class I areas and recommends applicants apply a Quantity over Distance (Q/D) test for sources located greater than 50 km from a Class I area, where Q/D ≤ 10 is an appropriate *de minimis* level to screen out of Class I modeling analysis.

Quantity over Distance test:

$$\frac{\text{Q}\ [SO_2 + NO_x + PM_{10} + H_2SO_4]\ (\text{tons per year})}{\text{D(km)}} \leq 10$$

Q (tons per year) = combined annual emissions of SO_2, NO_x, PM_{10}, and H_2SO_4 based on 24-hour maximum allowable emissions. Annual equivalents should be calculated for sources that do not operate year-round by dividing permitted total tons per year (for each pollutant) by hours of operation and multiplying the result by 8760.

D (km) = nearest distance to a Class I area boundary from the source.

Ohio EPA does not generally require Class I screening or analysis for facilities located further than 300 km from a Class I area and accepts the Q/D screening test for all facilities located more than 50 km from a Class I area boundary. If a Class I Modeling Analysis is required, it should be in consultation with Ohio EPA and the appropriate FLM and included in a modeling protocol. Approximate distances from several Ohio cities to regional Class I areas is provided in the table on the following page. The table on the following page shows Class I SILs, which Ohio EPA applies to determine significant impact.

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[15] Sometimes determination of worst-case is straightforward (e.g., shortest, coldest, lowest flow stack). When it is not clear, consult your DO/LAA.

[16] U.S. EPA. (1992). Screening procedures for estimating air quality impact of stationary sources, revised. EPA 454/R-92-019. https://www3.epa.gov/scram001/guidance/guide/EPA-454R-92-019_OCR.pdf

[17] AQRVs are defined as a resource, as identified by the FLM for one or more Federal areas, that may be adversely affected by a change in air quality.

[18] Federal Land Managers' Air Quality Related Values Work Group (FLAG). (October 2010). *Phase I Report – Revised*. Natural Resource Report NPS/NRPC/NRR–2010/232.

Distances from Ohio cities to nearby Class I Areas (km)

	Mammoth Cave	Dolly Sods/ Otter Creek	Great Smokey Mountains	Seney National Wildlife Refuge
Akron	560	250	590	650
Canton	550	230	570	690
Cincinnati	230	400	370	780
Cleveland	580	300	630	620
Columbus	380	280	440	700
Dayton	310	380	430	700
Portsmouth	310	270	320	850
Steubenville	570	160	550	770
Toledo	520	430	630	520
Youngstown	620	230	620	700

Question 7. How do I demonstrate net air quality improvement in nonattainment areas?

Proposed construction of major stationary sources or modifications in a nonattainment area must comply with OAC 3745-31-25 regarding atmosphere dispersion modeling demonstrations to ensure emissions offsets provide a net air quality benefit. In accordance with OAC 3745-31-22, modeling for net air quality benefits is not required for VOC or NO_x emissions in an ozone nonattainment area.

Because nonattainment areas have undergone SIP modeling in the attainment demonstration, Ohio EPA has identified key receptors susceptible to NAAQS violations; these receptors must be included in all nonattainment area NSR projects even if they are outside of the SIA[19]. Where potential offsets could impact these key receptors, modeling must show impact at those locations would be less than or equal to zero. For remaining receptors within the SIA, modeling must show no net increase for each averaging period. If modeling demonstrates area-wide receptors with a net increase, the applicant may present a complete NAAQS demonstration for the SIA of the project.

Source characterization

Question 8. What modeled emission rate(s) should be used for my facility?

Table 8-2 in the Guideline identifies emission rates of sources for demonstrating NAAQS compliance in a PSD assessment for inert pollutants.

To evaluate short-term standards (≤ 24 hours), model short-term allowable emission rates, if available. Otherwise, model short-term state and/or federally enforceable potential-to-emit emission rates. For state-only modeling, model peak short-term rates (for new sources) or increases (for modifications) that the permit allows. For air toxics[5] specifically, modeling shall be based on the maximum hourly rate of emissions from the source.

To evaluate long-term standards (quarterly or annual), use representative long-term actual emission rates for existing sources. Annual permit restrictions can be used to develop long-term average emission

[19] Question 9 has more information on determining the SIA.

rates for new or existing sources.

For a federal netting permit, results of the netting calculation are modeled for comparison to Ohio's GAIIs[9]; modeled emissions must be consistent with the permit's netting evaluation. For state-only netting modeling evaluations, the allowable-to-allowable difference is usually acceptable and must be included in a modeling protocol.

When a modification involves an emission increase only, the net change allowed by the permit is evaluated. The net change is the difference between existing emissions and new allowable emissions for PSD and other federal analyses. Existing emissions should be determined based on the most recent 24 months that are representative of normal source operation. For state-only review, the allowable-to-allowable difference is usually acceptable and must be included in a modeling protocol.

If all parameters are unchanged such that no increase in impact would be realized from the permit action, it is considered a like-kind replacement and does not require modeling. Replacements involving changes that may increase peak impact, such as a shorter stack or lower temperature, require modeling. Where a modification of stack parameters may increase the source's ambient impact, permit allowable emissions are modeled to determine if the impact of the modification is below Ohio's GAIIs. If the replacement when viewed alone exceeds Ohio's GAIIs, the source being replaced can be evaluated in a refined model using negative emission rates[20] to determine net peak impact; this netting analysis would be compared to Ohio's GAII.

Question 9. What other sources do I include in major source PSD and NAAQS analyses?

When an air quality analysis has determined a new or modifying source has the potential to cause or contribute to a violation of a NAAQS or PSD increment, it must proceed to a cumulative impact analysis. When reviewing a single-source analysis with sufficient meteorological coverage[21], Ohio EPA considers any modeled highest 1st high concentration that exceeds its respective SIL, identified in Table 3, as an indication of potential significant ambient impact. The modeling domain includes all locations where the initial demonstration determines emissions may cause a significant ambient impact. This impact area is the area with radius extending from the new or modifying source to:

1) the most distant location where modeling predicted a significant ambient impact will occur, or
2) 50 km,

whichever is *less*.

Section 8.3.3 of the Guideline discusses the identification and characterization of nearby sources that are not adequately captured in background ambient monitoring. The Guideline is not prescriptive with respect to selecting sources to include in a cumulative NAAQS impact analysis and places emphasis on the judgement of the permitting authority in the determination of a final cumulative source inventory. Therefore, the determination of a final inventory of offsite sources will be conducted during the modeling protocol phase of a project, in consultation with Ohio EPA.

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[20] Modeling of negative emission rates for NO_2 is not recommended since the multi-tiered approach is considered a screening method. Question 24 addresses NO_x modeling.

[21] Refer to Question 11 for meteorological coverage requirements.

Although the NAAQS modeling inventory will be compiled on a case-by-case basis, the following guidelines should be adhered to:

1) All sources within the SIA having potential-to-emit greater than PSD significant emission rates, identified in Table 3, must be included in the NSR NAAQS analysis.
2) All major sources within 20 km of the new source with potentials-to-emit greater than 100 tons per year should initially be considered for inclusion in the modeling inventory. Sources within 20 km of the new source can be excluded if it can be demonstrated that a source or group of sources is represented by background concentrations.
3) Major sources with potentials-to-emit greater than 100 tons per year located beyond 20 km and within 50 km of the new source should initially be considered for inclusion in the modeling inventory. These more-distant sources may be screened out if their facility-wide actual emission rate in tons per year is less than 20D, where D is the distance in kilometers between the source project and the potentially interacting source. Additional sources may be screened out if it can be demonstrated that a source or group of sources is adequately represented by background.

All PSD sources located within the SIA or an area where a PSD baseline has been triggered, whichever is *larger*, must be included in PSD increment analyses. PSD sources located outside of this area that are within 50 km and interact with the new source must also be included but may be screened out using the 20D approach.

Ohio EPA must be advised on what sources were screened and excluded and reasoning for the exclusion. Any or all of these sources may be required by Ohio EPA for inclusion based on professional judgement.

Inventory data for modeling nearby sources should be obtained from the state EIS or the national AIRS, which contain basic modeling source parameters, *e.g.*, release height, stack diameter, exit temperature, exit velocity, emission rate, etc[22]. Ohio EPA's EIS has placed several data sets on their website[23]. While later data sets have significant amounts of current information, it is important to check the 1990 and 1995 data, which contain information on short-term allowable emission rates and capacities. These are important for determining maximum short-term allowable emission rates for the significant sources consistent with Section 9.1 of the Guideline. If source information is missing or suspect, contact your DO/LAA for consultation and corrections. The most recent emissions inventory should be used in the modeling analysis.

Model inputs

Question 10. If a source emits more than one pollutant, is it necessary to model each one separately?

Gaussian models such as AERMOD, AERSCREEN, and SCREEN3 are linear with respect to emission rates. As such, results from a single run may be adjusted for each pollutant when emission characteristics are equivalent for each pollutant. Ohio EPA suggests an approach of modeling sources with an emission

[22] In Ohio, reported emissions in these inventories meet criteria in Table 8-2 of the Guideline for emissions limits with the exception of facilities that that use continuous emissions monitoring for inventory reporting purposes. For these facilities, Ohio EPA will assist in developing emission rates for modeling purposes in PSD and NAAQS analyses.

