RECOMMENDED PROCEDURES FOR AIR QUALITY DISPERSION MODELING

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

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DEQ can provide documents in an alternate format or in a language other than English upon request. Call DEQ at 800-452-4011 or email deqinfo@deq.state.or.us.

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TABLES (from OAR 340-245)

LIST OF ABBREVIATIONS

AERMAP	AERMOD preprocessor to determine terrain heights
AERMET	AERMOD preprocessor to determine meteorological inputs
AERMINUTE	AERMET preprocessor to determine wind speed corrections
AERMOD	American Meteorological Society/EPA preferred air dispersion modeling
AERSCREEN	Program to run AERMOD in screening mode
AERSURFACE	AERMOD preprocessor to determine land use characteristics
ASOS	Automated Surface Observing System
BPIP-Prime	Building Profile Input Program with PRIME downwash algorithm
CAO	Cleaner Air Oregon
DEM	Digital Elevation Model
DEQ	Oregon Department of Environmental Quality
DF	Dispersion Factor
ED	Exposure Duration
EPA	U.S. Environmental Protection Agency
ER	Emission Rate
EU	Emission Unit
GEP	Good Engineering Practice
GPS	Geospatial Positioning System
HI	Hazard Index
HQ	Hazard Quotient
MAKEMET	Meteorological pre-processing program for AERMOD or AERSCREEN
MIFF	Mesoscale Meteorological Interface Formatter
MERPs	Modeled Emission Rates for Precursors
NAAQS	National Ambient Air Quality Standards
NED	National Elevation Dataset
NLCD	National Land Cover Dataset
NO2	Nitrogen Dioxide
NSR	New Source Review
NW-AIRQUEST	Northwest International Air Quality Environmental Science and Technology Consortium
NWS	National Weather Service
OAR	Oregon Administrative Rules
O_3	Ozone
OLM	Ozone Limiting Method
$PM_{2.5}$	Particulate Matter with a diameter less than or equal to 2.5 microns
PSD	Prevention of Significant Deterioration
PVMRM	Plume Volume Molar Ratio Method
RAL	Risk Action Level
RBC	Risk-Based Concentration
REER	Risk Equivalent Emission Rate
RfC	Reference Concentration
SIL	Significant Impact Level
TAC	Toxic Air Contaminant
TEF	Toxic Equivalency Factor
TEU	Toxics Emission Unit
TRV	Toxicity Reference Value

INTRODUCTION

Prior to commencement of air dispersion modeling for regulatory applications, a modeling protocol will be submitted to DEQ for approval. The protocol should be developed in collaboration with DEQ following an initial discussion between the facility and their consultant and DEQ. Depending on the project, this pre-application meeting may include the permit writer, air quality modeling staff, regional office staff, and Cleaner Air Oregon (CAO) technical staff if applicable.

The following document consists of recommended procedures and a checklist of topics that should be addressed in the pre-application communication, the modeling protocol, and the final modeling/risk assessment report. This outline is not definitive, and individual assessments may require more or less information depending on the complexity of the analysis. DEQ intends these procedures to be dynamic and will be modified to provide additional clarification, as needed. If you have questions, concerns, or recommendation on this guidance, please contact DEQ.

This document is divided into five sections:

1. **Pre-application Communication and Meetings** – An overview of the topics to discuss before submitting a modeling protocol.
2. **General Modeling Components** – Elements of air quality dispersion modeling that are uniformly required, regardless of analysis type.
3. **New Source Review (NSR) Modeling Components** – Elements of air quality dispersion modeling that are unique to NSR analyses.
4. **Cleaner Air Oregon (CAO) Modeling Components** – Elements of air quality dispersion modeling that are unique to CAO analyses.
5. **Combined NSR/CAO Modeling Considerations** – A brief discussion of modeling demonstrations covering both NSR and CAO regulations.

1. PRE-APPLICATION COMMUNICATION

A pre-application meeting helps establish important agreements for developing a modeling protocol and report. Table 1 outlines the topics typically covered during pre-application communication, and the type of modeling to which they apply. In some cases a project may fall under both New Source Review (NSR) and Cleaner Air Oregon (CAO). In this situation, a single protocol is sufficient for both programs. A more thorough description of these topics is provided in subsequent sections, including information that is requested in the protocol and final report.

Table 1. Pre-Application Communication Topics

Topic	Description	NSR Project	CAO Project
General Modeling Elements			
Project Description	Discussion of the project, processes and emissions to be modeled, and regulatory considerations.	✓	✓
Source Characterization	Description of the emission unit locations, nearby terrain, nearby buildings, urban areas, etc.	✓	✓
Emissions Inventory	Characterization of the emissions inventory and how it relates to modeling.	✓	✓
Meteorological Data	Discussion of the available met data sets and their representativeness.	✓	✓
Modeling Domain and Receptor Placement	Description of the receptor grid, its extension, and receptor spacing.	✓	✓
Air Quality Model Selection	Discussion of the screening or refined modeling chosen.	✓	✓
Summary of Results	Discussion of the appropriate model and if screening or refined modeling is necessary.	✓	✓
NSR Modeling Elements			
Competing Source Inventory	Description of the competing sources and their locations.	✓	
Background Concentrations	Discussion of the background data that will be used in the analysis.	✓	
MERPs Analysis	Discussion of the considerations for modeling of Ozone (O_3) and Secondary $PM_{2.5}$.	✓	
NO_2 Modeling	Discussion of approach for modeling of NO_2.	✓	
Single Source Impact Analysis	Discussion of SIL analysis.	✓	
NAAQS Cumulative Impact Analysis	Discussion of Cumulative Impact Analysis.	✓	
Analysis of Class I Area Impacts	Discussion of nearby Class I Areas.	✓	
Additional Impact Analysis	Discussion of Additional Impact Analysis.	✓	
Environmental Justice Analysis	Discussion of Environmental Justice Analysis.	✓	
CAO Modeling Elements			
Modeling Considerations	Model level selection, Identification of toxic emission units and exposure locations. Calculation of concentrations by exposure scenario.		✓
Risk Assessment Considerations	Review of the process to calculate, summarize, and report risk.		✓

At the conclusion of pre-application communications, both DEQ and the facility should be in general agreement on the contents of the modeling demonstration.

2. GENERAL MODELING COMPONENTS

A written modeling protocol must be approved by DEQ prior to the commencement of air quality modeling for submittal to DEQ. The protocol and final modeling report for NSR modeling, CAO modeling or a combined NSR/CAO protocol should contain the following sections. All modeling protocols should be aligned with the Guideline on Air Quality Models, also known as Appendix W, (EPA 2017).

2.1 Project Description

The modeling protocol and report should contain a brief narrative that provides an overview of the project, including location, boundaries, production activities, emissions units and controls, pollutant(s) of concern, and a review of the regulatory and guidance requirements applicable to the project.

2.2 Source Characterization

2.2.1 Source Location Maps and Plots

The modeling protocol and report should include the following:

- Topographic features, nearby urban areas, air monitoring locations, and meteorological sites
- Facility plot plan with terrain, emission points and buildings labeled, and a scale and coordinate system identified
- Map showing the location of receptors
- For NSR, maps should include Class I areas, nonattainment areas, and nearby major sources.

2.2.2 Emission Units (EUs)

Information on the emission units should be included in the modeling protocol and report. The units should be broken into three main categories based on the operating status:

- Regular Operations: These EUs would be expected to run during normal operations of the facility. Facilities should consider both point and fugitive sources. For each EU, the facility should provide the following information:
  - Description of activity (e.g., boiler)
  - Source type (point, area, volume, etc.)
- Auxiliary Equipment: These EUs are operated less frequently. For these EUs, the following information should be provided:
  - Description of activity (e.g., emergency generator)
  - Source type (point, area, or volume, etc.)
  - Frequency of operation (e.g., hours/year)
- Batch Operations: EUs that run batch processing must be identified as such. For batch processes, the daily emission rate should be the maximum daily production, rather than

the annual emissions divided by 365. For these EUs, the following information should be provided:

- Description of activity (e.g., batch furnace)
- Source type (point, area, or volume, etc.)
- Frequency of operation (e.g., hours/day, days/week)
- Discussion of batch operations

- Startup and Shutdown: The facility should discuss changes in emissions and operations from EUs during startup and shutdown, if applicable.

