GUIDELINE FOR AMBIENT IMPACT ASSESSMENT OF TOXIC AIR POLLUTANT EMISSIONS

AIR PROTECTION BRANCH

Revised March 2017

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Historical Background and Scope

The previous Air Toxic Guideline were approved by the Director of the Environmental Protection Division (EPD) approved on September 10, 1984 under the provisions of Rule 391-3-1-.02(2)(a)3.(ii) of the Georgia Rules for Air Quality Control. The 1984 guidelines were subsequently revised and approved for use on June 28, 1998. The 1998 guidelines have been further revised as presented in this document and have been approved for use under the above stated provisions in March 2017. This current version of the guidelines supersedes all previous versions.

The guidelines will be used in the review of air quality applications for permit to construct/modify potential sources which emit any toxic air pollutant listed in Appendix A of this guideline above the Minimum Emission Rate (MER) and in other cases at the Director's discretion. The guidelines may also be employed to estimate the environmental impact of toxic air pollutants in any situation where approved ambient monitoring data is not available.

The guidelines are more specifically the list of toxic air pollutants (TAPs) and their Acceptable Ambient Concentrations (AAC). This list of toxic air pollutants will be periodically revised per the procedures laid out in Appendix C of this guidance document.

Section 1 Overview of Risk Assessment

1.0 Introduction

The purpose of this document is to provide a guide for facility owners to demonstrate to the Air Protection Branch of the Georgia Environmental Protection Division (EPD) that any toxic air pollutant listed in Appendix A of this guidance document will comply with Georgia Rules For Air Quality Control 391-3-1.02(2)(a)1. and 391-3-1.02(2)(a)3 . A toxic air pollutant (TAP) is defined as any substance which may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard.

1.1 Hazard Identification

In compiling the list of toxic air pollutants EPD looked at the approach used by other states. EPD found that most of the states were regulating compounds listed on EPA's list of 187 HAPs. However, in addition to the 187 HAPs Georgia has historically regulated other TAP based on IRIS, OSHA and NIOSH data. In this version EPD is providing the regulated community with a definitive list of pollutants. In order to compile this list of pollutants EPD considered following resources:

- EPA list of Hazardous Air Pollutants (HAP) which is available at https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications
- EPA Integrated Risk Information System (IRIS) database. The IRIS database is available at https://www.epa.gov/iris
- Occupational Safety and Health Administration (OSHA) Table Z1 thru Z3 which is available at https://www.osha.gov/dsg/annotated-pels/tablez-1.html

In developing the final list EPD eliminated all the duplicates and also compounds listed in IRIS and OSHA/NIOSH database that had no inhalation toxicity data. The final list of toxic air pollutants is provided in Appendix A of this document.

1.2 Exposure Assessment

A considerable amount of time is spent both by EPD and the regulated community in establishing the Allowable Ambient Concentration (AAC) during the permit review process. This version provides AAC for all the TAPs listed in Appendix A. The procedures for establishing AAC are provided in Appendix C.

In addition to AAC, EPD has also provided in Appendix A of this guidance, the Minimum Emission Rate (MER) for each TAP. The MER was established by using worst case dispersion scenarios based on EPD experience and using SCREEN3 computer air dispersion model. SCREEN3 is considered a very conservative dispersion model and is available at https://www3.epa.gov/ttn/scram/dispersion_screening.htm#screen3.

In establishing MER EPD considered both short term and long term exposure. The short term exposure was based on 15 min AAC while the long term exposure is based on continuous exposure to the TAP for 8760 hours per year for 70 years. The long term and short term AACs are combined with the SCREEN3 results to characterize the potential risk to receptors and establish MER for each TAP.

If the facility wide emissions are below the MER then no further analysis is required for that pollutant. The basis for establishing minimum emission rate is provided in Appendix B.

Section 2 Determination of Toxic Air Pollutant Impact

2.1 Who is required to demonstrate compliance with AAC?

The applicant is required to demonstrate compliance with this standard when the facility emits any one of TAPs listed in Appendix A of this document.

A demonstration is required for:

(a) All new facilities that requires a State Implementation Plan (SIP) Permit

(b) All existing facilities that are adding new equipment that require a SIP permit and emit toxic air pollutant listed in Appendix A.

(c) All existing facilities that are modifying existing equipment that increases the emission of toxic air pollutant listed in Appendix A.

(d) All existing facilities that are modifying existing equipment or making process changes that result in emission of toxic air pollutant listed in Appendix A not previously emitted from the facility.

(e) In some cases a demonstration may be required for sources that have never demonstrated compliance with the AAC.

(f) Case by case as determined by the Division.

2.2 Procedures for Demonstrating Compliance with AAC

The general procedure for determination of TAPs impact is a simple comparative method.

- For a pollutant that has a facility-wide emission rate below the MER established in the table in Appendix A, no further analysis is required.

- For pollutant that has a facility-wide emission rate above the MER established in the table in Appendix A, further analysis is required.

The maximum ground-level concentration (MGLC) found by dispersion analysis (Section 4) is compared to the AAC (Appendix A) for the pollutant. If the MGLC is less than the AAC, TAP impact is determined to be insignificant.

If the facility wide TAP emissions are greater than MER follow the steps below

STEP 1: Locate the long term and/or short term AAC for the toxic air pollutant emitted from the facility from the list in Appendix A.

STEP 2: Derive MGLC using SCREEN3 computer dispersion analysis. Adjust to the appropriate averaging time (24 hours, 15 minutes and annual).

STEP 3: Compare MGLC from dispersion analysis with AAC

(i) If MGLC is less than AAC, proceed with application review, pollutant impact is determined to be insignificant.

(ii) If MGLC is greater than AAC, proceed to step 4.

STEP 4: Perform AERMOD or ISCST3 analysis for MGLC per the procedures provided in Section 4.

STEP 5: Compare MGLC from AERMOD or ISCST3 with AAC

(i) If MGLC is less than AAC, proceed with application review, pollutant impact is indicated to be insignificant.

(ii) If MGLC is greater than AAC, it indicates potential adverse toxic air pollutant impact. Reduction in pollutant emission rate, additional controls, and/or increase in stack height may be considered. If these options fail to demonstrate compliance then a site specific risk analysis is required.

STEP 6: Perform a site specific risk analysis. The Division accepts the following approaches:

- Model the nearest (or worst case) receptor located in a residence area and compare with the annual AAC value;
- Model the nearest (or worst case) receptor located in a business area and compare with 8-hour AAC value (OSHA based);
- Model all other receptors in grids and compare with 15 minute short term AAC value (STEL or Ceiling based).

In addition to demonstrating compliance with AACs, the Division reserves the right to request the applicant to evaluate additive/synergistic effects from multiple pollutant exposure. In cases when two or more pollutants are known to have the same effect (e.g. reproductive effects, kidney toxicity, CNS stimulant, etc.) upon the same organ system of the body, the impacts of simultaneous exposure are considered "additive. The following formula shall be used to evaluate additive effect:

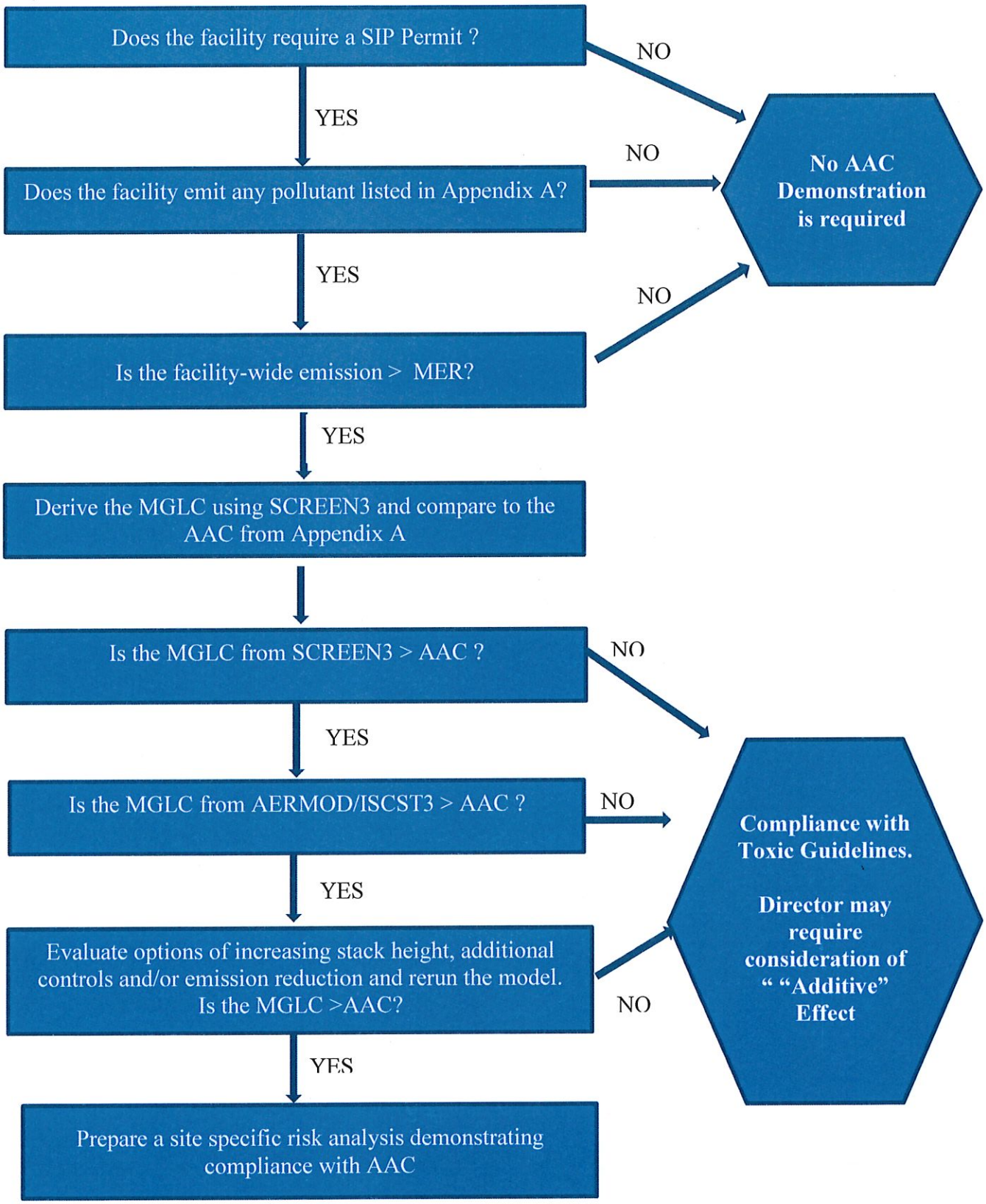
$$\frac{MGLC1}{AAC1} + \frac{MGLC2}{AAC2} \ldots\ldots + \frac{MGLCn}{AACn} > 1$$

Where;

MCLC 1, 2,n are the maximum ground level concentration of each pollutant
AAC 1,2,n are the acceptable ambient concentration of each pollutant.

If the result is greater than one then then further risk assessment would be necessary. The applicant should be able to demonstrate that annual air emissions from the facility would result in a cumulative non-cancer hazard and excess lifetime cancer risks that fall within the acceptable USEPA risk range/limits of 1E-06 to 1E-04 and below the cumulative hazard risk index of 1.

