



AERSCREEN User's Guide

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AERSCREEN User's Guide

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Preface

This document provides a description of AERSCREEN, the screening version of AERMOD. Included in the document are descriptions of inputs, processing methodology in AERSCREEN, and outputs. This document represents a revision to the previous AERSCREEN User's Guide, EPA document number EPA-454/B-15-005.

Acknowledgements

AERSCREEN and the AERSCREEN User's guide The AERSURFACE User's Guide has been developed by the Air Quality Modeling Group within EPA's Office of Air Quality Planning and Standards and AERSCREEN Workgroup, with input from the AERMOD Implementation Workgroup. The AERSCREEN code was initially developed by James Haywood, Michigan Department of Environmental Quality.

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1. Overview of AERSCREEN

AERSCREEN is EPA's recommended screening-level air quality model based on AERMOD (U.S. EPA, 2016a). The AERSCREEN model consists of two main components: 1) the MAKEMET program which generates a site-specific matrix of meteorological conditions for input to the AERMOD model; and 2) the AERSCREEN command-prompt interface program. AERSCREEN interfaces with MAKEMET for generating the meteorological matrix, but also interfaces with AERMAP (U.S. EPA, 2016b) and BPIPPRM (Schulman et al. 2000; U.S. EPA, 2004) to automate the processing of terrain and building information respectively, and interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs. AERSCREEN interfaces with version 09292 and later versions of AERMOD and will not work with earlier versions of AERMOD. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages.

The screening mode of the current version of AERMOD, which is controlled by the SCREEN option on the CO MODELOPT card, forces the model calculations to represent values for the plume centerline, regardless of the source-receptor-wind direction orientation. This option is included in AERMOD to facilitate the use of the model in a screening mode to estimate worst-case impacts. Since the screening option in AERMOD is designed to be used with a non-sequential meteorological data file representing a matrix of conditions, currently generated by the MAKEMET program, the SCREEN option also forces the use of the NOCHKD option even if NOCHKD is not included on the MODELOPT card. The NOCHKD option suspends the checks made within AERMOD for proper date sequences in the surface and profile meteorological input data files. The SCREEN option also restricts the averaging period options to 1-hour averages only on the CO AVERTIME card.

Given these two basic components of AERSCREEN, the AERMOD model can be run in a screening mode by either: 1) using the AERSCREEN command-prompt interface; or 2) using the stand-alone MAKEMET program to generate the matrix of meteorological conditions and running AERMOD directly with the SCREEN option. The first approach automates much of the processing for the user, including building and terrain processing, while the second approach gives the user more flexibility for defining the receptor network to be used in the screening analysis and may be more appropriate in certain situations, especially in very complex terrain settings. These two options for running AERMOD in a screening mode will not necessarily produce the same results. This is because the results for the stand-alone application of AERMOD with MAKEMET-generated meteorology will be determined by the user-specified receptor network, whereas the AERSCREEN program performs a more precise search to isolate the receptor distance with the highest impact, similar to the automated distance option in SCREEN3 (U.S. EPA, 1995). In general, the AERSCREEN program should produce slightly more conservative results than stand-alone AERMOD with MAKEMET data, depending on the receptor resolution used for the latter.

Before running AERSCREEN, users should consult and become familiar the following:

- AERMOD User's Guide (U.S. EPA, 2016a)
- AERMAP User's Guide (U.S. EPA, 2016b)
- AERMET User's Guide [for surface characteristics tables] (U.S. EPA, 2016c)
- BPIPPRM User's Guide (U.S. EPA, 2004)
- *Guideline on Air Quality Models (Appendix W)* (U.S. EPA, 2016d)
- AERSURFACE User's Guide (U.S. EPA, 2008)
- AERMOD Implementation Guide (U.S., EPA, 2016e)
- Screening Procedures for Estimating the Air Quality Impact of Stationary Sources (U.S. EPA, 1992)

The above documents and other support documents can be found at the AERMOD modeling page of the Support Center for Regulatory Atmospheric Modeling (SCRAM) page at: https://www3.epa.gov/ttn/scram/dispersion_prefrec.htm#aermod.

1.1 Description of AERSCREEN

As stated above, AERSCREEN is an interactive command-prompt application that interfaces with MAKEMET for generating the meteorological matrix, but also interfaces with AERMAP and BPIPPRM to automate the processing of terrain and building information, and interfaces with the AERMOD model utilizing the SCREEN option to perform the modeling runs. The AERSCREEN program also includes averaging time factors for worst-case 3-hr, 8-hr, 24-hr and annual averages. The AERSCREEN program is currently limited to modeling a single point (vertical uncapped stack), capped stack, horizontal stack, rectangular area, circular area, flare, or volume source.

Inputs or options to AERSCREEN are:

- Source parameters for point, rectangular area, circular area, volume, capped stack, horizontal stack or flare sources
- Building downwash information for point, capped stack, horizontal stack, and flare sources
- Ability to model NO_x to NO₂ conversion
 - Plume Volume Molar Ratio (PVMRM) (Hanrahan, 1999a and 1999b) or
 - Ozone Limiting Method (OLM)
 - Input of representative ozone background concentration
- Ability to use terrain heights for source and receptors via AERMAP
- Specify ambient minimum and maximum temperatures for MAKEMET
- Specify minimum wind speed and anemometer height for MAKEMET
- Specify surface characteristics for input to MAKEMET by the following methods:
 - user-defined single values for albedo, Bowen ratio, and surface roughness (no temporal or spatial variation in surface characteristics)
 - AERMET seasonal tables (temporal variation only)

- Values listed in an external file, either an AERSURFACE (U.S. EPA, 2008) output file or surface characteristics listed in an AERMET stage 3 input file
- Ability to adjust surface friction velocity based on AERMET algorithms
- Probe distance (maximum downwind distance) of receptors
- Use of flagpole receptors and define flagpole height
- Specify urban or rural source and urban population if urban source
- Minimum ambient distance for ambient air receptors
- Up to ten discrete receptor distances in a user supplied text file
- Plume fumigation due to inversion break-up
- Shoreline fumigation of plume
- Performs error checks on AERSCREEN inputs, AERMOD output and/or AERMAP output
- Calculate maximum concentration by distance
- Debug option to output intermediate output from PROBE or FLOWSECTOR as well as intermediate fumigation calculations.
- Search routine to find overall worst case scenario (maximum 1-hour concentration)

AERSCREEN automatically provides impacts for other averaging periods using scaling ratios. The averaging period ratios currently implemented in AERSCREEN are as follows (*SCREEN3 factors are shown for comparison*):

- | | | |
|-----------|---------------------|-------------|
| ● 3-hour | fixed ratio of 1.00 | <i>0.90</i> |
| ● 8-hour | fixed ratio of 0.90 | <i>0.70</i> |
| ● 24-hour | fixed ratio of 0.60 | <i>0.40</i> |
| ● Annual | fixed ratio of 0.10 | <i>0.08</i> |

For area sources (rectangular and circular), the averaging factors are based on guidance in Section 4.5.4 of the EPA screening guidance document (U.S. EPA, 1992). For area sources, the 3, 8, and 24-hour average concentrations are equal to the 1-hour average calculated by AERMOD in screening mode. No annual average concentration is calculated.

1.1.1 Changes to AERSCREEN

The original version of AERSCREEN is version 11060. Following is a list of changes since that version.

Version 11076

1. Modified subroutine MAKETERRAIN to change the variable XDIST to always be 1.1 times the probe distance for the DOMAINXY keyword that goes into AERMAP. In version 11060, for the FLOWSECTOR stage of AERSCREEN, XDIST was set to 1.1 times the probe distance while in FLOWSECTOR it is set to 1.1 times the final distance. In complex terrain, this change in DOMAINXY can affect hill height scales, affecting concentrations.

Version 11126

1. Modified subroutine MAKETERRAIN to accommodate the 12-character source identifier for AERMAP version 11103.
2. Modified subroutine READINP to set the discrete receptor use flag to N and discrete receptor file to "NA" when the discrete receptor data section is missing in AERSCREEN.INP

Version 14147

1. Modified subroutines MAKETERRAIN and MAKEGRID to include a new variable, REFDIST for calculating receptors for the REFINE stage. Previously, the variable NUMPT was used in these subroutines to represent the number of receptor points for the PROBE and FLOWSECTOR stages and distance for the REFINE stage. REFDIST was created to avoid confusion with different meanings of NUMPT. REFDIST is also set to the probe distance if REFDIST exceeds the probe distance.
2. Modified subroutine MAKEINPUT to eliminate a blank line as the first line of the AERMOD input file. This makes AERSCREEN compatible with AERMOD version 14134 and later due to the skipping of blank lines in AERMOD (see miscellaneous change #3 of AERMOD MCB #10).
3. Modified subroutine FINDMAX to read the AERMOD version number from AERSCREEN.FIL so that it is independent of the AERMOD version. Previous versions of AERSCREEN read the version number using a fixed format that changed with AERMOD 12345. AERSCREEN no longer uses a fixed format to read the version number and is flexible for later AERMOD versions.
4. Modified subroutine READINP to set the discrete receptor use flag DISCFLAG to N instead of setting the logical variable DISCDAT to N. Previous versions of AERSCREEN were setting the wrong variable (DISCDAT).

Version 15181

1. Added subroutines FUMINP, FUMIGATE, INVMAX, SHORELINE, SHOREMAX, RECALCPLUME, and TIBL to support inversion break-up and shoreline fumigation calculations
2. Added subroutine SUBSETMET to create matrix of hours with meteorological conditions of F stability and stack top wind speed of 2.5 m/s for fumigation calculations.
3. Added fumigation inputs including distance to shoreline, optional direction to shoreline, and option to run or not run full AERSCREEN in subroutine READINP.
4. Added fumigation error check flags to subroutine CHECKDAT.
5. Modified subroutine VALIDATE AND WRITETOLOG to add fumigation options
6. Added optional debug option to output PROBE, FLOWSECTOR, and fumigation calculations.
7. Updated subroutine PLUMEHGT to include plume height calculations for stable conditions.
8. Updated subroutine MAKEMET2 to include optional u* adjustment prompt for MAKEMET. At this time, this prompt is always set to no (do not include adjustment).
9. Eliminated numerous system calls of copying and deleting files by using write statements and close statements. This is to make code more portable across operating systems.

Version 16216

1. Corrected a bug in subroutine SUBSETMET related to the surface meteorological data filename.
2. Added the option to specify the use of adjusted u^* in subroutine READINP, VALIDATE, WRITETOLOG, METDATA, MAKEMET2, and OUTPUT.
3. Modified subroutine OUTPUT to only output non-zero minimum building widths when using user supplied building files.
4. Removed BETA flags for POINTCAP and POINTHOR source types in subroutine MAKEINPUT.

1.2 Description of MAKEMET

The MAKEMET program generates a matrix of meteorological conditions, in the form of AERMET-ready surface (AERSCREEN.sfc) and profile (AERSCREEN.pfl) files, based on user-specified surface characteristics, ambient temperatures, minimum wind speed, and anemometer height. See the AERMET User's Guide (U.S. EPA, 2016c) for file formats. The current version of MAKEMET also allows the user to specify the minimum wind speed to include in the matrix and the anemometer height as well. Beginning with version 15181, MAKEMET has the capability to include the adjustment to surface friction velocity, u^* , that is also a part of AERMET. These options have been included to facilitate comparisons of AERSCREEN estimates to estimates from AERMOD in a refined mode to eliminate differences that may be due to either the minimum wind speed in the refined data or the anemometer height. The suggested default values for routine application of MAKEMET are 0.5 m/s for the minimum wind speed and 10 meters for the anemometer height.

MAKEMET allows the user to specify more than one set of surface characteristics and ambient temperatures, such as for seasonal or monthly variations, and will concatenate the resulting meteorological matrices into single surface and profile files. For AERSCREEN, this option is not used and separate files are created for seasonal or monthly variations in surface characteristics. No variation in minimum and maximum temperature is done in MAKEMET. MAKEMET also allows the user to specify a single wind direction or a range of wind directions for the meteorological matrix. This option may be useful for applications involving building downwash to ensure that building dimensions for all sectors are included in the screening analysis (the treatment of building downwash in the AERSCREEN program is described in Section 3.2.2). However, in AERSCREEN processing, the wind direction is set to a single direction of 270 degrees.

MAKEMET can be run from the command-prompt, with the prompts in Figure 1 for user input.

ENTER SFC MET FILE NAME

ENTER PFL MET FILE NAME

ENTER MIN. WS (M/S)

ENTER ANEM HT (M)

ENTER OPTION TO ADJUST U (Y=adjust,N=no adjustment)*

ENTER NUMBER OF WIND DIRECTIONS

If the user enters one for the number of wind directions

ENTER WIND DIRECTION

Otherwise

ENTER STARTING WIND DIRECTION

ENTER CLOCKWISE WIND DIRECTION INCREMENT

ENTER MIN AND MAX AMBIENT TEMPS IN KELVIN

ENTER ALBEDO

ENTER BOWEN RATIO

ENTER SURFACE ROUGHNESS LENGTH IN METERS

DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE APPENDED TO CURRENT FILE?

[TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" TO EXIT

If ("Y" or "y") then the program loops through prompts 7 through 10 for each additional data set (e.g. seasonal).

Figure 1. User prompts for MAKEMET.

The MAKEMET program has a long complex history, dating back over 10 years. Suffice it to say that the version of MAKEMET supplied with AERSCREEN operates in the following manner. As mentioned earlier, MAKEMET generates a matrix of meteorological conditions for application of AERMOD in a screening mode and output the results in the form of AERMOD-ready surface and profile meteorological data files. The matrix is generated based on looping through a range of wind speeds, cloud covers, ambient temperatures, solar elevation angles, and convective velocity scales (w^* for convective conditions only) for user-specified surface characteristics (Z_o , B_o , r). For stable cases, the mechanical mixing height (Z_{im}) is calculated based on the friction velocity, u^* . A loop through Z_{im} factors (multiplied times the initial value calculated from u^*) is also included to account for smoothing of Z_{im} that occurs with refined AERMET data. Stable transition cases with solar angle greater than zero but less than the critical solar angle (ACRIT) are also included in the matrix.

The program calculates u^* , Monin-Obukhov length (L), and Z_{im} for each combination in the matrix, and also calculates the convective mixing height (Z_{ic}) based on w^* for convective cases. The program uses subroutines from AERMET (U.S. EPA, 2016c) to calculate boundary layer parameters for each combination in the matrix. The program generates a log file, called MAKEMET.LOG, which summarizes the inputs selected for that run, and the number of “hours” in the final screening matrix for each set of surface characteristics. An effort has been made to optimize the MAKEMET program for AERMOD screening applications by eliminating combinations that are unnecessary in terms of identifying worst-case impacts, based on a wide range of tests comparing screening to refined AERMOD estimates (which are briefly summarized below). The number of “hours” per set of surface characteristics will typically be around 300-400, but will vary depending on the user inputs. The number will tend to be larger for applications with lower surface roughness due to the internal checks made to eliminate unnecessary combinations.

MAKEMET uses the following scheme to assign dates for each of the “hours” in the meteorological matrix. The default starting year for the data is 10, and the year is incremented by 10 for each additional data set generated. Thus, for seasonal data files, the first season date will start with a '1', second season will start with a '2', etc. The hour is used to distinguish between stable and convective conditions, with hours 01 through 11 indicating stable hours, and hours 12 through 24 indicating convective hours. Note that for monthly data sets and/or for large numbers of wind directions (greater than 36), duplicate dates may be generated. A warning message is written to the log file in these cases. AERMOD will still run since the NOCHKD option is invoked, but determining which conditions produced the worst-case results could become problematic. In addition to the required variables for input to AERMOD, the surface file generated by MAKEMET also includes five columns of integer variables that provide the loop indices for each of the loops in the met matrix corresponding to each "hour" of screening meteorology. These indices can be used to analyze the frequency of occurrence for various combinations within the meteorological matrix resulting in the controlling (highest) concentration.

AERSCREEN provides three options for surface characteristics inputs for generating the screening meteorology. One option allows for user-specified surface characteristics – albedo, Bowen ratio, and surface roughness (no spatial or temporal variation), the second option is to use seasonally varying surface characteristics for generic land use classifications based on Tables 4-1, 4-2, and 4-3 of the AERMET User’s Guide (U.S. EPA 2016c). The third option is to input the name of an external file such as an AERSURFACE (U.S. EPA, 2008) output file or AERMET stage 3 input file that contains surface characteristics. Monthly, seasonal, and annual output for one sector or multiple sectors is allowed with the third option. AERSCREEN will setup and run the MAKEMET program to generate the screening meteorological data for input to AERMOD. AERSCREEN will run MAKEMET for each combination of temporal period and spatial sector of the surface characteristics. If AERSURFACE output is used, AERSCREEN does not call AERSURFACE, so the user must run AERSURFACE prior to running AERSCREEN.

1.3 Differences with SCREEN3

The three areas where AERSCREEN deviates significantly from SCREEN3 and will, thus, be the most difficult for first time users are:

- 1) **Building wake effects** – AERSCREEN utilizes all the advantages of PRIME (Schulman et al., 2000) including stacks detached from the building. This requires three additional pieces of information from the user beyond the normal building height and dimensions. The additional information is orientation of the maximum dimension relative to north, angle relative to north of the stack and, distance between the stack and building center. AERSCREEN will use this information to setup and run the BPIPPRM program and extract the information needed for the AERMOD model. More downwash details can be found in Section 2.2.
- 2) **Meteorology** – AERSCREEN provides three options for generating the screening meteorology. One option allows for user-specified surface characteristics – albedo, Bowen ratio, and surface roughness (no temporal or spatial variation) – the second option is to use seasonally varying surface characteristics for generic land use classifications based on Tables 4-1, 4-2, and 4-3 of the AERMET User’s Guide. The third option is to use surface characteristics listed in an external file such as an AERSURFACE output file or AERMET stage 3 input file. The user enters the name of the file. The user also specifies the overall minimum and maximum ambient temperatures. AERSCREEN will setup and run the MAKEMET program to generate the screening meteorological data for input to AERMOD. More details about meteorology can be found in Section 2.3.
- 3) **Terrain** – AERSCREEN provides the option for incorporating terrain impacts on the screening analysis. The user must create a file called demlist.txt. The first line of this file describes the type of terrain file being used. The file type must be DEM or NED. DEM refers to any DEM file type and NED refers to National Elevation Dataset. The third line of the file lists the location of the NAD conversion files and the fourth line begins the list of terrain files with each file on a separate line. When AERSCREEN is run, the user will be prompted to provide the source coordinates and associated NAD datum. AERSCREEN will then setup the necessary input file for AERMAP, run AERMAP, and extract the information needed for the AERMOD model. More terrain processing details can be found in Section 2.4

Given the use of surface characteristics and terrain, it is important that the user know the exact coordinates of the source, i.e., stack or center location of volume or area source.

2. AERSCREEN features

As noted in Section 1.1, AERSCREEN has many features and options available to the user. In this section, the features and inputs to the restart file, AERSCREEN.INP, are described. When running AERSCREEN from a restart file, the file must be named AERSCREEN.INP or AERSCREEN will automatically begin prompting the user for data. The prompts used to enter the data interactively are described in each relevant section as well. Prompts are not necessarily shown in the order in which they appear but in the order for the parameters shown in AERSCREEN.INP for each data section. The prompts described are based on metric units. When processing data from the input file, all units are assumed to be metric. Some variables listed below are not requested when using the prompts to enter data, but are automatically defaulted, such as when processing a rectangular area source, volume source, or circular area source. In the case of a rectangular area source, terrain use and downwash are automatically set to “no” and the user is not prompted for the choice of terrain processing and source coordinates. For all three source types, downwash is automatically set to “no” and downwash information is not requested. When reading data from the input file, if one of the data sections (source, building, terrain, meteorology, etc.) is missing, AERSCREEN will notify the user and stop processing. Also, if the source data is listed after the building, terrain, or miscellaneous data, AERSCREEN will alert the user and stop processing. This is done because the source type is needed to determine if parameters must be reset in the building or terrain sections, such as resetting building downwash to “no” if an area or volume source is being processed. Also, if data is missing or invalid (such as negative emission rate) when reading AERSCREEN.INP, AERSCREEN alerts the user and stops processing.

2.1 Source inputs

AERSCREEN can be used for a single point, flare, capped stack, horizontal stack, volume, rectangular area source, or circular area source. Below are listed the source types with required input variables and example values from the first line of the AERSCREEN.INP file. Building downwash is allowed for the point, capped stack, horizontal stack, and flare sources but not for volume or area (rectangular or circular) sources. Terrain processing is allowed for all sources except rectangular area sources. For all source types, emission rates are in g/s or lb/hr. For area source types, AERSCREEN calculates the emission rate per unit area, the required input for AERMOD.

2.1.1 Point, capped stacks and horizontal stack sources

Stack parameters for point (vertical stacks with no caps), capped stacks, and horizontal stacks are the same. Point sources are denoted by the term “** STACK DATA “ in the input file in the line

above the source parameters. Capped stacks are denoted by the term “** POINTCAP DATA” in the input file and horizontal stacks are denoted by the term “** POINTHOR DATA” in the input file. Source inputs for these three source types are, with English and metric units in parentheses:

- emission rate (lb/hr or g/s)
- stack height (feet or meters)
- stack diameter (inches or meters)
- stack temperature (degrees Fahrenheit or Kelvin)
- and stack velocity (ft/s or m/s) or flow rate (ACFM)

Note that stack velocity can be input as ft/s or m/s, regardless of using English or metric units for other parameters. AERSCREEN.INP and prompt inputs (shown in italics) are shown in Figures 2 through 4 for point, capped stack and horizontal stacks, respectively. If a stack temperature of zero (Fahrenheit or Kelvin) or negative stack temperature is entered, the entered temperature will be used as a difference between the stack and ambient temperature. A negative number, such as -10, implies that the stack is 10 degrees warmer than the ambient temperature.

AERSCREEN.INP point source inputs						
** STACK DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.
Point source prompts inputs						
If the user enters "P" or "p" for point source:						
<i>Enter Emission Rate (g/s):</i>						
<i>Enter Stack Height (meters):</i>						
<i>Enter Stack Diameter (meters):</i>						
<i>Enter Stack Temperature (K)</i>						
<i>Enter 0 for ambient temperature</i>						
<i>or a negative number for temperature difference ((K))</i>						
<i>between stack temperature and ambient temperature:</i>						
<i>Option (1) - Exit Velocity (m/s)</i>						
<i>Option (2) - Exit Velocity (ft/s)</i>						
<i>Option (3) - Flow Rate (ACFM)</i>						
<i>Enter Option for Flow Rate or Exit Velocity:</i>						
If the user chooses option 1, the prompt is:						
<i>Enter Exit Velocity (m/s):</i>						
If the user chooses option 2, the prompt is:						
<i>Enter Exit Velocity (ft/s):</i>						
If the user chooses option 3, the prompt is:						
<i>Enter Flow Rate (ACFM):</i>						

Figure 2. AERSCREEN.INP and prompts inputs for point sources.

AERSCREEN.INP capped stack source inputs						
** POINTCAP DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.
Capped stack source prompts inputs						
If the user enters "S" or "s" for capped stack source:						
<i>Enter Emission Rate (g/s):</i>						
<i>Enter Stack Height (meters):</i>						
<i>Enter Stack Diameter (meters):</i>						
<i>Enter Stack Temperature (K)</i>						
<i>Enter 0 for ambient temperature</i>						
<i>or a negative number for temperature difference ((K))</i>						
<i>between stack temperature and ambient temperature:</i>						
<i>Option (1) - Exit Velocity (m/s)</i>						
<i>Option (2) - Exit Velocity (ft/s)</i>						
<i>Option (3) - Flow Rate (ACFM)</i>						
<i>Enter Option for Flow Rate or Exit Velocity:</i>						
If the user chooses option 1, the prompt is:						
<i>Enter Exit Velocity (m/s):</i>						
If the user chooses option 2, the prompt is:						
<i>Enter Exit Velocity (ft/s):</i>						
If the user chooses option 3, the prompt is:						
<i>Enter Flow Rate (ACFM):</i>						

Figure 3. AERSCREEN.INP and prompts inputs for capped stack sources.