2.2.3 Stack Parameters

For each EU, based on source type, the following information should be included:

- Point Sources – location, stack height, inside stack diameter, exit velocity and temperature, base elevation, and configuration of release (e.g., vertical, horizontal, capped)
- Area Sources – size and location of area, and release height
- Volume Sources – size and location of volume, release height, and sigma values

2.2.4 Downwash

To address downwash in the protocol and report, the following items should be included:

- If subject to downwash influences (see Appendix W, Section 7.2.2.1), conduct BPIP-Prime modeling for input to AERMOD, with the following information included:
  - Building/tier heights and dimensions/coordinates of building corners
  - Base elevation for stacks and buildings – source of elevations, such as AERMAP, GPS, etc.
  - Results of BPIP-Prime modeling, including Good Engineering Practice (GEP) stack height, if applicable
  - Offsite buildings within 5x of L (see EPA GEP Stack Height Regulations)
- If the source is not subject to downwash influences, please provide justification.

2.2.5 Urban/Rural Determination

The facility must determine if the location should be classified as urban or rural, with the exception of a Level 1 Cleaner Air Oregon Risk Assessment. This determination should be consistent with Appendix W, Section 7.2.1.1(b) (EPA 2017). If the location is deemed urban and AERMOD is being used, the urban option should be activated, as appropriate.

2.3 Meteorological Data

Meteorological data can come from a variety of sources and should be reviewed to find the most representative source compared to the facility location. The protocol and report should include a brief discussion of available meteorological datasets and a justification for selection of the most representative. Table 2 provides a review of available sources for meteorological data, and the recommendations of each.

Once a meteorological dataset is selected, surface characteristics must be determined in order to run AERMET, the preprocessing model for AERMOD. Meteorological pre-processing for other models should be discussed with DEQ. AERSURFACE, a preprocessor for AERMET, is used to calculate surface characteristics (albedo, Bowen ratio, surface roughness) for the primary meteorological site, and any secondary site used for data substitution. Factors for running AERSURFACE and AERMET, and the basis for their selection, should be described in the modeling protocol. These factors include:

- Number and spatial distributions of sectors used for surface roughness calculation
- Map of land use/sectors surrounding met site and facility
- Assumptions used for climate variables (arid, non-arid, wet, dry, average)
- Assumptions used for snow cover characterization
- Season definitions (month-to-season assignments)
- Land use dataset used (1992 NLCD, 2001 NLCD, other.) - including the resolution, format, and projection
- Representativeness of land use data for time period modeled

Table 2. Meteorological Data Considerations for Air Dispersion Modeling

Meteorological Data Type	Requirements	Processing Options
Screening	MAKEMET generated for AERMOD, or as an integral part of AERSCREEN	n/a
On-site data	○ A minimum of **one year** of on-site data ○ Variables included in the data must meet the requirements outlined in Appendix W Section 8.4.4.2(a) (EPA 2017) ○ Tower siting and QA procedures (Meteorological Monitoring Guidance for Regulatory Modeling Applications (EPA-454/R-99005) (EPA 2000) ○ Concurrent representative National Weather Service (NWS) surface data should be used for data substitution, as needed	○ Adjusted surface friction velocity (u*) can be used. If used no turbulence parameters will be passed to AERMOD ○ Bulk Richardson Method
National Weather Service (NWS)	○ **Five years** of representative NWS surface data and concurrent representative upper air data ○ Specify the options used for filling missing NWS temperature and cloud cover ○ Specify the wind speed threshold used	○ Adjusted surface friction velocity (u*) can be used. If used no turbulence parameters will be passed to AERMOD
Prognostic (Modeled) Data	○ **Three years** of representative prognostic meteorological data ○ Grid resolution of the underlying prognostic meteorological data ○ For regulatory applications, prognostic data must be processed for input into AERMET consistent with the Guideline, Section 8.4 ○ MIFF processing of prognostic data must follow recommendations in the MMIF guidance document (EPA-454/B-16-003) ○ Model performance evaluation performed must be consistent with the MMIF guidance document (EPA-454/B-16-003)	○ Adjusted surface friction velocity (u*) can be used. If used no turbulence parameters will be passed to AERMOD ○ EPA generated MMIF data must be requested from DEQ. MMIF data generated from other sources must be approved by DEQ. Use in a regulatory application must also be approved by DEQ

In addition to surface characteristics, the following QA/QC procedures should be addressed related to the meteorological dataset. These items include:

- A wind rose of the wind speed and direction
- A summary of the number of calm and missing hours
- A summary of data filling and substitution
- Confirmation of the:
    - 1-minute ASOS data being processed in AERMINUTE
    - Meteorological data tower location
    - Base elevation of met tower for on-site and NWS data, if applicable
    - Prognostic meteorological data grid cell
    - Anemometer height and location for site-specific and NWS data, if applicable.

2.4 Modeling Domain and Receptors

The modeling domain determines the extent to which source impacts will be evaluated. As a general rule, the receptor grid should extend far enough to include all significant impacts and take into account areas of complex terrain and sensitive receptors. The following should be included in the modeling domain and receptor section:

- Maps of nearby terrain showing areas of complex terrain.
- Plot of receptor grids with corresponding coordinates.
- All maps should include a legend, scale bar, north arrow and any other identifying information.
- Modeling receptor locations for:
    - NSR must include all areas of Ambient Air where emissions may cause a significant ambient impact. Receptors should not extend further than 50 km from the facility.
    - CAO should extend from no less than 2 km and up to 10 km from the facility, but must include all areas where modeled risk is at or above 0.5 in 1 million Excess Cancer Risk, or at a Hazard Index (HI) of 0.5 for chronic and acute noncancer risk.
- Modeling receptors should be spaced as follows:
    - 25 m along fence line and out to 200 m from fence line
    - 50 m spacing 200 to 1,000 m
    - 100 m spacing 1,000 to 2,000 m
    - 200 m spacing 2,000 to 5,000 m
    - 500 m spacing 5 000 to 10,000 m
- High impact areas, such as elevated terrain, should have additional 25 m spaced modeling receptors. High impact areas can be identified as locations where initial modeling results indicate a hot spot of risk above 0.5 outside of the continuous area where risk is greater than 0.5.
- Discrete receptors should be place at sensitive areas such as \schools, or other child exposure areas, if gridded receptors don’t adequately pinpoint those locations.
- Terrain data should be specified, such as DEM, NED, source specific XYZ data, and resolution specified.

2.5 Air Quality Model Selection

AERMOD is the recommend model for most NSR and CAO modeling activities. If another model or alternative modeling technique is proposed, a justification with reference to the alternative model requirements of Appendix W, Section 3.2 (EPA 2017) is required. EPA recommended models can be found on the SCRAM website (EPA 2019). If an alternative model is considered, it should be approved by DEQ prior to the submission of the modeling protocol.

For AERMOD modeling, include the following in the modeling protocol and report:

- Identify the most current version number of AERMOD used in the analysis.
- Identify any graphical user interfaces (GUIs) used, such as BEEST, Lakes, and BREEZE.
- Identify all preprocessors, with version numbers, used in the analysis, including:
  - AERMET
  - AERSURFACE
  - AERMAP
  - AERMINUTE
  - BPIP-PRIME
- For screening modeling runs, identify if AERMOD-MAKEMET or AERSCREEN were used.
- For dry deposition, document the methodology and assumptions used for gravitational settling and deposition modeling.