[23] Ohio EPA DAPC. Emission Inventory System (EIS). http://epa.ohio.gov/dapc/aqmp/eiu/eis.aspx

rate of one gram per second; results may be scaled by the rates (in grams per second) that would be modeled for each pollutant. If emission characteristics vary for different pollutants, or the pollutants do not vary proportionately from each egress point, then a separate modeling analysis for each pollutant is necessary.

Question 11. What meteorological input is required or recommended for dispersion modeling?

Meteorological input data for dispersion models may come from observations from a nearby NWS station, a comparable station, or site-specific monitors; or they may be processed from prognostic data. AERMET must be used to preprocess the data for input into AERMOD. When processing prognostic meteorological data for AERMOD, the MMIF program should be used to process data for input to AERMET. In most cases, AERMINUTE should be used to process the data for input into AERMET.

Ohio EPA maintains recent five-year NWS data sets preprocessed in AERMET with local surface characteristics and upper air data to generate the surface (.sfc) and profile (.pfl) input files for AERMOD[11]. In most cases, these files are the default option for dispersion modeling. Refer to Table 1 of this guidance for county-specific data sets.

Site-specific data may be an alternative when it is available or when NWS data is determined not representative. Five-years of NWS data is acceptable for screening purposes in such cases, *e.g.*, for complex wind environments. At least one year of site-specific data is required when used in refined modeling and should occur in consultation with Ohio EPA.

When neither representative NWS nor comparable meteorological station data are available, and Ohio EPA finds it prohibitive or infeasible to collect representative site-specific data, three years of prognostic meteorological data may be evaluated for representativeness in consultation with Ohio EPA.

When using standard NWS data, site-specific data *without* turbulence parameters, or prognostic data, the ADJ_U* option in AERMET is a regulatory default option. The preprocessed NWS data sets[11] maintained by Ohio EPA are available with and without this option.

Ohio EPA accepts NWS data for all state-only modeling; evaluating representativeness for other regulatory applications is more prescribed. It is important when preparing to model, especially for major PSD or nonattainment sources, that a protocol is developed and approved to ensure representativeness and acceptability.

Question 12. What receptor grids should I use?

Receptor grids specify coordinates where a model estimates downwind concentrations in ambient air, where ambient air means that portion of the atmosphere, external to buildings, to which the general public has access.

Receptor grids must be sufficiently dense to identify maximum ambient impacts. Receptor density should be higher in areas of special concern, *e.g.*, areas of source interactions or significant terrain features. For most applications, receptor intervals should be no greater than 50 meters at fence lines and “hotspots” as determined from preliminary modeling results.

In general, receptors are not required within a secured property line, defined as a boundary that prevents general public access to property owned by a facility. Facilities without a distinct fence line or other secured boundary may apply a 25-meter buffer between receptors and structures with stacks. Receptors should extend from property boundaries to a distance sufficient to assure inclusion of maximum concentrations and coverage of the impact area[24].

Regulatory default for both AERMOD and AERSCREEN require terrain elevation data, which is necessary for determining receptor elevations. Receptor elevations are required in modeling, and any exception to the default option would be made on a case-by-case basis in consultation with Ohio EPA. The AERMOD Implementation Guide[25] discusses case examples where the default option may not be suitable.

AERMOD receptor grids must be exclusively developed using the AERMAP terrain preprocessor. While AERMAP can process both DEM and NED data, NED data is preferred because it is actively updated and quality-assured. NED files for source and receptor locations, elevations, and height scales can be downloaded at the USGS website[26] with selection of a maximum one arc second (30-meter resolution) data set. In some circumstances, a 1/3 arc second (10-meter resolution) data set may be necessary and would be determined in consultation with Ohio EPA or through a modeling protocol development.

Question 13. Which averaging times should I use?

Modeled averaging times should be consistent with the standard. Users may select averaging times for calculation in AERMOD and AERSCREEN. If using Screen3 for state-only modeling, conversion factors[27] should be applied to output for averaging times other than 1-hour. Table 3 in this guidance is organized according to standards and averaging times relative.

Question 14. Is building downwash required for state-only modeling?

Yes, stack source files must include building dimension data, and the 'include downwash' option must be selected in model execution for both screening and refined models. GEP stack height is measured from ground-level elevation at the base of the stack and is determined by evaluating all nearby structures using the following formula:

GEP stack height = H + 1.5L, where
H = height of nearby structure measured from ground-level elevation at stack base, and
L = lesser dimension of height or projected width of nearby structure.

A structure is considered "nearby" if it is within five times the lesser dimension of its height or projected width. GEP stack height is taken as the greatest height calculated from all nearby structures.

AERMOD accepts direction-specific building dimension inputs for 36 ten-degree wind sectors to evaluate

[24] A project's impact area includes the most distant location where air quality modeling predicts a significant ambient impact will occur or a distance out to 50 km, whichever is lesser. More information on significant impact areas is found in Question 9.

[25] US EPA. (December 2016). *AERMOD Implementation Guide*. EPA-454/B-16-013.

[26] USGS. *The National Map*. https://nationalmap.gov/elevation.html

[27] SCREEN3 conversion factors discussed in Question 2 of this guidance.

effects of structures for varying wind directions and determine GEP stack height. While facility plot plans may be referenced for manually determining dominant structures for each sector for each stack, US EPA has developed a PC-based preprocessing tool[28] that will produce AERMOD ready inputs for point source emissions. If direction-specific building dimensions are not calculated, the most conservative dimensions should be used for all directions, which are usually associated with height and diagonal width of the tallest nearby structure.

Building dimensions are not contained in state or federal emissions databases and must be obtained from facility personnel when sources at that facility are subject to building downwash. Distant background sources may be modeled without downwash with Ohio EPA approval since this generally maximizes those sources' impact in the study area and would, therefore, be conservative.

Question 15. How do I determine whether to apply urban or rural dispersion coefficients?

Dispersion coefficients are determined by analyzing land use or population within the total area, A_0, of a circle with radius 3 km from the source, as outlined in Section 7.2.1.1 of the Guideline. A summary of the methods is provided in the table on the following page.

Of the two methods, Ohio EPA prefers the land use approach and cautions use of the population density approach without prior discussion. The population density approach should generally not be applied in highly industrialized areas with low population density, where the area is built-up sufficiently to warrant an urban dispersion coefficient. Analyses of whole urban complexes should be modeled with an urban dispersion coefficient if most sources are located in urban classifications for consistency with regional urban heat island effects.

Sources located within an urban area near a large body of water may warrant a rural dispersion coefficient, though not always. Similarly, plume heights from tall stacks in or near small urban areas may extend above the urban boundary layer such that a rural coefficient would be appropriate. Ohio EPA will review such scenarios case-by-case.

Many counties in Ohio have had SIP development modeling performed that included sources across the region. When performing modeling over a wide area as part of a PSD or NAAQS analysis, consult the Central Office to ensure a consistent approach to historic classifications.

[28] US EPA. (2004). Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME). https://www3.epa.gov/ttn/scram/dispersion_related.htm#bpipprm

1) If applying the **land use method**, classify land use within A_0 using the Auer land scheme[29]; if the total land use of types I1, I2, C1, R2, and R3 (summarized in table below) account for at least 50% of A_0, an urban coefficient is appropriate.

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

2) If applying the **population density method**, compute the average population density, $\bar{p}$, per square kilometer within A_0; if $\bar{p}$ is at least 750 people per square kilometer, an urban coefficient is appropriate.

Question 16. How do I obtain background values for NAAQS cumulative impact analyses in Ohio?

When conducting NAAQS cumulative impact analyses, background concentrations account for natural sources, unidentified sources, and regional transport contributions from distant sources, all of which are not practicable to include in a modeling analysis. Ambient contributions from these sources are accounted for through addition of monitoring data to modeling results. Section 8.3 in the Guideline covers background concentrations in more detail.

Each NAAQS pollutant and averaging time requires a separate background value. Actual monitored data from a representative monitoring site(s) for the most recent year is the starting point for acceptable background values. For completeness without double-counting, the monitor should not be impacted by modeled major sources or minor local sources.

When an un-impacted monitor is available, the annual average is representative for annual background values, and the second highest value for each averaging time is representative for short-term values. For lead, a three-month rolling average is representative.

When an un-impacted monitor is not available, values from impacted monitors with un-impacted sectors, *i.e.*, sectors with no upwind sources, can be used to develop background values. Monitored values measured inside a 90-degree sector upwind from potentially impacting source(s) would represent an un-impacted sector. For 24-hour averaging times, no more than two hours should have winds from

[29] Auer, Jr., A. H. (1978). Correlation of land use and cover with meteorological anomalies. Journal of applied meteorology. 17(5): 636-645.

the impacting sectors to be considered an un-impacted sector; for 3-hour averaging times, no winds should be from the impacting sectors. The second highest un-impacted value would be representative for short-term backgrounds, and the average of the un-impacted values would be representative for long-term backgrounds. Unadjusted impacted monitor values are sufficient for a conservative background.