After performing a site specific risk assessment, If it is infeasible for the applicant to comply with the AAC's found in this guideline or the applicant is unable to demonstrate that the cumulative hazard risk index is below 1, the Director at his/her discretion may approve an application that includes the installation of New Source Maximum Available Control Technology (MACT) For the purpose of this guideline "New Source MACT" is defined as the control technology which reflects the maximum degree of reduction in emissions of hazardous air pollutants that the Director determines is achievable by the source, provided that such control technology is no less effective than the level of emission control which is achieved in practice by the best controlled similar source


Does the facility require a SIP Permit ?
NO
YES
Does the facility emit any pollutant listed in Appendix A?
NO
YES
Is the facility-wide emission > MER?
NO
YES
No AAC Demonstration is required
Derive the MGLC using SCREEN3 and compare to the AAC from Appendix A
Is the MGLC from SCREEN3 > AAC ?
NO
YES
Is the MGLC from AERMOD/ISCST3 > AAC ?
NO
YES
Evaluate options of increasing stack height, additional controls and/or emission reduction and rerun the model. Is the MGLC >AAC?
NO
YES
Compliance with Toxic Guidelines.
Director may require consideration of " "Additive" Effect
Prepare a site specific risk analysis demonstrating compliance with AAC

Section 3 Required Data for Dispersion Analysis

The following information is needed to perform an impact assessment of toxic air pollutant

3.1 Identification of Toxic Air Pollutants to be Emitted

The pollutants should be identified by the standard chemical nomenclature of the Chemical Abstract Service (CAS) with only a few substances that don't have a CAS number. Use of standard nomenclature provides information on elemental composition, and is the nomenclature most often used in reference materials on toxicity.

3.2 Emission source Parameters

For required parameters for each dispersion model, please refer to Section 5 and Section 6 for details.

3.3. Maximum Toxic Air Pollutant Emission Rate

This should be in the units of grams per second (g/s) for use in dispersion analysis (Some models allow lb/hr). This value should be the maximum emission rate expected under normal worse case conditions. This maximum emission rate is determined using the following methods.

A. When Performing 24-hour and 15-minute Evaluations

(i) For processes whose emissions are relatively constant (continuous processes) - The maximum emission rate is the maximum 1-hr average emission rate during worse case conditions. If 1-hr average maximum emission rates are not available use the shortest time period available.

(ii) For processes whose emissions vary significantly over time (batch processes)

a. 24-hour evaluations - The maximum emission rate is total emissions during the worst case batch divided by the length of the batch. The length of the batch does not include down time between batches.

b. 15-minute evaluations - The maximum emission rate is the emission rate during the highest emitting portion of the batch. For facilities which have multiple batch processes, the maximum emission rate should be based on the batch process which has the highest emission rate. Batch processes which routinely emit simultaneously should be considered together when determining the maximum emission rate to use in the evaluation. When a process emits more than one toxic pollutant, a maximum emission rate should be determined for each pollutant separately.

B. When Performing Annual Evaluations

(i) For processes whose emissions are relatively constant (continuous processes) - the maximum emission rate is the total annual emissions that would occur if the process is operating under worse case conditions for the entire year divided by 8760 hr/yr.

(ii) For processes whose emissions vary significantly over time (batch processes) - The maximum emission rate is the total emissions from the worst case batch times the maximum number of batches per year divided by 8760 hr/yr.

Section 4 Air Dispersion Analysis

The Division accepts screening analysis using the SCREEN3 and refined modeling analysis using AERMOD and ISCST3. Use of models other than those referred to in this Guideline must be approved by the Division. In addition, if the source is located in an area with complex terrain, AERMOD must be used. The computer models may be obtained from the following website https://www3.epa.gov/scram001/dispersionindex.htm. The latest versions of these models should be used where possible. The Division also allows the use of third party modeling software from Trinity Consultants (BREEZE), Lakes Environmental and Oris-Solution (BEEST). The Division requires the model to be run with the regulatory default options. If any non-default options are proposed to be used in the modeling, those options should be thoroughly discussed in the application.

4.1 General Notes on Dispersion Modeling Analysis

All guidance discussed in this document adheres to EPA guidance (U.S. Environmental Protection Agency, Guidelines on Air Quality Models – Appendix W to Part 51, U.S. EPA, Research Triangle Park, NC, 2005) for determining the impact of any pollutant. The guidelines presented in this document may change at any time as new guidance or new air quality modeling techniques become available.

A. Downwash

Due to safety factors built into this Guideline, the Division does not require the use of downwash calculations in any dispersion modeling procedures. The Division reserves the right to require the inclusion of downwash calculations if they are warranted by specific conditions.

B. Capped and Horizontal Stacks

For capped and horizontal stacks that are NOT subject to building downwash influences a simple screening approach can be applied, based on a procedure for ISCST3 that was approved by the Model Clearinghouse in July 1993. This approach is summarized below:

(i) Set the exit velocity to 0.001 m/s

(ii) Calculate an adjusted stack diameter (ds) that keeps the volume flow unchanged using the equation:

$$ds = 31.6 \times (d) \sqrt{V}$$

where,
ds = adjusted stack diameter
d = original stack diameter
V = original stack exit velocity

(iii) To appropriately account for stack-tip downwash, the user should first apply the non-default option of no stack-tip downwash (i.e., the NOSTD option on the MODELOPT keyword). Then, for capped stacks, the stack release height should be reduced by three actual stack diameters to account for the maximum stack-tip downwash adjustment, while no adjustment to release height should be made for horizontal releases.

C. Non Circular Stacks

For noncircular stack, use equivalent dimensions to calculate the inner diameter (d) of the circular stack using the formula

$$A = (\pi/4)\ d^2$$

where;
A = area of the noncircular stack

D. Industry Specific –Lumber Kilns

When modeling the Continuous drying Lumber kilns the following procedures will be used:

- For continuous kilns with powered vent, the total air toxic emissions should be split assuming 80 percent exit through powered vents and 20 percent exit through doors.
- For continuous kilns without powered vent assume all of the emissions are exited through the doors.
- Model the powered vent as a stack.
- The emission via the kiln door can be modeled in two ways:

As a volume source: Release height is set at the midpoint of the door. Initial lateral and vertical dimension are calculated from the actual door size plus the initial plume spread/rise, usually 2 ft for spread, and 5 ft for rise.

As a point source: Release height is set at the midpoint of the door. Effective diameter is the equivalent diameter calculated based on the equal area. Exit velocity is set to 0.001 m/s, similar to horizontal discharge.

Note: In addition, the default option is with stack-tip downwash. Use non-default option (without the stack-tip downwash) only if all gases exit through the kiln door.

When modeling Batch Kilns, assume all the emissions are exiting through the doors and model such release as volume source or point source adhering to same criteria as continuous kilns.

Section 5 SCREEN3 Modeling Procedures

An initial simplified evaluation of air toxic impacts can be made with the SCREEN3 model. For merging multiple stacks in SCREEN3 see section below.

Recommendations for each SCREEN3 run are as follows:

- The maximum toxic pollution emission rate (expressed as a 1-hour average) for each pollutant should be used.

- The option for flagpole receptors should generally not be used.

- Choose the rural or urban dispersion option based on the procedure in EPA's "Guideline on Air Quality Models (Revised)" which is available at https://www3.epa.gov/ttn/scram/guidance_permit.htm. The rural option is appropriate for most locations in Georgia.

- Choose the default atmospheric temperature of 293K.

- For each release, exercise the automated distance array choosing as the minimum receptor distance the appropriate nearest fence line distance for that release. The maximum concentration for that release will then be chosen as the maximum calculated concentration at or beyond the nearest fence line distance.

- For each release, the maximum 1-hour concentration should be noted. The maximum ground-level concentrations produced from the Gaussian dispersion model by the SCREEN3 computer program are estimated to be valid for an averaging period of 1 hour. Factors for adjusting the 1-hour average concentrations to applicable averaging periods are listed below:

Averaging Time	Multiplying Factor
15 minutes	1.32
24 hours	0.40
Annual	0.08

Further information on adjusting 1-hour concentrations to different averaging periods can be found in Appendix D of EPA-454/R-92-024, "Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants (REVISED)".

- In the case where emissions occur less than 24 hours per day, an additional adjustment to the 24-hour concentration can be made by using the formula described below.

$$C_e = C_c(y/1440)(1440/y)^{0.2} = C_c\,(y)^{0.8}\,(2.97 \times 10^{-3})$$

Where;

C_e is emission adjusted 24-hour concentration
C_c is calculated 24-hour concentration
y is minutes of emissions per 24 hours.

A. Merged Sources

These procedures are generally used during the use of SCREEN3 to minimize model runs for a facility that may emit two or more pollutants simultaneously from a single emission point. There will also be cases where the facility under review contains two or more emission points, each emitting two or more pollutants. If necessary, each pollutant from each emission point may be assessed for toxic impact. Such a procedure will certainly be time consuming if the facility under review has many emission points emitting many different pollutants. The following abbreviated toxic impact review schemes are recommended to be employed as time saving measures.

A single representative stack may be used to represent several sources that are identified as "similar". "Similar" stacks are those that are located less than 100 m apart, emit the same pollutants, and have stack heights and gas exit velocities differing by less than 20 percent. The procedure of merging sources identifies one (1) worst case representative stack from which all of the emissions from the sources involved are modeled. The merged stack is typically located at the closest location, of all the stacks involved, to the property line. This location, if all other parameters were the same, would result in the maximum modeled off-site concentrations. Dissimilar stacks may also be merged, but the merged source technique will result in conservatively high off-site concentrations. Therefore, merging dissimilar stacks should be done with caution. To determine which stack should be used as the representative stack, compute the parameter, M, for each stack, using the following equation:

$$M = (Hs\ V\ Ts) / Q$$

Where,

M = parameter accounting for the relative influence of stack height, plume rise, and emission rate on concentrations;
Hs = stack height (m);

$$V = (\pi/4)\ v2d2$$

Where;

V = stack gas volume flow rate parameter;

Note: Since it is possible for two stacks to have the same flow rate (V) and "M" value, while still having a large difference in momentum flux, and predicted ambient concentrations, the stack exit velocity (v) is squared when calculating the stack flow rate (V). This is consistent with the algorithms used by the SCREEN3 model to calculate momentum flux and will ensure a conservative emission point is used as the representative stack.

d = stack exit diameter (m);
v = stack gas exit velocity (m/s);
Ts = stack gas exit temperature (K); and
Q = pollutant emission rate (g/s).

The stack with the lowest "M" value is used as the representative stack. The sum of the emissions from all merged stacks is assumed to be emitted from the representative stack; i.e. the merged source is characterized by Hs1, Vs1, Ts1, and Q, where subscript 1 indicates the representative stack and Q = Q1 + Q2 + … + Qn (the combined emissions). The location of the representative stack is at the actual stack location closest to the property line.

To conservatively estimate ambient impacts using SCREEN3, the worst-case stack is determined using the lowest "M" factor calculated assuming a "Q" value of 1. The stack with the lowest "M" factor is then used as the representative stack. The sum of the facility-wide emissions and the parameters for the worst-case stack are then input into the model.

Section 6 Refined Modeling Procedures

If the screening modeling evaluation results in pollutant concentrations exceeding the AAC, the source emissions should be modeled using a refined dispersion model. The refined modeling analysis using either AERMOD or ISCST3 is acceptable. Use of other dispersion models needs to be approved on a case-by-case basis before application is submitted.