2.6 Reporting of Results

A set of plots, tables, statistics, and other methods as applicable, should be provided to support the results of each Criteria Pollutant or Toxic Air Contaminants (TAC) for comparison to the relevant standards or thresholds. For AERMOD and all pre- and post- processors, all input and output files should be submitted to DEQ along with the modeling report. Elements of the modeling report are further explained in subsequent sections. If on-site meteorological data is used, the raw unprocessed data should be provided in addition to all AERMET input and output files. See the NSR Modeling Elements (Section 3) and CAO Modeling Elements (Section 4) to see specific reporting requirements.

3. NSR MODELING COMPONENTS

The requirements for the analysis of Criteria Pollutants as part the New Source Review/Prevention of Significant Deterioration (NSR/PSD), include elements that are not required as part of a Cleaner Air Oregon analysis. The following section outlines the separate elements required in a NSR modeling protocol.

Trial Significant Emission Threshold (SET)

DEQ has developed trial short-term Significant Emission Thresholds (SETs) for $PM_{2.5}$, SO_2, and NO_x. The SET, as a short term-emissions based test, is similar to the use of the SER, which is an annual-emissions based test. Facilities may compare their facility-wide maximum short-term emission rates against the SET, and if the short-term emission rate is below the SET, further evaluation of the pollutant is not required to show compliance with the short-term NAAQS. If the emission rate is equal to or above the SET, the facility must further demonstrate compliance by following the process outlined in this document. The trial SETs are as followed:

Pollutant	**Trial SET**
24-hour $PM_{2.5}$	5 lbs/day
1-hour SO_2	3 lbs/hr
1-hour NO_x	3 lbs/hr

The SETs were developed using the 24-hour dispersion factors found in OAR 340-245-8010 Table 3, originally developed for the Cleaner Air Oregon program. The dispersion factor utilized for the development of the SETs was for a stack height of 10m and distance to a receptor (Ambient Air) of 100m and adjusted to the appropriate time scale (lbs/hr or lbs/day), depending on the pollutant. In addition, for NO_x, an 80% in stack ratio was applied to the dispersion factor to account for conversion of NOx to NO_2. To estimate significant emission rates, this dispersion factor was used with a target concentration based on values for each pollutant calculated as the NAAQS minus the maximum background concentration. The background values were taken from the 2014-2017 NW AIRQUEST Background design values (DVs). The final SET values were adjusted so that they protected at least 99.0% of all background data points in Oregon from causing a NAAQS exceedance, given the modeling assumptions and background values used in the analysis.

The trial SETs will be reviewed within three years (target date of 2025) to ensure they are meeting the dual objectives of protecting public health and improving efficiencies for the air quality permitting process.

3.1 Single Source Impact Analysis

The first step of an NSR analysis is an applicability test to determine if a source is significant and required to conduct an air quality analysis. This is generally done by comparing emission increases above the netting basis, which is zero for new sources, to the SER. If greater than the SER, the source is directed to OAR 340 division 225 and the modeling requirements. As

pointed out above, the annual-based SER test is not applicable to the short-term NAAQS pollutants 1-hr NO2, 1-hr SO2, and 24-hr PM2.5. However, the short-term based SET can perform the same screening function for the short-term NAAQS. For more details on the development of the SET, see the "Trial Significant Emission Threshold (SET)" inset box.

If either the SER or SET test shows that emissions are significant, the next steps determine the scope of the modeling. This usually entails a full single-source SIL analysis to determine if any modeling receptors have concentrations greater than the SIL. If all modeled concentrations are less than the SIL, additional modeling is not required. However, a full NSR NAAQS analysis is required for those receptors with modeled concentrations greater than the SIL, in accordance with OAR 340 division 225, EPA's Modeling Guidelines in Appendix W (cited above), and this Modeling Procedures document. The sequence and details of this analysis include:

- Determine if the SIL is protective of the NAAQS, by subtracting the representative background from the NAAQS, and comparing the difference to the SIL. If this difference is small because of high background, relative to the NAAQS, the SIL may not provide sufficient buffer to allow contributions to ambient air from the proposed source. If this is the case, the SIL is not be appropriate, and a NAAQS cumulative impact analysis would be required (see, 3.2 below)
- Use the maximum modeled concentrations for comparison to the SIL; do not include background at this step. If the modeled concentration is less than the SIL, the emission increases are not considered significant, and further analysis not required.
- For the short-term NAAQS analysis, the inclusion of nearby competing sources will not be necessary in most cases, because of the low probability of plume overlap. In this case, the full analysis will be the same as the single-source SIL analysis except for the addition of background, which is easy to obtain or can be supplied by DEQ. If SETs are used, and short-term emissions are higher than the SET and modeling is required, it will be easier to bypass the single source SIL step and go directly to the full NAAQS analysis, as a competing source analysis will generally not be required.
- For sources that complete a single-source SIL analysis, a full NAAQS cumulative impact analysis, described below, will be required if modeled concentrations are greater than the SIL in Class II areas, and for Class I areas within 50 km of the source.
- For Class I areas located greater than 50 km from the source, a screening method will be used, in consultation with DEQ, to compare modeled concentrations to Class I SILs.

3.2 NAAQS Cumulative Impact Analysis

For all pollutant concentrations that exceed the SIL, a second stage of an NSR analysis is required, the cumulative impact analysis. This analysis should include the following requirements and procedures:

- The domain of modeling receptors for the NAAQS analysis can be limited to only the receptors with single-source modeling concentrations greater than the SIL.
- Emissions used in the analysis must be the maximum permitted emissions for the NAAQS averaging times.
- A Modeled Emission Rates for Precursors (MERPs) analysis should be used to estimate secondary PM2.5 and O3 concentrations. The application of MERPs is described in following section.
- The design concentrations for each averaging period should include: modeled source concentrations in the form of the NAAQS, secondary PM2.5 concentrations from the

MERPS analysis, modeled contributions from nearby permitted sources based on the competing source inventory, if applicable, and background concentrations.
- O3 concentration from the MERPs analysis should be compared to the NAAQS to determine significance.
- The locations and concentrations of the pollutants, in the relevant form of the NAAQS, for each averaging time that are greater than the NAAQS, if any, should be identified.

3.3 Competing Source Inventory

If single source modeling of the source being analyzed shows impacts greater than the SIL for a Criteria Pollutant, a NAAQS analysis is required. (see Section 3.5, below). In order to show the full impact of a new or modified source, all significant competing sources and background must be included in the modeling demonstration. For modeling of emissions with 1-hr average NAAQS, such as NO2 and SO2, a competing source analysis is generally not required, with approval by DEQ. If required, an inventory of significant competing sources can be provided by DEQ upon request. This inventory includes both Plant Site Emission Level (PSELS) for the NAAQS analysis, and actual emissions for NSR/PSD. When making the request, provide the location of the facility and the anticipated short-term emissions of all modeled pollutants. DEQ determines which competing sources are significant based on the amount of permitted emissions and distance between the proposed source and existing sources.

3.4 Background Concentrations

Information about the method used to determine background concentrations should include:
- Ambient monitoring, if used:
  - Monitor locations, averaging times, and measurement period
  - Description of representativeness of monitored values
- NWAirquest gridded background Design Values, if used:
  - Description of the applicability and representativeness of the data
- Other method used to generate background values for background, if used:
  - Description of method and representativeness of data.

The gridded background Design Values noted above are available through NW-AIRQUEST (IDEQ 2019). DEQ can assist facilities in developing representative background concentrations and in competing source inventories, especially if double counting of concentrations from competing sources is of concern.