Contact Ohio EPA for a representative background for your project. Background values must be approved in a project's modeling protocol; alternative values[30] may be proposed for approval.

Thresholds and limits

Question 17. What are Ohio significant emission rates which trigger modeling?

Allowable emissions increases are compared to Ohio EPA significant emission rates, defined in rule OAC 3745-31-01(VVVVV)(1). Table 3 in this guidance has been constructed to provide a comprehensive list of emission rates that trigger state and federal modeling requirements.

Question 18. Can a modification trigger a modeling requirement without an emission rate increase?

Provisions for OAC 3745-31-01(SSS)(1)(b) were promulgated to ensure ambient air quality standards are protected. Concentrations in this rule are trigger concentrations, not maximum allowable impacts. When there is a physical change in or a change in the method of operation of a significant contaminant source project that would not otherwise require a PTI or PTIO, any modification[31], which would result in an incremental impact exceeding any concentration threshold at any receptor, would require a PTI, regardless of whether the change results in a change in total emissions.

If one or more of the increments in OAC 3745-31-01(SSS)(1)(b) are exceeded, further modeling may be required to ensure the modification does not cause or contribute to violations of ambient air quality standards or allowable increments pursuant to Ohio's permitting regulations, and BAT is not required. This provision is not required under federal regulation and has not been submitted to U.S. EPA for approval as part of the SIP.

For example, a scrubber proposed for installation at a coal-fired boiler may not result in any actual or allowable emissions increase of NO_x, but a resulting reduction in stack temperature and velocity may cause an increase of ambient concentration at a receptor. If this increase in concentration equals or exceeds the concentration in the rule, a PTI would be required before beginning construction. Stack height reductions are also subject to such scenarios. A screening or refined model may be used; the determining factor will be the maximum concentration increase anywhere on the receptor grid for the corresponding contaminant and averaging period.

[30] Ohio EPA recommends following U.S. EPA's March 1, 2011 memo: Additional clarification regarding application of Appendix W modeling guidance for the 1-hour NO2 ambient air quality standards.

[31] as defined in rule OAC 3745-31-01(SSS)

Question 19. What are Ohio's GAIIs?

Ohio's GAIIs reflect Ohio EPA's policy on air toxics[5] and policy to apply a limitation of one-half the PSD increment for new sources and modifications, as defined in OAC 3745-31-11. For criteria pollutants that do not have identified PSD increments, Ohio's GAIIs are one quarter of the NAAQS. Table 3 in this guidance provides a comprehensive list of federal and state standards, rates, increments and Ohio's GAIIs. Ohio EPA reserves the right to request modeling that falls below Ohio modeling SERs if the Director expresses concern that project emissions may cause or contribute to an exceedance.

Question 20. What if modeling estimates consumption of more than one-half of the PSD increment?

It is Ohio EPA's policy to apply a limitation of one-half of the PSD increment for new sources and modifications. The intent of Ohio EPA's policy is to encourage future growth by preventing any single emissions increase from exclusively consuming ½ of the increment. Non-PSD sources consume increment and increase background concentrations and could threaten future growth. As such, it is Ohio EPA's practice that any new source or modification, PSD or otherwise, will not consume more than one-half of the PSD increment. For criteria pollutants that do not have identified PSD increments, Ohio's GAIIs are one quarter of the NAAQS. These are general guidelines.

Ohio EPA may grant exceptions to this policy on a case-by-case basis when modeling predicts exceedances of one-half but less than 83 percent of the increment, provided public health will not be adversely affected. The following are examples of where exceptions may be granted:

1) The exceedance occurs in a localized area near the source, and it is unlikely future nearby sources will significantly impact the same area, such as may occur with a fugitive source having low release points and proximal maximum impact areas that Ohio EPA judges would not be affected by other facilities;
2) A source is located where Ohio EPA judges other major sources would not be likely to locate, such as a remote rural area;
3) A source is temporary, and the increment consumed will become available in the near future, such as a clean-up site slated to operate for a year or two; or
4) A source is locating in a "brownfield" area that would otherwise locate in a greenfield site.

Question 21. Do I include minor or exempt sources for a project exceeding SER thresholds?

All sources or units contained in permits that make up a project are initially considered significant with respect to the potential impact due to the project. Many small sources, while individually insignificant, could combine to cause or contribute to an ambient problem. Smaller sources can be removed from the modeling analysis if it can be demonstrated that their emissions are insignificant relative to the rest of the project. Sources not included in the modeling must be agreed upon in a modeling protocol before they can be eliminated from the modeling.

Question 22. Are there exceptions to modeling thresholds?

There are several source emissions scenarios which Ohio EPA has historically not reviewed for state-only modeling. These scenarios generally involve fugitive emissions from parking lots, roadways, material handling and storage piles. These scenarios usually represent situations where modeling results often indicate potential problems due to unreliable emission factors and/or unusual or extreme source configurations. Field experience with these sources, though, indicates that normal operating practices and compliance with required controls result in acceptable ambient impacts as demonstrated by ambient monitoring, field measurements of visible emissions, or a lack of verified complaints by local citizens.

In accordance with division (F)(4)(f) of ORC section 3704.03, which specifies source type exemptions from air toxics[5] modeling, the following sources/pollutants are not required in state-only air quality modeling[32] unless factors such as source size, tons of emissions, particle size, pre-existing concerns or proximity to other sources or citizen populations indicate that a modeling review is warranted[33]: parking lots; storage piles; storage tanks; transfer operations; grain silos; grain dryers; emergency generators; gasoline dispensing operations; sources emitting air contaminants solely from the combustion of fossil fuels; or emissions[32] of wood dust, sand, glass dust, coal dust, silica, and grain dust.

Pursuant to division (F)(4)(e) of ORC section 3704.03, air toxics modeling for permitting purposes does not apply to sources subject to a MACT or residual risk standard under section 112 of the CAA or to air contaminants identified in 40 CFR 51.166, division (b)(23) where BACT or LAER has been required that would restrict the amount of that pollutant that could be released. In order to sufficiently protect public health or environment from the emission of highly toxic compounds, the Director may use other methods to complete the toxic impact evaluation on a case-by-case basis.

Pollutant-specific

Question 23. How do I estimate impact from secondary pollutants: ozone and $PM_{2.5}$?

Whereas AERMOD does not account for chemical coupling, pollutant transformations, and atmospheric chemistry, there is no preferred modeling system or technique in the Guideline for estimating impact of ozone or secondary $PM_{2.5}$ formation. Table 3 in this guidance provides SERs for pollutants critical to formation of ozone (VOC, NO_x) and $PM_{2.5}$ (SO_2, NO_x). A demonstration is necessary when any of these pollutants exceed the respective SERs. U.S. EPA recommends a two-tiered approach to demonstrations, where most applicants should receive a determination based on the first tier.

Because impact depends on the nature of the source, its emissions and background environment, evaluating a source's significance based on technical information in combination with other supportive information and analysis as a first-tier analysis may be a sufficient demonstration. U.S. EPA has prepared

[32] It is Ohio EPA's policy to also exempt these sources/pollutants from state-only modeling of criteria pollutants, except that emissions of wood dust, sand, glass dust, coal dust, silica, and grain dust should be included for PM modeling.

[33] Division (F)(4)(f)(ii) of section 3704.03 of Ohio Revised Code enables the director's request of additional information from a source for the purposes of air toxic contaminant modeling if there is reason to believe the source will potentially cause an increase in ground level concentration exceeding the MAGLC beyond the facility's boundary.

draft guidance[34] on one approach to a tier 1 analysis, which should yield credible and appropriate relationships between emissions and impacts developed from previous modeling. Table 3 provides Class II SILs, which Ohio EPA applies to determine significant impact. Ohio EPA will make a determination of sufficiency and will consult with the owner/operator regarding additional analyses, if necessary.

U.S. EPA has provided guidance[35] on chemical transport modeling for use in tier 2 analyses. The methods presented are significantly more resource-intensive than methods under tier 1 analyses. Current U.S. EPA guidance indicates that photochemical grid modeling will only be required for the largest sources. Do not initiate this type of analysis without consulting air modeling staff at DAPC.

Specific to $PM_{2.5}$, direct emissions may be evaluated using standard approaches, e.g. AERSCREEN and AERMOD, and impacts should be combined with secondary contributions for a complete demonstration. Combinatory analysis will depend on whether an analysis for secondarily formed $PM_{2.5}$ is required and what methods are used in the analysis.

Question 24. Are there special modeling requirements for NO_2?

Because NO co-emitted with NO_2 may react with ambient ozone to increase NO_2 concentrations downwind, a multi-tiered approach is used to address the chemical environment of the plume. The approach is considered a screening technique where each tier increases in complexity and, therefore, data input requirements while decreasing in conservatism.