AERMOD is a steady-state plume model that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain. ISCST3 is a steady-state Gaussian plume model which can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. Effective December 9, 2005, AERMOD is the preferred and recommended refined dispersion model by EPA. As of December 9, 2006, AERMOD is fully promulgated as a replacement to ISCST3. The applicant is encouraged to use the preferred AERMOD as the refined dispersion modeling tool, though application using ISCST3 is also acceptable. The user may wish to review the material in the individual refined model user's guide and the EPA Guideline on Air Quality Models - Supplement C.

Both AERMOD and ISCST3 may be obtained from the EPA website (https://www3.epa.gov/ttn/scram/dispersionindex.htm). The latest versions of these models shall be used with the regulatory default options. Any non-default option proposed to be used in the modeling need to be approved by Georgia EPD before application is submitted.

The approved use of non-default options need to be documented in the application.

The following section listed the required input information and procedures for conducting refined modeling.

A. Plant layout information

Plant layout information for all facility buildings, emission sources and fence lines should be clearly provided within 2 meters of their actual locations.

B. Emission Source information

In general, industrial emission sources can be characterized in four different types:

1. Point sources

Examples include stacks, chimneys, exhaust fans, vents, and flares. The following input parameters are required:

Ptemis – point source emission rate in g/s,
Relhgt – release height above ground in meters,

Stktmp – stack gas exit temperature in degrees K,
Stkvel – stack gas exit velocity in m/s, and
Stkdia – stack inside diameter in meters.

2. Volume sources

Examples include open buildings, open storage tanks, building roof monitors, multiple vents, and conveyor belts. The following input parameters are required:

Vlemis – volume source emission rate in g/s,
Relhgt – release height (center of volume) above ground in meters,
Syinit – initial lateral dimension of the volume source in meters which is calculated by dividing the length of the side by 4.3, and
Szinit – initial vertical dimension of the volume source in meters which is calculate by dividing the vertical dimension by 2.5 for surface based sources and/or sources adjacent to building. For elevated sources not on or adjacent to a building, the vertical dimension is divided by 4.3

3. Area sources

Area sources refer to sources with low level or ground level releases with no plume rise such as storage piles, slag dumps, open pits, and lagoons. The following input parameters are required:

Aremis – area source emission rate in g/s/m2,
Relhgt – release height above ground in meters,
Xinit – length of X side the area source (in the east-west direction if Angle is 0 degrees) in meters,
Yinit – length of Y side of the area source (in the north-south direction if Angle is 0 degrees) in meters (optional),
Angle – orientation angle for the rectangular area in degrees from North, measured positive in the clockwise direction (optional), and
Szinit – initial vertical dimension of the area source plume in meters (optional).

4. Line sources

Examples include roadways and streets (motor vehicle sources) or lines of roof vents or stacks. In many cases, the line sources can be simulated using AERMOD as multiple point or volume sources. The applicant should contact the EPD before choosing this type of source.

C. Receptor Grids

1. Coordinate system

The Universal Transverse Mercator (UTM) system with NAD83 datum should be used for all coordinates used in the refined modeling such as stack emission locations,

fugitive emission locations, building locations, and receptors.

2. Receptor location and spacing

The applicant can use a combination of coarse and refined receptor grids to determine the maximum ground level concentration (MGLC) for each pollutant and averaging period evaluated. The receptors setup should provide sufficient resolution to identify the maximum pollutant impact. General guidelines are:

Receptors should be placed on the facility boundary and in the ambient area outside the facility provided that the general public does not have ready access to any portion of the property. Examples of areas with ready access to the public are: Commonly used roads; Rivers used by boaters or fishermen; Areas with picnic tables or jogging trails, etc.

Refined receptor grid should be placed at the facility fence-line and extending out to 2km with 100 meter spacing.

Coarse receptor grid should be set with 200 meter or 250 meter spacing extending from 2km to 5km.

In designing the receptor grid, emphasis should be placed on resolution and location and not on the total number of receptors. The MGLC must be resolved on the 100 m resolution grid. In addition, the refined grid should be of sufficient size to ensure that the refined receptor indicating the MGLC has at least one receptor on all sides showing a lower concentration.

3. Terrain elevations

Terrain elevations for receptors should be processed from USGS National Elevation Dataset (NED) data by the AERMAP program. The 1 or 1/3 arc-second NED data can currently be retrieved from the Multi-Resolution Land Use Characteristics Consortium website at: http://www.mrlc.gov

If the source is located in an area with complex terrain, AERMOD must be used.

D. Meteorological data

For AERMOD modeling, the EPA guidelines recommend the use of meteorological data from the closest and most representative NWS station. The Division has prepared five years meteorological data for various combinations of ASOS surface and upper air station pairings. The data can be located at https://epd.georgia.gov/air/georgia-aermet-meteorological-data. Assignment of station pairings to each county was based on distance to the centroid of the county, climatological zone, data collection period, and data completeness criteria. The data online will be updated periodically. For ISCST3 modeling analysis, five years of meteorological data from the nearest NWS station should be used. The data was prepared by the Division and can be downloaded via link

https://epd.georgia.gov/air/georgia-isc-meteorological-data. Due to the fact that ISCST3 is no longer a preferred model by EPA, the Division no longer provides updated meteorological data for this model.

E. Adjustment of Off-Property Maximum Pollutant Concentration to Correct Averaging Time

The model concentration outputs from ISCST3 and AERMOD are usually for averaging periods of 1-hour and longer. The 1-hour average concentrations should multiply by a factor of 1.32 when they are compared with a STEL or ceiling value for 15 minutes averaging period.

When the modeled concentration outputs are based on emissions which occur less than 24 hours per day, the modeled 24-hour concentration outputs are recommended to be adjusted using the following formula:

$$Ce = Cc(y/1440)\ (1440/y)^{0.2} = Cc\ (y)^{0.8}\ (2.97 \times 10\text{-}3)$$

Where;

Ce is the 24-hour concentration after adjustment,
Cc is the modeled 24-hour concentration outputs, and
y is minutes of emissions per 24 hours.

Reference Materials

U.S. Environmental Protection Agency, 1976. Estimation of Permissible Concentrations of Pollutants for Continuous Exposure. EPA-60/2-76-155. U.S. Environmental Protection Agency, Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1983. Regional Workshops on Air Quality Modeling: A Summary Report - Addendum. EPA-450/4-82-015. U.S. Environmental Protection Agency, Research Triangle Park, N.C.

U.S. Environmental Protection Agency, 1986. Guideline on Air Quality Models (Revised). EPA-450/2-78-027A. U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C. July 1986. Supplement A, 1988, Supplement B, 1993, Supplement C, 1995.

U.S. Environmental Protection Agency, 1986. User's Manual for the Human Exposure Model (HEM). U.S. EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C.

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Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, National Institute for Occupational Safety and Health (NIOSH). Washington, D.C. July 1997 DHHS (NIOSH) Publication Number 97-119

APPENDIX A

LIST OF TAP, AAC and MER

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
630206	1,1,1,2-tetrachloroethane	C	Annual	7.40E-06	IRIS RBAC			1.80E-03
594729	1,1-dichloro-1-nitroethane		24-hr	2.86E+01	NIOSH TWA	6000	OSHA CL	1.39E+03
76142	1,2-dichlorotetrafluoroethane; Fluorocarbon 114		24-hr	1.67E+04	OSHA PEL			8.11E+05
26471625	2,4/2,6toluene diisocyanate mixture (TDI)		Annual	7.00E-02	IRIS RfC			1.70E+01
504290	2-aminopyridine		24-hr	4.76E+00	OSHA PEL			2.32E+02
620111	3-amyl acetate; See Pentyl acetate		24-hr	1.25E+03	OSHA PEL	52500	ACGIH CL	6.08E+04
75070	acetaldehyde	B2	Annual	4.55E+00	IRIS RBAC	4500	ACGIH CL	1.11E+03
64197	acetic acid					3700	ACGIH STEL	5.46E+04
108247	acetic anhydride		24-hr	4.76E+01	OSHA	1251.5	ACGIH	2.32E+03
67641	acetone	D	24-hr	5.71E+03	OSHA PEL	178200	ACGIH STEL	2.78E+05
75868	acetone cyanohydrin as CN		24-hr	1.19E+01	OSHA PEL	500	NIOSH CL	5.79E+02
75058	acetonitrile	D	24-hr	1.67E+02	OSHA PEL	10100	ACGIH STEL	8.13E+03
98862	acetophenone	D	24-hr	1.17E+02	ACGIH TWA			5.69E+03
79276	acetylene tetrabromide		24-hr	3.33E+01	OSHA	141.4	ACGIH	1.62E+03
107028	acrolein	C	Annual	2.00E-02	IRIS RfC	23	ACGIH STEL	4.87E+00
79061	acrylamide	B2	Annual	7.70E-03	IRIS RBAC			1.87E+00
79107	acrylic acid		Annual	1.00E+00	IRIS RfC			2.43E+02
107131	acrylonitrile (vinyl cyanide)	B1	Annual	1.47E-01	IRIS RBAC	2170	OSHA CL	3.58E+01
309002	aldrin (aldrex; HHDN; drinox)		24-hr	5.95E-01	OSHA	5	ACGIH	2.90E+01
107186	allyl alcohol					950	ACGIH STEL	1.40E+04
107051	allyl chloride	C	Annual	1.00E+00	IRIS RfC	600	ACGIH STEL	2.43E+02
106923	allyl glycidyl ether (AGE)					4500	OSHA CL	6.64E+04
2179591	allyl propyl disulfide					1800	ACGIH STEL	2.66E+04
319846	alpha-Hexachlorocyclohexane (alpha-HCH)	B2	Annual	1.80E-03	IRIS RBAC			4.38E-01
98839	alpha-methylstyrene	B2	24-hr	5.76E+02	ACGIH TWA	48000	OSHA CL	2.80E+04
86884	alpha-naphthylthiourea (ANTU)		24-hr	7.14E-01	OSHA	30	ACGIH	3.48E+01
1344281	alumina; see Particulates not otherwise regulated		24-hr	3.57E+01	OSHA PEL			1.74E+03
7664417	ammonia		Annual	1.00E+02	IRIS RfC	2400	ACGIH STEL	2.43E+04
7773060	ammonium sulfamate		24-hr	1.19E+01	OSHA			5.79E+02
628637	amyl acetate (n-)		24-hr	1.25E+03	OSHA	26600	ACGIH	6.08E+04