AERSCREEN.INP horizontal stack source inputs						
** POINTHOR DATA	Rate	Height	Temp.	Velocity	Diam.	Flow
**	0.1896E+01	5.0902	353.7056	13.2662	0.6096	8204.
Horizontal stack source prompts inputs						
If the user enters “H” or “h” for horizontal stack source:						
<i>Enter Emission Rate (g/s):</i>						
<i>Enter Stack Height (meters):</i>						
<i>Enter Stack Diameter (meters):</i>						
<i>Enter Stack Temperature (K)</i>						
<i>Enter 0 for ambient temperature</i>						
<i>or a negative number for temperature difference ((K))</i>						
<i>between stack temperature and ambient temperature:</i>						
<hr/>						
<i>Option (1) - Exit Velocity (m/s)</i>						
<i>Option (2) - Exit Velocity (ft/s)</i>						
<i>Option (3) - Flow Rate (ACFM)</i>						
<hr/>						
<i>Enter Option for Flow Rate or Exit Velocity:</i>						
If the user chooses option 1, the prompt is:						
<i>Enter Exit Velocity (m/s):</i>						
If the user chooses option 2, the prompt is:						
<i>Enter Exit Velocity (ft/s):</i>						
If the user chooses option 3, the prompt is:						
<i>Enter Flow Rate (ACFM):</i>						

Figure 4. AERSCREEN.INP and prompts inputs for horizontal stack sources.

2.1.2 Flares

Flare sources are denoted by the term “** FLARE DATA” in the input file in the line above the source parameters. Flare source inputs are, with English and metric units:

- emission rate (lb/hr or g/s)
- stack height (feet or meters)
- total heat release rate (cal/sec)
- radiative heat loss fraction

The heat loss fraction can be user selected or the SCREEN3 default value of 0.55. For information about heat loss fractions, see Leahey and Davies (1984). AERSCREEN will process

the flare in AERMOD as a POINT source type. For the exit velocity and exit temperature, AERSCREEN defaults these values to 20 m/s and 1,273 K, respectively as done in SCREEN3 (U.S. EPA, 1995). The stack diameter and effective stack height used in AERMOD are calculated from the inputs as:

$$D = 9.88 \times 10^{-4} \times \sqrt{HR \times (1 - HL)} \quad (1)$$

$$h_{eff} = H_s + 4.56 \times 10^{-3} \times HR^{0.478} \quad (2)$$

Where D is effective stack diameter, HR is the heat release rate, HL is the heat loss fraction, H_{eff} is effective stack height and H_s is the stack height entered by the user.

AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 5.

AERSCREEN.INP flare source inputs				
** FLARE DATA	Rate	Height	Heat	HeatLoss
**	0.1000E+03	35.0000	0.1000E+08	0.550
Flare source prompts inputs				
If the user enters "F" or "f" for flare source:				
<i>Enter Emission Rate (g/s):</i>				
<i>Enter Flare Stack Height (meters):</i>				
<i>Enter Total Heat Release Rate (cal/sec):</i>				
<i>Enter Radiative Heat Loss Fraction –</i>				
<i><Enter> for default value of 0.55:</i>				

Figure 5. AERSCREEN.INP and prompts inputs for flare sources.

2.1.3 Volume sources

Volume sources are denoted by the term "*** VOLUME DATA" in the input file in the line above the source parameters. Volume source inputs are, with English and metric units:

- emission rate (lb/hr or g/s)
- release height, i.e. center of volume (feet or meters)
- initial lateral dimension of the volume (feet or meters)
- initial vertical dimension of the volume (feet or meters)

AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 6.

AERSCREEN.INP volume source inputs				
** VOLUME DATA	Rate	Height	Syinit	Szinit
**	0.1000E+03	2.0000	1.5000	3.0000
Volume source prompts inputs				
If the user enters “V” or “v” for volume source:				
<i>Enter Emission Rate (g/s):</i>				
<i>Enter Center of Volume Height (meters):</i>				
<i>Enter Initial Lateral Dimension (meters):</i>				
<i>Enter initial Vertical Dimension (meters):</i>				

Figure 6. AERSCREEN.INP and prompts inputs for volume sources.

2.1.4 Rectangular area sources

Rectangular area sources are denoted by the term “** AREA DATA” in the input file in the line above the source parameters. Rectangular area source inputs are, with English and metric units:

- emission rate (lb/hr or g/s)
- release height above ground (feet or meters)
- long and short dimensions of area (feet or meters)
- initial vertical dimension of plume (feet or meters)

As previously noted, the emission rate is in g/s or lb/hour, not emission rate per unit area as entered in AERMOD input files. AERSCREEN automatically calculates the emission rate per unit area to input into AERMOD. The angle of the source relative to north is automatically set to 0 degrees. Note that the long dimension of the area source is in the x-direction and short dimension in the y-direction. AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 7. For rectangular area sources, AERMOD uses the non-default FASTAREA keyword on the MODELOPT keyword in the CO pathway of the AERMOD.INP file.

AERSCREEN.INP rectangular area inputs						
** AREA DATA	Rate	Height	Length	Width	Angle	Szinit
**	0.1000E+03	2.0000	500.0000	200.0000	0.0	1.50
Rectangular area source prompts inputs						
If the user enters “A” or “a” for rectangular area source:						
<i>Enter Emission Rate (g/s):</i>						
<i>Enter Release Height Above Ground (meters):</i>						
<i>Enter Long Side of Area Source (meters):</i>						
<i>Enter Short Side of Area Source (meters):</i>						
<i>Enter Initial Vertical Dimension (meters):</i>						

Figure 7. AERSCREEN.INP and prompts inputs for rectangular area sources.

2.1.5 Circular area sources

Circular area sources are denoted by the term “** AREACIRC DATA” in the input file in the line above the source parameters. Circular area source inputs are, with English and metric units:

- emission rate (lb/hr or g/s)
- release height above ground (feet or meters)
- radius of circle (feet or meters)
- initial vertical dimension of plume (feet or meters)

As with rectangular area sources, the emission rate is in g/s or lb/hour, not emission rate per unit area. AERSCREEN.INP and prompt inputs (in italics) are shown in Figure 8. For circular area sources, AERMOD uses the non-default FASTAREA keyword on the MODELOPT keyword in the CO pathway of the AERMOD.INP file.

AERSCREEN.INP circular area source inputs						
** AREACIRC DATA	Rate	Height	Radius	NVerts	Szinit	
**	0.1000E+03	2.0000	250.0000	20	1.50	
Circular area source prompts inputs						
If the user enters “C” or “c” for circular area source:						
<i>Enter Emission Rate (g/s):</i>						
<i>Enter Release Height Above Ground (meters):</i>						
<i>Enter Radius of AREACIRC Source (meters):</i>						
<i>Enter Initial Vertical Dimension (meters):</i>						

Figure 8. AERSCREEN.INP and prompts inputs for circular area sources.

2.1.6 NO_x to NO₂ conversion

Beginning with version 11060, AERSCREEN allows the option to include NO_x to NO₂ conversion either by using the Plume Volume Molar Ratio Method (PVMRM) or the Ozone Limiting Method (OLM). See Section 2.4 of the AERMOD User's Guide Addendum for more information about PVMRM and OLM and Hanrahan (1999a and 1999b) for background on PVMRM.

When entering data via the prompts, the user is asked to enter an option for modeling NO_x to NO₂ conversion:

1. No chemistry or pollutant is not NO₂
2. Use Ozone Limiting Method (OLM)
3. Use Plume Volume Molar Ratio Method (PVMRM)

If option two or three is chosen, the user is prompted for the NO₂/NO_x in-stack ratio (AERMOD card CO NOSTACK) and a representative ozone background concentration (AERMOD card CO OZONEVAL). The NO₂/NO_x in-stack ratio can range from zero to one and units of the background concentration can be parts per million (ppm), parts per billion (ppb) or micrograms per cubic meter (µg/m³). For PVMRM the NO₂EQUIL ratio is set at the default value of 0.9. For OLM use, since only one source is being modeled, the OLMGROUP keyword is not needed.

When entering data via AERSCREEN.INP, the user can specify NO_x to NO₂ conversion by setting the appropriate keywords in the CO pathway of the AERMOD runstream file portion of AERSCREEN.INP. PVMRM or OLM must be included on the MODELOPT keyword string, POLLUTID must be NO₂, NO₂STACK must be specified with a ratio, and the background ozone concentration and units must be specified using OZONEVAL. Figure 9 shows the inputs using AERSCREEN.INP or interactive prompts.

AERSCREEN.INP NO_x to NO₂ chemistry inputs
MODELOPT CONC SCREEN OLM POLLUTID NO2 NO2STACK 0.9000 OZONEVAL 0.4000 UG/M3
MODELOPT CONC SCREEN PVMRM POLLUTID NO2 NO2STACK 0.9000 OZONEVAL 0.4000 UG/M3
NO_x to NO₂ chemistry prompts inputs
<p><i>Enter an option for modeling NO₂ chemistry</i></p> <ol style="list-style-type: none"> 1) <i>No chemistry or pollutant is not NO₂</i> 2) <i>Use Ozone Limiting Method (OLM)</i> 3) <i>Use Plume Volume Molar Ratio Method (PVMRM)</i> <p>If the user enters “2” or “3” <i>Enter in-stack NO₂/NO_x ratio (0 to 1.0):</i></p> <p><i>Enter concentration units for representative ozone concentration</i></p> <ol style="list-style-type: none"> 1) <i>Micrograms per cubic meter (ugm/m³)</i> 2) <i>Parts per million (ppm)</i> 3) <i>Parts per billion (ppb)</i> <p><i>Enter ozone concentration:</i></p>

Figure 9. AERSCREEN.INP and prompts inputs for NO_x to NO₂ conversion.

2.1.7 Other inputs

Other inputs in the source input prompts are urban/rural classification and minimum ambient distance. These are discussed in more detail in Section 2.7.

2.2 Downwash

Several parameters are needed by AERSCREEN for input into BPIPPRM. These are:

- Include downwash (Y=use building downwash, N=no downwash)
- Option to use an existing BPIPPRM input file or,
- Building height (feet or meters)
- Maximum building horizontal dimension (feet or meters)
- Minimum building horizontal dimension (feet or meters)
- Degrees from North of maximum building horizontal dimension (0-179 degrees)
- Degrees from North of stack location relative to building center (0-360 degrees)
- Distance between stack and building center (feet or meters)

Building parameter data are denoted by the term “** BUILDING DATA” in the input file in the line above the building dimensions. These inputs are listed in the second block of data of AERSCREEN.INP (Figure 10) and must be entered in the AERSCREEN.INP file after the emissions data or AERSCREEN will stop processing. The order of variables is as listed above. Prompts for building downwash are also shown in Figure 10. When entering data via the prompts, building prompts will only appear when processing point, capped stack, horizontal stacks, or flare sources. Building dimensions are in feet or meters. Angles are in degrees relative to North (0 to 360 degrees). An example building/stack configuration is shown in Figure 11. When entering building parameters, either through the building data line or prompts shown in Figure 10, the parameters are for a single tier rectangular or square shaped building. If the user wishes to use downwash for multiple buildings, tiers, or more complicated geometries, the user can enter a BPIPPRM input filename at the prompts (“Use pre-existing BPIPPRM input file”) or in the CO pathway of the AERSCREEN input file using the TITLETWO keyword. If a BPIPPRM input filename is entered, AERSCREEN will use the parameters from the file but will not overwrite parameters from the building data block. If a pre-existing BPIPPRM input file is used, the process, line 2 of the BPIPPRM input file, must be set to ‘P’ or ‘p’ for PRIME downwash and only one stack located within the file or AERSCREEN will abort.

AERSCREEN.INP building inputs on BUILDING DATA line								
**	BUILDING DATA	BPIP	Height	Max dim.	Min dim.	Orient.	Direct.	Offset
**		Y	34.0000	120.0000	60.0000	90.0000	26.6000	45.0000
AERSCREEN.INP building BPIPPRM input filename line								
CO	STARTING							
	TITLEONE flare							
	TITLETWO BUILDING.INP							
**	REFINE STAGE 3							
	MODELOPT CONC SCREEN							
	AVERTIME 1							
	POLLUTID OTHER							
	RUNORNOT RUN							
CO	FINISHED							
Building prompts inputs								
<i>Include Building Downwash? (y/n):</i>								
If user enters “y” or “Y”:								
<i>Use pre-existing BPIPPRM input file? (y/n):</i>								
If user enters “y” or “Y” for pre-existing BPIPPRM input file:								
<i>Enter user created BPIPPRM input file:</i>								
If user enters “n” or “N” for pre-existing BPIPPRM input file:								
<i>Enter Building Height (meters):</i>								
<i>Enter Maximum Horizontal Building Dimension (meters):</i>								
<i>Enter Minimum Horizontal Building Dimension (meters):</i>								
<i>Enter Maximum Building Dimension Angle to True North (0 - 179 degees):</i>								
<i>Enter Direction of Stack from Building Center (0 - 360 degrees):</i>								
<i>Enter Distance Between Stack and Building Center (meters):</i>								
If user enters “n” or “N” for building downwash use then no prompts are processed.								

Figure 10. AERSCREEN.INP and prompts inputs for building inputs.

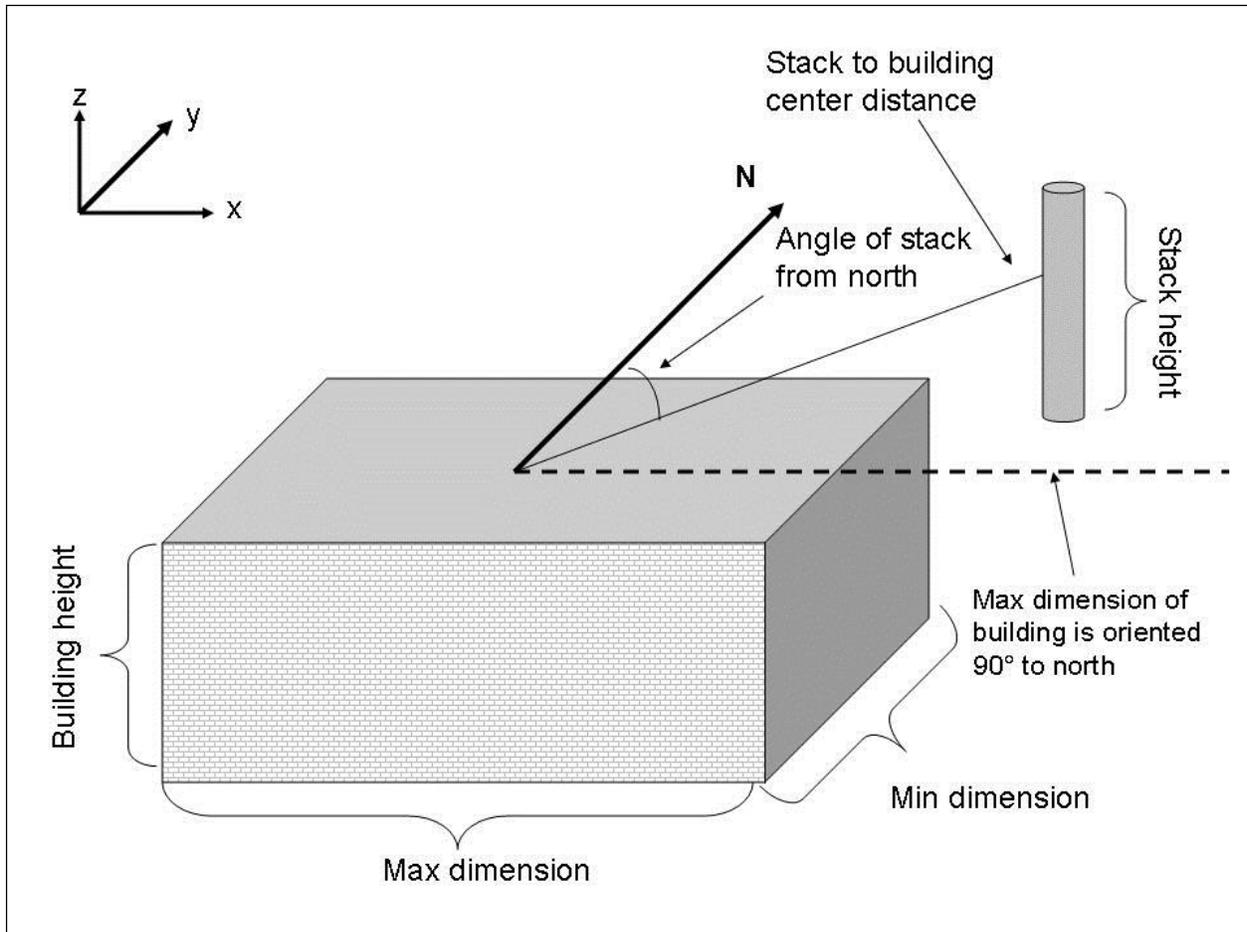


Figure 11. Stack and building orientation for a building oriented 90 degrees to north and stack oriented 45 degrees to north.

2.3 Meteorology and surface characteristics

For inputs to MAKEMET, the user enters the following:

- Minimum and maximum ambient air temperatures (Fahrenheit or Kelvin)
- Minimum wind speed (m/s)
- Anemometer height (m)
- Surface characteristics type (user-entered, AERMET tables, or surface characteristics listed in an external file)

When entering data via the prompts, the user can choose to enter default values for temperatures, wind speed, and anemometer height (see Figure 12). If using non-default values for temperatures, the record minimum and maximum temperatures for the area containing the source should be entered. If using a non-default value for the minimum wind speed, a wind speed less than 0.5 m/s is allowed. When entering surface characteristics, if the user chooses to utilize user-

entered single value surface characteristics, the user will be prompted for those values. If the user chooses to use AERMET seasonal tables, the user will be prompted for land use type and surface moisture (average, dry, or wet). If the user chooses to use an external file, i.e. AERSURFACE output or AERMET stage 3 input file, the user will be prompted to enter the name of the file. If the filename contains spaces or the pathname contains spaces, the pathname should be entered in quotations. If the surface characteristics are in a file that is not an AERSURFACE file or AERMET stage 3 input file, the format should follow that as outlined in the AERMET User's Guide, Section 4.7.7 (U.S. EPA, 2016c). After entering the filename, AERSCREEN will check for its existence and if it does not exist, the user will be re-prompted for the filename. AERSCREEN will also check the file for format and valid values for surface characteristics and if the format is incorrect or surface characteristics are not valid, the user will be re-prompted for the surface characteristics type (user, AERMET tables, or external file) when entering data from the prompts. If the data is entered from AERSCREEN.INP and the file is missing, the format is incorrect or surface characteristics are not valid, AERSCREEN will alert the user and stop processing.

AERSCREEN will also alert the user if the ambient temperatures exceed current world record temperatures (183 K and 331 K), Bowen ratio is less than -10 or greater than 10, and if the surface roughness is less than 0.001 (but positive) or greater than two meters. If surface roughness is less than 0.001 and not negative, AERSCREEN automatically resets the value to 0.001 and notifies the user. In the case of these warnings, AERSCREEN will use the entered values but warns the user that they may exceed reasonable values.

If the user uses the AERSCREEN input file to enter the meteorological parameters, the inputs are as follows in the third block of data of the input file and the data section is denoted by “**MAKEMET DATA” in the input file. The order of the MAKEMET data line relative to the other data sections is unimportant. In the AERSCREEN.INP file, temperatures are in degrees Kelvin. For prompts based input, temperatures are in degrees Fahrenheit or Kelvin. Regardless of the units convention, wind speeds are in m/s and anemometer height is in meters. The AERSCREEN.INP and prompts inputs are shown in Figure 12.

AERSCREEN.INP meteorological inputs										
**	MAKEMET DATA	MinT	MaxT	Speed	AnemHt	Surf Clim	Albedo	Bowen	Length	SC FILE
**		250.00	310.00	0.5	10.000	0	0	0.1600	0.8700	0.0440 "aersurface_12.out"
**	ADJUST U*	Y								
Prompts inputs										
<i>Enter Min & Max Ambient Temperatures (K) or <Enter> to default to 250 310 K...</i>										
<i>Enter Minimum Temperature (K):</i>										
If user enters a number for minimum temperature:										
<i>Enter Maximum Temperature (K):</i>										
<i>Enter Minimum Wind Speed or <Enter> to default to 0.5 m/s...</i>										
<i>Enter Anemometer Height or <Enter> to default to 10.0 meters...</i>										

1) Single user specified values										
2) AERMET seasonal tables										
3) External file										

<i>Enter surface characteristics option:</i>										
If the user enters 1										
<i>Enter Albedo:</i>										
<i>Enter Bowen Ratio:</i>										
<i>Enter Surface Roughness Length (m):</i>										
If the user enters 2										
1) Water										
2) Deciduous Forest										
3) Coniferous Forest										
4) Swamp										
5) Cultivated Land										
6) Grassland										
7) Urban										
8) Desert Shrubland										
<i>Enter Dominant Surface Profile:</i>										
1) Average Moisture										
2) Wet Conditions										
3) Dry Conditions										
<i>Enter Dominant Climate Profile:</i>										
If user enters 3										
<i>Enter filename containing surface characteristics. Enclose filename with quotes if path or filename includes spaces...</i>										
<i>Enter Y or y to adjust u* or N or n to not adjust u*</i>										

Figure 12. AERSCREEN.INP and prompts inputs for meteorological and surface characteristics data.

The parameters in the input file are:

- Minimum temperature
- Maximum temperature
- Minimum wind speed
- Anemometer height
- Land use type for surface characteristics
 - 0 = user-entered surface characteristics
 - 1 = water
 - 2 = deciduous forest
 - 3 = coniferous forest
 - 4 = swamp
 - 5 = cultivated land
 - 6 = grassland
 - 7 = urban
 - 8 = desert shrub land
 - 9 = use external file of surface characteristics
- Climatology type (for land use of 1 through 8)
 - 1 = average moisture
 - 2 = wet conditions
 - 3 = dry conditions
- User defined albedo (not used/requested if land use type is 1 through 9)
- User defined Bowen ratio (not used/requested if land use type is 1 through 9)
- User defined surface roughness (not used/requested if land use type is 1 through 9)
- External surface characteristics filename (not used/requested if land use type is 0 through 8)
- Option to adjust or not adjust surface friction velocity u^*

When determining surface characteristics, the user should consider the location of the source (stack or center of volume or area source). Often in emission inventories, the location given for a source is not the actual location of the source, but an average of sources in a facility or location of an address. The user should verify coordinates of a stack, volume, or area source. The exact location of the source is important in determining surface characteristics, especially when using a tool such as AERSURFACE. Inaccurate source locations can lead to inaccurate surface characteristics estimations, especially surface roughness. When determining surface characteristics for the source, regardless of method (user-entered, AERMET tables, or AERSURFACE), the user is highly encouraged to review Section 3.1 of the AERMOD Implementation Guide (U.S. EPA, 2016e) and if using AERSURFACE, to review the AERSURFACE User's Guide (U.S. EPA, 2008).