The Guideline has incorporated a three-tiered screening approach for both annual and 1-hour averaging times for NO_2 as follows, using AERMOD or another appropriate refined model:

Tier 1: Assume total conversion of NO to NO_2.

Tier 2: Multiply Tier 1 results by the appropriate ambient ratio. ARM2 is now a default regulatory option in AERMOD for this purpose, which uses a national minimum ambient NO_2/NO_x ratio of 0.5 and a maximum of 0.9. Use of an alternative minimum ratio must be in consultation with Ohio EPA.

Tier 3: Either method, OLM or PVMRM, may be used on a case-by-case basis. Both methods require specification of an ISR of NO_2/NO_x[36]. The Guideline notes that PVMRM works best for relatively isolated sources, and OLM works best for groups of sources. While this tier no longer requires approval as an alternative model, its application must occur in consultation with both Ohio EPA and the U.S. EPA Regional Office.

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[34] U.S. EPA. (2016). DRAFT Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and PM2.5 under the PSD permitting Program. EPA-454/R-16-006.

[35] U.S. EPA. (2016). Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: Ozone and $PM_{2.5}$. EPA-454/R-16-005.

[36] An ISR database and details on its use can be found here: https://www3.epa.gov/scram001/no2_isr_database.htm

Because this is a screening approach, additional scrutiny is required if proposing negative emission rates in NO_2 modeling and so must occur in consultation with Ohio EPA. Additional information can be found in a technical support document[37] and clarification memoranda[38,39,40] from U.S. EPA.

Question 25. Do I need to model Greenhouse Gases?

Ohio EPA does not conduct reviews of modeling for Greenhouse Gases.

Air toxics

Question 26. Do I need to model air toxics sources?

Ohio EPA regulates toxic air contaminants under OAC 3745-114. DAPC has an engineering guide[5] to address common questions associated with air toxic analysis. All air toxics emissions exceeding significant emission rates identified in Table 3 must be modeled. There are exemptions described in Question 22 in this guide and the air toxic analysis Engineering Guide 70[5]. Some compounds are considered “highly toxic” and may require modeling at rates less than that identified in Table 3. For more information on this, please see Engineering Guide 70 and its supporting documentation[41].

When modeling is required, the modeled rate is the maximum hourly emission rate. Maximum modeled concentrations are screened against the MAGLC for each pollutant, which is calculated according to procedures in “Option A – Review of New Sources of Air Toxic Emissions,” available in DAPC Engineering Guide 70[5]. The Director may use discretion to accept alternative values in calculating the MAGLC for some pollutants. Alternative values for formaldehyde emissions and further guidance on alternative values are provided in Engineering Guide 70.

Most routine releases will have similar density to air from dilution; nonetheless, screening evaluations of sources emitting 'light' or 'heavy' plumes may use a toxic release model that includes algorithms for density, such as TSCREEN[42,43].

Question 27. Should air toxics sources be modeled if there is no Time Weighted Average?

Yes, pollutants without a listed TWA are addressed by multiplying the Ceiling Limit Value by 0.737 and following procedures in “Option A - Review of New Sources of Air Toxic Emissions,” available in DAPC Engineering Guide 70[5], to develop a MAGLC.

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[37] U.S. EPA. (July 2015). Technical support document (TSD) for NO2-related AERMOD modifications. EPA-454/B-15-004

[38] U.S. EPA. (June 28, 2010). Applicability of Appendix W modeling guidance for the 1-hour NO2 National Ambient Air Quality Standard.

[39] U.S. EPA. (March 11, 2011). Additional clarification regarding application of Appendix W modeling guidance for the NO2 1-hour National Ambient Air Quality Standard.

[40] U.S. EPA. (September 30, 2014). Clarification on the use of AERMOD dispersion modeling for demonstrating compliance with the NO2 National Ambient Air Quality Standard.

[41] Engineering Guide 70 identifies "compounds… in the ACGIH handbook with A1 or A2 classification" as compounds generally considered highly toxic. The most recent version of this handbook (as of this revision) is cited as follows:
ACGIH. (March 20, 2018). 2018 TLVs and BEIs Based on the Documentation of the Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposure Indices. Cincinnati, OH: Signature Publications.

[42] U.S. EPA. (July 1994). User’s guide to TSCREEN: A model for screening toxic air pollutant concentrations (Revised). EPA-454/B94-023.

[43] U.S. EPA (December 1992). Workbook of screening techniques for assessing impacts of toxic air pollutants (Revised). EPA-454/R-92-024.

Question 28. What special requirements exist for sources of fluoride?

Because atmospheric deposition of fluoride may lead to damage of plants and property at concentrations less than the MAGLC, Ohio EPA has established a secondary target of 0.5 μg/m^3 with a 30-day averaging time. This secondary target was developed based on a literature review and an evaluation of other states with fluoride modeling requirements. A list of this literature is compiled in footnotes below[44-48]. Monthly averaging times can be computed directly in AERMOD. While AERSCREEN computes a suite of averaging times, it does not offer an option for monthly. Monthly averaging times from AERSCREEN are derived by applying a conversion factor of 0.18 to the maximum 1-hour concentration modeled. Use the same approach to convert SCREEN3 (state-only) results.

Nonstandard sources

Question 29. Is there any special guidance for nonstandard point source emissions?

Nonstandard source emissions are not specifically addressed in screening or refined models. For example, if emissions do not exit the stack in an upward (vertical) direction, alternative characterizations of the source should be developed to more accurately represent the release point. If the temperature of the release is near ambient, a characterization as an area or volume source might be appropriate. If temperature is significant, a virtual stack might be created to represent the emission point. Alternative characterizations should be discussed with Ohio EPA prior to modeling.

Question 30. Are fugitive emissions modeled?

Major new source PSD and nonattainment area NSR require modeling of all significant sources, including fugitive sources such as storage piles and roadways. U.S. EPA's guidance on haul roads[49] may be helpful for modeling haul road fugitive emissions.

Minor source permits require modeling of boiler or process source criteria and emissions increases (both controlled and fugitive) of air toxics[50]. It is not required to model non-process fugitive sources such as roadways, parking lots, or material storage and transfer operations for state-only modeling. Grinding, crushing, mixing, and screening operations are considered processes and should be modeled. An evaluation of all project emissions may be required in a state analysis if circumstances warrant.

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[44] World Health Organization (WHO). 2002. Fluorides. Environmental Health Criteria 227. WHO, Geneva.

[45] Canadian Environmental Protection Act (CEPA) Report. 1996. National Ambient Air Quality Objectives for Hydrogen Fluoride (HF). 1. Science Assessment Document for HF. Federal-Provincial Working Group on Air Quality Objectives and Guidelines. En42-17/6-1997E. Ottawa, Canada.

[46] Dyson Rose & John R. Marier. 1977. Environmental Fluoride National Research Council, Canada

[47] Texas Commission on Environmental Quality (TCEQ). 2006. Guidelines to develop effects screening levels, reference values, and unit risk factors. Chief Engineer's Office. RG-442.

[48] Texas Commission on Environmental Quality (TCEQ). 2015. Approaches to derive odor-based values. Texas Commission on Environmental Quality. Office of the Executive Director, Austin, TX.

[49] U.S. EPA. (2012). Haul Road Workgroup Final Report. www3.epa.gov/scram001/reports/Haul_Road_Workgroup-Final_Report_Package-20120302.pdf

[50] More information on these exemptions is found in the Air toxics of this guide.

Question 31. How do I model rain caps and horizontal releases?

Regulatory modeling of horizontal releases and rain caps has followed procedures based on a U.S. EPA MCH Memorandum dated July 9, 1993. Methods built on this approach were available as BETA options in AERMOD, requiring MCH approval. Beginning with version 16216, AERMOD now has regulatory options for modeling capped and horizontal stacks, using the POINTCAP and POINTHOR source types, respectively, with input of actual stack conditions. The options have been adjusted to account for the PRIME algorithm for sources subject to building downwash in concurrence with U.S. EPA Guideline on Air Quality Models[51].

Question 32. How do I account for a building with a pitched roof or multiple tiers?

Pitched roofs present a nonstandard modeling scenario where horizontal dimensions are reduced to a line at the roof peak. There are two approaches to modeling a pitched roof as a 3-dimensional structure using standard modeling techniques:

1) Assume horizontal dimensions are covered by a flat roof where the footprint of the building is unchanged but the height is adjusted to the height of the peak; or
2) assume a building height at an elevation that is at one half the height of the pitched roof where the building width is modified to correspond with the dimension of the roof at that height.

Buildings with multiple tiers can be viewed as independent, stacked structures as long as heights used are identical to building height at the location of that tier. For example, a flat-roofed building with a single tower may be represented as a single flat-roofed structure with tower stacked on top with base elevation that is the height of the flat structure.

Question 33. How do I model flares?