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
626380	amyl acetate (sec-)		24-hr	1.55E+03	OSHA	53.1	ACGIH	7.83E+02
62533	aniline	B2	Annual	1.00E+00	IRIS RfC			2.43E+02
29191524	anisidine (ortho and para isomers)		24-hr	1.19E+00	OSHA PEL			5.79E+01
1309644	antimony trioxide (as Sb)		Annual	2.00E-01	IRIS RfC			4.87E+01
7440360	antimony, elemental & compounds (as Sb)		Annual	2.40E-01	IRIS RfC			5.84E+01
140578	aramite	B2	Annual	7.10E-06	IRIS RBAC			1.73E-03
7440382	arsenic, inorganic compounds (as As)	A	Annual	2.33E-04	IRIS RBAC	0.2	NIOSH CL	5.67E-02
7784421	arsine		Annual	5.00E-02	IRIS RfC	0.2	NIOSH 15-min	2.95E+00
1332214	asbestos (fibers/cm3)	A	Annual	4.00E-06	IRIS RBAC			9.73E-04
86500	azinphos methyl (guthion)		24-hr	4.76E-01	OSHA	20	ACGIH	2.32E+01
151564	aziridine (ethylene imine)					8.81	ACGIH	1.30E+02
103333	azobenzene	B2	Annual	3.10E-05	IRIS RBAC			7.54E-03
7440393	barium		24-hr	1.19E+00	OSHA PEL			5.79E+01
7727437	barium sulfate, total dust; no asbestos & < 1% crystalline silica		24-hr	1.19E+01	OSHA			5.79E+02
17804352	benomyl		24-hr	1.19E+00	OSHA			5.79E+01
71432	benzene	A	Annual	1.30E-01	IRIS RBAC	1600	OSHA STEL	3.16E+01
92875	benzidine	A	Annual	2.00E-05	IRIS RBAC			4.87E-03
94360	benzoyl peroxide		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
100447	benzyl chloride	B2	24-hr	1.23E+01	OSHA PEL	500	NIOSH CL	5.99E+02
7440417	beryllium, elemental	B1	Annual	4.00E-03	IRIS RBAC	0.5	OSHA CL	9.73E-01
126998	beta-chloroprene (2-chloro-1,3-butadiene)		24-hr	2.14E+02	OSHA PEL			1.04E+04
319857	beta-Hexachlorocyclohexane (beta-HCH)	B2	Annual	5.30E-04	IRIS RBAC			1.29E-01
92524	biphenyl (diphenyl)	D	24-hr	2.40E+00	OSHA PEL			1.17E+02
117817	bis(2-ethylhexyl)phthalate (DEHP)		24-hr	1.19E+01	OSHA PEL	1000	NIOSH CL	5.79E+02
111444	bis(chloroethyl) ether		24-hr	2.14E+02	OSHA	2900	ACGIH	1.04E+04
542881	bis(chloromethyl) ether (BCME)	A	Annual	1.60E-05	IRIS RBAC			3.89E-03
1304821	bismuth telluride		24-hr	2.38E+01	NIOSH TWA			1.16E+03
1303862	boron oxide		24-hr	3.57E+01	OSHA PEL			1.74E+03
7637072	boron trifluoride (boron fluoride)					300	OSHA CL	4.43E+03

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
7726956	bromine					130	ACGIH STEL	1.92E+03
108861	bromobenzene		Annual	6.00E+01	IRIS RfC			1.46E+04
74975	bromochloromethane		24-hr	2.50E+03	OSHA	105800	ACGIH	1.22E+05
74964	bromoethane		24-hr	2.12E+03	OSHA	22000	ACGIH	1.03E+05
75252	bromoform	B2	Annual	9.00E+00	IRIS RBAC			2.19E+03
74839	bromomethane (methyl bromide)	D	Annual	5.00E+00	IRIS RfC	8000	OSHA CL	1.22E+03
106990	butadiene (1,3-)	A	Annual	3.00E-02	IRIS RBAC	1100	OSHA CL	7.30E+00
71363	butanol (n-) (syn: n-butyl alcohol)	D	24-hr	7.14E+02	OSHA PEL	15200	ACGIH CL	3.48E+04
78922	butanol (sec-) (syn: sec-butyl alcohol)		24-hr	7.26E+02	NIOSH	45.5	NIOSH	6.71E+02
75650	butanol (tert-) (syn: tert-butyl alcohol)		24-hr	7.14E+02	OSHA			3.48E+04
111762	butoxyethanol (2-) (syn: BGBE; ethylene glycol monobutyl ether)		Annual	1.30E+04	IRIS RfC			3.16E+06
123864	butyl acetate (n-)		24-hr	1.69E+03	OSHA PEL	95000	ACGIH STEL	8.23E+04
105464	butyl acetate (sec-)		24-hr	2.26E+03	OSHA			1.10E+05
540885	butyl acetate (tert-)		24-hr	2.26E+03	OSHA			1.10E+05
1189851	butyl chromate (tert-) (as Cr)		24-hr	2.38E-03	NIOSH	0.01	ACGIH	1.16E-01
2426086	butyl glycidyl ether (n-) (syn: BGE)		24-hr	6.43E+02	OSHA	16000	ACGIH	3.13E+04
109795	butyl mercaptan (butanethiol)		24-hr	8.33E+01	OSHA	184.4	ACGIH	2.72E+03
109739	butylamine (n-) (syn: 1-aminobutane)					1500	OSHA CL	2.21E+04
98511	butyltoluene (p-tert-)		24-hr	1.43E+02	OSHA	12.1	NIOSH	1.78E+02
7440439	cadmium, elemental and compounds	B1	Annual	5.56E-03	IRIS RBAC	30	OSHA CL	1.35E+00
1317653	calcium carbonate (total dust)		24-hr	3.57E+01	OSHA PEL			1.74E+03
156627	calcium cyanamide		24-hr	1.20E+00	ACGIH TWA			5.84E+01
1305620	calcium hydroxide		24-hr	1.19E+01	NIOSH TWA			5.79E+02
1305788	calcium oxide		24-hr	1.19E+01	ACGIH TWA			5.79E+02
1344952	calcium silicate (synthetic): see Particulates not otherwise regulated		24-hr	2.38E+01	NIOSH TWA			1.16E+03
7778189	calcium sulfate; see Particulates not otherwise regulated		24-hr	2.38E+01	NIOSH TWA			1.16E+03

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
76222	camphor, synthetic		24-hr	4.76E+00	OSHA	1867.4	ACGIH	2.32E+02
63252	carbaryl (Sevin)		24-hr	1.19E+00	OSHA	5	ACGIH	5.79E+01
1333864	carbon black		24-hr	8.30E+00	OSHA PEL			4.04E+02
75150	carbon disulfide		Annual	7.00E+02	IRIS RfC	5400	OSHA CL	7.97E+04
56235	carbon tetrachloride (tetrachloromethane)	B2	Annual	6.67E-01	IRIS RBAC	15670	OSHA CL	1.62E+02
9004346	cellulose (paper fiber); see Particulates not otherwise regulated		24-hr	2.38E+01	NIOSH TWA			1.16E+03
1306383	cerium oxide and cerium compounds		Annual	9.00E-01	IRIS RfC			2.19E+02
57749	chlordane		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
12789036	chlordane (Technical)	B2	Annual	1.40E-04	IRIS RBAC			3.41E-02
55720995	chlorinated diphenyl oxide		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
7782505	chlorine	D	24-hr	3.60E+00	ACGIH TWA	300	OSHA CL	1.75E+02
10049044	chlorine dioxide		Annual	2.00E-01	IRIS RfC	90	OSHA STEL	4.87E+01
7790912	chlorine trifluoride (chlorine fluoride)					40	OSHA CL	5.90E+02
75683	chloro-1,1-difluoroethane (1-) (syn: HCFC-142b)		Annual	5.00E+04	IRIS RfC			1.22E+07
600259	chloro-1-nitropropane (1-)		24-hr	2.38E+01	NIOSH TWA			1.16E+03
107200	chloroacetaldehyde					300	OSHA CL	4.43E+03
532274	chloroacetophenone (2-) (syn: phenacyl chloride)		Annual	3.00E-02	IRIS RfC			7.30E+00
108907	chlorobenzene	D	24-hr	8.33E+02	OSHA PEL			4.05E+04
2698411	chlorobenzylidene malononitrile (o-)					39	ACGIH CL	5.75E+02
75456	chlorodifluoromethane		Annual	5.00E+04	IRIS RfC	437500	NIOSH STEL	6.45E+06
53469219	chlorodiphenyl (42% chlorine-PCB)		24-hr	2.38E+00	OSHA	100	ACGIH	1.16E+02
11097691	chlorodiphenyl (54% chlorine-PCB)		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
67663	chloroform (trichloromethane)	A<-B2	Annual	4.35E-01	IRIS RBAC	24000	NIOSH STEL	1.06E+02
74873	chloromethane (methyl chloride)		Annual	9.00E+01	IRIS RfC	41400	OSHA CL	2.19E+04
76062	chloropicrin (nitrotrichloromethane)		24-hr	1.67E+00	OSHA	67.2	ACGIH	8.11E+01

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
13530682	chromic Acid and chromates		24-hr	2.38E-03	NIOSH TWA			1.16E-01
7440473	chromium (VI), elemental & compounds (as Cr)	A	Annual	8.30E-05	IRIS RBAC	10	OSHA CEIL	2.02E-02
7440473	chromium II & III compounds (as Cr2O3)	D	24-hr	1.20E+00	OSHA PEL			5.84E+01
18540299	chromium(VI) Mist	A	Annual	8.00E-05	IRIS RBAC			1.95E-02
18540299	chromium(VI) Particluate		Annual	1.00E-01	IRIS Rfc			2.43E+01
2971906	clopidol		24-hr	2.38E+01	NIOSH TWA	2000	NIOSH CL	1.16E+03
7440484	cobalt, elemental & compounds as Co		24-hr	2.40E-01	OSHA PEL			1.17E+01
8007452	coke oven emissions	A	24-hr	2.00E-03	IRIS RBAC			9.73E-02
7440508	copper (dusts and mists; as Cu)	D	24-hr	2.40E+00	OSHA PEL			1.17E+02
136787	crag Herbicide		24-hr	2.38E+01	NIOSH TWA			1.16E+03
1319773	cresol (cresylic acid; all isomers)		24-hr	5.24E+01	OSHA	2000	ACGIH	2.55E+03
108394	cresol (m-) (syn: 3-methylphenol)	C	24-hr	5.20E+01	OSHA PEL			2.53E+03
95487	cresol (o-) (syn: 2-methylphenol)	C	24-hr	5.20E+01	OSHA PEL			2.53E+03
106445	cresol (p-) (syn: 4-methylphenol)	C	24-hr	5.20E+01	OSHA PEL			2.53E+03
123739	crotonaldehyde; beta-methylacrolein		24-hr	1.43E+01	OSHA PEL	90	ACGIH CL	6.95E+02
98828	cumene	D	Annual	4.00E+02	IRIS RfC			9.73E+04
506774	cyanogen chloride (chlorine cyanide)					75	ACGIH CL	1.11E+03
110827	cyclohexane	D	Annual	6.00E+03	IRIS RfC			1.46E+06
108930	cyclohexanol		24-hr	4.76E+02	OSHA PEL			2.32E+04
108941	cyclohexanone		24-hr	4.76E+02	OSHA PEL	20000	ACGIH STEL	2.32E+04
110838	cyclohexene		24-hr	2.42E+03	OSHA PEL			1.18E+05
542927	cyclopentadiene		24-hr	4.76E+02	OSHA	162000	ACGIH	2.32E+04
17702419	decaborane		24-hr	7.14E-01	OSHA	5	ACGIH	3.48E+01
8065483	demeton (Systox)		24-hr	2.38E-01	OSHA	5	ACGIH	1.16E+01
123422	diacetone alcohol (4-hydroxy-4-methyl-2-pentanone)		24-hr	5.71E+02	OSHA PEL			2.78E+04
334883	diazomethane		24-hr	9.52E-01	OSHA	34.3	ACGIH	4.64E+01
19287457	diborane		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
96128	dibromo-3-chloropropane (1,2-) (syn: CBCP)		Annual	2.00E-01	IRIS RfC			4.87E+01
106934	dibromoethane (1,2-) (syn: ethylene dibromide)	A	Annual	1.67E-02	IRIS RBAC	23050	OSHA CL	4.06E+00
107664	dibutyl phosphate		24-hr	1.19E+01	OSHA	500	ACGIH	5.79E+02
84742	dibutyl phthalate	D	24-hr	1.19E+01	OSHA PEL			5.79E+02
118525	dichloro-5,5-dimethyl hydantoin (1,3-)		24-hr	4.76E-01	OSHA PEL	40	NIOSH STEL	2.32E+01
95501	dichlorobenzene (1,2-)	D	24-hr	3.57E+02	ACGIH TWA	30000	OSHA CL	1.74E+04
106467	dichlorobenzene (1,4-)		Annual	8.00E+02	IRIS RfC			1.95E+05
75718	dichlorodifluoromethane		24-hr	1.18E+04	OSHA PEL			5.74E+05
50293	dichlorodiphenyltrichloroethane (DDT)		24-hr	2.38E+00	OSHA	100	ACGIH	1.16E+02
75343	dichloroethane (1,1-) (syn: ethylidene dichloride)	C	24-hr	9.52E+02	OSHA PEL			4.63E+04
107062	dichloroethane (1,2-) (syn: ethylene dichloride)	B2	Annual	3.85E-01	IRIS RBAC	40500	OSHA CL	9.37E+01
75354	dichloroethylene (1,1-) (syn: vinylidene chloride)	C	Annual	2.00E+02	IRIS RfC	7900	ACGIH STEL	4.87E+04
540590	dichloroethylene (1,2-) (includes cis- & trans- isomers; syn: acetylene dichloride)		24-hr	1.88E+03	OSHA PEL			9.15E+04
94757	dichlorophenoxyacetic acid, salts & esters (syn: 2,4-D, salts & esters)		24-hr	2.38E+01	OSHA PEL			1.16E+03
78875	dichloropropane (1,2-) (syn: propylene dichloride)		Annual	4.00E+00	IRIS RfC	51700	ACGIH STEL	9.73E+02
542756	dichloropropene (1,3-)	B2	Annual	2.00E+00	IRIS RBAC			4.87E+02
62737	dichlorovos (DDVP)		Annual	5.00E-01	IRIS RfC			1.22E+02
102545	dicyclopentadienyl iron dust		24-hr	2.38E+01	NIOSH TWA			1.16E+03
60571	dieldrin (dieldrex; octolox; quintox)		24-hr	5.95E-01	OSHA	10	ACGIH	2.90E+01
111422	diethanolamine		24-hr	4.80E+00	ACGIH TWA			2.34E+02
109897	diethylamine					4500	ACGIH STEL	6.64E+04
100378	diethylaminoethanol (2-)		24-hr	1.19E+02	OSHA PEL			5.79E+03
75616	difluorodibromomethane		24-hr	2.05E+03	OSHA	85800	ACGIH	9.97E+04