2.4 Terrain

For terrain processing in AERMAP, the user enters the following:

- Include terrain processing (yes=include terrain, no=do not include terrain effects)
- Probe distance (meters)
- Include discrete receptor distances (discussed in Section 2.6) (beginning with version 11060)
- Flagpole receptors (discussed in Section 2.7)
- Source elevation or use AERMAP to determine source elevation
- Source coordinates (geographic or UTM)
- NAD datum (NAD 27 or 83)
- UTM zone (if UTM coordinates entered)

If the user is processing a rectangular area source, the only inputs the user enters via the prompts are probe distance, use of discrete receptor distances (version 11060), flagpole receptors, and source elevation. The user will not have the choice of using AERMAP for source elevation determination. If flat terrain is being processed for any source type, the user cannot use AERMAP for source elevation determination. When entering data via the prompts and processing terrain, the user has the choice of inputting geographic coordinates (latitude and longitude) or UTM coordinates, as well as the NAD datum of the coordinates, North American Datum of 1927 (NAD 27) or North American Datum of 1983 (NAD 83). If the user enters geographic or UTM coordinates with NAD 27 datum, AERSCREEN converts the coordinates to UTM coordinates with NAD 83 datum. If the user enters geographic coordinates with NAD 83, AERSCREEN converts the coordinates to UTM coordinates with NAD 83 datum and writes those to the AERSCREEN.INP file. If the terrain files read in AERMAP are NAD datum 27 and not datum 83, AERMAP will do the necessary conversions to NAD 27 for terrain processing in AERMAP. For more information about the NAD conversion process see the AERMAP User's Guide (U.S. EPA, 2016b).

If geographic to UTM conversion is performed, AERSCREEN will write the converted NAD 83 UTM coordinates to the new AERSCREEN.INP file with a message that the latitude and longitude coordinates were converted to UTM coordinates. AERSCREEN will also write a message to the input file if coordinates were switched from NAD 1927 to NAD 1983. When entering data using the AERSCREEN.INP file, coordinates must be in UTM coordinates. If the coordinates are indicated to be in NAD 1927, AERSCREEN will convert to NAD 1983 UTM coordinates and notify the user. Coordinates should only be in NAD 1927 if the user manually changed the coordinates and NAD in AERSCREEN.INP. The variables are as follows in the fourth line of the AERSCREEN input file (Figure 13). Terrain data is denoted by the term “** TERRAIN DATA” in the input file. Prompts are also shown in Figure 13.

AERSCREEN.INP inputs									
** TERRAIN DATA	Terrain	UTM East	UTM North	Zone	Nada	Probe	PROFBASE	Use AERMAP	elev
**	N	406672.0	3698970.8	12	1	5.0	18.30		N
Prompts inputs									
<i>Include Terrain Heights? (y/n):</i>									
If user enters “y” or “Y”:									
<i>Enter Maximum Distance (m) to probe</i>									
<i><Enter> for default (10000 m):</i>									
If user enters “n” or “N”:									
<i>Enter Maximum Distance (m) to probe</i>									
<i><Enter> for default (5000 m):</i>									
<i>Enter stack elevation (m) or</i>									
<i><Enter> for AERMAP derived elevation:</i>									
If the user enters “n” or “N” for terrain or source is a rectangular area source:									
<i>Enter source elevation (m) or</i>									
<i><Enter> for default 0 m:</i>									
If user enters “y” or “Y” for terrain:									
<i>Enter coordinate type:</i>									
<i>LATLON for latitude & longitude or</i>									
<i>UTM for UTM coordinates</i>									
If the user enters LATLON:									
<i>Enter Source Latitude (North positive) (xx.xxxx):</i>									
<i>Enter Source Longitude (West negative) (xxx.xxxx):</i>									
If the user enters UTM:									
<i>Enter Source UTM Easting (xxxxxx.x):</i>									
<i>Enter Source UTM Northing (xxxxxx.x):</i>									
The following prompt is shown for UTM coordinates:									
<i>Enter Source UTM Zone (xx):</i>									

<i>Option (1) - North American Datum of 1927</i>									
<i>Option (4) - North American Datum of 1983</i>									

<i>Enter Option for Applicable UTM Nada:</i>									

Figure 13. AERSCREEN.INP and prompts inputs for terrain data.

Input parameters in AERSCREEN.INP are:

- Terrain flag (Y=use terrain, N=do not use terrain)
- UTM X coordinate
- UTM Y coordinate
- UTM zone
- NAD datum of source location
- Probe distance in meters
- Source elevation (feet or meters)
- Override source elevation with AERMAP value (Y=yes, N=no)

When the probe distance is entered, AERSCREEN checks to see if the probe distance is a multiple of 25 meters. If the distance is not a multiple of 25, the probe distance is reset to the next distance that is greater than the entered probe distance and is a multiple of 25.

AERSCREEN alerts the user of the change. For example, if the entered probe distance is 1,031 m, AERSCREEN will reset the distance to 1,050 m. This is done because the receptor spacing between zero and 5 km is 25 m and a multiple of 100 between 5 km and the probe distance. The reset makes it easier to perform the calculations.

If the user enters the source coordinates as latitude and longitude, the UTM zone will not be requested and is determined by AERSCREEN. If not processing terrain, the user can enter the actual elevation for the source or choose a default of zero. The user will not be prompted for AERMAP override of user-entered source elevation.

When entering data via the prompts, the prompt for terrain processing and overriding of source elevation with AERMAP will appear for all source types except rectangular area sources. The other prompts will appear for all sources.

The name(s) of the terrain input file(s) that AERMAP reads are input into AERSCREEN by a file called demlist.txt, which is to be located in the same directory as the AERSCREEN executable or local folder in which the user is working. The demlist.txt file is not created by AERSCREEN but the user must create the file prior to running AERSCREEN. If terrain is to be processed, AERSCREEN will check for the existence of this file and if it is not present, AERSCREEN will stop processing. The general format of the file and three examples are shown in Figure 14. The general format is that the first line contains either “NED” or “DEM” (the case can be lower or upper case) as the first three characters to denote the file type. The rest of the line is for informational purposes and not read by AERSCREEN. The second line is a delineator between the file type and the file list, usually a series of dashes. The third line is to specify the location of the grid files (conus.las, conus.los, etc.) that will be used for NAD conversion (from 27 to 83 or vice versa). The location is specified by starting the line with “NADGRIDS” followed by the pathname of the files. If the pathname contains spaces, the entire pathname should be enclosed in quotations. Beginning with AERSCREEN version 11060, a trailing “\” is no longer necessary at the end of the pathname. In Figure 14a, AERSCREEN will accept

“c:\grid files\” or “c:\grid files”. If the files are in the current working directory¹, the rest of the line after “NADGRIDS” can be the full path of the current working directory, blank, or .\,. However, if the files are not in the working directory, AERSCREEN will stop processing. Regardless of the NAD datum of the coordinates, the field will be read by AERSCREEN and input into AERMAP. If the line beginning with NADGRIDS is not in the demlist.txt file, AERSCREEN will notify the user and stop processing.

Finally beginning with the fourth line, is the list of the files to be read into AERMAP, each file on a separate line. If the filename or pathname of the file contains spaces, the filename or pathname must be enclosed in quotations. For NED files only, the units of the terrain data can be included. The units are:

- FEET for units of feet
- DECI-FEET or DECIFEET for units of decifeet
- DECA-FEET or DECAFEET for units of decafeet
- METERS for meters
- DECI-METERS or DECIMETERS for units of decimeters
- DECA-METERS or DECAMETERS for units of decameters

Note that the units are not case sensitive, so lower-case text is allowed. If no units are entered, i.e. blank after the filename, the units are understood to be meters and AERMAP will give a non-fatal warning to the user when AERMAP is executed. If units are included, when AERSCREEN creates the AERMAP.INP file, the TIFFDEBUG keyword will be added to the DATAFILE line in the AERMAP.INP file.

In Figure 14a, a single National Elevation Data (NED) file called ned_file.tif is to be read into AERMAP with units of meters by default. Also, the NADGRIDS files are located in a folder with spaces in the pathname so the filename is in quotations. Figure 14b gives an example of a NED file whose pathname contains spaces, so the name is enclosed in quotations. The units of the terrain are specified to be meters. Figure 14b also shows that the location of the grid files used for NAD conversion. Figure 14c shows a list of DEM files that will be processed in AERMAP with NAD grid files located in the current working directory. Note that units cannot be included with DEM files.

Users are encouraged to use NED data as DEM data is static and no longer updated. NED data is more up to date and is regularly updated.

¹ Current working directory refers to the directory or folder that a DOS prompt is working in when using a DOS window or to the folder that the AERSCREEN executable is in when double clicking the AERSCREEN executable icon.

<p>NED : Must be either DEM or NED</p> <p>-----</p> <p>NADGRIDS "c:\grid files\ ned_file.tif</p>	a
<p>NED : Must be either DEM or NED</p> <p>-----</p> <p>NADGRIDS c:\aermap\grids "test dir\ned_file.tif" meters</p>	b
<p>DEM : Must be either DEM or NED</p> <p>-----</p> <p>NADGRIDS test01.dem test02.dem test03.dem</p>	c

Figure 14. Example formats of demlist.txt.

If terrain is to be included, users should consult the AERMOD Implementation Guide, specifically sections 4.3, 4.4, and 4.5 (U.S. EPA, 2016e) as well as the AERMAP User’s Guide and addendum (U.S. EPA, 2016b).

2.6 Inclusion of discrete distances

Beginning with version 11060, AERSCREEN allows for the input of up to ten discrete receptor distances that are not part of the regularly spaced receptor network created by AERSCREEN (See Section 3.4). These could include distances to specific locations near a source such as a monitor, school, residential area, etc. AERSCREEN will read all of the locations input by the user but will only process receptors that are between the ambient distance and probe distance. Discrete receptor use is entered in AERSCREEN.INP via the 6th data line in AERSCREEN.INP (Figure 15) or during the terrain processing prompts when entering via the prompts. If the user wishes to include discrete distances, the distances should be entered into a simple text file. The user will also be prompted for the filename of distances. The distances listed in the file can be in

several units: meters, feet, kilometers, or miles and is independent of whether other data (source inputs, meteorology, etc.) are in metric or English units. To define the units, the first line of the text file should be the line “units: “ followed by the units of the distances. An example file is shown in Figure 16 with distances listed in meters. The format of the units line is not case sensitive but it must be the first line of the file. Distances can be entered as:

- FEET or FT for feet
- METERS for meters
- KILOMETERS, KILO-METERS, or KM for kilometers
- MILES for miles

If the units line is present but no distance units are entered, i.e. the line is just “units: “, then AERSCREEN will assume distance units of meters. When entering the filename from AERSCREEN.INP, if the file does not exist, or the number of receptors exceeds ten, or no units line is listed, AERSCREEN will alert the user and stop processing. If entering the filename using prompts and one of the conditions above is met, AERSCREEN will alert the user and re-prompt for a filename.

If the discrete receptor data line is not in AERSCREEN.INP, AERSCREEN will assume no discrete receptor distances will be used in modeling. The user can then include discrete receptor use in the data validation phase of AERSCREEN.

AERSCREEN.INP inputs		
** DISCRETE RECEPTORS	Discflag	Receptor file
**	Y	"discrete rec.txt"
Prompts inputs		
<i>Include up to 10 discrete receptors (y/n)?</i>		
If user enters “y” or “Y”:		
<i>Enter name of file with discrete receptors.</i>		
<i>Enclose filename with quotes if path or filename includes spaces...</i>		

Figure 15. AERSCREEN.INP and prompts inputs for including discrete distances.

units: meters
26.0
35.1
111.5
427.35
535.0

Figure 16. Sample distances in a discrete distances text file.

2.7 Other inputs

Other inputs or options used by AERSCREEN are:

- units of inputs (metric or English),
- urban/rural classification
- urban population if urban
- minimum ambient distance (feet or meters)
- use of flagpole receptors
- flagpole receptor height (feet or meters)

These variables in the sixth line of the AERSCREEN input file are shown in Figure 15 and are denoted by the term “** UNITS/POPULATION.” This line must be listed after the source input line. While entering data via prompts, the English or metrics unit prompt is before any other prompts, while the urban/rural and ambient distance prompts occur during the source input processing. The flagpole receptor prompts occur in the terrain inputs processing.

AERSCREEN.INP inputs							
** UNITS/POPULATION	Units	R/U	Population	Amb. dist.	Flagpole	Flagpole height	
**	M	R	0.	50.000	N	0.00	
Prompts inputs							
<i>English or Metric Units? (E or M):</i>							
<i>Rural or Urban? (R or U):</i>							
<i>Enter Population of Urban Area:</i>							
<i>Enter Minimum Distance (meters) to Ambient Air – <Enter> for default (1 m):</i>							
<i>Use Flagpole receptors? (y or n):</i>							
If user enters “y” or “Y”:							
<i>Enter Flagpole receptor height (meters)</i>							

Figure 17. AERSCREEN.INP and prompts inputs for other inputs.

Inputs in AERSCREEN.INP are:

- Units of data (M=metric, E=English)
- Urban/rural flag (U=urban, R=Rural)
- Population for urban source
- Minimum ambient distance
- Use Flagpole receptors
- Flagpole receptor height (ignored if flagpole receptors = no)

If the units flag in AERSCREEN.INP is set to “E” AERSCREEN will stop processing and notify the user that the flag is not set to “M.” for metric. The user can enter the data in English units when entering data from the prompts but AERSCREEN will change the units flag to metric and convert the variables from English to metric units during processing. When AERSCREEN creates the AERSCREEN.INP file from prompt-entered data, there will be a comment in the new input file that units were converted from English to metric.

For minimum ambient air distances for non-volume sources, when entering data with English units, the default value listed will be 3.3 feet, or 1 meter. For volume sources, the ambient distance must be greater than or equal to 2.15 times the initial lateral dimension, $2.15\sigma_y$ plus one meter. In AERMOD, receptors with source-receptor distances less than $2.15\sigma_y$ plus one meter are not included in concentration calculations. When entering data via the prompts, the default value that is listed will be $2.15\sigma_y$ plus 1 m (or equivalent in feet). If the user chooses the default value by hitting <Enter>, that will be the ambient distance. If the user enters a different value from the listed default value, it must be greater than or equal to the default value listed. Otherwise, the user will receive a message that the value reset to $2.15\sigma_y$ plus 1 m. When obtaining the ambient distance from AERSCREEN.INP, AERSCREEN will compare that value against $2.15\sigma_y$ plus 1 m and if the entered value is less than $2.15\sigma_y$ plus 1m, it is reset to $2.15\sigma_y$ plus 1 m. If the user does not wish to use the reset value, it change be changed at the validation page but must be greater than or equal to $2.15\sigma_y$ plus 1m.

When the source is a non-volume source and the ambient distance is less than 1 meter in the AERSCREEN.INP, the distance will be reset to 1 meter and AERSCREEN will alert the user. If the user enters a distance less than 1 meter using the prompts, the distance will be reset to 1 m and the user will be alerted.

2.8 Fumigation options

Beginning with version 15181, AERSCREEN will calculate fumigation due to inversion break-up and coastal fumigation for point sources with release heights (above ground level) 10 m or more in height. The fumigation equations are taken from SCREEN3 (U.S. EPA, 1995) and follow the methodology of Turner (1970). The inputs to AERSCREEN.INP are:

- Calculate inversion break-up fumigation (Y=calculate fumigation, N=do not calculate fumigation)
- Calculate shoreline fumigation (Y=calculate fumigation, N=do not calculate fumigation)

- Minimum distance to shoreline in meters (less than 3,000 m)
- Optional direction to shoreline from source (0-360 degrees or -9 for no specified direction)

For shoreline fumigation, the user also enters the minimum distance to the shoreline from the source and the user has the option to specify the direction from the source to the shoreline when using spatially varying surface characteristics for MAKEMET. This option allows AERSCREEN to use appropriate surface characteristics corresponding to the upwind direction from the source to shoreline. For the fumigation options, the source is considered rural, no downwash effects are included, and no terrain effects are included. The inputs for fumigation are shown in Figure 18.

AERSCREEN.INP inputs						
** FUMIGATION	Inversion Break-up	Shoreline	Distance	Direct	Run	
AERSCREEN						
** FUMIGATION	Inversion Break-up	Shoreline	Distance	Direct	Run	
		AERSCREEN				
**	N	N	0.00	0.0	Y	
Prompts inputs						
<i>Apply inversion break-up fumigation (y/n):</i>						
<i>Apply shoreline fumigation (y/n):</i>						
<i>Enter minimum distance to shoreline (m):</i>						
<i>Enter optional direction to shoreline (0 - 360 degrees) or enter -9 or <Enter> for no specific direction:</i>						
<i>Run AERSCREEN (y/n):</i>						

Figure 18. AERSCREEN.inp and prompt inputs for fumigation.

2.9 Optional debug file

Beginning with version 15181, AERSCREEN allows for the option to output a debug file that contains all intermediate output from the stages of AERSCREEN (PROBE and FLOWSECTOR) described in Section 3.5 and 3.6 of this guide. When fumigation options are selected, the debug option will also output the meteorological variables and iterations of the fumigation calculations. The inputs for the debug option are shown in Figure 19.

AERSCREEN.INP inputs	
** DEBUG OPTION	Debug
**	N
Prompts inputs	
<i>Enter Y or y to turn on the debug option or <Enter> to not use the debug option</i>	

Figure 19. AERSCREEN.inp and prompt inputs for fumigation.

2.10 Non-default name for output file

The default output files for AERSCREEN are AERSCREEN.OUT and max_conc_distance.txt. The default name for the optional debug file is concentrations.txt and fumigate_debug.txt for fumigation output. AERSCREEN.OUT lists the inputs and various outputs of the AERSCREEN run. The file max_conc_distance.txt, lists the maximum concentration by distance. Beginning with AERSCREEN version 11060, the user can choose different names other than the defaults. The filename must have an “.out” extension. The user can specify a filename within the current working folder or a complete path. If a complete pathname is entered, AERSCREEN will check to make sure that the target folder or directory exists. If the folder does not exist, the user must re-enter the filename. The filename that is used for output file is also used to construct the maximum concentration by distance file as well the debug files. The prefix (including folder name) of the new output file is used for the maximum concentration file and debug files. The prefix (including folder name) is also used to copy the final AERSCREEN.INP file and AERSCREEN.LOG files to new files that have the same prefix as the output file. The user can change the filename using prompts or by the seventh data line beginning with “** OUTPUT FILE” followed by the output filename. Figure 20 shows the AERSCREEN.INP inputs and prompts inputs. If the output file option is not listed in AERSCREEN.INP, AERSCREEN will assume the default AERSCREEN.OUT for the filename and the user can change the filename during the data validation phase of AERSCREEN.

AERSCREEN.INP inputs
** OUTPUT FILE "AERSCREEN.OUT"
Prompts inputs
<i>Enter name of AERSCREEN output file Enter <Enter> to use default name AERSCREEN.OUT Filename should include .out or .OUT extension If filename contains spaces, enter entire filename in quotations</i>

Figure 20. AERSCREEN.INP and prompts inputs for output filename.

2.11 Error checking

When entering data via the AERSCREEN.INP file or via prompts, AERSCREEN will check for invalid responses for flags (use downwash, terrain, urban/rural, etc.) and numeric values (stack height, building height, etc.). When processing input from the AERSCREEN.INP file, any flags or parameters found to be invalid or outside a realistic data range (minimum ambient temperature is greater than maximum ambient temperature), AERSCREEN lists error messages for the parameters to the AERSCREEN.LOG file and stops AERSCREEN processing to allow the user to correct the values in the AERSCREEN.INP file. Examples would be a character other than “Y”, “y”, “N”, or “n” for the building downwash flag or a negative building height for

downwash. If processing input data from the prompts, AERSCREEN will re-prompt the user for a valid response. For the two examples listed above, AERSCREEN would re-prompt the user for responses. Appendix A lists the input parameters, reasons for invalid values, and actions taken by AERSCREEN.

When entering data from AERSCREEN.INP, AERSCREEN checks to make sure that the emissions data is listed before the building, terrain, and miscellaneous data lines. If the emissions data line is listed after one of the other three lines, AERSCREEN notifies the user and stops processing.

AERSCREEN also checks for the presence of several files, if applicable:

- Demlist.txt (when processing terrain)
- BPIPprm input file (if processing downwash and filename is entered)
- External surface characteristics file (if isurf equals 9)
- Discrete receptor file (if processing discrete receptors)

If these files are not found, AERSCREEN issues a message and stops processing. Note that if demlist.txt does not exist, AERSCREEN stops processing, regardless of whether data is being entered via prompts or AERSCREEN.INP. AERSCREEN will also check if the pathname of the output file is valid. If the folder or directory does not exist, AERSCREEN issues a message and stops processing. AERSCREEN also checks for the presence of the AERMOD and MAKEMET executables in the current working folder. If one of those executables is not present, AERSCREEN issues a warning and prompts the user for the location of the executable. AERSCREEN will copy the executable from the entered locations to the current working folder. If processing downwash, AERSCREEN will check for the presence of the BPIPprm executable and the AERMAP executable if processing terrain. If those are not present, AERSCREEN will issue a warning, prompt the user for the locations of the executables, and copy them to the current working folder.

3. AERSCREEN Program Execution

The AERSCREEN program can be run from the command-prompt or by double-clicking on the AERSCREEN.EXE from Windows Explorer. The user should make sure that demlist.txt, the AERMOD, MAKEMET, and if necessary the AERMAP and BPIPFRM executables are in the current working directory. General AERSCREEN processing is shown in Figure 21. If a restart file generated from a previous run (called 'AERSCREEN.INP') is present in the folder, then the user will be asked to continue with the restart file or enter data via the prompts (Figure 22a). If there is no restart file, the prompts will begin automatically (Figure 22b).

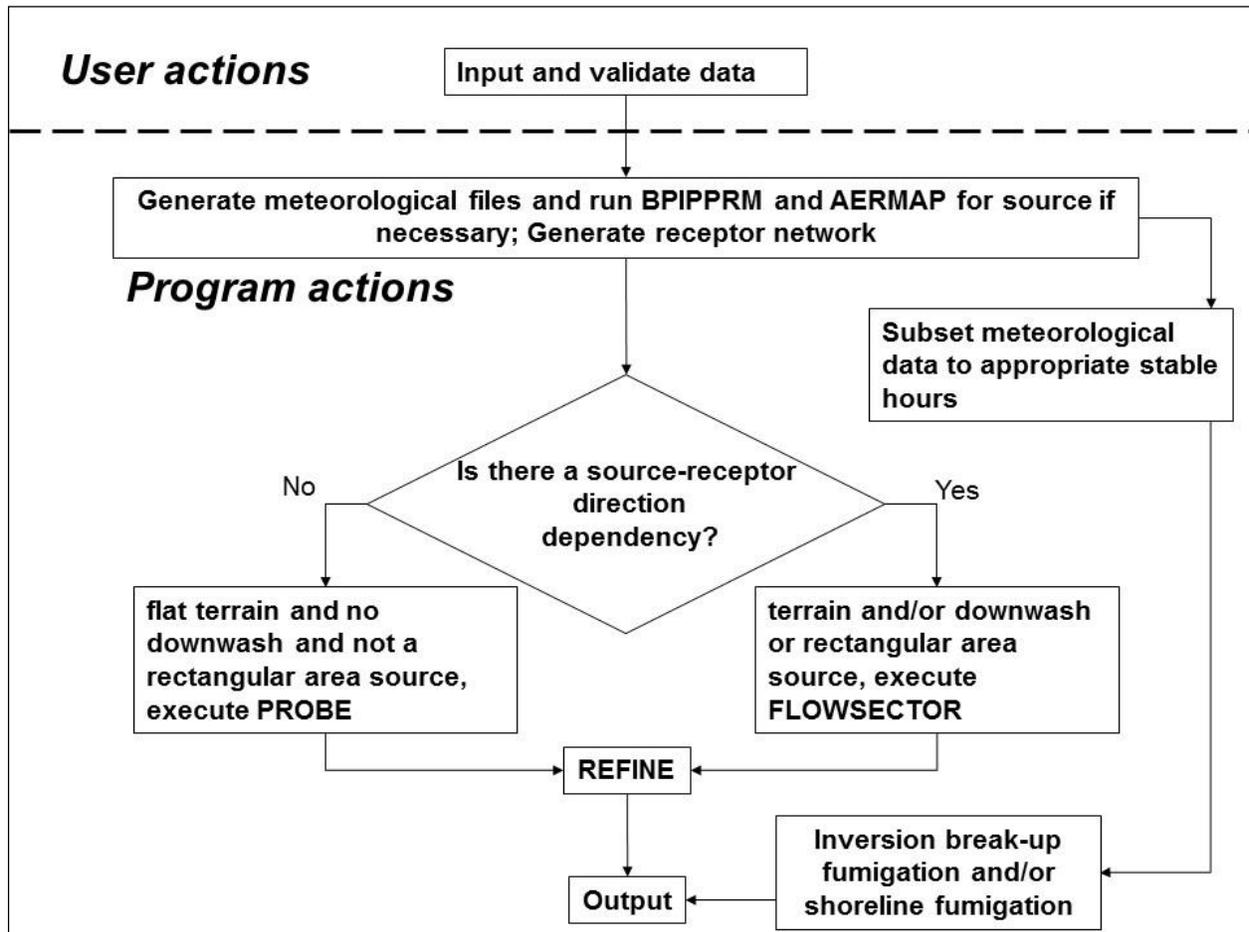


Figure 21. AERSCREEN processing and stages.