Flares are nonstandard point sources characterized by significant radiative heat loss that reduces heat available for plume rise. In addition to this heat loss, entrainment of excess air increases the volume of gas and lowers its temperature. As a result, combusted gas temperature at the tip of a visible flame falls around 1200 to 1800 ^{o}F. Thus, a flare may be modeled as a point source where plume rise is calculated from flame tip rather than actual stack exit height using an effective stack exit diameter calculated from Briggs' equations for bent-over, hot buoyant plumes[52]. This is the method employed with the flare option in both AERSCREEN and SCREEN3 (for state-only modeling), which are acceptable for screening purposes. For refined modeling, users may apply this method by following some simple calculations based on stack parameters and assumptions provided below.

AERSCREEN (and SCREEN3)
Users are prompted to input the following (metric only in SCREEN3):

1) Actual emission rate (lb/h or g/s)
2) Actual flare stack height (feet or meters)

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[51] US EPA. (Jan. 17, 2017). Revisions to the Guideline on Air Quality Models: Enhancements to the AERMOD Dispersion Modeling System and Incorporation of Approaches To Address Ozone and Fine Particulate Matter. 82 F.R. 5182.

[52] Beychok, M. R. (1994). Fundamentals of stack gas dispersion, 3rd edition. ISBN 0-9644588-0-2. Irvine, CA.

3) Total heat release rate (cal/sec)

The total heat release rate is calculated by multiplying the heating value of the flare gas by the actual gas flow rate. Both tools default to a radiative heat loss fraction[53,54] of 0.55, which reduces the total heat release rate to a sensible heat content remaining for plume buoyancy. Though AERSCREEN allows a user-defined input for the heat loss fraction, use of other values should be in consultation with Ohio EPA. Other parameters, *i.e.*, stack exit temperature and velocity, ambient temperature, are defaulted in the model to determine effective stack height and diameter for calculating ground level concentrations at receptor sites. Details about the calculation and default parameters the tools employ can be found below in the refined modeling section.

AERMOD (or other refined modeling tool)

No flare option is available in AERMOD, but a flare may be modeled as a point source, which requires input for stack height, diameter, temperature, and exit velocity. For flares, temperature is assumed 1273 K, and velocity is assumed 20 m/s. An effective diameter and height must be calculated employing these and other assumptions, described in this section. The Briggs equations for bent-over, hot buoyant plumes[52] derives a "buoyancy flux parameter" written in the following equivalent forms:

$$F_b = \frac{g v_s d^2}{4}\left(\frac{T_s - T_a}{T_s}\right) = \frac{g Q_s}{\pi \rho_a c_{pa} T_a}$$

where

$F_b (m^4/s^3)$ = buoyancy flux parameter
$g\ (m/s^2)$ = gravitational acceleration
$v_s (m/s)$ = stack exit velocity
$d\ (m)$ = stack exit diameter
$T_s (K)$ = stack exit temperature
$T_a (K)$ = ambient air temperature
$\rho_a (g/m^3)$ = ambient air density
$c_{pa} \left({}^{cal}/_{g * K}\right)$ = specific heat of ambient air
$Q_s (cal/sec)$ = stack sensible heat emission

For flares, $Q_s = Q_t(1 - f_{hl})$, where f_{hl} is the radiative heat lost fraction[53,54] and Q_t is the total flared gas heat release rate calculated by multiplying the heating value of the flare gas by the actual gas flow rate. Ohio EPA recommends using a radiative heat loss fraction of 0.55 and requires justification for use of other values. The following values are given or assumed for flares:

$g\ (m/s^2) = 9.807$
$v_s (m/s) = 20$
$T_s (K) = 1273$

[53] Leahey, D.M. & Davies, M J.E. (1984). Observations of plume rise from sour gas flares. *Atmospheric Environment*. 18(5):917-922.

[54] Guigard, S.E., Kindzierski, W.B., and Harper, N. (2000). Heat radiation from flares. Report prepared for Science and Technology Branch, Alberta Environment. ISBN 0-7785-1188-X. Edmonton, Canada.

$$T_a(K) = 293$$
$$\rho_a(g/m^3) = 1205$$
$$c_{pa}\left({cal}/{g * K}\right) = 0.24$$

Solving the Briggs equation with the above inputs, we arrive at the following results depending on the unit of the heat release rate; the second form assumes $f_{hl} = 0.55$:

$F_b(m^4/s^3) = 3.68 * 10^{-5}Q_t = 1.66 * 10^{-5}Q_s$, for $Q(cal/s)$
$F_b(m^4/s^3) = 2.58 * 10^{-6}Q_t = 1.16 * 10^{-6}Q_s$, for $Q(Btu/h)$
$F_b(m^4/s^3) = 2.58Q_t = 1.16Q_s$, for $Q(MMBtu/h)$
$F_b(m^4/s^3) = 8.80Q_t = 3.96Q_s$, for $Q(MW)$

The Briggs equation can be solved for an effective diameter, d_{eff}, by substituting one of the above sets of values for the buoyancy flux parameter, F_b, in terms of heat release rate, Q:

$$d_{eff} = \sqrt{\frac{4}{gv_s}\left(\frac{T_s}{T_s - T_a}\right)F_b}$$

To determine an effective stack height for dispersion modeling, an empirical equation[52,55] is employed with an assumption of flame tilt at 45⁰ to calculate the height of the flame, h_f:

$h_f = (\sin 45^0) * 0.006{Q_t}^{0.478} = 0.0042{Q_t}^{0.478}$, for $Q(Btu/h)$; $h(ft)$

The effective stack height, h_s, is found by adding the flame length to actual stack height, h_s.

$$h_{eff} = h_s + h_f$$

Therefore, Ohio EPA recommends the following inputs for modeling a flare as a point source in AERMOD:

Exit velocity: $v_s(m/s) = 20$

Exit temperature: $T_s(K) = 1273$

Effective stack diameter (m), calculated (assuming heat loss fraction $f_{hl} = 0.55$ for Q_s):
$d_{eff}(m) = 9.88 * 10^{-4}Q_t = 6.63 * 10^{-4}Q_s$, for $Q(cal/s)$
$d_{eff}(m) = 2.61 * 10^{-4}Q_t = 1.75 * 10^{-4}Q_s$, for $Q(Btu/h)$
$d_{eff}(m) = 2.61 * 10^{-1}Q_t = 1.75 * 10^{-1}Q_s$, for $Q(MMBtu/h)$
$d_{eff}(m) = 4.83 * 10^{-1}Q_t = 3.24 * 10^{-1}Q_s$, for $Q(MW)$

Effective stack height (m), calculated:
$h_{eff} = h_s + 4.56 * 10^{-3}{Q_t}^{0.478}$, for $Q(cal/s)$
$h_{eff} = h_s + 1.28 * 10^{-3}{Q_t}^{0.478}$, for $Q(Btu/h)$
$h_{eff} = h_s + 9.45 * 10^{-1}{Q_t}^{0.478}$, for $Q(MMBtu/h)$
$h_{eff} = h_s + 1.70{Q_t}^{0.478}$, for $Q(MW)$

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[55] API standard 521. (1969). Pressure-relieving and depressuring systems. Note: units of Btu/h and feet are used in the empirical equation construction in this source. Inputs in this guide take into account conversions to meters and other heating values.

This method may not apply to every situation. Applicants may submit an alternative method with documentation for consideration in a modeling protocol. The references cited here may be helpful in such a case.

Question 34. How do I model combustion turbines?

Combustion turbines (CTs) operate variably at full loads or partial loads at steady-state or in start-up and shut-down modes. Stack temperatures, emission rates, and exit velocities will vary with operating scenarios and ambient conditions of temperature, pressure, and humidity. CTs should be evaluated to determine worst-case operating scenarios by screening impacts at multiple loads, *e.g.*, 50%, 75%, and 100% of design capacity, and sufficient meteorology for a range of ambient conditions[56]. Three approaches are described below for modeling CTs in a PSD application. (The same approaches can be followed for state-only modeling for meeting Ohio's GAII[9].)

Approach 1: Screen each scenario using AERSCREEN. The demonstration is considered complete if the maximum concentration for every variation is considered insignificant. Otherwise, carry forward the worst-case scenario, or scenarios when no single worst case is clear, throughout the analysis using AERMOD.

Approach 2: Model each scenario in AERMOD with the most recent complete year of meteorology to identify the worst-case scenario. Model this scenario, or scenarios when no single worst-case is clear, using AERMOD with five years of meteorology. If any impact is not considered insignificant, carry this case(s) forward throughout the analysis.

Approach 3: Construct a virtual worst-case scenario by combining the greatest emission rates with most impacting stack parameters from all scenarios and use this construction throughout the analysis using AERMOD.

Question 35. How do I model sources in a building without identified vents to the outside?

Sources can be located within an enclosure or building with no obvious control and/or vent moving the emissions to the outside. It must be assumed that all emissions coming from the device are either captured and controlled or escaping to ambient air. If they are not being captured and controlled where cleaned air is reintroduced to the work area, the emissions must be escaping the building, and the modeler must determine how the emissions are escaping the building or enclosure to ambient air. The emission rate leaving the building or enclosure is assumed the same as the emission rate from the source(s). Any credit for some portion of the emissions being retained in the building due to "building capture" must be supported and will be evaluated on a case-by-case basis.