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
75376	difluoroethane (1,1-)		Annual	4.00E+04	IRIS RfC			9.73E+06
2238075	diglycidyl ether (DGE)					280	OSHA CL	4.13E+03
108838	diisobutyl ketone (2,6-dimethyl-4-heptanone)		24-hr	6.90E+02	OSHA PEL			3.36E+04
108189	diisopropylamine		24-hr	4.76E+01	OSHA	2069.5	ACGIH	2.32E+03
109875	dimethoxymethane (methylal)		24-hr	7.38E+03	OSHA	311000	ACGIH	3.59E+05
127195	dimethyl acetamide		24-hr	8.33E+01	OSHA	3562.4	ACGIH	4.06E+03
77781	dimethyl sulfate	B2	24-hr	1.19E+01	OSHA PEL			5.79E+02
300765	dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate		24-hr	7.14E+00	OSHA	100	ACGIH	3.48E+02
124403	dimethylamine		24-hr	4.29E+01	OSHA	922.3	ACGIH	2.09E+03
1300738	dimethylaminobenzene (xylidine)		24-hr	2.36E-02	NIOSH			1.15E+00
121697	dimethylaniline (N,N-) (syn: dimethyl phenylamine)					5000	ACGIH STEL	7.38E+04
119937	dimethylbenzidine (3,3-)					2	NIOSH CL	2.95E+01
68122	dimethylformamide		Annual	3.00E+01	IRIS RfC			7.30E+03
57147	dimethylhydrazine (1,1-)		24-hr	2.38E+00	OSHA PEL	15	NIOSH CL	1.16E+02
534521	dinitro-o-cresol (4,6-)		24-hr	4.76E-01	OSHA PEL			2.32E+01
25321146	dinitrotoluene		24-hr	3.60E+00	OSHA PEL			1.75E+02
121142	dinitrotoluene (2,4-)	B2	24-hr	3.60E+00	OSHA PEL			1.75E+02
123911	dioxane (1,4-) (syn: 1,4-diethylene dioxide)	B2	24-hr	8.57E+02	OSHA TWA	360	NIOSH CL	5.31E+03
101688	diphenylmethane-4,4'-diisocyanate (MDI)	D	Annual	6.00E-01	IRIS RfC	20	OSHA CL	1.46E+02
34590948	dipropylene glycol methyl ether		24-hr	1.43E+03	OSHA PEL	90000	ACGIH STEL	6.95E+04
12415348	emery; see Particulates not otherwise regulated		24-hr	3.57E+01	OSHA PEL			1.74E+03
72208	endrin (hexadrin; mendrin; endrex)		24-hr	2.38E-01	OSHA	10	ACGIH	1.16E+01
106898	epichlorohydrin (1-chloro-2,3-epoxypropane)		Annual	1.00E+00	IRIS RfC			2.43E+02
106887	epoxybutane (1,2-)		Annual	2.00E+01	IRIS RfC			4.87E+03
64175	ethanol		24-hr	4.50E+00	ACGIH TWA			2.19E+02
141435	ethanolamine (2-aminoethanol)					1500	ACGIH STEL	2.21E+04

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
110805	ethoxyethanol (2-) (syn: cellosolve; EGEE)		Annual	2.00E+02	IRIS RfC			4.87E+04
111159	ethoxyethyl acetate (2-) (syn: ethylene glycol monoethyl acetate)		24-hr	6.43E+00	NIOSH TWA			3.13E+02
141786	ethyl acetate		24-hr	3.33E+03	OSHA PEL			1.62E+05
140885	ethyl acrylate		24-hr	2.38E+02	OSHA	20000	ACGIH	1.16E+04
541855	ethyl amyl ketone (5-methyl-3-heptanone)		24-hr	3.10E+02	OSHA	5200	ACGIH	1.51E+04
100414	ethyl benzene	D	Annual	1.00E+03	IRIS RfC	54300	ACGIH STEL	2.43E+05
106354	ethyl butyl ketone (3-heptanone)		24-hr	5.48E+02	OSHA	23300	ACGIH	2.67E+04
75003	ethyl chloride		Annual	1.00E+04	IRIS RfC			2.43E+06
60297	ethyl ether (diethyl ether)		24-hr	2.86E+03	OSHA	180000	ACGIH	1.39E+05
109944	ethyl formate		24-hr	7.14E+02	OSHA	30300	ACGIH	3.48E+04
75081	ethyl mercaptan (ethanethiol)		24-hr	3.10E+00	ACGIH TWA	2500	OSHA CL	1.51E+02
2104645	ethyl p-nitrophenyl benzenethiophosphonate (EPN)		24-hr	1.19E+00	OSHA	132.2	ACGIH	5.79E+01
78104	ethyl silicate		24-hr	2.02E+03	OSHA	85000	ACGIH	9.85E+04
75047	ethylamine					2760	ACGIH STEL	4.07E+04
107073	ethylene chlorohydrin (2-chloroethanol)					330	ACGIH CL	4.87E+03
107211	ethylene glycol		24-hr	4.14E+02	NIOSH LD50	10000	ACGIH CL	2.01E+04
628966	ethylene glycol dinitrate					100	OSHA CL	1.48E+03
75218	ethylene oxide (oxirane)	A	24-hr	1.43E+00	OSHA PEL	900	OSHA STEL	6.95E+01
107153	ethylenediamine		24-hr	5.95E+01	OSHA	2458	ACGIH	2.90E+03
14484641	ferbam; ferric N,N-dimethylthiocarbamate		24-hr	2.38E+01	NIOSH TWA			1.16E+03
12604589	ferrovanadium dust		24-hr	2.38E+00	OSHA PEL	300	NIOSH STEL	1.16E+02
16984488	fluoride dust		24-hr	5.95E+00	OSHA PEL			2.90E+02
7782414	fluorine		24-hr	4.76E-01	OSHA	155.4	ACGIH	2.32E+01
50000	formaldehyde	B1	Annual	7.70E-01	IRIS RBAC	245	OSHA STEL	1.87E+02
64186	formic acid		24-hr	2.14E+01	OSHA	940.7	ACGIH	1.04E+03
98011	furfural		24-hr	4.80E+01	OSHA PEL			2.34E+03
98000	furfuryl alcohol		24-hr	4.76E+02	OSHA	40000	ACGIH	2.32E+04

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
58899	gamma-hexachlorocyclohexane (lindane)		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
56815	glycerol (glycerin)		24-hr	1.19E+01	OSHA PEL			5.79E+02
556525	glycidol (2,3-epoxy-1-propanol)		24-hr	3.57E+02	OSHA	6100	ACGIH	1.74E+04
7782425	graphite, natural respirable dust		24-hr	5.95E+00	NIOSH TWA			2.90E+02
13397245	gypsum Dust		24-hr	2.38E+01	NIOSH TWA			1.16E+03
76448	heptachlor		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
1024573	Heptachlor epoxide	B2	Annual	2.10E-03	IRIS RBAC			5.11E-01
142825	heptane (n-)	D	24-hr	4.76E+03	OSHA PEL	200000	ACGIH STEL	2.32E+05
118741	hexachlorobenzene	B2	Annual	2.00E-02	IRIS RBAC			4.87E+00
77474	hexachlorocyclopentadiene	D	Annual	2.00E-01	IRIS RfC			4.87E+01
57653857	hexachlorodibenzo-p-dioxin (HxCDD)	B2	Annual	2.00E+00	IRIS Rfc			4.87E+02
67721	hexachloroethane	C	Annual	2.50E+01	IRIS RBAC			6.08E+03
1335871	hexachloronaphthalene		24-hr	4.76E-01	OSHA	20	ACGIH	2.32E+01
822060	hexamethylene diisocyanate (1,6-)		Annual	1.00E-02	IRIS RfC	14	NIOSH STEL	2.43E+00
110543	hexane (n-)		Annual	7.00E+02	IRIS RfC	17600	ACGIH STEL	1.70E+05
108849	hexyl acetate (sec-)		24-hr	7.14E+02	OSHA			3.48E+04
302012	hydrazine/hydrazine sulfate	B2	Annual	2.00E-03	IRIS RBAC	4	NIOSH CL	4.87E-01
10035106	hydrogen bromide		24-hr	2.38E+01	OSHA	661.7	ACGIH	1.16E+03
7647010	hydrogen chloride		Annual	2.00E+01	IRIS RfC	700	OSHA CL	4.87E+03
74908	hydrogen cyanide	D	Annual	8.00E-01	IRIS RfC	500	ACGIH CL	1.95E+02
7664393	hydrogen fluoride (hydrofluoric acid; as F)		24-hr	5.84E+00	OSHA PEL	245	ACGIH STEL	2.84E+02
7722841	hydrogen peroxide		24-hr	3.33E+00	OSHA	139	ACGIH	1.62E+02
7783075	hydrogen selenide (as Se)		24-hr	4.76E-01	OSHA	16.5	ACGIH	2.32E+01
7783064	hydrogen sulfide		Annual	2.00E+00	IRIS RfC	2790	OSHA CL	4.87E+02
2148878	hydrogen sulfide		Annual	2.00E+00	IRIS RBAC			4.87E+02
123319	hydroquinone (dihydroxybenzene)		24-hr	4.80E+00	OSHA PEL	200	ACGIH TWA	2.34E+02
7553562	iodine					100	OSHA CL	1.48E+03
1309371	iron oxide fume		24-hr	2.38E+01	OSHA PEL			1.16E+03
123922	isoamyl acetate		24-hr	1.25E+03	OSHA	26600	ACGIH	6.08E+04
123513	isoamyl alcohol (primary and secondary)		24-hr	8.57E+02	OSHA	36000	ACGIH	4.17E+04