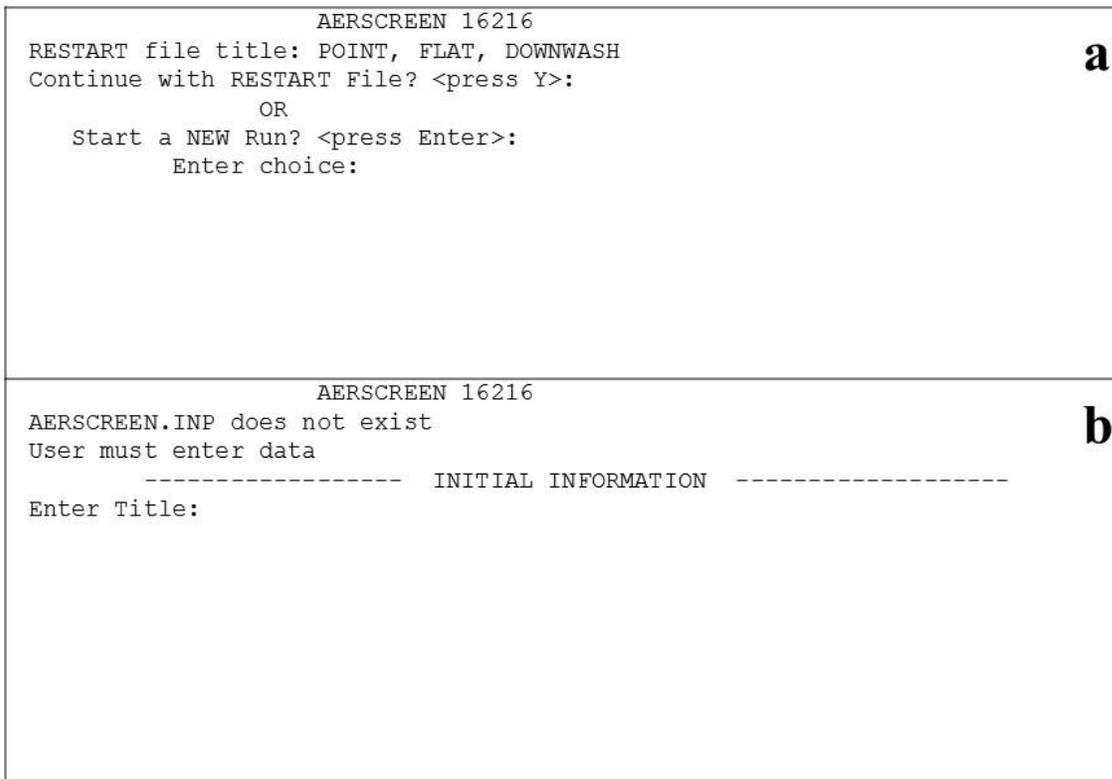


Figure 22. AERSCREEN start screen.

3.1 Data input and validation

If the user chooses the restart file, AERSCREEN goes directly into the user validation page. The user should carefully review the data to ensure accurate inputs. If processing terrain, particular attention should be paid to the coordinates to ensure that any NAD conversions were successful. Also on the validation page, the user will have the option of rerunning the same inputs or selectively modifying specific components, such as building or terrain information (Figure 23). For example, if changes are to be made to building parameters, the user chooses option 2 and a list of further options will appear (Figure 25). The user can change individual parameters without having to re-enter all the parameters. The option to re-enter all parameters is a choice as well. Changes to individual parameters are available for source, meteorological, and terrain parameters as well. Some options cannot be changed without changing another parameter first. These include changing urban population for a rural source or surface characteristics (i.e. user defined values when AERMET tables are chosen). Figure 24 shows the list of choices for various source types, Figure 25 shows the choices for building parameters, Figure 26 lists the choices for terrain processing, Figure 27 lists the choices for meteorological processing and Figure 28 lists the fumigation options. For each submenu, once the desired changes are made,

the user can hit <Enter> to return to the validation page. Some changes will automatically return the user to the validation page, such as choosing option 1 in Figure 25a for building downwash or turning the debug option on or off.

Note, that if the user chooses to change source data, the source type cannot be changed; only parameters for the source type from the AERSCREEN.INP file or from the prompts. For example, the user cannot change the source from point to rectangular area. For building data, if the user is running AERSCREEN for an area source, rectangular or circular, or a volume source (which do not use building downwash) and chooses option 2 from the validation page, AERSCREEN will give the message that building parameters cannot be changed due to source type and return to the validation page. The same is true for changing terrain data when running a rectangular area source. The user may also change parameters in the AERSCREEN.INP file before running AERSCREEN, instead of modifying the data using the prompts.

```

AERSCREEN 16216
----- DATA ENTRY VALIDATION -----
          METRIC          ENGLISH
** STACKDATA ** -----
Emission Rate:  1.0000 g/s          7.937 lb/hr
Stack Height:   61.00 meters        200.13 feet
Stack Diameter: 5.000 meters        196.85 inches
Stack Temperature: 415.0 K          287.3 Deg F
Exit Velocity:  11.000 m/s          36.09 ft/s
Stack Flow Rate: 457646 ACFM
Model Mode:     RURAL
Dist to Ambient Air: 50.0 meters      164. feet

** BUILDING DATA **
User defined BPIPPRM input file:
BUILDING.INP

** TERRAIN DATA **
No Terrain Elevations
Source Base Elevation: 25.0 meters      82.0 feet

Probe distance: 10000. meters      32808. feet

No flagpole receptors

Using discrete receptors in
discrete_rec.txt

Only receptors between the ambient and probe distances will be included
Input distance units are: METERS

** FUMIGATION DATA **
No fumigation requested

** METEOROLOGY DATA **
Min/Max Temperature: 270.0 / 310.0 K   26.3 /   98.3 Deg F

Minimum Wind Speed: 0.5 m/s

Anemometer Height: 10.000 meters

Using surface characteristics in file:
season_3.out

Surface friction velocity (u*): adjusted

DEBUG OPTION OFF

AERSCREEN output file:
AERSCREEN_FLAT_DW.OUT

*** AERSCREEN Run is Ready to Begin - Choose Option to Proceed ***

    1 - Change Source Data;
    2 - Change Building Data;
    3 - Change Terrain Data;
    4 - Change Meteorology Data;
    5 - Change Fumigation Data;
    6 - Change Title;
    7 - Change Debug Option;
    8 - Change Output Filename;
    9 - Stop AERSCREEN;
      - or -
Hit <Enter> to Start Run

```

Figure 23. AERSCREEN validation page.

<p>Enter number of parameter to change or <Enter> to return to validation page a</p> <p>Point Source</p> <ol style="list-style-type: none"> 1) Emission rate 2) Stack height 3) Stack diameter 4) Stack temperature 5) Exit velocity 6) Urban/Rural 7) Urban population 8) Distance to ambient air 9) NO2 chemistry 10) NO2/NOx in stack ratio 11) Ozone concentration 12) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page b</p> <p>Volume Source</p> <ol style="list-style-type: none"> 1) Emission rate 2) Center of volume height 3) Initial lateral dimension 4) Initial vertical dimension 5) Urban/Rural 6) Urban population 7) Distance to ambient air 8) NO2 chemistry 9) NO2/NOx in stack ratio 10) Ozone concentration 11) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page c</p> <p>Rectangular area source</p> <ol style="list-style-type: none"> 1) Emission rate 2) Release height 3) Long side dimension 4) Short side dimension 5) Initial vertical dispersion parameter 6) Urban/Rural 7) Urban population 8) Distance to ambient air 9) NO2 chemistry 10) NO2/NOx in stack ratio 11) Ozone concentration 12) Update all parameters 	
<p>Enter number of parameter to change or <Enter> to return to validation page d</p> <p>Circular area source</p> <ol style="list-style-type: none"> 1) Emission rate 2) Release height 3) Radius 4) Initial vertical dispersion parameter 5) Urban/Rural 6) Urban population 7) Distance to ambient air 8) NO2 chemistry 8) NO2/Nox in stack ratio 10) Ozone concentration 11) Update all parameters 		<p>Enter number of parameter to change or <Enter> to return to validation page e</p> <p>Flare Source</p> <ol style="list-style-type: none"> 1) Emission rate 2) Stack height 3) Total heat release rate 4) Heat loss fraction 5) Urban/Rural 6) Urban population 7) Distance to ambient air 8) NO2 chemistry 9) NO2/Nox in stack ratio 10) Ozone concentration 11) Update all parameters 	

Figure 24. Submenus for changing source parameters for a) point, capped or horizontal stack, b) volume, c) rectangular area, d) circular area, and e) flare sources.

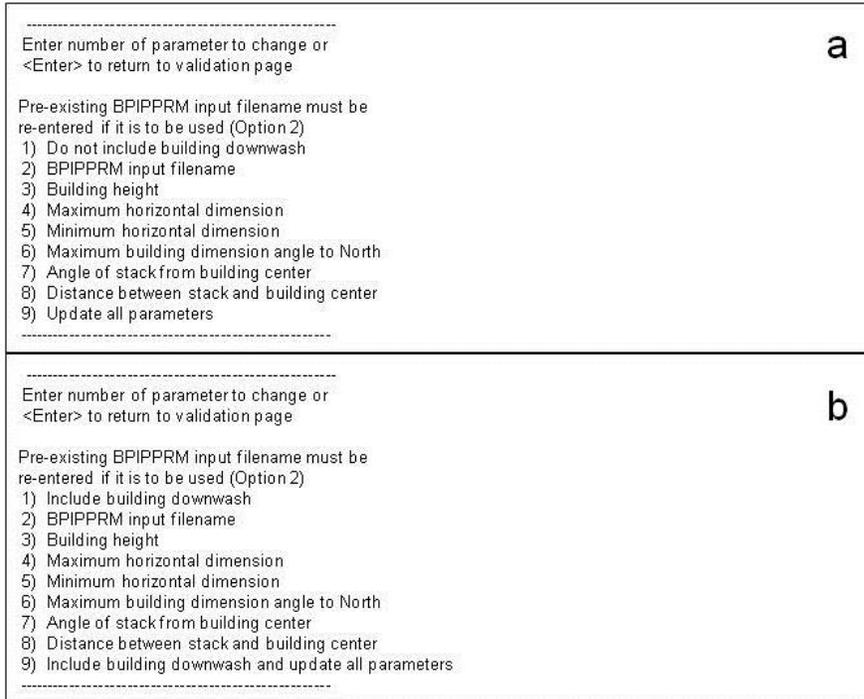


Figure 25. Building downwash submenus for a) building downwash included and b) building downwash not included.

<p>----- Enter number of parameter to change or <Enter> to return to validation page</p> <p>1) Do not include terrain heights 2) Probe distance 3) Use flagpole receptors 4) Flagpole receptor height 5) Source elevation input (user entered or AERMAP) 6) Input coordinate type and coordinates (LATLON or UTM), UTM zone, and NAD 7) Include discrete receptors 8) Filename of discrete receptor list 9) Update all parameters</p> <p>-----</p>	a
<p>----- Enter number of parameter to change or <Enter> to return to validation page</p> <p>1) Include terrain heights 2) Probe distance 3) Use flagpole receptors 4) Flagpole receptor height 5) Source elevation input (user entered or AERMAP) 6) Input coordinate type and coordinates (LATLON or UTM), UTM zone, and NAD 7) Include discrete receptors 8) Filename of discrete receptor list 9) Include terrain heights and update all parameters</p> <p>-----</p>	b
<p>----- Enter number of parameter to change or <Enter> to return to validation page</p> <p>1) Probe distance 2) Use flagpole receptors 3) Flagpole receptor height 4) Source elevation input 5) Include discrete receptors 6) Filename of discrete receptor list 7) Update all parameters</p> <p>-----</p>	c

Figure 26. Terrain submenus for a) terrain heights included, b) terrain heights not included and c) rectangular area sources.

<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">a</p> <ol style="list-style-type: none"> 1) Use default min and max temperatures 2) Minimum temperature 3) Maximum temperature 4) Minimum wind speed 5) Anemometer height 6) Input surface characteristics 7) User albedo 8) User Bowen ratio 9) User surface roughness length 10) landuse 11) Moisture 12) AERSURFACE output file 13) Adjust u^* 14) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">b</p> <ol style="list-style-type: none"> 1) Use default min and max temperatures 2) Minimum temperature 3) Maximum temperature 4) Minimum wind speed 5) Anemometer height 6) Input surface characteristics 7) User albedo 8) User Bowen ratio 9) User surface roughness length 10) landuse 11) Moisture 12) AERSURFACE output file 13) Do not adjust u^* 14) Update all parameters
--	---

Figure 27. Meteorological data submenu for a) when not adjusting u^* and b) when adjusted u^* is being used.

<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">a</p> <ol style="list-style-type: none"> 1) Apply inversion break-up fumigation 2) Apply shoreline fumigation, enter minimum distance to shoreline, and optional direction to shoreline 3) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">b</p> <ol style="list-style-type: none"> 1) Apply inversion break-up fumigation 2) Do not apply shoreline fumigation 3) Minimum distance to shoreline 4) Optional direction to shoreline 5) Do not run AERSCREEN 6) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">c</p> <ol style="list-style-type: none"> 1) Apply inversion break-up fumigation 2) Do not apply shoreline fumigation 3) Minimum distance to shoreline 4) Optional direction to shoreline 5) Run AERSCREEN 6) Update all parameters
<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">d</p> <ol style="list-style-type: none"> 1) Do not apply inversion break-up fumigation 2) Apply shoreline fumigation, enter minimum distance to shoreline, and optional direction to shoreline 3) Do not run AERSCREEN 4) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">e</p> <ol style="list-style-type: none"> 1) Do not apply inversion break-up fumigation 2) Do not apply shoreline fumigation 3) Minimum distance to shoreline 4) Optional direction to shoreline 5) Do not run AERSCREEN 6) Update all parameters 	<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">f</p> <ol style="list-style-type: none"> 1) Do not apply inversion break-up fumigation 2) Apply shoreline fumigation, enter minimum distance to shoreline, and optional direction to shoreline 3) Run AERSCREEN 4) Update all parameters
<p>Enter number of parameter to change or <Enter> to return to validation page</p> <p style="text-align: right;">g</p> <ol style="list-style-type: none"> 1) Do not apply inversion break-up fumigation 2) Do not apply shoreline fumigation 3) Minimum distance to shoreline 4) Optional direction to shoreline 5) Run AERSCREEN 6) Update all parameters 		

Figure 28. Fumigation submenus for various fumigation options.

If the user chooses to run from the restart file, while reading the file, AERSCREEN may automatically change some of the options in the file, depending on other options. If the source being modeled is a rectangular area source and the terrain flag is set to “y” or “Y” then the terrain flag is reset to “N.” For rectangular area sources, circular area sources, or volume sources, if the BPIP flag is set to “Y” or “y” in the input file then the BPIP flag is set to “N” and no downwash is calculated. If the user enters data using prompts instead of the AERSCREEN.INP file, the validation page will appear after all prompts have been processed for the source, building, terrain, and meteorological data.

3.2 Meteorological data files

After reading the input file or prompt inputs, and prompting the user for any changes, AERSCREEN processes the surface characteristics and runs MAKEMET to create the AERMOD meteorological input files (.sfc, and .pfl files). MAKEMET is run for each temporal period /spatial sector combination of surface characteristics. Depending on the temporal resolution and number of spatial sectors of the surface characteristics, one surface and one profile file (annual, 1 sector) to a maximum of 144 (monthly, 12 sector) surface files and 144 profile files are created, one for each temporal period/spatial sector combination (Figure 29). In the meteorological files naming convention, the first set of 2-digit numbers refers to the temporal period of the surface characteristics, which ranges from 1 to 12. If processing annual surface characteristics, the number would be “01” and if processing seasonal or monthly surface characteristics, the number would be range from “01” to “04” for seasonal output and “01” to “12” for monthly output. The second set of numbers in the filenames is the number of spatial sectors for surface roughness. This can range from “01” to “12” for one sector to 12 sectors. In Figure 26, aerscreen_01_01.sfc and aerscreen_01_01.pfl use surface characteristics for January, sector 1; aerscreen_01_02.sfc and aerscreen_01_02.pfl use surface characteristics for January, sector 2 and so on with aerscreen_12_12.sfc and aerscreen_12_12.pfl using surface characteristics for December, and sector 12.

```
Creating met files aerscreen_01_01.sfc & aerscreen_01_01.pfl
Creating met files aerscreen_01_02.sfc & aerscreen_01_02.pfl
Creating met files aerscreen_01_03.sfc & aerscreen_01_03.pfl
Creating met files aerscreen_01_04.sfc & aerscreen_01_04.pfl
Creating met files aerscreen_01_05.sfc & aerscreen_01_05.pfl
.
.
.
Creating met files aerscreen 12 12.sfc & aerscreen 12 12.pfl
```

Figure 29. Meteorological file creation for monthly 12 sector AERSURFACE output.

The input parameters to MAKEMET, which are normally entered using prompts, are written to a text file called prompts.inp by AERSCREEN and then “piped” to the MAKEMET call by AERSCREEN with the call system command, “makemet < prompts.inp.” Using the MAKEMET prompts shown in Figure 1 as a guide, AERSCREEN assigns the names for the surface and upper air meteorological files requested in the first two prompts shown in Figure 1 based on the file naming convention described above. The minimum wind speed and anemometer height are assigned the values entered by the user. The number of wind directions is automatically set to 1 by AERSCREEN and the wind direction is set to 270 degrees. The minimum and maximum temperatures are assigned the values entered by the user. The albedo, Bowen ratio and surface roughness length are assigned the values for the particular

temporal/spatial combination being processed. The final prompt, “DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE APPENDED TO CURRENT FILE? [TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" TO EXIT]” is set not to generate another file. An example for monthly, 12 sector AERSURFACE output is shown in Table 1.

Table 1. MAKEMET prompts and example values for the first month and surface roughness sector and last month and surface roughness sector for monthly 12 sector AERSURFACE output.

MAKEMET prompt	Value (month 1, sector 1)	Value (month 12, sector 12)
ENTER SFC MET FILE NAME	aerscreen_01_01.sfc	aerscreen_12_12.sfc
ENTER PFL MET FILE NAME	aerscreen_01_01.pfl	aerscreen_12_12.pfl
ENTER MIN. WS (M/S)	User input minimum wind speed	User input minimum wind speed
ENTER ANEM HT (M)	User input anemometer height	User input anemometer height
ENTER OPTION TO ADJUST U* (Y=adjust,N=no adjustment)	User entered option (Y or N)	User entered option (Y or N)
ENTER NUMBER OF WIND DIRECTIONS	1	1
ENTER WIND DIRECTION	270	270
ENTER MIN AND MAX AMBIENT TEMPS IN KELVIN	User entered temperatures	User entered temperatures
ENTER ALBEDO	Albedo for month 1, sector 1	Albedo for month 12, sector 12
ENTER BOWEN RATIO	Bowen ratio for month 1, sector 1	Bowen ratio for month 12, sector 12
ENTER SURFACE ROUGHNESS LENGTH IN METERS	Surface roughness for month 1, sector 1	Surface roughness for month 12, sector 12
DO YOU WANT TO GENERATE ANOTHER MET SET THAT WILL BE APPENDED TO CURRENT FILE? [TYPE EITHER "Y" OR "y" FOR YES; OR HIT "ENTER" EXIT]	N	N

3.3 BPIPPRM execution

If downwash is to be considered, BPIPPRM inputs are calculated and written to a BPIPPRM input file or the user entered input file is used. For either method, BPIPPRM is executed to create the projected building dimensions for input into AERMOD. If a user-entered file is used and the processing flag (line 2) of the BPIPPRM input file is not a “P” or “p” then BPIPPRM will abort and AERSCREEN will notify the user and stop processing. Beginning with AERSCREEN version 11060, AERSCREEN also checks to make sure only one stack is listed in the BPIPPRM input file. If more than one stack is listed, AERSCREEN will stop processing and notify the user.

3.4 Source elevation calculation

If terrain is being used, AERSCREEN calls AERMAP to get the source location's elevation. The source elevation, user-entered or AERMAP calculated, can be used as the source elevation in the SO pathway of the AERMOD runstream file, AERMOD.INP, and as the station elevation, keyword PROFBASE in the ME pathway of the AERMOD input file. If the user has chosen to replace the input source elevation, either from the restart file or via prompts, AERSCREEN will use the AERMAP elevation as the source location's elevation. If the user chose to keep the input elevation, AERSCREEN will calculate a percent difference between the user-entered elevation and the AERMAP calculated elevation and write the difference to the AERSCREEN log file.

3.4 Receptor network

An array of receptor distances is also created including the minimum ambient distance, automatically calculated distances (as described in steps 1 and 2 below), and any discrete receptor distances. The probe distance is set to the user-specified probe distance, or reset probe distance (as described in Section 2.4). Depending on the probe distance, there may be two receptor spacing values:

1. 25 meters from zero to 5 km
2. From 5 km to the final probe distance, the spacing is the greater of 25 m or a spacing calculated by: $(\text{probe distance} - 5,000 \text{ m})/100$ where 100 represents 100 receptors

For example, if the user enters a probe distance of 12,500 m, the receptor spacing from zero to 5,000 m is 25 m and the spacing from 5,000 to 12,500 is 75 m ($7,500 \text{ m}/100$).

Receptors located at distances less than the minimum ambient distance, either discrete or automatically calculated, are not included in the set of receptors. Also, any discrete receptor distances that exceed the probe distance are not included. Discrete receptors that are also equal to any distance in the automatic array are not included to avoid duplicate receptors. Receptor distances are relative to $x=0$ and $y=0$. For point, capped stacks, horizontal stacks, and flare sources, $x=0$ and $y=0$ represent the stack or flare location. For volume and circular area sources, $x=0$ and $y=0$ represent the center of the source.