Often emissions are removed by the building ventilation system. Sometimes, exchange with outdoor air occurs through open doors and windows. In any event, the modeler must identify the egress point(s) and characterize releases as a modeling release scenario – point, area, or volume. If best engineering judgment justifies assigning a fraction of the total emissions through specific egress points, these points

[56] Guideline Section 8.2.2(d) require establishing load or operating condition for point sources that causes maximum ground-level concentrations.

can be modeled with their assigned emission rates. When using a single source screening model, the modeled peaks are then added together[57]. The worst-case egress point must be assumed if it is unclear through which potential egress point the emissions are actually venting. If unclear which egress point is worst-case, each scenario should be modeled with highest results compared to the applicable standard.

Question 36. Do emissions from start-ups and shut-downs require modeling?

Whereas the Guideline requires consideration of changes in operating conditions that affect emissions, start-ups and shut-downs may require modeling if their emission rates are greater than steady-state rates or if operating conditions may cause higher ground-level concentrations. In such cases, consult with Ohio EPA for a case-by-case determination.

Question 37. Do I model intermittent sources?

Intermittent sources are emission units that operate for short periods of time for testing and maintenance purposes and are present at a facility for emergency situations or are otherwise random and unscheduled. Examples include emergency generators and fire pumps. Start-up and shut-down operations may be considered intermittent, depending on permit conditions. Although not strictly defined by operating hours, intermittent sources are typically permitted for 500 hours of operation or less annually to include routine testing, maintenance, and operation in emergencies or scenarios that meet criteria for intermittent designation. Sources with set operating schedules are not considered intermittent by Ohio EPA and must be included in modeling analyses.

A proposed emission unit consistent with intermittent operation must be evaluated against long-term standards in the dispersion modeling analysis. The unit may otherwise be considered for exclusion of the short-term standards: 1-hour NO_2, 1-hour SO2, and 24-hour $PM_{2.5}$. Exclusion from modeling analysis must be agreed upon in a modeling protocol.

Question 38. How do I model hot-mix asphalt plants?

New or modifying hot-mix asphalt plants seeking to utilize No. 4 fuel oil, No. 6 fuel oil, and/or on-spec used oil as a fuel source, and/or seeking to utilize slag aggregate as part of their raw material mix will be required to demonstrate via dispersion modeling that the 2010 1- SO_2 NAAQS is not threatened. DAPC staff have developed a three-step methodology for this demonstration, which can be found on the DAPC modeling website[58].

Submission to Ohio EPA

Question 39. When are modeling protocols required?

Modeling protocols are required for all Nonattainment NSR projects, PSD projects, and projects where non-default options are selected. Modeling protocols are not required for state-only modeling when all default options are selected, except for reasons stated elsewhere in this engineering guide. Ohio EPA recommends obtaining an approved protocol before advancing to final modeling where the model may

[57] See Question 5 on screening models for more than one source.

[58] Ohio EPA. "State Implementation Plan Section/Modeling." http://epa.ohio.gov/dapc/model/modeling

be complex or unusual. Where protocols are required, they should be submitted to Ohio EPA for approval in advance of the final modeling submittal.

Question 40. What files need to be submitted to Ohio EPA for a modeling review?

The following files must be submitted to Ohio EPA for a complete modeling review submission, depending on the modeling platform:

AERMOD

1) Approved modeling protocol (when applicable)
2) All AERMOD input and output files, including BPIP/PRIME files
3) All downwash files
4) All AERMAP output files
5) Modeling report[59]

When using meteorological data not supplied by Ohio EPA, you must also include:

6) All AERMET input and output files
7) All AERSURFACE input and output files

AERSCREEN

1) AERSCREEN input file
2) All terrain files, including "demlist.txt" and DEM or NAD files
3) BPIPPRM input file
4) Discrete receptor file, if used
5) External surface characteristics file, if used
6) AERSCREEN output file

SCREEN3

The output file is sufficient for Ohio EPA to review SCREEN3 modeling.

[59] More details on the components of a modeling report are available in Appendix B of this guide.

Appendix A. AERSCREEN Model Application Guidance

AERSCREEN is EPA's recommended screening model for most applications in all types of terrain and for applications involving building downwash. Through a command-prompt interface, AERSCREEN utilizes the MAKEMET meteorological data generator – a standalone program that generates a matrix of meteorological conditions by looping through a range of wind speeds, cloud covers, ambient temperatures, solar elevation angles, and convective velocity scales for user-specified surface characteristics. The model interfaces with AERMAP and BPIPPRM to process terrain and building information, respectively. AERSCREEN then invokes AERMOD in a screening mode.

By supplying a command-prompt interface to access these tools, AERSCREEN eliminates the need for securing site-specific meteorological data unless necessary and automates much of the processing for users to produce worst-case 1-hour concentration estimates, including conversions to worst-case 3-hour, 8-hour, 24-hour, and annual concentration estimates. AERMOD guidance, where applicable, will also apply to AERSCREEN modeling. More details about the program are in the AERSCREEN user guide[60]. Please refer to Question 40 in this guide for what files to submit when using AERSCREEN in a modeling analysis for Ohio EPA.

AERSCREEN Input

AERSCREEN allows the user to load and edit a previous run by calling a restart file, which must be named AERSCREEN.INP and be located in the same directory as the executable file. When this file is not present, AERSCREEN will prompt the user for a run title, which will appear at the head of the output file and will be the reference title in the AERSCREEN.INP file generated. The user will then be prompted for project information, beginning with units (metric or English) and source type[61]. After additional prompts about the source, dispersion, and NO_2 chemistry, AERSCREEN prompts for input about downwash, terrain, and meteorology. Below is a summary of the AERSCREEN prompts, which are described in detail in the user guide[60].

Source, dispersion, and NO_2 chemistry
The source options in AERSCREEN are identified below (input keystroke in quotes):

1. Point: "P" or "p"; release from a vertical stack or isolated vent
2. Capped stack: "S" or "s"; release from an obstructed stack
3. Horizontal stack: "H" or "h"; release from a horizontal stack
4. Flare: "F" or "f"; release from a stack flare[62]
5. Volume: "V" or "v"; release from a variety of industrial sources (*e.g.*, building roof monitors, multiple vents, conveyor belts)
6. Rectangular area: "A" or "a"; low or ground-level releases with no plume rise (e.g., storage piles, slag dumps, lagoons)
7. Circular area: "C" or "c"; low or ground-level releases from a source having a circular shape

[60] U.S.EPA. (December 2016). AERSCREEN User's Guide. EPA-454/B-16-004. www3.epa.gov/scram001/models/screen/aerscreen_userguide.pdf

[61] AERSCREEN evaluates a single source; Question 5 in this guidance addresses screening multiple sources.

[62] See Question 33 in this guide for details on modeling flares in AERSCREEN.

After selecting the source type, the user will be prompted to enter source parameters, which will vary depending on the source. The user then selects rural or urban[63] land use classification and enters the minimum distance to ambient air. The user must then select an option for NO_2 chemistry[64].

Downwash and terrain
The user must select whether to include building downwash[65]. If "y" is entered, the user must supply a pre-existing BPIPPRM file or input parameters for a single building: height, minimum and maximum horizontal dimensions, maximum building dimension angle to true North, direction of stack from building center and distance between building center and stack. Then, the user must select whether to include terrain heights[66], enter a maximum probing distance, and select options to include up to ten discrete receptors and a flagpole receptor height. The user will then enter a value for source elevation; if "y" was entered for including terrain heights, the user will have the option to use AERMAP-derived values and must enter latitude and longitude or UTM coordinate details for the source.

Meteorology
To generate the meteorological matrix, AERSCREEN requires input for minimum temperature, maximum temperature, minimum wind speed, anemometer height, and surface characteristics (albedo, Bowen ratio, and roughness length) for the project area. The user has the option to use AERMET seasonal tables or an external file for surface characteristics or may enter them directly.

After entering meteorological input, AERSCREEN will prompt for fumigation and debug options and ask for a file name to generate output. Before execution, the user may review and change any input in the same manner that is available when loading from an AERSCREEN.INP file.

Suggested estimation methods for initial lateral (σ_{yo}) and vertical (σ_{zo}) dimensions for volume sources

Description of Source	Initial Dimension
(a) Initial Lateral Dimensions (σ_{yo})	
Single Volume Source	σ_{yo} = length of side divided by 4.3
(b) Initial Vertical Dimensions (σ_{zo})	
Surface-Based Source (h_e ~ 0)	σ_{zo} = vertical dimension of source divided by 2.15
Elevated Source (h_e > 0) on or Adjacent to a Building	σ_{zo} = building height divided by 2.15
Elevated Source (h_e > 0) not on or Adjacent to a Building	σ_{zo} = vertical dimension of source divided by 4.3

[63] Rural land use is default; user must provide urban population, if urban land use is selected.

[64] If OLM or PVMRM is selected, the user must enter the ISR and a representative ozone background concentration.