3.5 Modeled Emission Rates for Precursors (MERPs)

The current EPA Tier 1 method for estimating Ozone (O_3) and Secondary $PM_{2.5}$ impacts from industrial facilities is the application of MERPs, which incorporates the results of photochemical grid modeling of hypothetical sources across the country. EPA organized the modeling results by region, including the Western U.S. Region. For Tier 1, the guidance recommends first using the most conservative values in the Western Region, and then using values from the most representative site for the facility being reviewed. For Oregon, the most representative conservative site for is usually the Morrow site located near Arlington on the Columbia River. See the Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for O_3 and $PM_{2.5}$ under the PSD Permitting Program EPA-454/R-

19-003, April 2019 (EPA 2016a) (https://www.epa.gov/sites/default/files/2019-05/documents/merps2019.pdf) for more information. If MERPs are used, include a description in the modeling protocol.

If a Tier 2 O_3 or Secondary $PM_{2.5}$ assessment is necessary, a more refined case-specific air quality analysis may be required following consultation with DEQ, with reference to Guidance on the Use of Models for Assessing the Impacts of Emissions from Single Sources on the Secondarily Formed Pollutants: O_3 and $PM_{2.5}$ (EPA-454/R-16-005) (EPA 2016b) (https://www.epa.gov/sites/default/files/2019-02/documents/singlesources2016.pdf).

3.6 Conversion of NO_X to NO_2

Methodologies for modeling the conversion of NO_x to NO_2 should follow the tiers laid out in U.S. EPA's Appendix W, Section 4.2.3.4 (EPA 2017) (https://www.epa.gov/scram/2017-appendix-w-final-rule). They are as follows:

- Tier 1: Assume 100% conversion of NOx to NO2, no additional steps or data needed.
- Tier 2: ARM2 ratio. The minimum and maximum NO2/NOx ratios should use EPA default values (0.5 and 0.9, respectively).
- Tier 3: Ozone Limiting Method (OLM) and Plume Volume Molar Ratio Method (PVMRM). The EPA default values for the NO2/NOx In-Stack Ratio (ISR) and NO2/NOx Equilibrium Ratio (0.5 and 0.9, respectively) should be used.
- Non-default ISR values can be used if technical justification is provided, such as stack test results, manufacturer test data, or EPA's ISR database.
- PVMRM is most appropriate for analyses with relatively isolated and elevated sources.
- OLM is more appropriate for analyses with area sources, near-surface releases, or where plume overlap from multiple sources will occur.
- When using OLM in AERMOD, use the option OLMGROUP ALL.

3.7 PSD Increment Cumulative Analysis

For all sources located in Class II areas, the applicant is required to provide an air quality analysis for Class II PSD Increment including the following considerations and information:

- The domain of modeling receptors for the increment analysis may be limited to receptors with single-source modeling concentrations greater than the SIL.
- Design concentrations reported since the baseline date, for each averaging period should include: modeled source concentrations in the form of the NAAQS, modeled contributions from nearby permitted sources based on the competing source inventory, and secondary PM2.5 concentrations from the MERPS analysis.
- Actual emissions are used in the increment analysis, although permitted emissions may be used as a conservative default.
- Locations and maximum design concentrations of pollutants should be identified in the relevant form of the standard for each averaging time.

3.8 Analysis of Class I Area Impacts

It is recommended that all sources within 200 km of a Class I area provide an air quality analysis for Class I PSD Increment. Federal Major PSD facilities are also required to perform an Air Quality Related Values (AQRV) analysis. (Reference 40 CFR 52.21(p) (https://www.epa.gov/sites/default/files/2017-06/documents/cfr-2015-title40-vol3-part52.pdf) and 51.166(p)) (https://www.govinfo.gov/content/pkg/CFR-2011-title40-vol2/pdf/CFR-2011-title40-vol2-sec51-166.pdf).

- For Federal Major Sources, notify appropriate Federal Land Manager (FLM) with an emissions over distance (Q/d) analysis for their determination of significance.
- If a source is located within 10 km of a Class I area and has an impact of 1 µg/m3 on a 24-hour basis on the Class I area, a Class I PSD analysis is required.

3.9 Additional Impact Analysis

Applicants must address additional impacts on Class II areas. Generally, this requirement can be met with reference to the NAAQS secondary standards and a qualitative assessment of these impacts. Additional impacts may include those on soils, vegetation, and visibility, as well as the expected general commercial, residential, and industrial growth associated with the new or modified source

3.10 Environmental Justice Analysis

It is recommended that the application contains a discussion of environmental justice impacts, such as disproportionate impacts to Black, Indigenous, People of Color (BIPOC) and low income populations. Before undergoing an environmental justice analysis, please contact DEQ to discuss potential areas of concern and the scope of the analysis.

3.11 Reporting of NSR Results

The results of an NSR analysis should include, at a minimum, the following elements:

- Graphical plots showing the distribution of modeled concentrations for the SIL and NAAQS analysis.
- For the SIL Analysis, a table showing the pollutant, averaging period, applicable SIL, maximum modeled concentration, and an indication if the concentration is above the SIL.
- For the SIL Analysis, a figure showing all the receptors that were above the SIL.
- For the NAAQS Analysis, a table showing the pollutant, averaging period, relevant modeled concentration (max, 99th percentile, etc.), background, total impact, NAAQS, and the percent of NAAQS.
- For the Class II PSD Increment Analysis, a table showing the pollutant, averaging period, applicable Class II PSD Increment, relevant modeled concentration, and an indication if the concentration is above the increment.
- For the Class I PSD Increment Analysis, a table showing the pollutant, averaging period, applicable Class I PSD Increment, relevant modeled concentration, and an indication if the concentration is above the increment.

- All input and output files, including pre- and post-processors, should be provided to
- DEQ.

4. CLEANER AIR OREGON MODELING COMPONENTS

The level of modeling required for a Cleaner Air Oregon assessment is dependent on the risk assessment level as determined by the facility. The following sections outline the elements of a modeling protocol and demonstration at each of these levels. For more information on the risk assessment analysis, please see the Recommended Procedures for Toxic Air Contaminant Health Risk Assessments (Risk Assessment Procedures) (DEQ 2020).

4.1 Fundamentals

Regardless of risk assessment level, there are a few considerations that are universally required. This includes the Exposure Location categories, Exposure Scenarios, and the method for modeling emissions a facility will use to undergo the risk assessment. These items are discussed prior to addressing the unique Risk Assessment Level requirements.

4.1.1 Exposure Locations

There are four types of Exposure Locations defined by the Cleaner Air Oregon Program:

- Residential exposure: includes long-term exposure to children and adults.
- Nonresident child exposure: includes schools and daycare facilities.
- Worker exposure, or nonresident adult exposure: includes workers in office buildings, commercial buildings, or industrial facilities.
- Acute exposure: includes areas where people may spend all or several hours of a day, such as parks, sports facilities, or agricultural fields.

For more information on Exposure Locations, see Section 2.4 of the Risk Assessment Procedures document. A crosswalk between state zoning classifications and recommended exposure locations is available on the Cleaner Air Oregon website.

4.1.2 Exposure Scenarios

There are seven risk Exposure Scenarios that facilities need to report risk for when conducting a risk assessment. These are developed by combining the four Exposure Locations with cancer and noncancer health effects. The seven Exposure Scenarios are as followed:

- Residential cancer
- Residential chronic noncancer
- Nonresident child cancer
- Nonresident child chronic noncancer
- Worker cancer
- Worker chronic noncancer
- Acute noncancer

A facility may choose to report non-cancer risk by target organ, as specified in the Risk Assessment Procedures document (DEQ 2020). If target organs are included, the analyses for the four noncancer Exposure Scenarios should be reported for each target organ.

4.1.3 Emissions Approach

An important factor in modeling and risk assessment is the decision of when to link the modeling function, which predicts level and location of impacts, and the assignment of risk to these modeled impacts. The standard approach is to use unit emission rates in the model (e.g., 1 g/s). The resulting modeled concentrations are then post-processed using the actual emission rates for each Toxic Air Contaminant (TAC) by Exposure Scenario.