There are three main routines in AERSCREEN: PROBE, FLOWSECTOR and REFINE as shown in Figure 19. There are two optional fumigation routines FUMIGATE and SHORELINE used to calculate maximum concentrations due to inversion break-up fumigation and shoreline fumigation respectively. PROBE is executed when there is no source-receptor direction dependency (no terrain, no building downwash, and the source is not a rectangular area source). FLOWSECTOR is executed when there is a source-receptor direction dependency (terrain and/or building downwash, or source is a rectangular area source). REFINE is executed after PROBE or FLOWSECTOR. FUMIGATE and SHORELINE are executed, if chosen, after REFINE.

Details about each section and the final output of AERSCREEN are described in each of the following sections.

3.5 PROBE

PROBE executes AERMOD for each combination of temporal periods and spatial sectors. For example, if user defined surface characteristics are used (annual, 1 spatial sector), AERMOD is executed once (Figure 30a). If monthly, 12 spatial sector AERSURFACE output is used, then AERMOD is executed 144 times, 12 months x 12 sectors (Figure 30b).

Running probe for Annual sector 1	a
Running probe for January sector 1	b
Running probe for January sector 2	
Running probe for January sector 3	
Running probe for January sector 4	
Running probe for January sector 5	
Running probe for January sector 6	
Running probe for January sector 7	
Running probe for January sector 8	
Running probe for January sector 9	
Running probe for January sector 10	
Running probe for January sector 11	
Running probe for January sector 12	
.	
Running probe for December sector 1	
Running probe for December sector 2	
Running probe for December sector 3	
Running probe for December sector 4	
Running probe for December sector 5	
Running probe for December sector 6	
Running probe for December sector 7	
Running probe for December sector 8	
Running probe for December sector 9	
Running probe for December sector 10	
Running probe for December sector 11	
Running probe for December sector 12	

Figure 30. Sequence of AERMOD runs in PROBE for different surface characteristics combinations.

AERSCREEN reads the output from AERMOD for each run and the highest concentration and its distance from the source are stored in arrays that will be used to find the highest overall concentration in REFINE. AERSCREEN also retains the high first high (H1H) 1-hour concentration for each receptor. These concentrations are later used in determining the maximum concentration by downwind distance.

3.6 FLOWSECTOR

FLOWSECTOR is executed when there is a source-receptor direction dependency (terrain and/or building downwash, or rectangular area source).

If terrain is to be used, AERSCREEN checks for the presence of output from a previous AERMAP run. If there is output available, AERSCREEN checks the following against the same parameters in the current AERSCREEN run:

- source location
- probe distance
- minimum ambient distance
- receptor spacing
- number of receptors
- NAD datum
- UTM zone
- Type (DEM or NED files), number and names of terrain input files
- If all of the above parameters match between the existing AERMAP output and the current AERSCREEN run, AERSCREEN then checks the receptor coordinates in the previous AERMAP run to ensure the distances and directions match the receptor spacing of the current run and that all 36 radial directions are included. This step is done in case the file was changed or corrupted without the user's knowledge or if different discrete receptors are used, but the number of receptors has not changed.

If any of the above parameters differ, AERMAP will be executed to create new receptor elevations. If all parameters match, the user is prompted to decide to use the elevations from the previous output, or to run AERMAP to create new elevations. If the older AERMAP output is for a source type different than the one being processed in the current run, the user may want to consider re-running AERMAP. AERSCREEN sets the ANCHORXY, $x=0$ and $y=0$ to the source location and receptor locations are relative to this location. For volume and circular area sources, this represents the center of the source. For point and flare sources, this is the stack location.

If AERMAP is run in FLOWSECTOR, AERSCREEN will calculate a domain for the receptor grid to include with the DOMAINXY keyword in the AERMAP.INP file that AERSCREEN generates to run AERMAP. This will speed up processing, especially if large terrain files are used. For FLOWSECTOR, the domain is 1.1 times the probe distance.

After running AERMAP for the receptor elevations, AERSCREEN checks the AERMAP.OUT file for any warnings or errors. If any are found, they are written to the AERSCREEN log file and AERSCREEN stops processing.

3.6.1 Rectangular area sources

For rectangular area sources, the angle of the diagonal is calculated from the center to the corner of the rectangle. Next, radials are calculated every five degrees, beginning with 0 degrees up to the nearest 5 degrees past the diagonal. For example, if the diagonal of the source was found to be 26 degrees, radials are calculated for 0, 5, 10, 15, 20, 25, and 30 degrees, as shown in Figure 31.

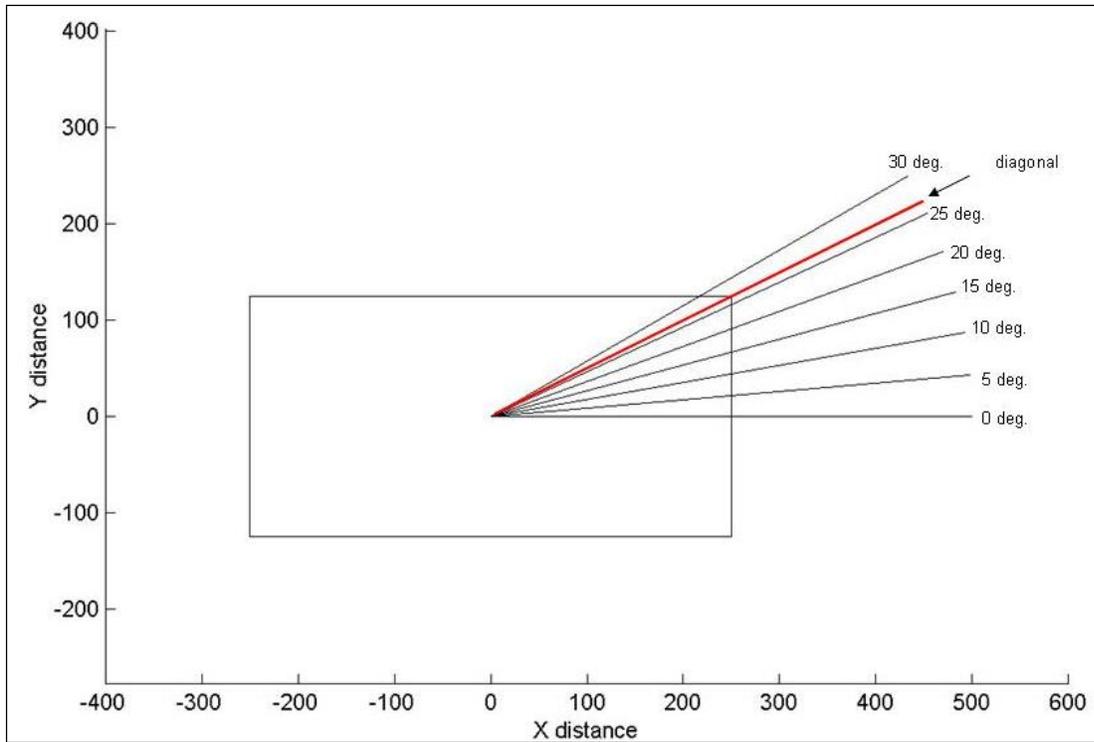


Figure 31. Receptor radials for rectangular area sources.

For each one of these radials, receptors are placed out to the probe distance at the calculated spacing(s). For each radial, the WDROTATE keyword is used in the ME pathway of the AERMOD runstream input file with the value set to the angle of the radial (0, 5, 10, etc.). See Figure 32 for examples.

<pre> ME STARTING SURFFILE AERSCREEN.SFC FREE PROFFILE AERSCREEN.PFL FREE SURFDATA 11111 2010 SCREEN UAIRDATA 22222 2010 SCREEN PROFBASE 18.3 METERS ME WDRotate 0.0 ME FINISHED </pre>	<pre> ME STARTING SURFFILE AERSCREEN.SFC FREE PROFFILE AERSCREEN.PFL FREE SURFDATA 11111 2010 SCREEN UAIRDATA 22222 2010 SCREEN PROFBASE 18.3 METERS ME WDRotate 5.0 ME FINISHED </pre>
<pre> ME STARTING SURFFILE AERSCREEN.SFC FREE PROFFILE AERSCREEN.PFL FREE SURFDATA 11111 2010 SCREEN UAIRDATA 22222 2010 SCREEN PROFBASE 18.3 METERS ME WDRotate 10.0 ME FINISHED </pre>	<pre> ME STARTING SURFFILE AERSCREEN.SFC FREE PROFFILE AERSCREEN.PFL FREE SURFDATA 11111 2010 SCREEN UAIRDATA 22222 2010 SCREEN PROFBASE 18.3 METERS ME WDRotate 15.0 ME FINISHED </pre>

Figure 32. ME pathway in the AERMOD runstream with WRDOTATE keyword and values for various angles.

The WDRotate keyword rotates the wind to be along the radial being processed in AERMOD because the wind direction in the meteorological files is 270 degrees. Receptor x and y coordinates are also calculated based on the angle of the radial, i.e. for the 10 degree radial at 50 m x=49.24 m, y=8.68 m. AERMOD is run for each of the radials for each surface characteristic temporal/spatial sector combination. In the example in Figure 28, for annual surface characteristics for the whole 360 degree sector, AERMOD is executed seven times, once for each radial. For seasonal surface characteristics for 2 spatial sectors, AERMOD is executed 56 times, once for each radial for each season and sector. For monthly surface characteristics with the maximum 12 sectors for surface roughness, AERMOD is executed 1,008 times, once for each radial, month, and surface roughness sector. Figure 33 shows sample AERMOD run sequences for seasonal, 12 sector surface characteristics for a rectangular area source with six radials. First, winter surface characteristics for sector 1 are used for each of the six radials. Next, winter surface characteristics for sector 2 are used for each of the six radials. This process is followed for each season and surface characteristic sector finishing with autumn sector 12 surface characteristics. For each temporal/sector combination, AERSCREEN then determines the worst case concentration, associated radial, and meteorology to be used later in the REFINE stage.

```

Processing Winter
Processing surface roughness sector 1
Processing wind flow sector 1
Processing wind flow sector 2
Processing wind flow sector 3
Processing wind flow sector 4
Processing wind flow sector 5
Processing wind flow sector 6
Processing surface roughness sector 2
Processing wind flow sector 1
Processing wind flow sector 2
Processing wind flow sector 3
Processing wind flow sector 4
Processing wind flow sector 5
Processing wind flow sector 6
.
.
Processing surface roughness sector 12
Processing wind flow sector 1
Processing wind flow sector 2
Processing wind flow sector 3
Processing wind flow sector 4
Processing wind flow sector 5
Processing wind flow sector 6
.
.
Processing Autumn
Processing surface roughness sector 12
Processing wind flow sector 1
Processing wind flow sector 2
Processing wind flow sector 3
Processing wind flow sector 4
Processing wind flow sector 5
Processing wind flow sector 6

```

Figure 33. AERMOD run sequences for rectangular area source for seasonal 12 sector surface characteristics.

3.6.2 Non-rectangular area sources

For non-rectangular area sources, FLOWSECTOR arranges receptors along 36 radials from the source, every 10 degrees, shown below in Figure 34. AERMOD is executed for each temporal period (annual, seasonal, or monthly) of the surface characteristics (Figure 35). However, it is not executed for each surface roughness sector. Instead, for each radial, AERSCREEN determines the upwind surface roughness sector of the radial being processed. That is, AERSCREEN determines the sector that contains the direction 180 degrees from the radial being processed. That is done because the radial is considered in the direction of the flow while surface characteristics are for the sector from which the wind is blowing, i.e. upwind. Figure 36 shows which sector is used for the 10 degree flow vector (solid black arrow) for three sectors from AERSURFACE output. In this case, the upwind direction of 10 degrees, 190 degrees (dashed black arrow), is contained in the 90 to 225 surface roughness sector.

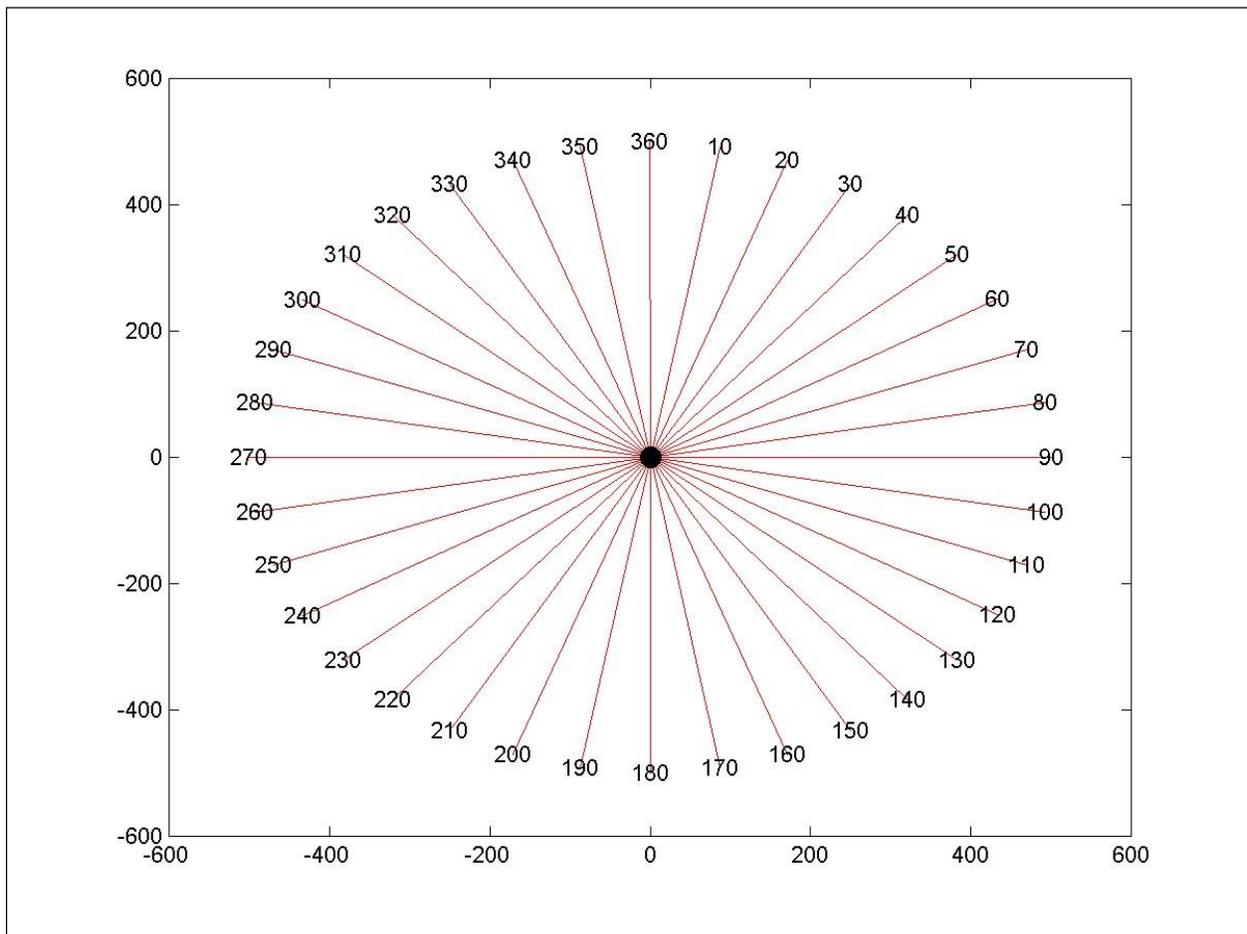


Figure 34. Receptor placement for point (including capped and horizontal stacks), flare, volume, or circular area sources in FLOWSECTOR.

```

Processing Winter
Processing wind flow sector 10
Processing wind flow sector 20
Processing wind flow sector 30
Processing wind flow sector 40
.
.
Processing wind flow sector 360
.
.
Processing Spring
Processing wind flow sector 10
.
.
Processing Autumn
Processing wind flow sector 10
Processing wind flow sector 20
Processing wind flow sector 30
Processing wind flow sector 40
.
.
Processing wind flow sector 360

```

Figure 35. AERMOD sequence for seasonal 12 sector surface characteristics when processing terrain and/or building downwash.

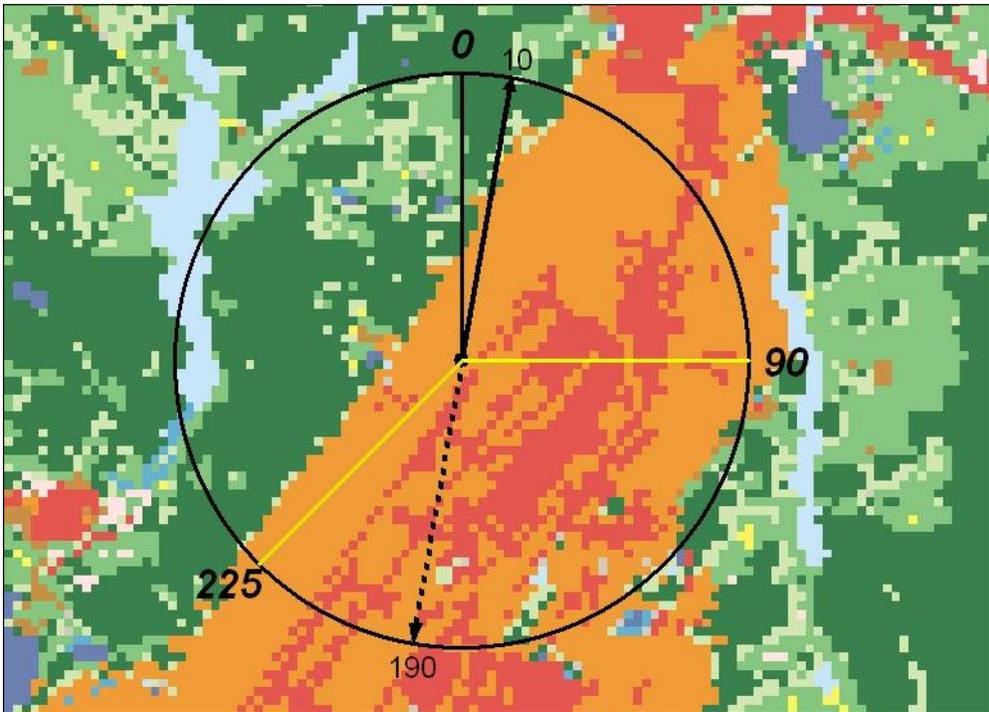


Figure 36. Flow vector (solid arrow) of 10 degrees and associated upwind surface roughness sector for three surface roughness sectors (0 to 90, 90 to 225, 225 to 0).

If building downwash is considered, projected building dimensions calculated by BPIPFRM for the flow direction being modeled are included in the AERMOD run. If terrain is processed, AERSCREEN will find the appropriate receptors (based on distance and direction) from the AERMAP output and include the appropriate terrain data in the AERMOD input file. AERSCREEN also checks to ensure the receptor coordinates match the specified distance and direction. If they do not, AERSCREEN will issue an error and stop processing. Since AERSCREEN generates the receptor elevations via AERMAP, this should not happen, unless the AERMAP output file became corrupted during processing. When extracting the appropriate receptors, if any receptors have a missing elevation, i.e. -9999.0, AERSCREEN will skip those receptors and they will not be included in the AERMOD run for that particular direction. AERSCREEN will notify the user of how many receptors were skipped for the particular AERMOD run (Figure 37a). If any receptors did have missing elevations, the warning messages for those receptors will appear in the AERSCREEN.LOG file for the AERMAP quality assurance check (Figure 37b). AERSCREEN will notify the user of the total number of receptors skipped for FLOWSECTOR at the end of the AERSCREEN run (Figure 37c). If the user finds that receptors have been skipped due to missing elevations, the user may want to check the input terrain files for gaps or other irregularities or reconsider the probe distance, as this can affect the final maximum 1-hour concentration from AERSCREEN.

<pre> Running AERMOD Processing Winter ***** Processing wind flow sector 10 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 10 0 receptors skipped due to missing elevations . . . Processing wind flow sector 150 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 150 8 receptors skipped due to missing elevations . . . Processing wind flow sector 160 AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 160 7 receptors skipped due to missing elevations </pre>	a
<pre> Running AERMAP for FLOWSECTOR *** AERMAP Finishes Successfully *** for stage 2 ***** WARNING MESSAGES ***** OU W400 7265 FIND4:Receptor Location Outside Range of Profiles, IREC= 2997 OU W410 7265 MAIN:Receptor Elevation is Missing (-9999.0), IREC= 2997 OU W400 7265 FIND4:Receptor Location Outside Range of Profiles, IREC= 2998 OU W410 7265 MAIN:Receptor Elevation is Missing (-9999.0), IREC= 2998 . . . OU W410 7265 MAIN:Receptor Elevation is Missing (-9999.0), IREC= 4210 51 receptors have missing elevations and will be skipped in AERMOD processing </pre>	b
<pre> ***** AERSCREEN Finished Successfully But with Warnings 51 receptors skipped for FLOWSECTOR 0 receptors skipped for REFINE Check log file for details ***** </pre>	c

Figure 37. Receptor skipping notification during FLOWSECTOR run, with notification of missing elevations in AERMAP, and total number of receptors skipped for FLOWSECTOR and REFINE.

For each AERMOD run in FLOWSECTOR, the maximum concentration, downwind distance, and terrain (if applicable) are stored for later use in REFINE. The stored concentrations are concentrations for each radial and temporal period of the surface characteristics.

3.7 REFINE

REFINE finds the maximum concentration and associated distance and date output from PROBE or FLOWSECTOR. If output is from PROBE or a rectangular area source from FLOWSECTOR, REFINE uses the meteorological files for the temporal period and surface

roughness sector of the maximum concentration. If output is from FLOWSECTOR for non-rectangular area sources, REFINE finds the upwind surface characteristic sector of the flow direction of maximum concentration as in Figure 36. REFINE then uses the meteorological files for the appropriate temporal and surface characteristics sector. Receptor spacing becomes one, two, or five meters, depending on maximum concentration distance, to refine the output. For rectangular area sources, the receptors are placed along the radial associated with the maximum concentration. Any discrete receptors supplied by the user are not included in the REFINE AERMOD run. If building downwash is used, building dimensions based on the flow direction of maximum concentration are used. If terrain is used, REFINE will rerun AERMAP with the new receptors in the flow direction of the maximum concentration output from FLOWSECTOR. As in FLOWSECTOR, REFINE will create a domain to be used with the DOMAINXY keyword in AERMAP. After running AERMAP, REFINE then runs AERMOD using the new receptors and appropriate meteorological, building and terrain data. As with FLOWSECTOR, if any receptors have a missing elevation, they will be skipped, and the user will be notified of how many were skipped (see Figure 37c for example).

3.8 Fumigation

The optional fumigation calculations, inversion break-up and shoreline fumigation are based on the equations implemented in SCREEN3 (U.S. EPA, 1995). The inversion break-up calculations are based on procedures described in Turner (1970). Fumigation calculations are only made for point type sources, including flares, with release heights 10 m or more above ground level.

3.8.1 Selection of meteorological data

Before fumigation calculations are performed, AERSCREEN determines the appropriate hours to use from the meteorological data created by MAKEMET. For the fumigation calculations, the fumigations are based on assumptions of F stability and a stack top wind speed of 2.5 m/s (U.S. EPA, 1995). Also, for the fumigation calculations AERSCREEN assumes the source is a rural source, ignores building downwash, and ignores terrain effects.

AERSCREEN reads the meteorological data files that are created as described in Section 3.2 of this document. Using various meteorological variables, AERSCREEN determines a stability class (A, B, C, D, E, or F) and stack top wind speed. For those hours that meet the criteria of F stability and stack top wind speed of 2.5 m/s, AERSCREEN calculates an array of variables that will be needed for the fumigation calculations.

If no hours meet the stability and wind speed criteria, AERSCREEN issues a notice that no hours meeting the criteria and fumigation calculations are not performed. Otherwise, AERSCREEN proceeds with the calculations.