[65] For area and volume sources, downwash is defaulted to "no" and information is not requested.

[66] For rectangular area sources, terrain is set to "no" and no information is requested.

Appendix B. Air Quality Modeling Report Guidelines

Modeling reports should present a narrative of all major components of the analyses performed, including modeled results in tabular form. An air quality modeling report is a part of the permit record. As such, it should provide sufficient detail for any reviewing agency or member of the general public to replicate all stages of the modeling demonstration. Providing a prescriptive list of all components of a modeling report is not feasible given the case-by-case nature of air quality modeling assessments. Ohio EPA recommends the following items that should be presented in any modeling report.

- Project Description
- Model Selection
  - Version
  - Land use analysis
  - Pollutants modeled
  - Table of project's emission rates and comparison to Significant Emission Rates
- Meteorological Data
  - Identify surface and upper air stations
  - Identify years of met data used
  - Identify source of data, if not Ohio EPA
- Receptor Grid
  - Describe extent of receptor grid
  - Identify the resolution of the elevation data used
  - Describe the spacing of the fenceline receptors and the nested grids
- Emissions and Release Parameters
  - Table of pollutant emission rates for long and short-term modeling
  - Table of modeled release point parameters
  - Description of intermittent or emergency units
  - Description of sources with startup/shutdown emissions
  - Cross-reference table for model unit IDs and permit/application IDs
- Significant Impact Analysis (PSD)
  - Describe emission scenarios modeled
  - Table of modeled impacts compared to relevant SIL values
- NAAQS Analysis (PSD)
  - Describe emission scenarios modeled
  - Table of maximum modeled impacts compared to relevant NAAQS
  - Table of background values
  - Cause or contribute analysis, if needed
- Increment Analysis
  - Describe emission scenarios modeled
  - Table of maximum modeled impacts compared to relevant PSD and/or GAIIs increments
- Air Toxics Analysis
  - Inventory of air toxics modeled
  - Table of maximum modeled 1-hour concentrations, the associated MAGLCs, and a calculated ratio of modeled concentrations to MAGLCs
- Additional Impact Analysis (PSD)
  - Construction impacts

  - Growth impacts
  - Soil and vegetation impacts
  - Visibility analysis (Class II)
- Class I Area Analysis (PSD)
  - Detail on distances to Class I areas
  - Q/D analysis
  - Description of any FLM actions and correspondence regarding project
- Figures and Maps
  - The narrative should be supplemented with aerial photos, topographic maps, and project site plans, which clearly indicate building locations, egress points, roadways, fencelines, and other pertinent information.

Appendix C. Reference Tables

1. NWS assignments

Table 1. Meteorological assignments by county

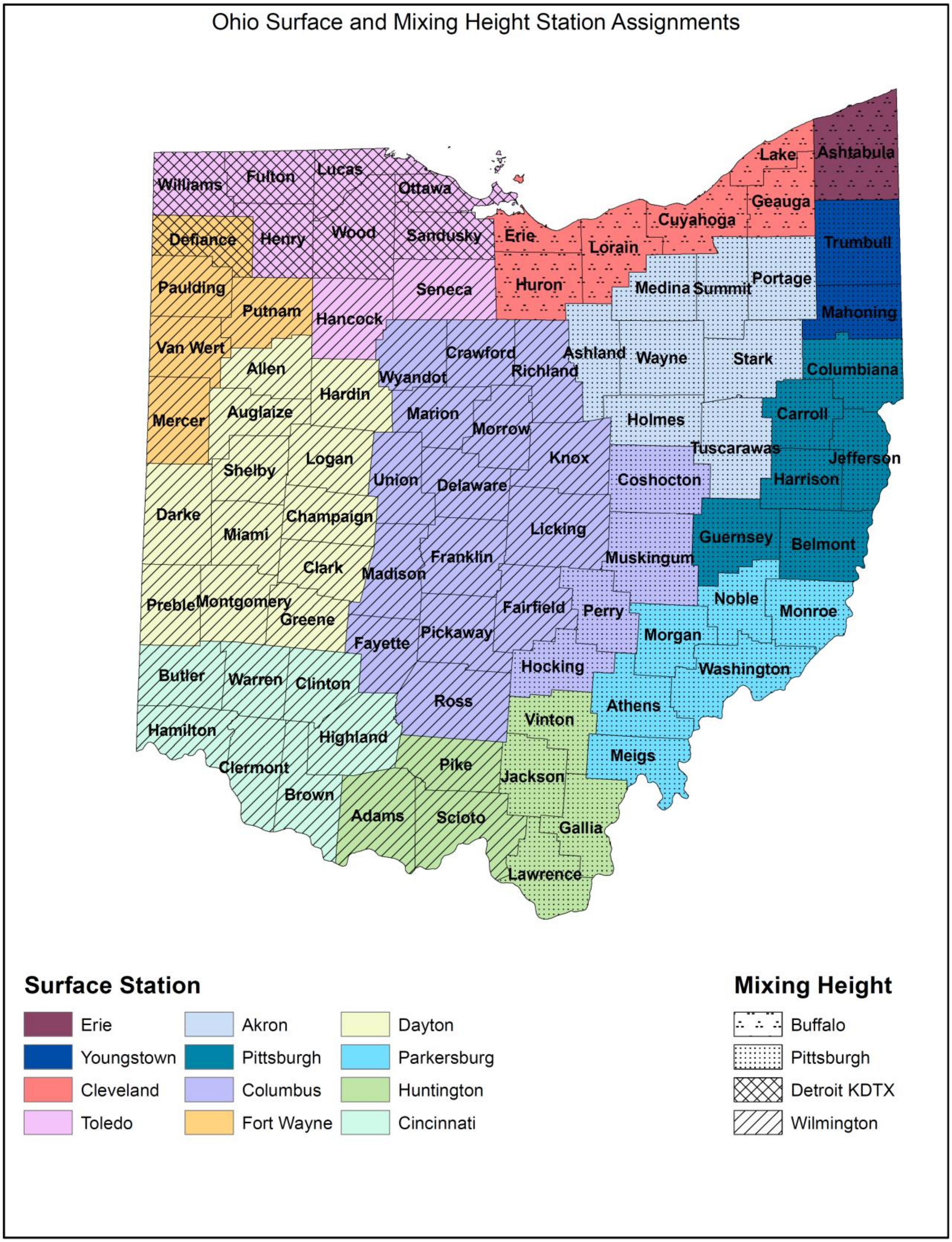
County	Surface	Mixing height
ADAMS	Huntington	Wilmington
ALLEN	Dayton	Wilmington
ASHLAND	Akron	Pittsburgh
ASHTABULA	Erie	Buffalo
ATHENS	Parkersburg	Pittsburgh
AUGLAIZE	Dayton	Wilmington
BELMONT	Pittsburgh	Pittsburgh
BROWN	Cincinnati	Wilmington
BUTLER	Cincinnati	Wilmington
CARROLL	Pittsburgh	Pittsburgh
CHAMPAIGN	Dayton	Wilmington
CLARK	Dayton	Wilmington
CLERMONT	Cincinnati	Wilmington
CLINTON	Cincinnati	Wilmington
COLUMBIANA	Pittsburgh	Pittsburgh
COSHOCTON	Columbus	Pittsburgh
CRAWFORD	Columbus	Wilmington
CUYAHOGA	Cleveland	Buffalo
DARKE	Dayton	Wilmington
DEFIANCE	Fort Wayne	Detroit KDTX
DELAWARE	Columbus	Wilmington
ERIE	Cleveland	Buffalo
FAIRFIELD	Columbus	Wilmington
FAYETTE	Columbus	Wilmington
FRANKLIN	Columbus	Wilmington

County	Surface	Mixing height
FULTON	Toledo	Detroit KDTX
GALLIA	Huntington	Pittsburgh
GEAUGA	Cleveland	Buffalo
GREENE	Dayton	Wilmington
GUERNSEY	Pittsburgh	Pittsburgh
HAMILTON	Cincinnati	Wilmington
HANCOCK	Toledo	Wilmington
HARDIN	Dayton	Wilmington
HARRISON	Pittsburgh	Pittsburgh
HENRY	Toledo	Detroit KDTX
HIGHLAND	Cincinnati	Wilmington
HOCKING	Columbus	Pittsburgh
HOLMES	Akron	Pittsburgh
HURON	Cleveland	Buffalo
JACKSON	Huntington	Pittsburgh
JEFFERSON	Pittsburgh	Pittsburgh
KNOX	Columbus	Wilmington
LAKE	Cleveland	Buffalo
LAWRENCE	Huntington	Pittsburgh
LICKING	Columbus	Wilmington
LOGAN	Dayton	Wilmington
LORAIN	Cleveland	Buffalo
LUCAS	Toledo	Detroit KDTX
MADISON	Columbus	Wilmington
MAHONING	Youngstown	Pittsburgh