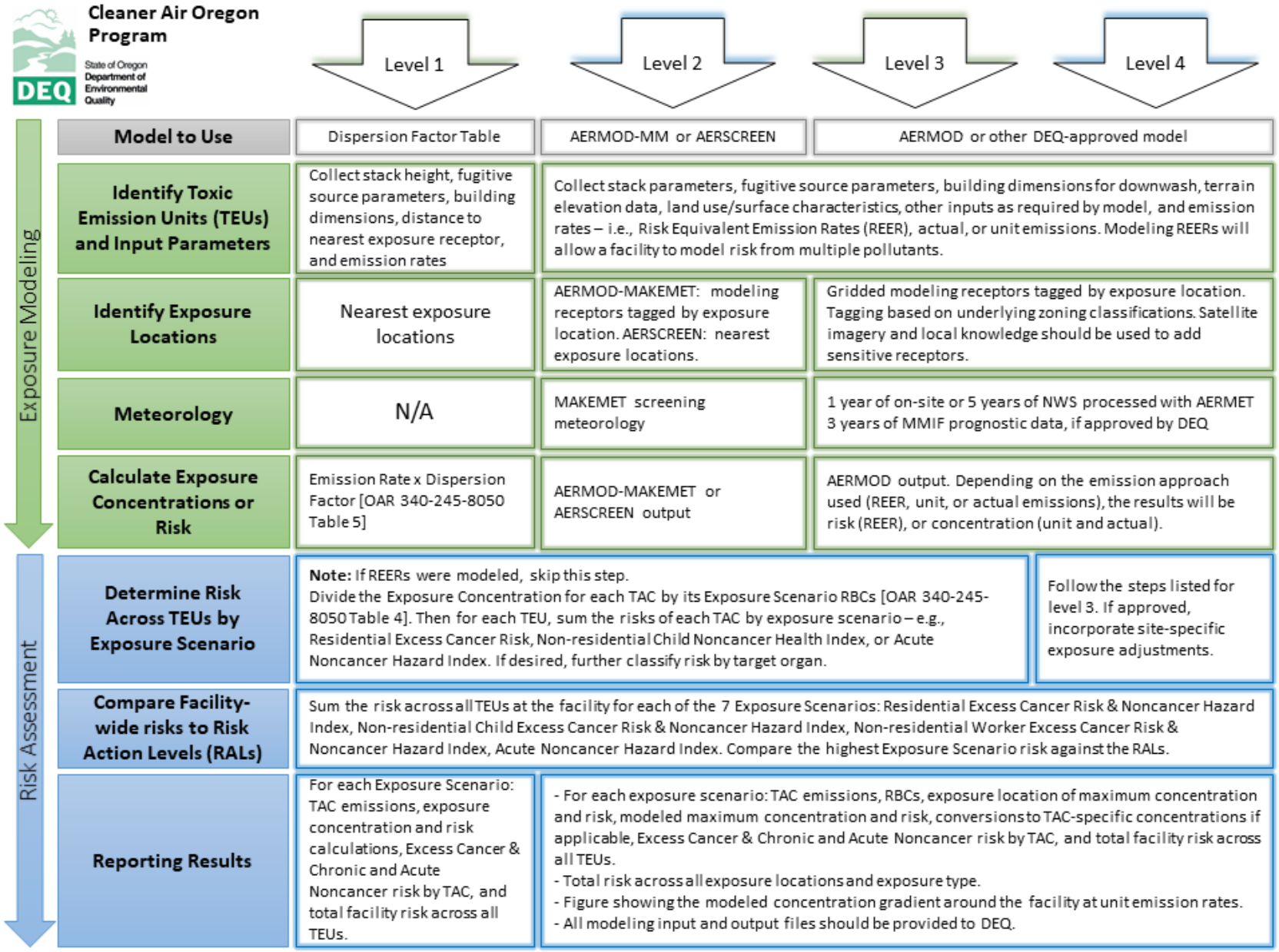
Another approach is to normalize TAC emissions, and their RBCs in $\mu g/m^3$, to a Risk Equivalent Emission Rate (REER) with an RBC of 1.0 $\mu g/m^3$. REER emissions can be summed across TACs and modeled. The modeled results will be risk, rather than concentrations, reducing post-modeling calculations. These REER modeled emissions can be used at all risk assessment levels, including the Level 1 lookup tables. A description of the unit emission rate and REER emissions approaches is provided in Appendix A.

4.2 Exposure and Risk Assessment Overview

The CAO risk assessment levels range from Level 1 to Level 4. These levels are briefly described below. For more information about these levels see the Risk Assessment Procedures document (DEQ 2020).

- Level 1 – This level involves choosing dispersion factors from [OAR 340-245-8050 Table 5] based on site-specific information. This includes stack height and distances to various Exposure Locations for stack emissions, and building height, dimensions, and distances to Exposure Locations for fugitive emissions. In the absence of site-specific information, a default dispersion factor representing a 5 m stack and a 50 m distance to the nearest exposure receptor (the upper left corner of the table) can be used. A Risk Assessment Work Plan is not required in Level 1, so the exposure assessment portion of the risk assessment should be specified in the Modeling Protocol.
- Level 2 – At this level, basic site-specific information (i.e., stack height, stack parameters, and distances to various Exposure Locations) is used to perform modeling using AERMOD in Screening Mode, either using AERMOD-MAKEMET (MM), or AERSCREEN, with internally generated MAKEMET. A Risk Assessment Work Plan is not required in Level 2, so the exposure assessment portion of the risk assessment should be specified in the Modeling Protocol.
- Level 3 – At this level, detailed site-specific information (i.e., stack heights, building heights, topography, and distances to various Exposure Locations) and representative meteorological data for the facility are used to perform complex modeling with AERMOD. A Risk Assessment Work Plan is required for Level 3. See the Risk Assessment Procedures document for more information on the Risk Assessment Work Plan.
- Level 4 – The most comprehensive risk assessment option uses the same air dispersion modeling conducted in Level 3, but may also consider factors to refine the exposure assessment. For more information, see the Risk Assessment Procedures document.

The graphic below is an overview of the Cleaner Air Oregon modeling and risk assessment process. The subsequent sections provide clarity to the requirements at each level.