3.8.2 Inversion break-up fumigation

Inversion break-up fumigation in AERSCREEN uses the inversion break-up fumigation equations from SCREEN3 (U.S. EPA, 1995) which are based on Turner (1970). For the fumigation calculations, the distance to maximum fumigation is based on an estimate of the time required for the mixing layer to develop from the top of the stack to the top of the plume is calculated by:

$$X_{max} = (u\rho_a c_p / R)(\Delta\Theta / \Delta z)(h_i - h_s)[(h_i - h_s) / 2] \quad (3)$$

where:

X_{max} =distance to maximum concentration (m)

u = stack top wind speed (2.5 m/s)

ρ_a =ambient air density (1205 g/m³ at 20°C)

c_p =specific heat of air at constant pressure (0.24 cal/gK)

R =net rate of sensible heating of an air column by solar radiation (67 cal/m²/s)

$\Delta\Theta/\Delta z$ =potential temperature gradient (0.035 K/m for F stability)

h_i =height of the top of the plume ($h_e + 2\sigma_{ze}$) where h_e is the plume centerline height (m)

h_s =physical stack height or release height (m)

σ_{ze} =vertical dispersion parameter incorporating buoyancy induced dispersion (m)

and the maximum concentration is calculated as:

$$X_f = Q / [(2\pi)^{0.5} u (\sigma_{ye} + h_e / 8) (h_e + 2\sigma_{ze})] \quad (4)$$

where:

X_f =maximum ground level concentration due to inversion break-up fumigation ($\mu\text{g}/\text{m}^3$)

Q =emission rate in g/s

u =stack top wind speed (2.5 m/s)

σ_{ye} =horizontal dispersion parameter incorporating buoyancy induced dispersion (m)

Other parameters are defined as in Equation 3. To calculate X_{max} , AERSCREEN uses an iterative approach to solve Equation 3, beginning with an initial value of 5,000 m. This iteration is done for each hour of appropriate meteorology. Once X_{max} is found, X_f is calculate for the hour using Equation 4. After all hours have been processed, the highest value of X_f is the maximum ground level concentration.

3.8.3 Shoreline fumigation

AERSCREEN will calculate shoreline fumigation for sources within 3 km of the coastline. Again, AERSCREEN incorporates the calculations from SCREEN (U.S. EPA 1995). The assumptions in the calculations are described in Section 3.8.1 above, F stability and onshore flow

of 2.5 m/s at stack top. The maximum ground-level shoreline fumigation concentration is assumed to occur where the top of the stable plume intersects the top of the well-mixed thermal internal boundary layer (TIBL). The TIBL height for rural flat terrain as a function of inland distance can be estimated by:

$$h_T = Ax^{0.5} \quad (5)$$

where:

h_T =TIBL height (m)

A= TIBL factor containing physics needed for TIBL parameterization (including heat flux) ($m^{1/2}$) set to 6 (U.S. EPA, 1995).

x=inland distance (m)

As with the inversion break-up fumigation, the distance to the maximum concentration due to shoreline fumigation is an iterative process for each hour. The distance, X_{max} is found by:

$$X_{max} = [(h_e + 2\sigma_{ze})/6]^2 - x_s \quad (6)$$

Where x_s is the shoreline distance and all other variables are defined as in Section 3.8.2. The maximum concentration at X_f is found by:

$$X_f = Q / [(2\pi)^{0.5} u (\sigma_{ye} + h_e/8) (h_e + 2\sigma_{ze})] \quad (7)$$

Where

X_f =maximum ground level concentration due to shoreline break-up fumigation ($\mu g/m^3$) and all other variables defined as above.

Before proceeding with the shoreline fumigation calculations, AERSCREEN determines if any of the meteorological hours determined in Section 3.8.1 or hours that match upwind surface characteristics from the shoreline have a plume height above the TIBL height by calculating the distance at which the effective stack height is equal to the TIBL height and taking the difference with the shoreline distance to calculate x_0 :

$$x_0 = (h_e/6)^2 - x_s \quad (8)$$

If x_0 is less than zero for all relevant hours then the plume is considered to be below the TIBL height for the shoreline distance x_s and no shoreline fumigation calculations will be performed at all. If x_0 is greater than zero for any relevant hour then shoreline fumigation calculations will proceed.

As with inversion break-up fumigation, to calculate X_{max} for shoreline fumigation AERSCREEN uses an iterative approach to solve Equation 6, beginning with an initial value of equal to x_0 (Equation 8) that is calculated for the particular hour being processed. This iteration is done for each hour of appropriate meteorology. Once X_{max} is found, X_f is calculate for the hour using Equation 7. After all hours have been processed, the highest value of X_f is the maximum ground level concentration for shoreline fumigation.

3.8.4 AERSCREEN run option

Beginning with version 15181, when the interest is only in the fumigation concentrations, AERSCREEN allows the option of skipping the screening modeling portion of AERSCREEN (PROBE, FLOWSECTOR, and REFINE) to save processing time.

3.9 Outputs

AERSCREEN creates the file AERSCREEN.OUT or user-supplied output filename which contains the following: source information, output from either PROBE or FLOWSECTOR, meteorology associated with the maximum concentration output from PROBE or FLOWSECTOR, maximum concentrations by distance, REFINE output (final maximum concentration and maximum concentration at the minimum ambient distance), and optional fumigation results. See Section 4 for example output. AERSCREEN also outputs a file called max_conc_distance.txt, or name based on the user-supplied output filename, that contains the highest concentration by distance, independent of worst case meteorology and flow direction, with associated meteorology for the concentrations. These concentrations were calculated in PROBE or FLOWSECTOR. Also included in the file is the overall maximum concentration output from REFINE. This concentration is denoted by an asterisk in the file. The format of this file is shown in Table 2. If the optional debug output is chosen a file containing PROBE or FLOWSECTOR results is created and has a similar format to the max_conc_distance.txt file with the exception that for AREA sources, the individual diagonal angles are listed. If fumigation options are chosen along with the debug option, a fumigation debug file will be created with the intermediate fumigation calculations. AERSCREEN also copies the AERMOD.INP file from the REFINE AERMOD run to the file AERSCREEN.INP, containing the inputs to AERSCREEN entered via prompts or a previous AERSCREEN.INP file with any changes that were made during AERSCREEN processing². AERSCREEN also copies the AERSCREEN.INP and AERSCREEN.LOG files to new files with names based on the user-supplied filename.

² If at any time, AERSCREEN aborts during PROBE, FLOWSECTOR, or REFINE, the user may be able to copy the current AERMOD.INP file to AERSCREEN.INP to avoid re-entering data.

Table 2. Variables listed in max_conc_distance.txt.

Variable	Description
Concentration	Maximum 1-hour screening concentration ($\mu\text{g}/\text{m}^3$). A concentration with a preceding asterisk is the overall maximum concentration.
Distance	Distance (m) from source of maximum 1-hour concentration
Elevation	Elevation (m) of maximum 1-hour concentration
Flow	Flow vector (degrees) associated with maximum 1-hour concentration
Season/Month	Season/Month of maximum 1-hour concentration (can be annual, season, or month)
Zo sector	Surface roughness sector number of maximum 1-hour concentration
Date	Date of maximum 1-hour concentration
H0	Heat flux (W/m^2) of hour of maximum 1-hour concentration
U*	Friction velocity (m/s) of hour of maximum 1-hour concentration
W*	Convective velocity (m/s) of hour of maximum 1-hour concentration
DT/DZ	Lapse rate (K/m) of hour of maximum 1-hour concentration
ZICNV	Convective mixing height (m) of hour of maximum 1-hour concentration
ZIMCH	Mechanical mixing height (m) of hour of maximum 1-hour concentration
M-O LEN	Monin-Obukhov length (m) of hour of maximum 1-hour concentration
Z0	Surface roughness length (m) of hour of maximum 1-hour concentration
Bowen	Bowen ratio of hour of maximum 1-hour concentration
Albedo	Albedo of hour of maximum 1-hour concentration
REF WS	Wind speed (m/s) of hour of maximum 1-hour concentration
HT	Anemometer height (m) of hour of maximum 1-hour concentration
REF TA	Temperature (K) of hour of maximum 1-hour concentration
HT	Height of Temperature (m) of hour of maximum 1-hour concentration

4. Example run

This section will show an example AERSCREEN run for a point source with building downwash and terrain. Inversion break-up fumigation will also be selected as well as the output of a debug file. Table 3 gives a summary of the AERSCREEN inputs and Figure 38 shows the building/stack orientation. Table 4 lists the seasonal surface characteristics and Figure 39 shows the land use and terrain for the example. Figure 40 lists the inputs for demlist.txt and Figure 41 lists the discrete receptor file contents.

Table 3. Inputs for example AERSCREEN run.

Parameters	Inputs	Input values
Source	Source type	POINT
	Stack height	20 m
	Emission rate	1 g/s
	Stack diameter	0.5 m
	Stack exit temperature	300 K
	Stack exit velocity	15 m/s
Building	Include building downwash	Yes
	Building height	34 m
	Maximum horizontal dimension	120 m
	Orientation of maximum building dimension to North	90°
	Minimum horizontal dimension	60 m
	Direction of stack from North	26.6°
	Distance from stack to building center	67 m
Meteorology	Minimum temperature	261.4
	Maximum temperature	313.1
	Minimum wind speed	1.5 m/s
	Anemometer height	10 m
	Source of surface characteristics	AERSURFACE (aersurface_12.out)
	Adjust u*	Yes
Terrain	Include terrain	Yes
	Coordinate type	Latitude and longitude (LATLON)
	Source latitude	35.891400° N
	Source longitude	78.781940° W
	NAD	83
	Probe distance	1 km
	Source elevation	126.8
	Override input elevation with AERMAP derived value	No
Discrete receptors	Use five discrete receptors, units in meters	discrete_receptors.txt
Other inputs	Input units	Metric
	Rural/urban	Urban
	Input population	2400000
	Minimum ambient distance	30 m
	Use flagpole receptors	No
Fumigation	Inversion break-up	Yes
	Shoreline fumigation	No
Debug option	Yes	
Output file	Use non-default name	aerscreen_example.out

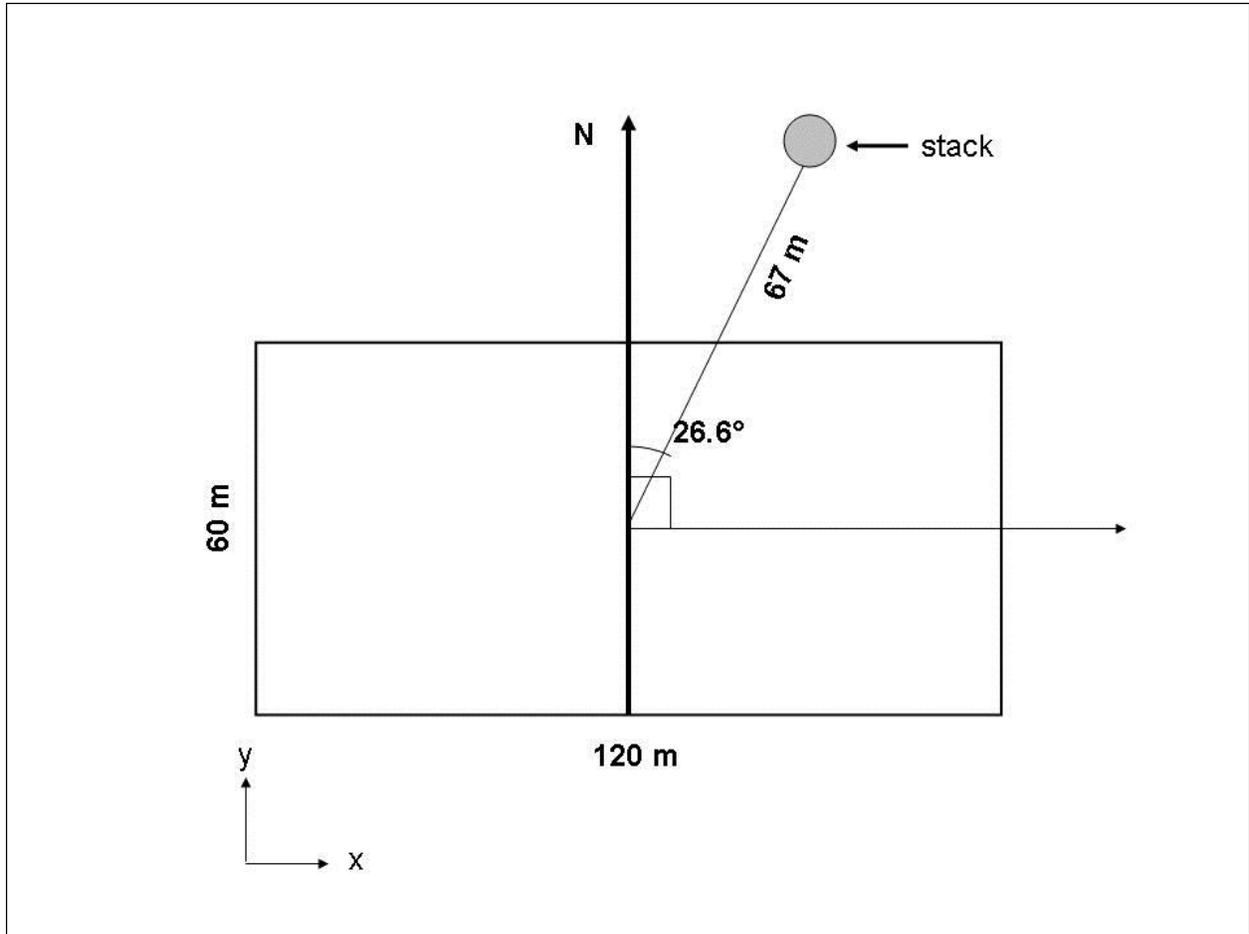


Figure 38. Plane view of building and stack orientation for example AERSCREEN run.

Table 4. Seasonal surface characteristics by sector.

Variable	Season	Sector											
		1	2	3	4	5	6	7	8	9	10	11	12
Albedo	Winter	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Spring	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
	Summer	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Autumn	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Bowen ratio	Winter	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
	Spring	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
	Summer	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
	Autumn	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
Surface roughness	Winter	0.089	0.011	0.025	0.029	0.032	0.034	0.031	0.013	0.115	0.244	0.391	0.305
	Spring	0.118	0.016	0.032	0.036	0.04	0.042	0.038	0.019	0.141	0.289	0.458	0.379
	Summer	0.143	0.022	0.038	0.043	0.048	0.049	0.045	0.025	0.163	0.335	0.509	0.435
	Autumn	0.123	0.016	0.032	0.036	0.041	0.042	0.038	0.019	0.142	0.311	0.478	0.405

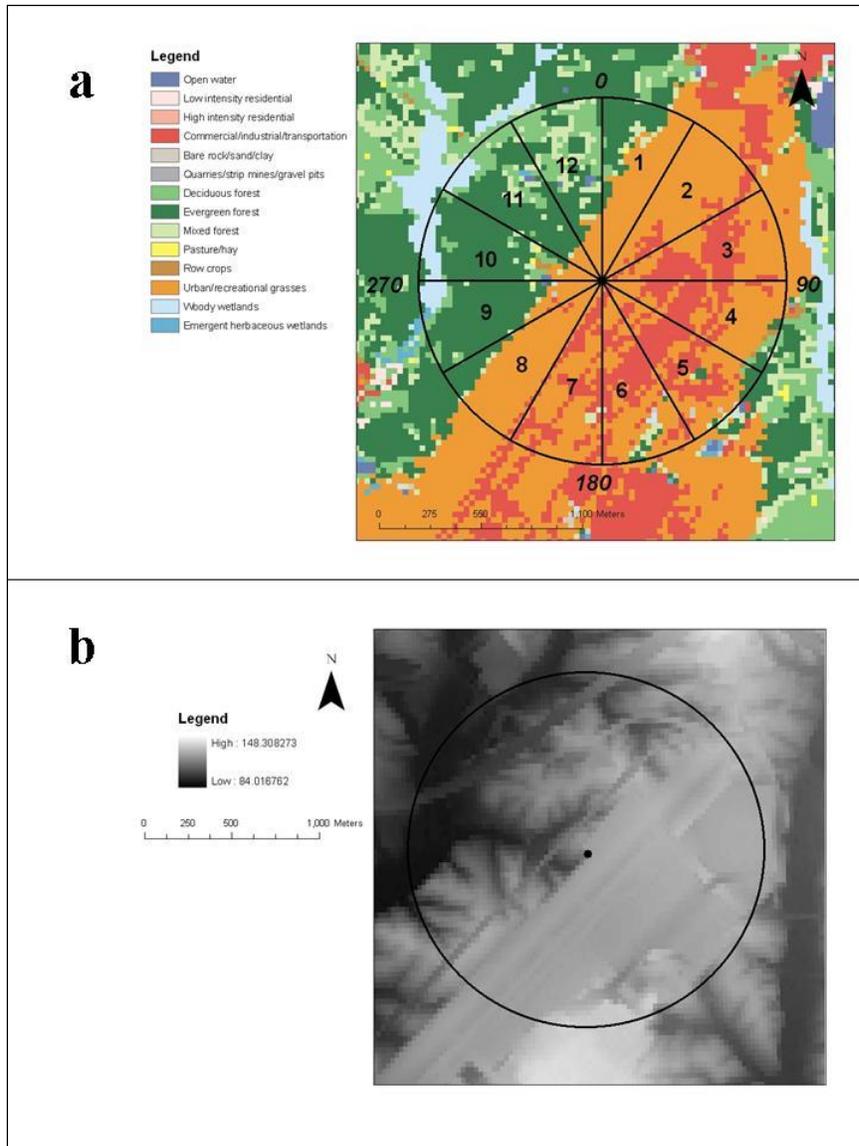


Figure 39. a) land use pattern and sectors used for surface characteristics and b) terrain. The circle represents the 1 km radius from the source.

```

NED :
-----
NADGRIDS .\
NED_22944813\NED_22944813.tif

```

Figure 40. Contents of demlist.txt for terrain processing.

```
units: METERS
53
105
201
503
702
```

Figure 41. Contents of discrete_receptors.txt.

4.1 Processing and log file

Below in Figures 42 through 47 are the prompts and inputs for the source, building information, terrain data and meteorological data. In Figure 39, the initial prompts are shown. Since there is no existing AERSCREEN.INP file, AERSCREEN alerts the user that AERSCREEN.INP does not exist and the user must enter the data. The user enters a title, whether the inputs are in English or metric units, and the source type (point, volume, etc.).

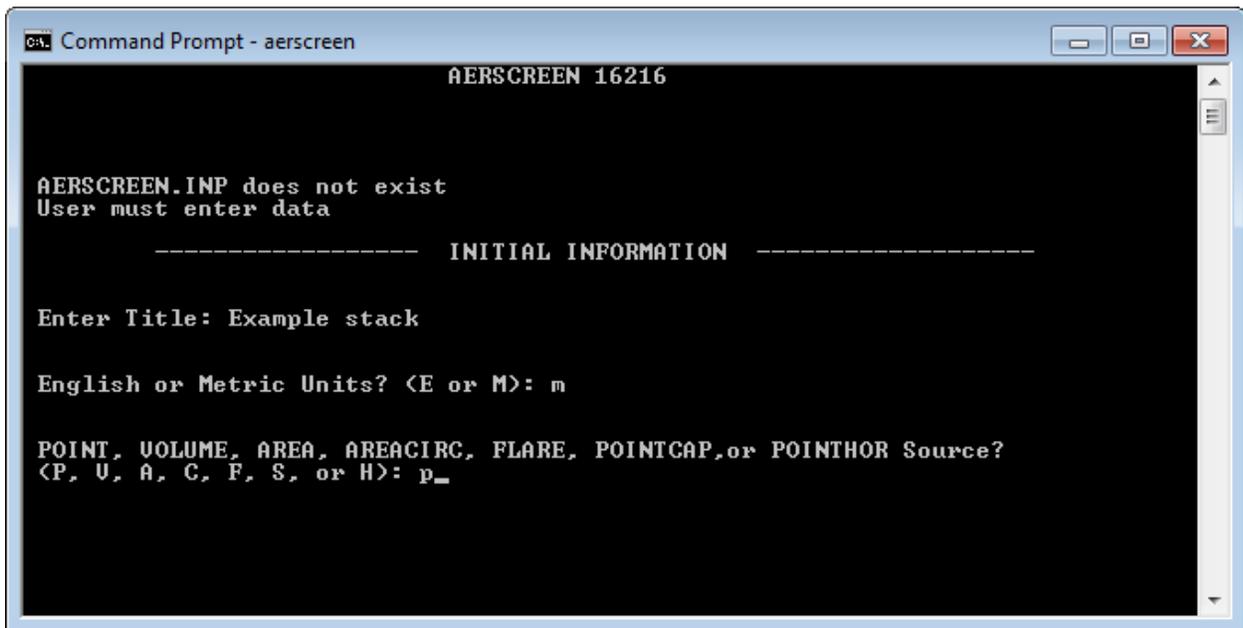


Figure 42. Initial AERSCREEN title, units, and source type prompts.

After the initial prompts, the user then enters source parameters (Figure 43). The stack parameters, stack height, inner stack diameter, stack exit temperature, stack velocity units, and stack velocity. The user also enters if the source is urban or rural, and the urban population if an urban source. The user then enters the minimum distance to ambient air, i.e. ambient boundary. Values entered are as described in Table 3.

```
Command Prompt - aerscreen

AERSCREEN 16216
----- SOURCE INFORMATION -----

Enter Emission Rate (g/s): 1

Enter Stack Height (meters): 20.0

Enter Stack Diameter (meters): 0.5

Enter Stack Temperature (K)
Enter 0 for ambient temperature
or a negative number for temperature difference (K)
between stack temperature and ambient temperature: 300

-----
Option (1) - Exit Velocity (m/s)
Option (2) - Exit Velocity (ft/s)
Option (3) - Flow Rate (ACFM)
-----

Enter Option for Flow Rate or Exit Velocity: 1
Enter Exit Velocity (m/s): 15

Rural or Urban? (R or U): u

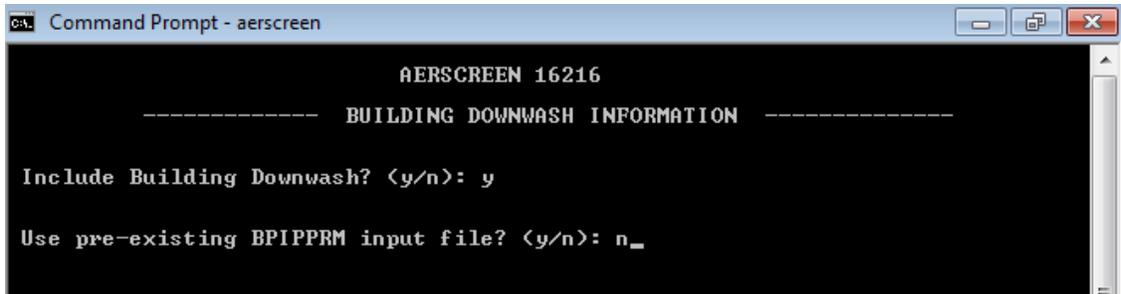
Enter Population of Urban Area: 2400000

Enter Minimum Distance (meters) to Ambient Air
<Enter> for default (1 m): 30

Enter an option for modeling NO2 chemistry
1) No chemistry or pollutant is not NO2
2) Use Ozone Limiting Method (OLM)
3) Use Plume Volume Molar Ratio Method (PUMRM)
1_
```

Figure 43. Source parameter inputs.