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
110190	isobutyl acetate		24-hr	1.67E+03	OSHA PEL			8.11E+04
78831	isobutyl alcohol (isobutanol)		24-hr	7.14E+02	OSHA PEL			3.48E+04
78591	isophorone	C	24-hr	3.33E+02	OSHA PEL	2800	ACGIH CL	1.62E+04
108214	isopropyl acetate		24-hr	2.26E+03	OSHA PEL	118500	ACGIH STEL	1.10E+05
67630	isopropyl alcohol (isopropanol)		24-hr	2.33E+03	OSHA PEL	98000	ACGIH STEL	1.14E+05
108203	isopropyl ether		24-hr	5.00E+03	OSHA	104000	ACGIH	2.43E+05
4016142	isopropyl glycidyl ether (IGE)		24-hr	5.71E+02	OSHA	23700	ACGIH	2.78E+04
75310	isopropylamine		24-hr	2.86E+01	OSHA	1208.6	ACGIH	1.39E+03
1332587	kaolin; (respirable dust containing no		24-hr	2.38E+01	NIOSH TWA			1.16E+03
463514	ketene		24-hr	2.14E+00	OSHA	85.9	ACGIH	1.04E+02
7439921	lead, elemental, inorganic compounds(as Pb)	B2	24-hr	1.20E-01	OSHA PEL			5.84E+00
7580678	lithium hydride		24-hr	5.95E-02	OSHA	2.5	ACGIH	2.90E+00
546930	magnesite Dust		24-hr	2.38E+01	NIOSH TWA			1.16E+03
1309484	magnesium oxide fume		24-hr	3.57E+01	OSHA PEL			1.74E+03
121755	malathion, total dust		24-hr	3.57E+01	OSHA	1351.3	ACGIH	1.74E+03
108316	maleic anhydride		24-hr	2.38E+00	OSHA PEL			1.16E+02
7439965	manganese, elemental & compounds (as Mn)	D	Annual	5.00E-02	IRIS RfC	500	OSHA CL	1.22E+01
7439976	mercury, alkyl compounds (as Hg)	D	Annual	3.00E-01	IRIS RfC	10	OSHA CL	7.30E+01
7439976	mercury, elemental & inorganic compounds (as Hg)		Annual	3.00E-01	IRIS RfC	10	OSHA CL	7.30E+01
	mercury, organic compounds except akyl & aryl (as Hg)					10	OSHA CL	1.48E+02
141797	mesityl oxide		24-hr	2.38E+02	OSHA	6018.4	ACGIH	1.16E+04
72435	methoxychlor		24-hr	3.57E+01	OSHA	1000	ACGIH	1.74E+03
109864	methoxyethanol (2-) (syn: methyl cellosolve)		Annual	2.00E+01	IRIS RfC			4.87E+03
79209	methyl acetate	C	24-hr	4.76E+02	OSHA PEL	75750	ACGIH TLV	2.32E+04
74997	methyl acetylene (propyne)		24-hr	3.93E+03	OSHA	164000	ACGIH	1.91E+05
96333	methyl acrylate	D	24-hr	8.33E+01	OSHA PEL			4.05E+03
67561	methyl alcohol (methanol)		24-hr	6.19E+02	OSHA PEL	32800	ACGIH STEL	3.01E+04
110496	methyl cellosolve acetate		24-hr	1.19E+00	NIOSH TWA			5.79E+01

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
78933	methyl ethyl ketone (2-butanone)		Annual	5.00E+03	IRIS RfC	88500	ACGIH STEL	1.22E+06
107313	methyl formate		24-hr	5.95E+02	OSHA	12300	ACGIH	2.90E+04
60344	methyl hydrazine (monomethyl hydrazine)		24-hr	4.50E-02	ACGIH TWA	35	OSHA CL	2.19E+00
74884	methyl iodide (iodomethane)		24-hr	6.70E+01	OSHA PEL			3.26E+03
110123	methyl isoamyl ketone		24-hr	1.13E+03	OSHA	93400	ACGIH	5.50E+04
108112	methyl isobutyl carbinol (methyl amyl alcohol)		24-hr	2.38E+01	OSHA	1045	ACGIH	1.16E+03
108101	methyl isobutyl ketone (hexone)		Annual	3.00E+03	IRIS RfC	30700	ACGIH STEL	4.53E+05
624839	methyl isocyanate		24-hr	1.19E-01	OSHA	4.67	ACGIH	5.79E+00
74931	methyl mercaptan (methanethiol)		24-hr	2.40E+00	ACGIH TWA	2000	OSHA CL	1.17E+02
80626	methyl methacrylate		Annual	7.00E+02	IRIS RfC			1.70E+05
110430	methyl n-amyl ketone		24-hr	1.11E+03	OSHA PEL			5.39E+04
591786	methyl n-butyl ketone (2-hexanone)		Annual	3.00E+01	IRIS RfC	4100	ACGIH STEL	7.30E+03
107879	methyl propyl ketone (2-pentanone)		24-hr	1.26E+03	NIOSH TWA	53000	ACGIH STEL	6.14E+04
1634044	methyl tert-butyl ether		Annual	3.00E+03	IRIS RfC			7.30E+05
74895	methylamine		24-hr	2.86E+01	OSHA PEL	1900	ACGIH STEL	1.39E+03
108872	methylcyclohexane		24-hr	4.76E+03	OSHA PEL			2.32E+05
25639423	methylcyclohexanol		24-hr	1.12E+03	OSHA	23400	ACGIH	5.45E+04
583608	methylcyclohexanone		24-hr	1.10E+03	OSHA	22900	ACGIH	5.33E+04
101144	methylene bis 2-chloroaniline (4,4-) (syn: MOCA)		24-hr	2.60E-01	ACGIH TWA			1.27E+01
75092	methylene chloride (dichloromethane)	B2	Annual	2.13E+01	IRIS RBAC	43460	OSHA CL	5.18E+03
7439987	molybdenum, insoluble cmpds & dusts (as Mo)		24-hr	3.57E+01	OSHA			1.74E+03
100618	monomethyl aniline		24-hr	2.14E+01	OSHA	219.2	ACGIH	1.04E+03
110918	morpholine		24-hr	1.67E+02	OSHA PEL	10500	NIOSH STEL	8.11E+03
108383	m-Xylenes		Annual	1.00E+02	IRIS RfC	65500	NIOSH STEL	2.43E+04
100743	n- Ethylmorpholine		24-hr	5.48E+01	NIOSH TWA			2.67E+03
8030317	Naphtha, coal tar		24-hr	9.52E+02	OSHA PEL			4.64E+04
91203	naphthalene		Annual	3.00E+00	IRIS RfC	7500	ACGIH STEL	7.30E+02

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
13463393	nickel carbonyl (as Ni)	B2	24-hr	1.70E-02	OSHA PEL			8.27E-01
	nickel refinery dust	A	Annual	4.00E-03	IRIS RBAC			9.73E-01
12035722	nickel subsulfide (as Ni)	A	Annual	2.00E-03	IRIS RBAC			4.87E-01
7440020	nickel, elemental & compounds (as Ni)	A	24-hr	7.94E-01	OSHA PEL			3.86E+01
54115	nicotine		24-hr	1.20E+00	OSHA PEL			5.84E+01
1929824	nitrapyrin (2-chloro-6-(trichloromethyl)pyridine)		24-hr	2.38E+01	NIOSH TWA	2000	NIOSH STEL	1.16E+03
7697372	nitric acid		24-hr	1.20E+01	OSHA PEL	1000	ACGIH STEL	5.84E+02
10102439	nitric oxide; NO		24-hr	7.14E+01	OSHA PEL			3.48E+03
100016	nitroaniline (p-)		24-hr	7.14E+00	NIOSH			3.48E+02
98953	nitrobenzene	D	24-hr	1.20E+01	OSHA PEL			5.84E+02
100005	nitrochlorobenzene (p-)		24-hr	2.38E+00	OSHA			1.16E+02
79243	nitroethane		24-hr	7.38E+02	OSHA PEL			3.59E+04
10102440	nitrogen dioxide		24-hr	7.14E-01	ACGIH TWA	180	NIOSH STEL	3.48E+01
7783542	nitrogen trifluoride		24-hr	6.90E+01	OSHA PEL			3.36E+03
55630	nitroglycerin					200	OSHA CL	2.95E+03
75525	nitromethane		24-hr	5.95E+02	OSHA PEL			2.90E+04
108032	nitropropane (1-)		24-hr	2.14E+02	OSHA PEL			1.04E+04
79469	nitropropane (2-)		Annual	2.00E+01	IRIS RfC			4.87E+03
62759	nitrosodimethylamine (N-)	B2	Annual	7.10E-04	IRIS RBAC			1.73E-01
88722	nitrotoluene, o, m, p Isomer		24-hr	2.62E+01	NIOSH TWA			1.27E+03
55185	n-nitrosodiethylamine	B2	Annual	4.30E-02	IRIS RBAC			1.05E+01
924163	n-nitroso-di-n-butylamine	B2	Annual	1.60E-03	IRIS RBAC			3.89E-01
930552	n-nitrosopyrrolidine	B2	Annual	1.40E-02	IRIS RBAC			3.41E+00
2234131	octachloronaphthalene		24-hr	2.38E-01	OSHA	10	ACGIH	1.16E+01
20816120	osmium tetroxide		24-hr	4.76E-03	OSHA	0.16	ACGIH	2.32E-01
144627	oxalic acid		24-hr	2.38E+00	OSHA	100	ACGIH	1.16E+02
7783417	oxygen difluoride		24-hr	2.38E-01	OSHA	11	ACGIH	1.16E+01
95476	o-Xylenes		Annual	1.00E+02	IRIS RfC	65500	NIOSH STEL	2.43E+04
56382	parathion		24-hr	2.38E-01	OSHA	5	ACGIH	1.16E+01
19624227	pentaborane		24-hr	2.38E-02	OSHA	1.2	ACGIH	1.16E+00
1321648	pentachloronaphthalene		24-hr	1.19E+00	OSHA	50	ACGIH	5.79E+01
87865	pentachlorophenol	B2	24-hr	1.20E+00	OSHA PEL			5.84E+01