Cleaner Air Oregon Program
State of Oregon Department of Environmental Quality
DEQ
Level 1
Level 2
Level 3
Level 4
Exposure Modeling
Risk Assessment
Model to Use
Dispersion Factor Table
AERMOD-MM or AERSCREEN
AERMOD or other DEQ-approved model
Identify Toxic Emission Units (TEUs) and Input Parameters
Collect stack height, fugitive source parameters, building dimensions, distance to nearest exposure receptor, and emission rates
Collect stack parameters, fugitive source parameters, building dimensions for downwash, terrain elevation data, land use/surface characteristics, other inputs as required by model, and emission rates – i.e., Risk Equivalent Emission Rates (REER), actual, or unit emissions. Modeling REERs will allow a facility to model risk from multiple pollutants.
Identify Exposure Locations
Nearest exposure locations
AERMOD-MAKEMET: modeling receptors tagged by exposure location. AERSCREEN: nearest exposure locations.
Gridded modeling receptors tagged by exposure location. Tagging based on underlying zoning classifications. Satellite imagery and local knowledge should be used to add sensitive receptors.
Meteorology
N/A
MAKEMET screening meteorology
1 year of on-site or 5 years of NWS processed with AERMET
3 years of MMIF prognostic data, if approved by DEQ
Calculate Exposure Concentrations or Risk
Emission Rate x Dispersion Factor [OAR 340-245-8050 Table 5]
AERMOD-MAKEMET or AERSCREEN output
AERMOD output. Depending on the emission approach used (REER, unit, or actual emissions), the results will be risk (REER), or concentration (unit and actual).
Determine Risk Across TEUs by Exposure Scenario
Note: If REERs were modeled, skip this step.
Divide the Exposure Concentration for each TAC by its Exposure Scenario RBCs [OAR 340-245-8050 Table 4]. Then for each TEU, sum the risks of each TAC by exposure scenario – e.g., Residential Excess Cancer Risk, Non-residential Child Noncancer Health Index, or Acute Noncancer Hazard Index. If desired, further classify risk by target organ.
Follow the steps listed for level 3. If approved, incorporate site-specific exposure adjustments.
Compare Facility-wide risks to Risk Action Levels (RALs)
Sum the risk across all TEUs at the facility for each of the 7 Exposure Scenarios: Residential Excess Cancer Risk & Noncancer Hazard Index, Non-residential Child Excess Cancer Risk & Noncancer Hazard Index, Non-residential Worker Excess Cancer Risk & Noncancer Hazard Index, Acute Noncancer Hazard Index. Compare the highest Exposure Scenario risk against the RALs.
Reporting Results
For each Exposure Scenario: TAC emissions, exposure concentration and risk calculations, Excess Cancer & Chronic and Acute Noncancer risk by TAC, and total facility risk across all TEUs.
- For each exposure scenario: TAC emissions, RBCs, exposure location of maximum concentration and risk, modeled maximum concentration and risk, conversions to TAC-specific concentrations if applicable, Excess Cancer & Chronic and Acute Noncancer risk by TAC, and total facility risk across all TEUs.
- Total risk across all exposure locations and exposure type.
- Figure showing the modeled concentration gradient around the facility at unit emission rates.
- All modeling input and output files should be provided to DEQ.

4.3 Modeling Considerations

The risk assessment level selected will affect the information to be submitted in the modeling protocol, as can be seen in the graphic above. The following sections walk through the different recommended components and how they vary depending on the risk assessment level – these components are as follows:

- Identify all Toxic Air Contaminants (TACs), with and without RBCs
- Identify Toxic Emission Units (TEU) and their respective TACs
- Identify Exposure Locations
- Identify a Meteorological Dataset
- Calculate Exposure Concentrations

4.3.1 Identify all TACs, with and without a Risk Based Concentration (RBC)

Regardless of the Risk Assessment Level, the facility should list each of the TACs emitted from the facility as provided in the emissions inventory. Preferably this will be done in two tables. The first table should list out all TACs with RBCs, representing the TACs that will be modeled and evaluated for risk. This table should include the following information:

- The total annual and max daily emissions from the facility of each TAC.
- The RBC for each TAC, as provided in OAR 340-245-8040 Table 4.

The second table should be a list of all TACs without RBCs; these results will be considered in the uncertainty section of the risk assessment.

4.3.1.1 Identify All Compounds that Require Conversion

Some TACs, such as lead chromate or nickel containing compounds, require conversion to their primary components when establishing accurate modeled emission rates for the component TACs with corresponding RBCs. This conversion should be done based on the molecular weight ratio of the individual TACs of interest to the emitted compound. A facility should include a table in the modeling protocol that includes each compound, the emissions of the compound as provided in the emissions inventory, the conversion multiplier, and the final emission rates to be modeled. An example of this table is below.

Emission Inventory Compound	Emissions in Inventory (lbs/yr)	Toxic Air Contaminant with RBC	CAS No.	Conversion Multiplier	Emissions to be Modeled (lbs/yr)[a]
Lead Chromate	50.0	Lead and Compounds	7439-92-1	0.641104978	32.06
Lead Chromate	50.0	Chromium VI, chromate and dichromate particulate	18540-29-9	0.160882695	8.04

Emission Inventory Compound	Emissions in Inventory (lbs/yr)	Toxic Air Contaminant with RBC	CAS No.	Conversion Multiplier	Emissions to be Modeled (lbs/yr)[a]
Barium Chromate	20.0	Chromium VI, chromate and dichromate particulate	18540-29-9	0.205217666	4.10

[a] Emissions to be Modeled = Emissions in Inventory x Conversion Multiplier

4.3.2 Identify all TEUs

Regardless of risk assessment level, the facility should identify all toxic emission units (TEUs). These are all emission units at the facility that release TACs reported in the emission inventory.

4.3.2.1 Level 1 Considerations

The facility should provide the following information:

- Location of each TEU in a figure, typically an aerial photograph.
- Emission type (point or fugitive) for each TEU.
- Stack height for point sources.
- Building dimensions for fugitive sources.
- Annual and max daily emission rates, in lbs/yr or lbs/day, respectively, of each TAC by TEU.

4.3.2.2 Level 2, Level 3, and Level 4 Considerations

The facility should provide the following information:

- Location of each TEU in UTM coordinates.
- Emission type (point, area, volume, etc.) for each TEU.
- The model-ready stack parameters for each TEU.
- Annual and max daily emission rates, in g/s, of each TAC by TEU.

Under Cleaner Air Oregon, a small number of toxic emission units (TEUs) are considered exempt per OAR 340-245-0060(3). Toxic emission units are emission units that release toxic air contaminants. TEUs that fall under the Natural Gas Exemption [OAR 340-245-0050(5)] must still report risk, following the procedures outlined in this document. Natural gas TEUs are excluded from determining compliance with the Risk Action Levels. If the natural gas TEU also uses other fuel types, the natural gas emissions and risk should be reported separately from other modes of operation. All other exempt TEUs do not need to report risk. Aggregate TEUs must report total aggregate risk to compare with the aggregate TEU risk level (OAR 340-245-0010 Table 1).If a facility is requesting to be a *de minimis* source, aggregate TEU risk must be added to the total source risk when comparing to the Risk Action Level.

4.3.3 Identify Exposure Locations

The facility must identify all Exposure Locations within the model boundaries as determined by the underlying land use zoning classifications. If the land use zoning categories are grouped together, a crosswalk should be provided showing how the original categories were grouped.

Satellite imagery and local knowledge should be used to add residential, child, and acute receptors to schools, daycares, parks, pools, and houses in areas zoned for other purposes. Agriculture Exposure Locations should be identified as acute, however there could be site-specific instances where worker Exposure Locations may be appropriate.

The modeling protocol should include a map showing all the identified Exposure Locations in comparison to the facility as well as the underlying land use zoning classifications. There may be places where it is not appropriate for risk to be evaluated for any of the exposure location types. This includes roadways and railroads. Please consult with DEQ about other situations that many be excluded from a risk assessment.

If excluding receptors from a risk analysis, it is important to include that receptor in the modeling domain to maintain the integrity of the receptor grid. Similar to receptors being tagged by exposure location, a receptor tagged as 'risk not evaluated' should still be modeled, but excluded from any risk calculations. See the facility FAQ page on the Cleaner Air Oregon website for more case by case exposure location questions.

When identifying Exposure Locations, each receptor should be assigned only one chronic exposure location (residential, child, or worker). All receptors, with the exception of excluded receptors, should be evaluated for acute exposure.

4.3.3.1 Level 1 and Level 2 AERSCREEN Considerations

Distances to all Exposure Locations should be identified. This should include the distance to the location of the nearest area zoned for each exposure location, or where satellite imagery or local knowledge indicates one exists (e.g., a house on farmland).

4.3.3.2 Level 2 AERMOD-MAKEMET Considerations

Define a receptor grid and tag each receptor for a specific Exposure Location using land use zoning information, satellite imagery, or local knowledge. Generally, a Cartesian grid is recommended, please contact DEQ if you wish to use a polar grid in a Level 2 Risk Assessment.