After source parameters have been entered, the user enters the building parameters for building downwash effects (Figures 44 and 45). In Figure 44, the initial prompts are shown. The user is prompted to include downwash if desired and if so, the user is prompted if an existing BPIPPRM input file is to be used. If the answer is yes to downwash but no to an existing BPIPPRM file, the user is then prompted for the building dimensions, building orientation, and stack orientation relative to the building (Figure 45). The inputs are building height, maximum horizontal dimension, minimum horizontal dimension, angle of maximum horizontal dimension to North, angle of stack from North, and distance between stack and building center. Building dimensions are shown in Table 3 and Figure 38.



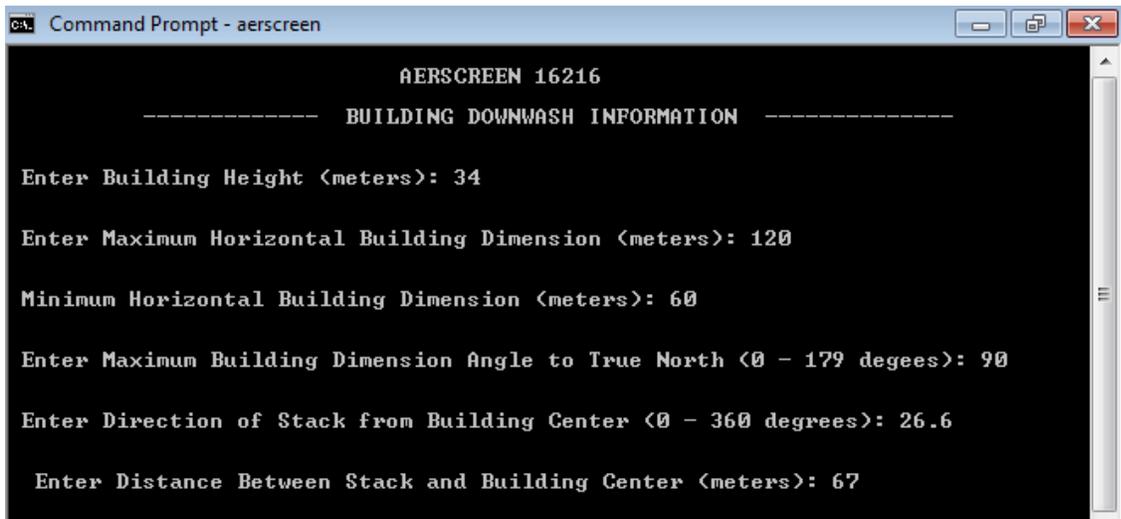
```
Command Prompt - aerscreen

AERSCREEN 16216
----- BUILDING DOWNWASH INFORMATION -----

Include Building Downwash? <y/n>: y

Use pre-existing BPIPRM input file? <y/n>: n_
```

Figure 44. Initial building downwash prompts.



```
Command Prompt - aerscreen

AERSCREEN 16216
----- BUILDING DOWNWASH INFORMATION -----

Enter Building Height <meters>: 34

Enter Maximum Horizontal Building Dimension <meters>: 120

Minimum Horizontal Building Dimension <meters>: 60

Enter Maximum Building Dimension Angle to True North <0 - 179 degees>: 90

Enter Direction of Stack from Building Center <0 - 360 degrees>: 26.6

Enter Distance Between Stack and Building Center <meters>: 67
```

Figure 45. Building parameter inputs.

The next set of inputs is for terrain (Figure 46). The user is prompted if terrain is to be used. The user is then prompted for the probe distance with a default of 10 km available. Note, that the terrain input file or files (NED or DEM), must encompass the probe distance. Following the probe distance, the user is prompted for the use of discrete receptors and then the user is prompted for the use of flagpole receptors and if so, the flagpole height. After the flagpole information, the source elevation is input by the user. This can be an elevation or the user can hit <Enter> to use AERMAP to calculate elevation. In this case, the user has entered 126.8 m. Note if terrain is not used, this is the last prompt in the terrain section of inputs. If terrain is to be used, the user enters the coordinate type and coordinates. The NAD datum is also entered by the user. If coordinates are UTM coordinates, the user will be prompted for the UTM zone. Since geographic coordinates are used in this example, the UTM zone is determined by AERMAP.

```
Command Prompt - aerscreen

AERSCREEN 16216
----- TERRAIN HEIGHT INFORMATION -----

Include Terrain Heights? (y/n): y

Enter Maximum Distance (m) to probe
<Enter> for default (10000 m): 1000

Include up to 10 discrete receptors (y/n)? y

Enter name of file with discrete receptors.
Enclose filename with quotes if path or filename includes spaces...
discrete_receptors.txt

Use Flagpole receptors? (y or n): n

Enter source elevation (m) or
<Enter> for AERMAP derived elevation: 126.8

Enter coordinate type:
LATLON for latitude & longitude or
UTM for UTM coordinates
latlon

Enter Source Latitude (North positive) (xx.xxxx): 35.8914

Enter Source Longitude (West negative) (xx.xxxx): -78.78194

-----
Option (1) - North American Datum of 1927
Option (4) - North American Datum of 1983
-----

Enter Option for Applicable UTM Nada: 4
```

Figure 46. Terrain parameter prompts.

The meteorological parameters are the next inputs by the user (Figure 47). The user enters the minimum and maximum air temperatures for the AERSCREEN run or accepts defaults of 250 and 310 K. The user then enters the minimum wind speed and anemometer height. For this example, a minimum of 1.5 m/s was selected for the wind speed and the default 10 m anemometer height was entered. After the anemometer height, the surface characteristics type, user-entered single values (option 1), AERMET seasonal tables (option 2), or use of an external file (option 3) is chosen. Option 3, an external file, is chosen by the user and the user then enters the filename. The file is in the same folder as the current working directory so no pathnames are necessary. For the example, the surface friction velocity will not be adjusted. Figures 48 and 49 show the fumigation inputs and debug selection respectively. After processing the debug option, the user is prompted for the name of the output file (Figure 50).

```
Command Prompt - aerscreen

AERSCREEN 16216
----- MAKEMET METEOROLOGY -----

Enter Min & Max Ambient Temperatures (K)
or <Enter> to default to 250 310 K...

Enter Minimum Temperature (K): 261.4

Enter Maximum Temperature (K): 313.1

Enter Minimum Wind Speed or <Enter> to default to 0.5 m/s... 1.5

Enter Anemometer Height or <Enter> to default to 10.0 meters...

-----
1) Single user specified values
2) AERMET seasonal tables
3) External file
-----
Enter surface characteristics option: 3

Enter filename containing surface characteristics
Enclose filename with quotes if path or filename includes spaces...
or <Enter> to return to the surface characteristics option selection
aersurface_12.out

Enter Y or y to adjust u* or
N or n to not adjust u*
n
```

Figure 47. Meteorological parameter prompts and inputs.

```
Command Prompt - aerscreen

AERSCREEN 16216
----- FUMIGATION -----

Source is an urban source, will assume rural for fumigation calculations

Apply inversion break-up fumigation (y/n): y

Apply shoreline fumigation (y/n): n
```

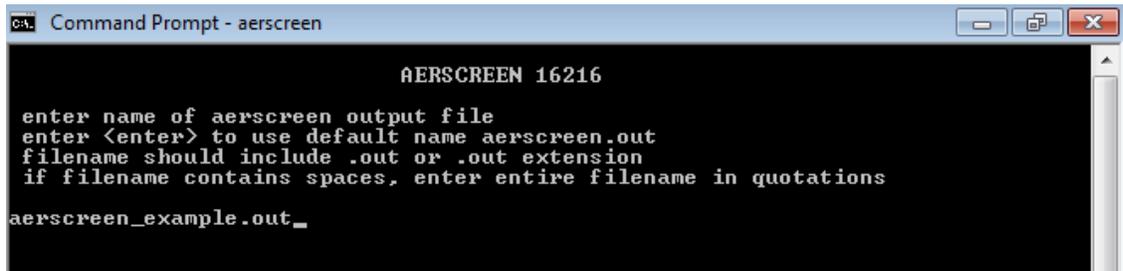
Figure 48. Fumigation prompts.

```
Command Prompt - aerscreen

AERSCREEN 16216

Enter Y or y to turn on the debug option or <Enter> to not use the debug option
y_
```

Figure 49. Debug option input.



```
Command Prompt - aerscreen

AERSCREEN 16216

enter name of aerscreen output file
enter <enter> to use default name aerscreen.out
filename should include .out or .out extension
if filename contains spaces, enter entire filename in quotations

aerscreen_example.out_
```

Figure 50. Output filename prompt and response.

Finally after the output file options, the validation page is displayed to the user listing all input parameters for the source, building downwash, terrain, and meteorological data (Figure 51). The source and building parameters are listed in both metric and English units as well as the minimum and maximum temperatures, source elevation and probe distance. AERSCREEN also displays the UTM and geographic coordinates for the source with the message that coordinates were converted from geographic to UTM coordinates. Coordinates are displayed in NAD datum of 1983. If coordinates were initially entered in NAD 1927 datum, those coordinates would be listed as well with the message that coordinates were switched from NAD 27 to NAD 83 with the NAD 27 geographic and UTM coordinates listed as well. The validation page indicates that inversion break-up fumigation calculations will be performed and that the urban source will be assumed to be rural for fumigation. Meteorological data are listed followed by the message that the debug option is on and the name of the output file. The options listed below the output filename can be used to change parameters for the source, building, terrain, meteorological data, fumigation options, run title, debug option, and output filename. If options 1 through 6 are chosen, the user then sees a sub-menu of parameters to choose (See Section 3). If the user is ready to proceed, the user enters <Enter> and AERSCREEN begins processing the data. After choosing to run AERSCREEN, the same data as seen on the validation page is written to the AERSCREEN.LOG file (Figure 52).

```

ca. Command Prompt - aerscreen
Emission Rate:          1.0000 g/s          7.937 lb/hr
Stack Height:           20.00 meters        65.62 feet
Stack Diameter:         0.500 meters        19.69 inches
Stack Temperature:      300.0 K            80.3 Deg F
Exit Velocity:          15.000 m/s         49.21 ft/s
Stack Flow Rate:        6240 ACFM
Model Mode:             URBAN
Population:             2400000
Dist to Ambient Air:    30.0 meters         98. feet

** BUILDING DATA **
Building Height:        34.0 meters         111.5 feet
Max Building Dimension: 120.0 meters        393.7 feet
Min Building Dimension: 60.0 meters         196.9 feet
Building Orientation:   90.0 degrees
Stack Direction:        26.6 degrees
Stack Distance:         67.0 meters         219.8 feet

** TERRAIN DATA **
Input coordinates switched from geographic to UTM
Source Longitude:      -78.78194 deg        700198. Easting
Source Latitude:       35.89140 deg         3974176. Northing
UTM Zone:              17                  Reference Datum: 4 (NAD 83)
Source Base Elevation: 126.8 meters         416.0 feet

Probe distance:        1000. meters         3281. feet

No flagpole receptors

Using discrete receptors in
discrete_receptors.txt

Only receptors between the ambient and probe distances will be included
Input distance units are: METERS

** FUMIGATION DATA **
Urban source, assume rural for fumigation
Inversion break-up fumigation requested

** METEOROLOGY DATA **
Min/Max Temperature:   261.4 / 313.1 K      10.9 / 103.9 Deg F
Minimum Wind Speed:     1.5 m/s
Anemometer Height:     10.000 meters

Using surface characteristics in file:
aersurface_12.out

Surface friction velocity (u*): not adjusted

DEBUG OPTION ON

AERSCREEN output file:
aerscreen_example.out

*** AERSCREEN Run is Ready to Begin - Choose Option to Proceed ***

1 - Change Source Data;
2 - Change Building Data;
3 - Change Terrain Data;
4 - Change Meteorology Data;
5 - Change Fumigation Data;
6 - Change Title;
7 - Change Debug Option;
8 - Change Output Filename;
- or -
Hit <Enter> to Start Run

```

Figure 51. Data validation page.

```

Start date and time 10/20/16 10:46:08
                    AERSCREEN 16216

Example stack

                    Example stack

----- DATA ENTRY VALIDATION -----
          METRIC                ENGLISH
** STACKDATA ** -----
Emission Rate:    1.0000 g/s          7.937 lb/hr
Stack Height:     20.00 meters        65.62 feet
Stack Diameter:   0.500 meters        19.69 inches
Stack Temperature: 300.0 K            80.3 Deg F
Exit Velocity:    15.000 m/s          49.21 ft/s
Stack Flow Rate:  6240 ACFM
Model Mode:       URBAN
Population:       2400000
Dist to Ambient Air: 30.0 meters      98. feet

** BUILDING DATA **
Building Height:   34.0 meters        111.5 feet
Max Building Dimension: 120.0 meters  393.7 feet
Min Building Dimension: 60.0 meters   196.9 feet
Building Orientation: 90.0 degrees
Stack Direction:  26.6 degrees
Stack Distance:   67.0 meters        219.8 feet

** TERRAIN DATA **
Input coordinates switched from geographic to UTM
Source Longitude: -78.78194 deg       700198. Easting
Source Latitude:  35.89140 deg       3974176. Northing
UTM Zone:         17                 Reference Datum: 4 (NAD 83)
Source Base Elevation: 126.8 meters   416.0 feet

Probe distance:   1000. meters        3281. feet

No flagpole receptors

Using discrete receptors in
discrete_receptors.txt

Only receptors between the ambient and probe distances will be included
Input distance units are: METERS

** FUMIGATION DATA **
Urban source, assume rural for fumigation

Inversion break-up fumigation requested

** METEOROLOGY DATA **
Min/Max Temperature: 261.4 / 313.1 K   10.9 / 103.9 Deg F

Minimum Wind Speed:    1.5 m/s

Anemometer Height:    10.000 meters

Using surface characteristics in file:
aersurface_12.out

Surface friction velocity (u*): not adjusted

DEBUG OPTION ON

AERSCREEN output file:
aerscreen_example.out

*** AERSCREEN Run is Ready to Begin

Terrain to be used,AERMAP will be run
*****

```

Figure 52. Input data in AERSCREEN.LOG.

After data validation, AERSCREEN reads the AERSURFACE output file and lists the surface characteristics (Figure 53).

```

SURFACE CHARACTERISTICS & MAKEMET
Obtaining surface characteristics...

Using seasonal surface characteristics for 12 spatial sector(s)
Sector   Start   End
  1       0     30
  2      30     60
  3      60     90
  4      90    120
  5     120    150
  6     150    180
  7     180    210
  8     210    240
  9     240    270
 10     270    300
 11     300    330
 12     330     0

Season   Sector   Albedo   Bo       zo
Winter   1         0.15    0.85    0.089
Winter   2         0.15    0.85    0.011
Winter   3         0.15    0.85    0.025
Winter   4         0.15    0.85    0.029
Winter   5         0.15    0.85    0.032
Winter   6         0.15    0.85    0.034
Winter   7         0.15    0.85    0.031
Winter   8         0.15    0.85    0.013
Winter   9         0.15    0.85    0.115
Winter  10        0.15    0.85    0.244
Winter  11        0.15    0.85    0.391
Winter  12        0.15    0.85    0.305
Spring   1         0.14    0.63    0.118
Spring   2         0.14    0.63    0.016
.
.
.
Autumn   11        0.15    0.84    0.478
Autumn   12        0.15    0.84    0.405

Creating met files aerscreen_01_01.sfc & aerscreen_01_01.pfl
Creating met files aerscreen_01_02.sfc & aerscreen_01_02.pfl
.
.
.
Creating met files aerscreen_04_11.sfc & aerscreen_04_11.pfl

Creating met files aerscreen_04_12.sfc & aerscreen_04_12.pfl
*****

```

Figure 53. Surface characteristics processing and meteorological files creation.

AERSCREEN then runs AERMAP for the source and determines the percent difference between the user-entered source elevation and the AERMAP derived elevation (Figure 54). The AERMAP elevation will not be used by AERSCREEN. AERSCREEN also lists any fatal error or warning messages from AERMAP. In this case warning messages about the use of default elevation units of meters for the NED file are displayed. For the example case, the difference between the AERMAP elevation, 120.98 m, and the user-entered elevation, 126.8 m, differ by 4.59%.

```
Running AERMAP for source
*** AERMAP Finishes Successfully *** for stage 0
***** WARNING MESSAGES *****
OU W473 26 NEDCHK:Default elevation units of METERS used; NED file: 1
AERMAP elevation, 120.98 differs from user entered elevation, 126.80 by 4.59%
```

Figure 54. AERMAP processing and elevation of source.

Once AERMAP has been run for the source, AERSCREEN then begins the FLOWSECTOR stage and executes AERMAP for the receptors (Figure 55). While processing the receptors, AERMAP writes the processing status to the screen (Figure 56). Once AERMAP is completed for all receptors for all thirty-six directions, AERSCREEN checks the AERMAP.OUT file for any warnings or errors (Figure 57).

```
Buildings and/or terrain present or rectangular area source, skipping probe
FLOWSECTOR started 10/20/16 10:48:08
*****
Running AERMAP for FLOWSECTOR
```

Figure 55. AERSCREEN.LOG records for AERMAP processing for FLOWSECTOR.

```

C:\> Command Prompt - aerscreen.exe
+Now Processing Receptor 628 of 1621
+Now Processing Receptor 629 of 1621
+Now Processing Receptor 630 of 1621
+Now Processing Receptor 631 of 1621
+Now Processing Receptor 632 of 1621
+Now Processing Receptor 633 of 1621
+Now Processing Receptor 634 of 1621
+Now Processing Receptor 635 of 1621
+Now Processing Receptor 636 of 1621
+Now Processing Receptor 637 of 1621
+Now Processing Receptor 638 of 1621
+Now Processing Receptor 639 of 1621
+Now Processing Receptor 640 of 1621
+Now Processing Receptor 641 of 1621
+Now Processing Receptor 642 of 1621
+Now Processing Receptor 643 of 1621
+Now Processing Receptor 644 of 1621
+Now Processing Receptor 645 of 1621
+Now Processing Receptor 646 of 1621
+Now Processing Receptor 647 of 1621
+Now Processing Receptor 648 of 1621
+Now Processing Receptor 649 of 1621
+Now Processing Receptor 650 of 1621
+Now Processing Receptor 651 of 1621
+Now Processing Receptor 652 of 1621
+Now Processing Receptor 653 of 1621
+Now Processing Receptor 654 of 1621
+Now Processing Receptor 655 of 1621
+Now Processing Receptor 656 of 1621
+Now Processing Receptor 657 of 1621
+Now Processing Receptor 658 of 1621
+Now Processing Receptor 659 of 1621
+Now Processing Receptor 660 of 1621
+Now Processing Receptor 661 of 1621
+Now Processing Receptor 662 of 1621
+Now Processing Receptor 663 of 1621
+Now Processing Receptor 664 of 1621
+Now Processing Receptor 665 of 1621
+Now Processing Receptor 666 of 1621
+Now Processing Receptor 667 of 1621
+Now Processing Receptor 668 of 1621
+Now Processing Receptor 669 of 1621
+Now Processing Receptor 670 of 1621
+Now Processing Receptor 671 of 1621
+Now Processing Receptor 672 of 1621
+Now Processing Receptor 673 of 1621
+Now Processing Receptor 674 of 1621
+Now Processing Receptor 675 of 1621
+Now Processing Receptor 676 of 1621
+Now Processing Receptor 677 of 1621
+Now Processing Receptor 678 of 1621
+Now Processing Receptor 679 of 1621
+Now Processing Receptor 680 of 1621
+Now Processing Receptor 681 of 1621
+Now Processing Receptor 682 of 1621
+Now Processing Receptor 683 of 1621
+Now Processing Receptor 684 of 1621
+Now Processing Receptor 685 of 1621

```

Figure 56. Status of AERMAP processing for FLOWSECTOR.

```

*** AERMAP Finishes Successfully *** for stage 2
***** WARNING MESSAGES *****
OU W473 1462 NEDCHK:Default elevation units of METERS used; NED file:
1
*****

```

Figure 57. AERSCREEN.LOG summary of AERMAP.OUT warning and error messages.

Figure 58 shows partial AERMAP output for FLOWSECTOR. It is from this output that AERSCREEN will extract the receptor elevations for AERMOD processing in FLOWSECTOR. Receptor spacing for this example was 25 m since the probe distance was less than 5 km. Summing across all 36 radials, excluding receptors less than the minimum ambient distance, including the ambient distance, discrete receptors, and the source location, results in 1,621 total receptors. Also listed in the output is information that will be used for later AERSCREEN runs to determine if AERMAP needs to be rerun for FLOWSECTOR. This includes the UTM coordinates, probe distance (meters), receptor spacing, UTM zone, NAD datum, number of NED files and number of receptors. Coordinates, probe distance, receptor spacing, UTM zone, and NAD datum are listed in the line after “** Example stack.”

```

** AERMAP - VERSION 11103                                     10/20/16
**                                                         10:48:08
** Example stack
**   700198.4 3974175.8   1000.0   25.0   25.0   17   4
** A total of      1 NED files were used
** A total of    1621 receptors were processed
** DOMAINXY      699098.2  3973075.5  17   701298.2  3975275.5  17
** ANCHORXY       0.0      0.0      0.0   700198.2  3974175.5  17   4
** Terrain heights were extracted by default

RE ELEVUNIT METERS
DISCCART      0.00      0.00   120.98   120.98
DISCCART      5.21     29.54   119.75   119.75
DISCCART      8.68     49.24   119.60   119.60
DISCCART     13.02     73.86   120.82   120.82
DISCCART     17.36     98.48   120.82   120.82
DISCCART     21.71    123.10   120.73   120.73
DISCCART     26.05    147.72   120.36   120.36
DISCCART     30.39    172.34   119.77   120.36
DISCCART     34.73    196.96   117.76   120.49
DISCCART     39.07    221.58   117.96   120.49
DISCCART     39.07    221.58   117.96   117.96

```

Figure 58. Partial AERMAP output for FLOWSECTOR.