County	Surface	Mixing height
MARION	Columbus	Wilmington
MEDINA	Akron	Pittsburgh
MEIGS	Parkersburg	Pittsburgh
MERCER	Fort Wayne	Wilmington
MIAMI	Dayton	Wilmington
MONROE	Parkersburg	Pittsburgh
MONTGOMERY	Dayton	Wilmington
MORGAN	Parkersburg	Pittsburgh
MORROW	Columbus	Wilmington
MUSKINGUM	Columbus	Pittsburgh
NOBLE	Parkersburg	Pittsburgh
OTTAWA	Toledo	Detroit KDTX
PAULDING	Fort Wayne	Wilmington
PERRY	Columbus	Pittsburgh
PICKAWAY	Columbus	Wilmington
PIKE	Huntington	Wilmington
PORTAGE	Akron	Pittsburgh
PREBLE	Dayton	Wilmington
PUTNAM	Fort Wayne	Wilmington
RICHLAND	Columbus	Wilmington
ROSS	Columbus	Wilmington
SANDUSKY	Toledo	Detroit KDTX
SCIOTO	Huntington	Wilmington
SENECA	Toledo	Wilmington
SHELBY	Dayton	Wilmington
STARK	Akron	Pittsburgh
SUMMIT	Akron	Pittsburgh
TRUMBULL	Youngstown	Pittsburgh

County	Surface	Mixing height
TUSCARAWAS	Akron	Pittsburgh
UNION	Columbus	Wilmington
VAN WERT	Fort Wayne	Wilmington
VINTON	Huntington	Pittsburgh
WARREN	Cincinnati	Wilmington
WASHINGTON	Parkersburg	Pittsburgh
WAYNE	Akron	Pittsburgh
WILLIAMS	Toledo	Detroit KDTX
WOOD	Toledo	Detroit KDTX
WYANDOT	Columbus	Wilmington

Table 1a. Supplemental map to Table 1



2. Anemometer heights

Table 2. National Weather Service anemometer height and station numbers

Site	Anemometer height	Station number
Akron/Canton (CAK)	10 meters	14895
Cincinnati Lunken (LUK)	10 meters	93812
Cleveland Hopkins (CLE)	10 meters	14820
Cleveland Burke (BKL)	7.9 meters	04853
Columbus (CMH)	10 meters	14821
Dayton Intl. (DAY)	10 meters	93815
Defiance Memorial (DFI)	10 meters	04851
Lorain County (LPR)	10 meters	04849
Mansfield (MFD)	10 meters	14891
Toledo Express (TOL)	10 meters	94830
Toledo Metcalf (TDZ)	10 meters	04848
Youngstown (YNG)	10 meters	14852
Charleston Yeager, WV (CRW)	7.9 meters	13866
Cincinnati/Covington, KY (CVG)	10 meters	93814
Erie, PA (ERI)	10 meters	14860
Fort Wayne, IN (FWA)	10 meters	14827
Huntington, WV (HTS)	7.9 meters	03860
Pittsburgh, PA (PIT)	10 meters	94823
Parkersburg, WV (PKB)	10 meters	03804
Wheeling, WV (HLG)	10 meters	14894

3. Table of standards and screening values

Table 3 on the following page is a practical compilation of standards and screening values used in air quality modeling in Ohio. More information about the standards, levels, and terminology can be found in this guide and in sources referenced in the table. The values in this table are current as of publication date and subject to change with revisions and updates to corresponding rules, policies, and guidance. Where state or federal rules are changed that conflict with the values in this table, the appropriate updated rule supersedes these values. Entries with a "---" represent a standard, increment, or level without an established value.

Acronyms and abbreviations found in Table 3 are listed here:

GAII	Generally Acceptable Incremental Impact
MAGLC	Maximum Acceptable Ground-Level Concentration
$\mu g/m^3$	micrograms per cubic meter
NAAQS	National Ambient Air Quality Standards
NSR	New Source Review
Ohio EPA	Ohio Environmental Protection Agency
$PM_{2.5}$	particulate matter with aerodynamic diameter less than or equal to 2.5 microns
PM_{10}	particulate matter with aerodynamic diameter less than or equal to 10 microns
ppb	parts per billion
ppm	parts per million
PSD	Prevention of Significant Deterioration
SER	Significant Emission Rate
SIL	Significant Impact Level
SMC	Significant Monitoring Concentration
tpy	tons per year

Table 3. Modeling standards and screening levels

Pollutant	Averaging Period	NAAQS standards (µg/m³) unless noted [A] Primary		Secondary		NSR SER (tpy) [B]	SMC (µg/m³) [C]	PSD Class I Increment (µg/m³) [D]		PSD Class I SIL (µg/m3)		PSD Class II Increment (µg/m³) [D]		PSD Class II SIL (µg/m³)		Ohio EPA SER (tpy)		Ohio EPA GAII (µg/m³)	
Carbon Monoxide	1-hour	35 ppm 40000	a	revoked		100	-----	-----		-----		-----		2000	E	100		10000	a
	8-hour	9 ppm 10000	a	revoked			575	-----		-----		-----		500	E			2500	a
Lead	rolling 3-month	0.15	b	F		0.6	0.1	-----		-----		-----		-----		0.6		0.0375	b
Nitrogen Dioxide	1-hour	100 ppb 188	c	-----		40	-----	-----		-----		-----		7.5 4 ppb	G	40		188	b
	Annual	53 ppb 100	b	F			14	2.5	b	0.1	H	25	b	1	E			12.5	b
Ozone	8-hour (2008)	0.075 ppm	d	F		VOC - 40	-----	-----		-----		-----		-----		-----		-----	
	8-hour (2015)	0.070 ppm	d	F		NO_x - 40	-----	-----		-----		-----		-----					
$PM_{2.5}$ filterable + condensable	24-hour	35	e	F		$PM_{2.5}$ - 10	0	2	b	0.27	I	9	a	1.2	I	10		4.5	a
	Annual	12	f	15	f	SO_2 - 40 NO_x - 40	0	1	b	0.05	I	4	b	0.2	I			2	b
PM_{10} filterable + condensable	24-hour	150	g	F		15	10	8	a	0.3	H	30	a	5	E	15		15	a
	Annual	revoked		revoked			-----	4	b	0.2	H	17	b	1.0	E			8.5	b
Sulfur Dioxide	1-hour	75 ppb 196	h	-----		40	-----	-----		-----		-----		7.9 3 ppb	J	40		196	b
	3-hour	-----		0.5 ppm 1300	a		-----	25	a	1.0	H	512	a	25	E			256	a
	24-hour	revoked		-----			13	5	a	0.2	H	91	a	5	E			45.5	b
	Annual	revoked		-----			-----	2	b	0.1	H	20	b	1	E			10	b
Air Toxics	1-hour	-----														1.0	K	MAGLC	i

A Air quality standards found in 40 CFR 50 are codified in OAC 3745-25-02.
B PSD Significant Emission Rates found in 40 CFR 52.21(b)(23) are codified in OAC 3745-31-01(VVVVV).
C Not to be exceeded. The PSD Monitoring De Minimis Concentrations (SMCs)found in 40 CFR 52.21(i)(5)(i) are codified in OAC 3745-31-13(H)(1).
D PSD Class I and Class II Ambient Air Increments found in 40 CFR 52.21(c) are codified in OAC 3745-31-11(B).
E Not to be exceeded. SILs found in PSD regulations 40 CFR 51.165(b)(2) are codified in OAC 3745-31-23(A).
F Secondary standard has the same level and form as primary standard.
G Not to be exceeded. U.S. EPA. (June 29, 2010). "Guidance Concerning the Implementation of the 1-hour NO2 NAAQS for the Prevention of Significant Deterioration Program"
H Not to be exceeded. SILs based on proposed rule 61 F.R. 38250 "Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NSR)"
I Not to be exceeded. U.S. EPA (April 17, 2018). "Guidance on Significant Impact Levels for Ozone and Fine Particles in the Prevention of Significant Deterioration Permitting Program"
J Not to be exceeded. U.S. EPA. (August 23, 2010). "Guidance Concerning the Implementation of the 1-hour SO2 NAAQS for the Prevention of Significant Deterioration Program"
K Compounds considered highly toxic may require modeling at rates less than 1.0 tpy.

a Model may not demonstrate exceedance of the standard more than once per year (H2H 1-yr).
b Modeled maximum may not exceed the standard for respective averaging time (H1H).
c Modeled 98th percentile 1-hour daily maximum must not exceed the standard (H8H 5-yr average).
d Modeled fourth-highest 8-hour daily maximum must not exceed the standard (H4H 5-yr average).
e Modeled 98th percentile 24-hour concentrations must not exceed the standard (H8H 5-yr average).
f Modeled average of annual mean must not exceed the standard (H1H 5-year average).
g Modeled three-year average not to be exceeded more than once per year over three-year period (H6H 5-yr).
h Modeled 99th percentile 1-hour daily maximum must not exceed the standard (H4H 5-yr average).
i Modeled maximum must not exceed MAGLC calculated by procedures described in "Option A" in DAPC's Engineering Guide 70 "Air Toxic Analysis."