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
115775	pentaerythritol, respirable fraction		24-hr	3.57E+01	OSHA	1000	ACGIH	1.74E+03
109660	pentane		24-hr	7.02E+03	OSHA PEL	180000	NIOSH CL	3.42E+05
594423	perchloromethyl mercaptan		24-hr	1.90E+00	OSHA	76	ACGIH	9.27E+01
7616946	perchloryl fluoride		24-hr	3.21E+01	OSHA	1257.7	ACGIH	1.56E+03
108952	phenol	D	24-hr	4.52E+01	OSHA PEL	6000	NIOSH CL	2.20E+03
101848	phenyl ether, vapor		24-hr	1.67E+01	OSHA	1.6	ACGIH	2.36E+01
122601	phenyl glycidyl ether (PGE)		24-hr	1.43E+02	OSHA	0.613	NIOSH	9.04E+00
106503	phenylenediamine (p-)		24-hr	2.38E-01	OSHA			1.16E+01
100630	phenylhydrazine		24-hr	5.24E+01	OSHA	0.0618	NIOSH	9.12E-01
7786347	phosdrin (mevinphos)		24-hr	2.38E-02	NIOSH	0.0275	NIOSH	4.06E-01
75445	phosgene (carbonyl chloride)		Annual	3.00E-01	IRIS RfC	80	NIOSH CL	7.30E+01
7803512	phosphine		Annual	3.00E-01	IRIS RfC	100	NIOSH STEL	7.30E+01
7664382	phosphoric acid		Annual	1.00E+01	IRIS RfC	300	ACGIH STEL	2.43E+03
7723140	phosphorus	D	24-hr	2.40E-01	OSHA PEL			1.17E+01
10026138	phosphorus pentachloride		24-hr	2.38E-01	OSHA			1.16E+01
1314803	phosphorus pentasulfide		24-hr	2.38E+00	OSHA	0.3	NIOSH	4.43E+00
7719122	phosphorus trichloride		24-hr	3.57E+00	NIOSH	0.3	NIOSH	4.43E+00
85449	phthalic anhydride		24-hr	1.43E+01	NIOSH			6.95E+02
1918021	picloram Total Dust		24-hr	3.57E+01	OSHA PEL			1.74E+03
88891	picric acid (2,4,6-trinitrophenyl)		24-hr	2.38E-01	OSHA	0.03	NIOSH	4.43E-01
83261	pindone (2-pivalyl-1,3-indandione)		24-hr	2.38E-01	OSHA			1.16E+01
26499650	plaster of Paris; calcium sulfate hemihydrate;		24-hr	2.38E+01	NIOSH TWA			1.16E+03
7440064	platinum		24-hr	2.38E+00	NIOSH TWA			1.16E+02
151508	potassium cyanide (as CN)		24-hr	1.19E+01	OSHA PEL	500	OSHA CL	5.79E+02
1310583	potassium hydroxide					200	ACGIH CL	2.95E+03
74986	propane		24-hr	4.29E+03	OSHA PEL			2.09E+05
123386	propionaldehyde		Annual	8.00E+00	IRIS RfC			1.95E+03
109604	propyl acetate (n-)		24-hr	2.00E+03	OSHA PEL	105000	ACGIH STEL	9.73E+04
71238	propyl alcohol (n-) (propanol)		24-hr	1.19E+03	OSHA PEL	62500	ACGIH STEL	5.79E+04
627134	propyl nitrate (n-)		24-hr	2.62E+02	OSHA	10700	ACGIH	1.27E+04
107982	propylene glycol monomethyl ether		Annual	2.00E+03	IRIS RfC	54000	ACGIH STEL	4.87E+05
75569	propylene oxide (1,2-epoxypropane)	B2	Annual	2.70E+00	IRIS RBAC			6.57E+02

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
75558	propyleneimine (1,2-) (syn: 2-methyl aziridine)		24-hr	1.19E+01	OSHA	0.00211	NIOSH	3.11E-02
106423	p-Xylenes		Annual	1.00E+02	IRIS RfC	65500	NIOSH STEL	2.43E+04
8003347	pyrethrum		24-hr	1.19E+01	OSHA			5.79E+02
110861	pyridine		24-hr	3.57E+01	OSHA			1.74E+03
7440166	rhodium, metal		24-hr	2.38E-01	OSHA PEL			1.16E+01
299843	ronnel		24-hr	2.38E+01	NIOSH			1.16E+03
83794	rotenone		24-hr	1.19E+01	OSHA			5.79E+02
7783791	selenium Hexafluoride		24-hr	9.52E-01	OSHA PEL			4.64E+01
7782492	selenium, elemental & compounds (as Se)	D	24-hr	4.80E-01	OSHA PEL			2.34E+01
409212	silicon carbide		24-hr	2.38E+01	NIOSH TWA			1.16E+03
7440213	silicon; see Particulates not otherwise regulated		24-hr	2.38E+01	NIOSH TWA			1.16E+03
7440224	silver, metal and soluble cmpds. (as Ag)	D	24-hr	2.40E-02	OSHA PEL			1.17E+00
62748	sodium fluoroacetate		24-hr	1.19E+00	OSHA			5.79E+01
1310732	sodium hydroxide		24-hr	4.80E+00	OSHA PEL	200	ACGIH CL	2.34E+02
7803523	stibine		24-hr	2.38E-01	OSHA			1.16E+01
8052413	stoddard solvent		24-hr	8.33E+02	NIOSH	180	NIOSH	2.66E+03
7789062	strontium chromate	A1	24-hr	1.20E-03	ACGIH TWA			5.84E-02
57249	strychnine		24-hr	3.57E-01	OSHA			1.74E+01
100425	styrene (phenylethylene; vinyl benzene)		Annual	1.00E+03	IRIS RfC	85200	OSHA CL	2.43E+05
2551624	Sulfur hexafluoride		24-hr	1.43E+04	OSHA PEL			6.95E+05
10025679	sulfur monochloride		24-hr	1.43E+01	OSHA	0.552	NIOSH	8.14E+00
5714227	sulfur pentafluoride		24-hr	5.95E-01	OSHA	0.0104	NIOSH	1.53E-01
7664939	sulfuric acid		24-hr	2.40E+00	OSHA PEL	300	ACGIH STEL	1.17E+02
2699798	sulfuryl fluoride		24-hr	4.76E+01	OSHA	4	NIOSH	5.90E+01
7440257	tantalum, metal and oxide dust		24-hr	1.19E+01	OSHA	1	NIOSH	1.48E+01
608731	technical Hexachlorocyclohexane (t-HCH)	B2	Annual	5.10E-04	IRIS RBAC			1.24E-01
7783804	tellurium hexafluoride		24-hr	4.76E-01	OSHA PEL			2.32E+01
3383968	temephos Total Dust		24-hr	2.38E+01	NIOSH TWA			1.16E+03

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
76120	tetrachloro-1,2-difluoroethane (1,1,2,2-)		24-hr	9.93E+03	OSHA PEL			4.83E+05
76119	tetrachloro-2,2-difluoroethane (1,1,1,2-)		24-hr	9.93E+03	OSHA PEL			4.83E+05
1746016	tetrachlorodibenzo-p-dioxin (2,3,7,8-)		24-hr	1.50E-03	NIOSH LD50			7.30E-02
79345	tetrachloroethane (1,1,2,2-)	C	Annual	1.70E+00	IRIS RBAC			4.14E+02
127184	tetrachloroethylene (perchloroethylene)		24-hr	1.61E+03	OSHA PEL	135600	OSHA CL	7.86E+04
1335882	tetrachloronaphthalene		24-hr	4.76E+00	OSHA			2.32E+02
78002	tetraethyl lead (as Pb)		24-hr	7.14E+00	OSHA			3.48E+02
107493	tetraethyl pyrophosphate (TEPP)		24-hr	1.19E-01	OSHA			5.79E+00
811972	tetrafluoroethane (1,1,1,2-) (syn: HFC-134a)		Annual	8.00E+04	IRIS RfC			1.95E+07
109999	tetrahydrofuran		24-hr	1.41E+03	OSHA PEL	73700	ACGIH STEL	6.84E+04
75741	tetramethyl lead (as Pb)		24-hr	1.79E-01	OSHA			8.69E+00
3333526	tetramethyl succinonitrile		24-hr	7.14E+00	OSHA			3.48E+02
509148	tetranitromethane		24-hr	1.90E+01	OSHA			9.27E+02
137268	thiram		24-hr	1.19E+01	OSHA			5.79E+02
21651194	tin, organic compounds		24-hr	2.38E-01	OSHA PEL	20	ACGIH STEL	1.16E+01
13463677	titanium dioxide (total dust)		24-hr	3.57E+01	OSHA PEL			1.74E+03
108883	toluene	D	Annual	5.00E+03	IRIS RfC	113000	OSHA CL	1.22E+06
584849	toluene-2,4-diisocyanate		Annual	7.00E-02	IRIS RfC	14	OSHA CL	1.70E+01
95534	toluidine (o-)		24-hr	5.24E+01	OSHA PEL			2.55E+03
8001352	toxaphene (chlorinated camphene)	B2				100	ACGIH STEL	1.48E+03
126738	tributyl phosphate		24-hr	5.24E+00	OSHA			2.55E+02
76131	trichloro-1,2,2-trifluoroethane (1,1,2-)					959000	ACGIH STEL	1.41E+07
120821	trichlorobenzene (1,2,4-)	D	24-hr	5.20E+01	NIOSH LD50	4000	ACGIH CL	2.53E+03
71556	trichloroethane (1,1,1-) (syn: methyl chloroform)	D	24-hr	4.52E+03	OSHA PEL	245000	ACGIH STEL	2.20E+05
79005	trichloroethane (1,1,2-)	C	Annual	6.25E+00	IRIS RBAC			1.52E+03
79016	trichloroethylene		Annual	2.00E+00	IRIS RBAC	107500	OSHA CL	4.87E+02
1321659	trichloronaphthalene		24-hr	1.19E+01	OSHA			5.79E+02

CAS Number	Substance Name	Weight of Evidence Classification	Long Term Averaging Period	Long Term AAC (ug/m3)	Long Term Data Source	15-min AAC (ug/m3)	Short Term Data Source	MER (1) (lb/yr)
88062	trichlorophenol (2,4,6-)	B2	Annual	3.00E+00	IRIS RBAC			7.30E+02
93765	trichlorophenoxyacetic acid (2,4,5-)		24-hr	2.38E+01	OSHA PEL			1.16E+03
96184	trichloropropane (1,2,3-)		Annual	3.00E-01	IRIS RfC			7.30E+01
121448	triethylamine		Annual	7.00E+00	IRIS RfC	1200	ACGIH STEL	1.70E+03
75638	trifluorobromomethane		24-hr	1.45E+04	OSHA			7.07E+05
118967	trinitrotoluene (2,4,6-) (syn: TNT)		24-hr	1.19E+00	NIOSH TWA			5.79E+01
78308	triorthocresyl phosphate		24-hr	2.38E-01	OSHA			1.16E+01
115866	triphenyl phosphate		24-hr	7.14E+00	OSHA			3.48E+02
8006642	turpentine		24-hr	1.33E+03	OSHA			6.49E+04
1314621	vanadium pentoxide, fume as V2O5		24-hr	1.20E-01	ACGIH TWA	10	OSHA CL	5.84E+00
108054	vinyl acetate		Annual	2.00E+02	IRIS RfC	5280	ACGIH STEL	4.87E+04
593602	vinyl bromide		Annual	3.00E+00	IRIS RfC			7.30E+02
75014	vinyl chloride (syn: chloroethylene)	A1	Annual	2.30E-01	IRIS RBAC	1280	OSHA STEL	5.60E+01
25013154	vinyl toluene		24-hr	1.14E+03	OSHA			5.56E+04
81812	warfarin		24-hr	2.38E-01	OSHA			1.16E+01
1330207	xylene (o-, m-, p-isomers)		Annual	1.00E+02	IRIS RfC	65500	ACGIH STEL	2.43E+04
7646857	zinc chloride fume		24-hr	2.38E+00	OSHA PEL	200	ACGIH STEL	1.16E+02
13530659	zinc chromate, as Cr		24-hr	2.38E-03	NIOSH TWA			1.16E-01
1314132	zinc oxide, fume		24-hr	1.20E+01	OSHA PEL	1000	ACGIH STEL	5.84E+02
557051	zinc Stearete		24-hr	2.38E+01	NIOSH TWA			1.16E+03
7440677	zirconium compounds		24-hr	1.19E+01	OSHA			5.79E+02