4.3.3.3 Level 3, and Level 4 Considerations

Define a receptor grid following the guidelines listed in the general modeling elements section of this document. Once the modeling receptors are established, each receptor must be tagged for a specific Exposure Location using land use zoning information, satellite imagery, or local knowledge.

4.3.3.4 Adjustment of CAO Modeling Domain

There may be situations where the standard modeling domain, as recommended in Section 2.4 of this document, is not appropriate for a CAO analysis. If a smaller modeling domain is desired, modeling receptor locations for CAO should extend from no less than 2 km and up to 10 km from the facility, and must include all areas where modeled risk is at or above 0.5 in 1 million Excess Cancer Risk, or at a Hazard Index (HI) of 0.5 for chronic and acute noncancer risk

For more information on Exposure Location identification, see Section 2.4 of the Risk Assessment Procedures document.

4.3.4 Identify a Meteorological Dataset

For most levels of risk assessment, a meteorological dataset is required to conduct the exposure modeling. The following outlines the different considerations at each level:

4.3.4.1 Level 1 Considerations

There is no need to identify a meteorological dataset.

4.3.4.2 Level 2 Considerations

A worst case meteorological dataset is required at a Level 2 Risk Assessment. This is created with MAKEMET. For AERSCREEN runs, this is done automatically, while AERMOD-MAKEMET runs must explicitly create this dataset.

4.3.4.3 Level 3 and Level 4 Considerations

Meteorological data for input to AERMOD should be representative of the facility location. There are numerous options for developing a representative data set. See Section 2.3 of this document.

4.3.5 Additional Considerations

For **Level 2 AERMOD-MAKEMET, Level 3, or Level 4**, there are additional inputs to AERMOD that are required. See the general modeling elements in Section 2 of this document for more information on the following elements:

- Dimensions of facility buildings and nearby buildings, if downwash influence is a consideration. For more information on downwash, see Section 2.2.4 of this document.
- Terrain data including running AERMAP on the source and receptor locations to get elevation for input to AERMOD.
- Urban/rural determination based on land use and population of the urban area. If the area is determined to be urban, the urban setting should be activated in AERMOD.

4.3.6 Calculate Exposure Concentrations

The method used to calculate exposure concentrations varies by level and the emission approach used (See Appendix A). In a Level 1 Risk Assessment, the exposure concentration is calculated using a dispersion factor lookup table, while Levels 2, 3, and 4 require dispersion modeling to determine the exposure concentration. In addition, the decision to model emissions at a unit emission rate or to use a Risk Equivalent Emission Rate (REER) will result in different calculation methodologies. See the Risk Assessment Procedures document (DEQ 2020) for more information about calculating exposure concentrations.

4.3.6.1 Level 1 Considerations

Exposure concentrations are calculated by the following equation:

C_{air} (µg/m^3) = ER (lbs/yr or lbs/day) x DF (µg/m^3 per lbs/yr or µg/m^3 per lbs/day)

Where:
C_{air} = air concentration (µg/m^3)
ER = emission rate (lbs/yr or lbs/day)
DF = dispersion factor (µg/m^3 per lbs/yr or µg/m^3 per lbs/day) obtained from [OAR 340-245-8050 Table 5].

When extracting the dispersion factors from Table 5, the following sub-tables should be used:

- Table 5A: Annual exposure to point sources
- Table 5B: Acute 24-hour exposure to point sources
- Table 5C: Annual exposure to fugitive sources
- Table 5D: Acute 24-hour exposure to fugitive sources

4.3.6.2 Level 2 Considerations

Modeled output from AERMOD-MM and AERSCREEN is given as 1-hr concentrations. The resulting maximum concentration (24-hr and annual) at each Exposure Location will be used in the risk assessment to compare against the Risk Action Levels. If a unit emission rate is used, modeled concentrations are factored by the ratio of actual emissions to the unit emission rate for each TAC by TEU. If a REER approach is used, the resulting concentrations will be risk. In AERSCREEN, each stack is modeled separately, while AERMOD-MAKEMET can run all stacks in one model run.

4.3.6.3 Level 3 and Level 4 Considerations

The resulting maximum concentration by Exposure Location will be used in the risk assessment analysis. To clarify, the highest annual average receptor for chronic exposure scenarios, and the maximum daily receptor for the acute exposure scenario should be used. In addition, the modeled results across the receptor grid will be used to graphically show the spatial distribution of risks and/or concentrations. See the Risk Assessment Procedures document for more information on Level 3 and Level 4 exposure concentrations.

4.4 Risk Assessment Considerations

Once an exposure concentration has been determined, risk assessment is similar across all levels of analysis, with a few key differences. This section briefly outlines the risk assessment process. For more detailed information on how to calculate risk, see the Recommended Procedures for Toxic Air Contaminant Health Risk Assessments document (DEQ 2020).

4.4.1 Calculating Risk

Risk is calculated by dividing the exposure concentrations by the RBCs. If risk equivalent emission rates were modeled, this step is not necessary. Risk should be calculated for all Exposure Scenarios for all TEUs.

4.4.2 Summarizing Risk

Once the risk at each TEU for each Exposure Scenario is calculated, the risk should be totaled across all TEUs. The results should be a total facility risk for each Exposure Scenario.

4.4.3 Reporting Risk

The level of detail required in the risk assessment report varies by the risk assessment level selected. You should provide sufficient information to allow DEQ to duplicate the results of the modeling and risk assessment during DEQ's review process. The following information outlines the recommendations by level. More information about the risk assessment report can be found in Section 3.7 of the Risk Assessment Procedures document (DEQ 2020)

4.4.3.1 Level 1 and Level 2 AERSCREEN

The following information should be reported:

- Provide a summary report detailing the process and findings of the risk assessment.
- Provide a map depicting the source location and all relevant exposure locations
- For each TAC, provide the RBCs from [OAR 340-245-8040 Table 4], dispersion factors from [OAR 340-245-8050 Table 5], maximum exposure concentrations, and total excess cancer risk and hazard quotients across all Exposure Scenarios reported by individual TEU and for the facility as a whole.

- Demonstrate how the total risk across the entire facility was calculated and compared to the risk action levels.

4.4.3.2 Level 2 AERMOD-MAKEMET, Level 3, and Level 4

The following information should be reported:

- Provide a summary report detailing the process and findings of the risk assessment.
- For each TAC, provide the RBCs from [OAR 340-245-8040 Table 4], location of maximum exposure concentration, maximum exposure concentration, and total excess cancer risk and hazard quotients across all Exposure Scenarios, reported for both TEUs and for the facility as a whole. Note: For chronic exposure scenarios, the maximum concentration is the highest annual average concentration (averaged across all years). For acute exposure, the maximum concentration is the highest daily concentration.
- Demonstrate how the total risk across the entire facility was calculated and compared to the risk action levels.
- Provide all modeling input and output files to DEQ. Specifically, DEQ requests the following files:
    - AERMOD input file
    - AERMOD source and receptor files (SOU and ROU)
    - Terrain data files
    - BPIP files
    - Met data (sfc and pfl files)
    - Other submitted modeling files needed for running input file
    - Table listing any referenced receptor IDs, geocoordinates (UTM, lat/long), and assigned Exposure Location.

In addition to the information above, DEQ requests the following information. If a facility does not provide this data, DEQ may create it to better understand the risk near a facility.

- Provide figures showing the concentration/risk plots and gradients around the facility for each exposure scenario.
- For modeling risk using the REER approach, present results in units of risk. Isopleths should represent total risk for each exposure scenario.

Example figures are provided below. DEQ prefers that contour plots show excess risk for a facility for each Exposure Scenario. In the example below, residential excess cancer risk from a facility is shown. This example does not represent real risk at any location, and is shown for demonstration purposes only.

Figure 1. Noncancer Acute Risk in Proxyland, USA

Figure 2. Zoomed in Noncancer Acute Risk in Proxyland, USA

Concentrations can also be provided in figures if risk is calculated during post processing. An example of a concentration plot is shown below.

Figure 3. Modeled Concentrations (µg/m^3) in Proxyland, OR

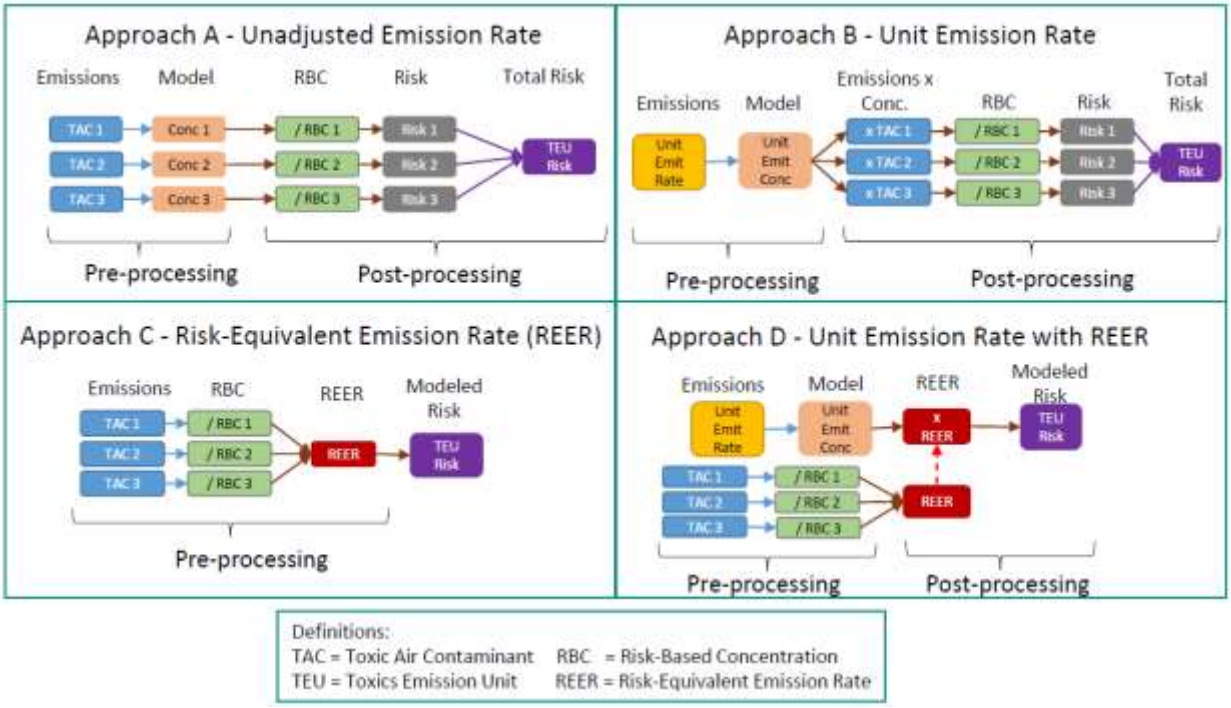
5. NSR/CAO MODELING CONSIDERATIONS

Some projects may require both NSR and CAO modeling. In this case, one modeling protocol is desired. All aspects outlined in this guidance should be included in the modeling protocol. Care should be taken to specify which sections will apply to only the NSR modeling, such as MERPs, competing source inventories, and background concentrations, or the CAO modeling, such as the identification of Exposure Locations and Scenarios. Contact DEQ to ensure all components are included and to determine where redundancies can be eliminated.

APPENDIX A: EMISSION APPROACHES

DEQ will consider four approaches for modeling multiple TACs from an emission unit or a facility: Actual Emissions, a Unit Emissions Rate (UER), a Risk Estimate Emission Rate (REER), and a UER combined with the REER approach. The methodologies for these approaches are illustrated in Figure A-1 and detailed below.

Figure A-1. Emission Approaches for CAO.



Approach A: Unadjusted Emission Rate

The unadjusted emission approach involved conducting a modeling run for each TAC, with the actual annual and daily emission rate, as reported in the approved emission inventory.

Approach B: Unit Emission Rate (UER)

The UER approach models each TEU with a unit emission rate of 1 g/s; if modeling in AERMOD each TEU would be assigned its own Source Group in order to track the resulting modeled concentrations from individual TEUs. After the model runs, the UER modeled concentrations from each Source Group are used to convert the actual TEU emission rates to exposure concentrations, which are then apportioned by the respective TAC emission rates from that TEU. From these exposure concentrations an excess cancer risk and/or HI can be calculated at each model receptor from each TAC. For an analysis with multiple TEUs and multiple TACs this can entail large, unwieldy spreadsheets, databases, or other data management processes in order to estimate maximum risks over the modeling domain as the results at each modeling receptor from each TEU must be summed separately by excess cancer risk, chronic HI, and acute HI.

Approach C: The Risk Equivalent Emission Rate (REER)

The REER approach utilizes TAC emission rates normalized to a constant RBC value for a specified exposure scenario (e.g. Residential Cancer or Acute Noncancer). If the TAC emission rates are normalized to an RBC of 1 µg/m^3, these TAC Risk Equivalent Emission Rates, or REERs, can be summed across TACs and modeled as a total risk rather than exposure concentration. The resulting model plots will represent isopleths of total risk for each Exposure Scenario. If modeling using AERMOD, TEUs can be assigned Source Groups to track the risk contribution from the individual TEUs.

To better understand this, consider Benzene with an emission rate of 0.00092 g/s and an RBC of 0.13 µg/m^3 for a Residential Cancer exposure scenario. Using the REER approach, we would determine the benzene REER as a new hypothetical reference toxic with an RBC of 1 µg/m^3, which represents a 1 in a million Excess Cancer Risk, or for noncancer, chronic or acute health effects, an HI of 1.0. This reference toxic can be referred to as a risk-equivalent emission rate, or for convenience, a name such as Proxytox. In this approach we derive an emission rate for Proxytox that is equivalent in risk to the TAC with its emission rate and RBC. We can do this by comparing the ratio of Proxytox in g/s to its RBC of 1 µg/m^3, and the ratio of the TAC emissions in g/s to its RBC, as shown in the calculation below:

$$\frac{Proxytox\ [g/s]}{Proxytox\ RBC\ [\mu g/m^3]} = \frac{TAC\ [g/s]}{TAC\ [\mu g/m^3]};$$

$$\therefore Proxytox\ [g/s] = \frac{TAC\ [g/s] * Proxytox\ RBC\ [\mu g/m^3]}{TAC\ RBC\ [\mu g/m^3]}$$

Following from the example above using a Benzene emission rate of 0.00092 g/s and RBC of 0.13 µg/m^3:

$$Proxytox\ [g/s] = \frac{0.00092\ [g/s] * 1\ [\mu g/m^3]}{0.13\ [\mu g/m^3]} = 0.0071\ [g/s]$$

This result indicates that emissions of Proxytox at 0.0071 g/s, relative to its RBC of 1.0 µg/m^3, will give the same risk as 0.00092 g/s of benzene relative to its RBC of 0.13 µg/m^3. The advantage with this approach is that we can add Proxytox emissions representing all the different TACs from all the TEUs in the same exposure scenario to calculate a total Proxytox emission rate for a facility, which can then be used to model total risk directly for that Exposure Scenario. This approach also provides an efficient method by which to directly analyze model results to determine the extent of receptors with risk values greater than 0.5 x 10^{-6} Excess Cancer Risk and 0.5 HI, as well as, immediately indicating the highest risk receptors for each Exposure Scenario.

Approach D: UER with REER

The UER and REER approach can be combined by applying the REER to the UER modeling results. This allows for fewer modeling runs and potentially fewer post-processing steps.

DEQ will accept any emission approach but may apply a different approach when verifying the risk assessment results.

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