Note

1. MER applicable to point source emissions only. Volume and Area sources should not use MER for screening purposes.

APPENDIX B

REFINED MODEL CHECKLIST

Refined Model Check List (including general information)

- **Description of New Source or Source / Process Modification**: provide a short description of the new or modified source(s) and a brief discussion of how this change affects facility production or process operation.
- **Source / Pollutant Identification**: provide a table of the affected pollutants, by source, which identifies the source type (point, area, or volume), maximum pollutant emission rates over the applicable averaging period(s), and, for point sources, indicate if the stack is capped or non-vertical (C/N).
- **Pollutant Emission Rate Calculations**: indicate how the pollutant emission rates were derived (e.g., AP-42, mass balance, etc.) and where applicable, provide the calculations.
- **Site / Facility Diagram**: provide a diagram or drawing showing the location of all existing and proposed emission sources, buildings or structures, public right-of-ways, and the facility property (toxics) / fence line boundaries. The diagram should also include a scale, true north indicator, and the UTM or latitude/longitude of at least one point.
- **Topographic Map**: A topographic map covering approximately 5km around the facility must be submitted. The facility boundaries should be annotated on the map as accurately as possible.
- **Model**: The latest version of AERMOD or ISCST3 should be used.
- **Source / Source Emission Parameters**: Provide a table listing the sources modeled and the applicable source emission parameters.
- **Terrain**: Use digital elevation data from the USGS NED database.
- **Coordinate System**: Specify the coordinate system used to identify the source, building, and receptor locations. A North American Datun of 1983 (NAD83) is recommended to use in AERMAP input file.
- **Receptors**: The receptor grid should be of sufficient size and resolution to identify the maximum pollutant impact.
- **Meteorology**: Indicate the Division pre-processed, 5-year dataset used in the modeling demonstration.
- **Modeling Results**: For each affected pollutant and averaging period, modeling results should be summarized and presented in tabular format indicating compliance status with the applicable AAC.
- **Modeling Files:** Submit input and output files for AERMOD, AERMAP or ISCST3. Also include the contour plot files and raw meteorological data.

APPENDIX C

Basis of Minimum Emission Rate

Basis for Minimum Emission Rate Determination

The following criteria were used to perform a SCREEN3 modeling to establish the minimum quantity for each compound. These criteria provide poor dispersion and hence a worst case ground level concentration.

- Stack Height = 20 feet
- Stack Gas Velocity = 10 ft/sec
- Stack Gas Temperature = 77 degrees F
- Stack Inside Diameter = 1 feet
- No Downwash
- Target MGLC = 50 % of the AAC

Calculation of Dilution Factor

The SCREEN3 modeled was run with the above parameters using a 1 lb/hr emission rates to get a maximum ground level concentration. SCREEN3 results provided MGLC of 225 ug/m^3. Since we were targeting 50 % AAC the MGLC was doubled to 450 ug/m3.

Dilution factor (DF) was then calculated to be 0.0022 (1/450). The 1 hour MGLC of 450 ug/m^3 was then multiplied by 0.40 for 24 hour average and 0.08 for annual average in accordance with the SCREEN3 guidance to get an 24 hour dilution factor (DF 24) which equates to 0.0055 (1/(450*0.40) and Annual dilution factor (DF Annual) which equates to 0.028(1/(450*0.08). For short term AAC of 15 min the 1 hour MGLC was multiplied by 1.32 to provide a 15 min Dilution factor (DF 15) which equates to 0.0017 (1/(450*1.32)

Calculating the MER

The minimum quantities for each averaging period were calculated by multiplying the established AAC for each averaging period with their respective dilution factors.

Based on 15 minute AAC

MER (lb/yr) = 15 min AAC x (DF 15) X 8760 hr/yr
= 15 min AAC x 14.75

Based on a 24 hour AAC

MER (lb/yr) = 24 hour AAC x (DF 24) x 8760 hr/yr = 24 hour AAC x 48.67

Based on a Annual AAC

MER (lb/yr) = Annual AAC x (DF Annual) x 8760
= Annual AAC x 243.33

The lowest of the MERs calculated for each substance using the above procedure was selected as MER for that substance. MER were rounded to one significant digit.

APPENDIX D

PROCEDURES FOR ESTABLISHING AAC

The List of Toxic Air Pollutants in Appendix A will be updated periodically as new data becomes available.

An acceptable ambient concentration must be developed for each toxic air pollutant added or revised. It is recommended that toxicity data be used according to the following priority schedule. The reviewer should use the most recent version of each reference that is available at the time of the review

STEP 1: Acquisition of Pollutant Toxicity Data

- IRIS – Inhalation Unit Risk (IUR) presented as the upper bound estimate of the probability of cancer formation per unit concentration of chemical, expressed in risk per microgram of TAP in a cubic meter of air (ug/m^3)-1 and/or reference concentration (RfC) that is not likely to cause deleterious health effects during a chronic exposure period, expressed in mg-TAP/ m^3 air (mg/m^3). IUR estimates are used to calculate the RBAC that provides a cancer risk of 1 in 1,000,000 for pollutants with an IRIS weight-of-evidence classification of A, 1 in 100,000 for pollutants with an IRIS weight-of-evidence classification of B, and 1 in 10,000 for pollutants with an IRIS weight-of-evidence classification of C. The RBAC is calculated by dividing the cancer risk by the IUR. The results of this calculation are generally presented in IRIS. Both the RfC and RBAC are given an annual average. If both values exist use the lower one.

- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL) – PELs should be converted to units of mg/m^3. These are found in 29 CFR Part 1910 Subpart Z. Ceiling limits should be used for acute sensory irritant and toxic evaluations based on a 15-minute average. Eight-hour Time Weighted Average (TWA) are used for chronic effect evaluations based on a 24-hour average.

- American Conference of Governmental Industrial Hygienist (ACGIH)- Recommended Threshold Limit Values (TLV's) should be converted to units of mg/m3. Use short term exposure limits (STEL) or ceiling limits (CL) for acute sensory irritant and toxic evaluations based on a 15-minute average. Eight-hour TWA are used for chronic effect evaluations based on a 24-hour average.

- National Institute of Occupational Safety and Health (NIOSH) Recommended Standards (REL's) - The 8-hour TWAs should be converted to units of mg/m3. Use STEL or CL for acute sensory irritant and toxic evaluations based on a 15-minute average. Some of the NIOSH TWAs are available in the NIOSH Pocket Guide to Chemical Hazards (NPG). EPD did not consider any LD50 data since we are setting the standards for Inhalation exposure. All of the NIOSH TWAs are available in the Registry of Toxic Effects of Chemical Substances (RTECS) Database.

- The recommended conversion formula to be used when the limit is given in units of parts per million (ppm) is:

  $C\ (mg/m3) = C\ (ppm) \times (MW) \div 24.45$

Where;

C	=	Concentration of pollutant in air in units of mg/m^3 or ppm
MW	=	Molecular weight of the pollutant in units of gram/mole
24.45	=	Molar volume at 25°C and 760 mmHg

STEP 2: Adjustment of Toxicity Data for Potential Public Exposure in Excess of Occupational Exposure

The pollutant toxicity data acquired from RBAC and/or RfC has already been determined as an annual average pollutant exposure limit. For purposes of evaluating the pollutant impact using these estimates, the toxicity data acquired does not need to be converted.

The TWA data acquired from OSHA, NIOSH or ACGIH are usually based on a 40 hour per week pollutant exposure. Many sources operate more than 40 hours per week subjecting the public to exposure to toxic pollutant emissions for more than 40 hours per week.

Therefore, it is required that this type of toxicity data be adjusted to account for emissions that occur more than 40 hours per week. The adjustment accounts for potential public pollutant exposure and uptake in excess of that exposure (40 hours per week) upon which the TWA's are based. The recommended adjustment formula is:

$$TA = TO\ (40/X)$$

Where:

X	=	Number of hours per week emissions occur. Use 168 for all initial analysis (24 hours per day x 7 days per week). Use actual hours when performing a site specific risk analysis.
TO	=	TWA data
TA	=	Toxicity data adjusted for exposure greater than 40 hours per week

The toxicity data should not be adjusted in cases where emissions occur less than 40 hours per week or when using a STEL or ceiling limit.

STEP 3: Applying Safety Factor to establish AAC

A Safety factor is applied to account for pollutant exposure to members of the public who may be more sensitive to pollutant effects (persons with respiratory maladies, suppressed immune systems, and/or genetic susceptibilities, young children or the elderly) than the average citizen. No safety factors are applied to toxicity data acquired from IRIS (IUR and/or RfC) since RfC account for effects to the sensitive population over 70 year period and; in case of

IUR safety factor is already accounted for. Therefore, the acceptable ambient concentration (AAC) is the same value as the RBAC or RfC.

The exposure adjusted toxicity data acquired from TWA as calculated in Step 2, is further adjusted by application of a safety factor. The recommended formula for application of the safety factor is:

$$AAC = TA / \text{safety factor}$$

Where;

AAC - acceptable ambient pollutant concentration
TA - exposure adjusted toxicity data from Section 2 of this Part.

The following safety factor are used

- For pollutants which are not known human carcinogen (From IRIS database) - 100.
- For known human carcinogens (From IRIS database) - 300.
- For acute sensory irritants (those pollutants with ceiling limits or STELs) - 10.

The averaging period for the AAC using TWA will be 24 hours. The averaging period for the AAC is defined to be 15 minutes when using a STEL or ceiling limit value.

SUMMARY

An AAC is developed for each toxic air pollutant. Toxicity data is acquired from a priority list of references (Step 1). The toxicity data is adjusted for potential public exposure if the emissions are emitted in excess of 40 hours per week (Step 2) when using the pollutant toxicity data acquired from an 8-hour TWA. A further adjustment is made by application of a safety factor (Step 3.) when using the pollutant toxicity data acquired from TWA's, STEL's, and ceiling limits. This results in the AAC. A safety factor is not necessary when using pollutant toxicity data acquired from RBAC and/or RfC data since safety factors have already been incorporated (the AAC has the same value as the RBAC or RfC). The result of the Step 3 is the acceptable ambient concentration.

APPENDIX E

LIST OF ACRONYMS

LIST OF ACRONYMS

AAC:	Acceptable Ambient Concentration
ACGIH:	American Conference of Governmental Industrial Hygienist
AERMOD:	AERMIC Model
CAS:	Chemical Abstract Service
BACT:	Best Available Control Technology
CL:	Ceiling Limit
EPD:	Georgia Environmental Protection Division
HAP:	Hazardous Air Pollutant
ISC:	Industrial Source Complex
IRIS:	Integrated Risk Information System
MACT:	Maximum Available Control Technology
MGLC:	Maximum Ground Level concentration
MER:	Minimum Emission Rate
NED:	National Elevation Database
NIOSH:	National Institute for Occupational Safety and Health
NWS:	National Weather Service
OSHA:	Occupational Safety and Health Administration
PEL:	Permissible Exposure Limit
PSD:	Prevention of Significant Deterioration
RBAC:	Risk Based Air Concentration
RfC:	Reference Inhalation Concentration
STEL:	Short Term Exposure Limit
TAP:	Toxic air Pollutant
TWA:	Time Weighted Average
USEPA:	United States Environmental Protection Agency