Once AERMAP has been run for all receptors, AERSCREEN processes each flow vector every 10 degrees from 10 degrees to 360 degrees. The appropriate building dimensions and meteorological files are used for each flow vector. During processing, AERSCREEN notifies the user what season or month and flow vector is being processed (Figure 59). A sample AERMOD.INP file is shown in Figure 60 with projected building dimensions and receptors for a particular flow vector. Note that the y-coordinate for each receptor is reset to 0. After AERMOD is executed for each flow vector, AERSCREEN checks the AERMOD.OUT file and notifies the user of any warning or error messages for that flow vector (Figure 61).

```
ca. Command Prompt - aerscreen
AERSCREEN 16216
----- DERIVING WORST CASE FLOW SECTOR -----
Processing Winter
+ Processing wind flow sector 10
+ Processing wind flow sector 20
+ Processing wind flow sector 30
+ Processing wind flow sector 40
+ Processing wind flow sector 50
+ Processing wind flow sector 60
+ Processing wind flow sector 70
+ Processing wind flow sector 80
+ Processing wind flow sector 90
+ Processing wind flow sector 100
+ Processing wind flow sector 110
+ Processing wind flow sector 120
+ Processing wind flow sector 130
+ Processing wind flow sector 140
+ Processing wind flow sector 150
+ Processing wind flow sector 160
+ Processing wind flow sector 170
+ Processing wind flow sector 180
+ Processing wind flow sector 190
+ Processing wind flow sector 200
+ Processing wind flow sector 210
+ Processing wind flow sector 220
+ Processing wind flow sector 230
+ Processing wind flow sector 240
+ Processing wind flow sector 250
+ Processing wind flow sector 260
+ Processing wind flow sector 270
+ Processing wind flow sector 280
+ Processing wind flow sector 290
+ Processing wind flow sector 300
+ Processing wind flow sector 310
+ Processing wind flow sector 320
+ Processing wind flow sector 330
+ Processing wind flow sector 340
+ Processing wind flow sector 350
+ Processing wind flow sector 360
Processing Spring
+ Processing wind flow sector 10
+ Processing wind flow sector 20
+ Processing wind flow sector 30
+ Processing wind flow sector 40
```

Figure 59. AERSCREEN processing during FLOWSECTOR.

```

SO STARTING
LOCATION SOURCE POINT    0.0  0.0  126.80
SRCPARAM SOURCE 0.1000E+01  10.000  300.000  15.000  0.500

BUILDHGT SOURCE 36*34.00
BUILDWID SOURCE 36*133.28
BUILDLEN SOURCE 36*97.42
XBADJ SOURCE 36*-115.27
YBADJ SOURCE 36*7.70

URBANSRC SOURCE

SRCGROUP ALL

SO FINISHED

RE STARTING
** Fence line receptor
DISCCART    30.0      0.0    120.90    120.90
** Automatic receptors
DISCCART    50.0      0.0    120.84    120.84
DISCCART    53.0      0.0    120.88    120.88
DISCCART    75.0      0.0    121.31    121.31
.
.
.
RE FINISHED

```

Figure 60. Partial AERMOD.INP file used in FLOWSECTOR for 20 degree flow vector.

```
Running AERMOD
Processing Winter
*****
Processing wind flow sector 10

AERMOD Finishes Successfully for FLOWSECTOR stage 2 Winter sector 10

    0 receptors skipped due to missing elevations
***** WARNING MESSAGES *****
          *** NONE ***
*****
.
.
*****
Processing wind flow sector 360

AERMOD Finishes Successfully for FLOWSECTOR stage 2 Autumn sector 360

    0 receptors skipped due to missing elevations
***** WARNING MESSAGES *****
          *** NONE ***

FLOWSECTOR ended 10/20/16 10:50:18
```

Figure 61. AERSCREEN.LOG partial output of AERMOD.OUT checks for FLOWSECTOR.

After FLOWSECTOR, AERSCREEN enters the REFINE subroutine and calculates the overall maximum concentration and its associated distance, flow vector, projected building dimensions, terrain and meteorology. AERSCREEN then reruns AERMAP (Figure 62) and AERMOD with refined receptor spacing using the terrain, projected building dimensions, and meteorology of the maximum concentration’s flow vector. The receptors include the minimum ambient receptor and receptors near the maximum concentration with 1 to 5 m spacing. See Figure 63 for the partial AERMOD.INP file used in REFINE. Messages from AERSCREEN.LOG for REFINE are shown in Figure 64. The maximum concentration is along the 160 degree flow vector.


```

SO STARTING
LOCATION SOURCE POINT          0.0    0.0    126.80
SRCPARAM SOURCE    0.1000E+01    20.000    300.000    15.000    0.500

BUILDHGT SOURCE    36*34.00
BUILDWID SOURCE    36*133.28
BUILDLEN SOURCE    36*97.42
XBADJ    SOURCE    36*-2.68
YBADJ    SOURCE    36*-48.68

URBANSRC SOURCE

SRCGROUP ALL

SO FINISHED

RE STARTING
** Fence line receptor
DISCCART          30.00          0.00          121.70          121.70
** Refined receptors
DISCCART          125.00          0.00          120.82          120.82
DISCCART          126.00          0.00          120.79          120.79
DISCCART          127.00          0.00          120.76          120.76
DISCCART          128.00          0.00          120.73          120.73
.
.
RE FINISHED

```

Figure 63. Partial AERMOD.INP file for REFINE processing.

```

REFINE          started 10/20/16 10:50:18
*****
Running AERMAP for REFINE
  *** AERMAP Finishes Successfully ***   for stage 3
  ***** WARNING MESSAGES *****
OU W473   123 NEDCHK:Default elevation units of METERS used; NED file:           1

AERMOD Finishes Successfully for REFINE stage 3 Winter sector 160

  0 receptors skipped due to missing elevations
  ***** WARNING MESSAGES *****
          *** NONE ***

REFINE          ended 10/20/16 10:50:21

```

Figure 64. REFINE messages.

After REFINE, the inversion break-up fumigation calculations begin (Figure 65) and the final messages are written to the AERSCREEN.LOG file. AERSCREEN ends and notifies the user that AERSCREEN ended successfully with warnings and gives the end time.

```
FUMIGATE      started 10/20/16 10:50:21

Calculating maximum distance of fumigation concentration

*****
AERSCREEN Finished Successfully
But with Warnings
Source coordinates switched from lat/lon to UTM
      0 receptors skipped for FLOWSECTOR
      0 receptors skipped for REFINE
Check log file for details
*****

Ending date and time 10/20/16 10:50:40
```

Figure 65. Fumigation and final AERSCREEN messages.

AERSCREEN also outputs the overall maximum 1-hour concentration, maximum 1-hour ambient boundary concentration, and maximum 1-hour inversion break-up fumigation concentration with scaled 3, 8, 24-hour, and annual average concentrations (Figure 66). Also listed are the distances, flow vectors direction, and receptor elevations relative to the source elevation. For the example case, the overall maximum 1-hour concentration was 215.6 $\mu\text{g}/\text{m}^3$ at 171 m toward 160° and the receptor's elevation was 6.12 m below the source or 122.68 m. The maximum ambient boundary concentration was 149.4 $\mu\text{g}/\text{m}^3$ north of the source at an elevation of about 118.93 m or 7.87 m below the source elevation. The maximum concentration due to inversion break-up was 759.5 $\mu\text{g}/\text{m}^3$ at a distance of 100 m from the source.

```

ca. Command Prompt
AERSCREEN 16216
Calculating max concentrations by distance
Writing debug file...

      MAXIMUM      SCALED      SCALED      SCALED      SCALED
CALCULATION      1-HOUR      3-HOUR      8-HOUR      24-HOUR      ANNUAL
PROCEDURE        CONC        CONC        CONC        CONC        CONC
                <ug/m3>    <ug/m3>    <ug/m3>    <ug/m3>    <ug/m3>
-----
ELEVATED TERRAIN  215.6      215.6      194.0      129.3      21.56

DISTANCE FROM SOURCE 171.00 meters directed toward 160 degrees
RECEPTOR HEIGHT   -6.12 meters

IMPACT AT THE
AMBIENT BOUNDARY    149.4      149.4      134.5      89.65      14.94

DISTANCE FROM SOURCE 30.00 meters directed toward 360 degrees
RECEPTOR HEIGHT   -7.87 meters

-----
***** AERSCREEN FUMIGATION SUMMARY *****
-----

      MAXIMUM      SCALED      SCALED      SCALED      SCALED
FUMIGATION      1-HOUR      3-HOUR      8-HOUR      24-HOUR      ANNUAL
PROCEDURE        CONC        CONC        CONC        CONC        CONC
                <ug/m3>    <ug/m3>    <ug/m3>    <ug/m3>    <ug/m3>
-----
INVERSION BREAK-UP  759.5      759.5      683.6      455.7      75.95

DISTANCE FROM SOURCE 100.00 meters

** Restart file is written to "AERSCREEN.INP" **

** Output is written to
aerscreen_example.out

*****
AERSCREEN Finished Successfully
But with Warnings
Source coordinates switched from lat/lon to UTM
0 receptors skipped for FLOWSECTOR
0 receptors skipped for REFINE
Check log file for details
*****

```

Figure 66. Overall maximum, maximum ambient boundary concentration, and maximum inversion break-up fumigation concentration statistics.

4.2 AERSCREEN output

Output from AERSCREEN is written to AERSCREEN_EXAMPLE.OUT. Following are sections with explanations.

The first section shown lists information also shown in the log file, emissions inputs, terrain information (input terrain file and probe distance), and building inputs in both metric and English units (Figure 67).

```

AERSCREEN 16216 / AERMOD 16216
10/20/16
10:50:22

TITLE: Example stack

-----
***** STACK PARAMETERS *****
-----

SOURCE EMISSION RATE:          1.0000 g/s          7.937 lb/hr
STACK HEIGHT:                  20.00 meters          65.92 feet
STACK INNER DIAMETER:         0.500 meters          19.69 inches
PLUME EXIT TEMPERATURE:      300.0 K              80.3 Deg F
PLUME EXIT VELOCITY:         15.000 m/s           49.21 ft/s
STACK AIR FLOW RATE:          6241 ACFM
STACK BASE LONGITUDE:         -78.7819 deg          700198. Easting
STACK BASE LATITUDE:          35.8914 deg          3974176. Northing
STACK BASE UTM ZONE:          17
REFERENCE DATUM (NADA):       4
STACK BASE ELEVATION:         126.80 meters          416.01 feet
RURAL OR URBAN:               URBAN
POPULATION:                   2400000

DIGITAL ELEVATION MAP(S)      NED_22944813\NED_22944813.tif

INITIAL PROBE DISTANCE =      1000. meters          3281. feet

-----
***** BUILDING DOWNWASH PARAMETERS *****
-----

BUILDING HEIGHT:              34.0 meters          111.5 feet
MAX BUILDING DIMENSION:       120.0 meters          393.7 feet
MIN BUILDING DIMENSION:       60.0 meters          196.9 feet
BUILDING ORIENTATION TO NORTH: 90. degrees
STACK DIRECTION FROM CENTER:  27. degrees
STACK DISTANCE FROM CENTER:   67.0 meters          219.8 feet

```

Figure 67. AERSCREEN_EXAMPLE.OUT section with source and building information.

The next section gives information about the results of FLOWSECTOR (Figure 68). The header for the section gives the receptor spacing, 25 m. Next, follows the flow sectors from 10 to 360 degrees. Included for each sector are the projected building width and length output from BPIPPRM, the x and y building adjustments from BPIPPRM, the maximum 1-hour concentration ($\mu\text{g}/\text{m}^3$), the downwind distance from the source, and the elevation of the receptor relative to the source (receptor – source). Concentrations are written in with the “G” FORTRAN descriptor with 4 significant digits. The sector followed by an “*” indicates that this is the highest concentration sector or “worst case sector.” In this case it is flow sector 160° with a concentration of approximately 201.2 $\mu\text{g}/\text{m}^3$ at 175 m from the source. The relative receptor

elevation is -5.95 m, meaning the receptor is at an elevation of approximately 125.8 m. The temporal period associated with the maximum concentration is winter.

```

***** FLOW SECTOR ANALYSIS *****
25 meter receptor spacing: 30. meters - 1000. meters

```

FLOW SECTOR	BUILD WIDTH	BUILD LENGTH	XBADJ	YBADJ	MAXIMUM 1-HR CONC (ug/m3)	IMPACT DIST (m)	RECEPTOR HEIGHT (m)	TEMPORAL PERIOD
10	128.60	79.93	-104.17	19.14	127.8	53.0	-7.02	WIN
20	133.28	97.42	-115.27	7.70	117.7	30.0	-6.27	WIN
30	133.92	111.96	-122.86	-3.97	83.83	30.0	-5.90	SUM
40	130.49	123.10	-126.73	-15.53	62.52	150.0	-4.95	SPR
50	123.10	130.49	-126.74	-26.61	60.34	150.0	-4.48	SPR
60	111.96	133.92	-122.90	-36.88	89.96	75.0	-4.81	WIN
70	97.42	133.28	-115.32	-46.04	94.09	75.0	-4.63	SPR
80	79.93	128.60	-104.25	-53.79	167.1	53.0	-4.78	SPR
90	0.00	0.00	0.00	0.00	59.91	325.0	-4.04	WIN
100	0.00	0.00	0.00	0.00	59.40	350.0	-4.28	WIN
110	0.00	0.00	0.00	0.00	58.83	325.0	-4.65	WIN
120	111.96	133.92	-62.99	-66.88	173.8	75.0	-4.63	SPR
130	123.10	130.49	-49.72	-65.18	171.9	100.0	-5.31	SPR
140	130.49	123.10	-34.94	-61.49	177.1	125.0	-6.10	SPR
150	133.92	111.96	-19.10	-55.94	195.4	150.0	-6.32	WIN
160*	133.28	97.42	-2.68	-48.68	201.2	175.0	-5.95	WIN
170	128.60	79.93	13.83	-39.95	196.7	175.0	-6.76	SPR
180	120.00	60.00	29.91	-30.00	132.6	100.0	-5.14	WIN
190	128.60	79.93	24.25	-19.14	147.6	105.0	-5.17	SPR
200	133.28	97.42	17.85	-7.70	158.4	125.0	-5.34	SPR
210	133.92	111.96	10.90	3.97	199.8	125.0	-5.69	SUM
220	130.49	123.10	3.63	15.53	194.1	150.0	-6.42	WIN
230	123.10	130.49	-3.76	26.61	172.6	125.0	-7.80	WIN
240	111.96	133.92	-11.03	36.88	148.0	200.0	-13.12	WIN
250	97.42	133.28	-17.96	46.04	164.7	150.0	-19.31	WIN
260	79.93	128.60	-24.35	53.79	170.7	105.0	-21.97	SUM
270	0.00	0.00	0.00	0.00	65.81	400.0	-13.94	WIN
280	0.00	0.00	0.00	0.00	65.65	375.0	-21.22	WIN
290	0.00	0.00	0.00	0.00	65.65	375.0	-23.80	WIN
300	111.96	133.92	-70.94	66.88	157.1	75.0	-15.94	SPR
310	123.10	130.49	-80.77	65.18	121.8	100.0	-12.98	WIN
320	130.49	123.10	-88.16	61.49	122.8	100.0	-11.30	SUM
330	133.92	111.96	-92.86	55.94	100.4	100.0	-11.07	WIN
340	133.28	97.42	-94.75	48.68	64.08	150.0	-8.70	SPR
350	128.60	79.93	-93.75	39.95	106.1	30.0	-8.58	WIN
360	120.00	60.00	-89.91	30.00	149.4	30.0	-7.87	SPR

* = worst case flow sector

Figure 68. FLOWSECTOR results in AERSCREEN_EXAMPLE.OUT.

Next, follows meteorological inputs and meteorology used to calculate the overall worst case scenario (Figure 69). Listed first are the inputs: minimum and maximum temperatures (K), minimum wind speed and anemometer height. Also listed is the dominant season and surface roughness sector associated with the worst case concentration. For this case it is winter and roughness sector 12 with beginning direction 330° and ending with 0° (or 360°). Note that this is

the sector of the upwind direction of the worst case scenario. Shown below the season and sector are the surface characteristics for that season and sector.

Next, follows the meteorological parameters used to predict the worst case concentration at the ambient boundary (Figure 69): year, month, day, Julian date, hour, heat flux, u^* , w^* , lapse rate, convective mixing height, mechanical mixing height, Monin-Obukhov length, surface roughness, Bowen ratio, albedo reference wind speed, anemometer height, temperature, and temperature measurement height (2 meters). The surface characteristics listed should match those listed in association with the dominant season and sector in the AERSURFACE output file or AERSCREEN.LOG file. After the meteorological parameters, the final plume rise is also shown with stack top wind speeds. After that are listed the meteorological parameters and plume height of the maximum concentration at the ambient boundary. Plume heights do not include downwash effects.

```

***** MAKEMET METEOROLOGY PARAMETERS *****
-----
MIN/MAX TEMPERATURE: 261.4 / 313.1 (K)
MINIMUM WIND SPEED: 1.5 m/s
ANEMOMETER HEIGHT: 10.000 meters
SURFACE CHARACTERISTICS INPUT: aersurface_12.out
DOMINANT SECTOR: 12 (330 0)
DOMINANT SEASON: Winter
ALBEDO: 0.15
BOWEN RATIO: 0.85
ROUGHNESS LENGTH: 0.305 (meters)
SURFACE FRICTION VELOCITY (U*) NOT ADJUSTED

METEOROLOGY CONDITIONS USED TO PREDICT OVERALL MAXIMUM IMPACT
-----
YR MO DY JDY HR
-- -- -- -- --
10 01 14 14 12

H0 U* W* DT/DZ ZICNV ZIMCH M-O LEN Z0 BOWEN ALBEDO REF WS
-- -- -- -- --
4.72 0.185 0.600 0.020 1604. 183. -117.1 0.305 0.85 0.15 1.50

HT REF TA HT
-- -- -- -- --
10.0 287.2 2.0

WIND SPEED AT STACK HEIGHT (non-downwash): 1.7 m/s
STACK-TIP DOWNWASH ADJUSTED STACK HEIGHT: 20.0 meters
ESTIMATED FINAL PLUME RISE (non-downwash): 10.8 meters
ESTIMATED FINAL PLUME HEIGHT (non-downwash): 30.8 meters

METEOROLOGY CONDITIONS USED TO PREDICT AMBIENT BOUNDARY IMPACT
-----
YR MO DY JDY HR
-- -- -- -- --
10 06 10 14 12

H0 U* W* DT/DZ ZICNV ZIMCH M-O LEN Z0 BOWEN ALBEDO REF WS
-- -- -- -- --
34.75 0.239 1.200 0.020 1913. 268. -37.7 0.038 0.63 0.14 3.00

HT REF TA HT
-- -- -- -- --
10.0 313.1 2.0

WIND SPEED AT STACK HEIGHT (non-downwash): 3.3 m/s
STACK-TIP DOWNWASH ADJUSTED STACK HEIGHT: 20.0 meters
ESTIMATED FINAL PLUME RISE (non-downwash): 6.9 meters
ESTIMATED FINAL PLUME HEIGHT (non-downwash): 26.9 meters

```

Figure 69. Meteorological data associated with maximum FLOWSECTOR concentration and ambient boundary concentration.

After the meteorological parameters, follows a summary of maximum concentrations by distance (Figure 70). The concentrations shown are not necessarily in the same direction as the overall maximum concentration shown in the flow sector analysis, i.e., the maximum 30 m concentration may not be directed toward 180. Details about the concentrations' meteorology can be found in the file aerscreen_example_max_conc_distance.txt, whose format is listed in Table 1. The maximum concentration and its distance, 175 m (shown in red in Figure 70) found from FLOWSECTOR should be listed in the table and in aerscreen_example_max_conc_distances.txt.

```

-----
***** AERSCREEN AUTOMATED DISTANCES *****
OVERALL MAXIMUM CONCENTRATIONS BY DISTANCE
-----

```

DIST (m)	MAXIMUM 1-HR CONC (ug/m3)	RECEPTOR HEIGHT (m)	DIST (m)	MAXIMUM 1-HR CONC (ug/m3)	RECEPTOR HEIGHT (m)
30.00	149.4	-7.87	503.00	132.1	-6.91
50.00	166.9	-4.82	525.00	131.7	-7.24
53.00	167.1	-4.78	550.00	130.2	-7.94
75.00	173.8	-4.63	575.00	128.5	-8.66
100.00	181.5	-5.30	600.00	127.4	-8.91
105.00	180.7	-5.43	625.00	123.5	-10.77
125.00	199.8	-5.69	650.00	123.0	-10.40
150.00	199.5	-5.73	675.00	124.6	-8.89
175.00	201.2	-5.95	700.00	126.4	-7.54
200.00	193.8	-6.47	702.00	126.2	-7.55
201.00	193.8	-6.47	725.00	124.8	-7.63
225.00	126.5	-6.50	750.00	121.3	-8.42
250.00	117.4	-5.87	775.00	116.6	-9.28
275.00	115.4	-5.92	800.00	112.6	-9.90
300.00	113.1	-6.01	825.00	108.9	-10.43
325.00	110.7	-6.13	850.00	105.2	-11.04
350.00	108.6	-13.95	875.00	101.7	-11.64
375.00	112.2	-15.03	900.00	97.01	-13.40
400.00	116.1	-14.10	925.00	92.22	-16.03
425.00	120.5	-11.78	950.00	88.78	-17.60
450.00	125.0	-9.54	975.00	86.55	-17.23
475.00	130.1	-7.34	1000.00	84.33	-16.96
500.00	132.0	-6.94			

Figure 70. Summary of maximum concentrations by distance in AERSCREEN_EXAMPLE.OUT.

The final section of the output file lists the results of REFINE and fumigation calculations (Figure 71). The REFINE result is the overall maximum concentration in the direction of the worst case scenario found in FLOWSECTOR, using the same surface characteristics (winter, 90 to 120 degrees sector). In addition to the 1-hour concentration calculated by AERMOD, the scaled 3-hr, 8-hr, 24-hr, and annual concentrations are calculated by AERSCREEN and output. Also output is the distance of the maximum concentration and its direction. Similar output is listed for the maximum concentration at the minimum ambient distance. The maximum 1-hour

inversion break-up fumigation concentration is listed along with the scaled 3-hr, 8-hr, 24-hr, and annual concentrations.

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***** AERSCREEN MAXIMUM IMPACT SUMMARY *****
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CALCULATION PROCEDURE	MAXIMUM 1-HOUR CONC (ug/m3)	SCALED 3-HOUR CONC (ug/m3)	SCALED 8-HOUR CONC (ug/m3)	SCALED 24-HOUR CONC (ug/m3)	SCALED ANNUAL CONC (ug/m3)
ELEVATED TERRAIN	215.6	215.6	194.0	129.3	21.56
DISTANCE FROM SOURCE 171.00 meters directed toward 160 degrees					
RECEPTOR HEIGHT -6.12 meters					
IMPACT AT THE					
AMBIENT BOUNDARY 149.4 149.4 134.5 89.65 14.94					
DISTANCE FROM SOURCE 30.00 meters directed toward 360 degrees					
RECEPTOR HEIGHT -7.87 meters					

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***** AERSCREEN FUMIGATION SUMMARY *****
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FUMIGATION PROCEDURE	MAXIMUM 1-HOUR CONC (ug/m3)	SCALED 3-HOUR CONC (ug/m3)	SCALED 8-HOUR CONC (ug/m3)	SCALED 24-HOUR CONC (ug/m3)	SCALED ANNUAL CONC (ug/m3)
INVERSION BREAK-UP	759.5	759.5	683.6	455.7	75.95
DISTANCE FROM SOURCE 100.00 meters					

Figure 71. Maximum concentration impact, ambient boundary, and inversion break-up fumigation concentration summaries in AERSCREEN_EXAMPLE.OUT.

Figure 72 shows partial output for aerscreen_example_max_conc_distances.txt. Note that the overall maximum concentration 215.6 $\mu\text{g}/\text{m}^3$ is denoted by the asterisk. See Table 2 for format. Figure 73 shows partial output for the debug file, aerscreen_example_concentrations.txt. This file has a similar format as aerscreen_example_max_conc_distances.txt, but lists the intermediate outputs from FLOWSECTOR.

Concentration	Distance	Elevation	Flow	Season/Month	Zo sector	Date	H0	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O	LEN	ZO	BOWEN	ALBEDO	REF	WS	HT	REF	TA	HT
0.14942E+03	30.00	-7.87	360	Spring	180-210	10061012	34.75	0.239	1.200	0.020	1913.	268.	-37.7	0.038	0.63	0.14	3.00	10.0	313.1	2.0			
0.16692E+03	50.00	-4.82	80	Spring	240-270	10020712	170.58	0.209	1.200	0.020	390.	219.	-5.1	0.141	0.63	0.14	1.50	10.0	313.1	2.0			
0.16713E+03	53.00	-4.78	80	Spring	240-270	10020712	170.58	0.209	1.200	0.020	390.	219.	-5.1	0.141	0.63	0.14	1.50	10.0	313.1	2.0			
0.17382E+03	75.00	-4.63	120	Spring	300-330	10012112	17.55	0.222	0.600	0.020	473.	241.	-59.9	0.458	0.63	0.14	1.50	10.0	313.1	2.0			
0.18151E+03	100.00	-5.30	160	Winter	330-0	10011412	4.75	0.185	0.600	0.020	1604.	183.	-117.1	0.305	0.85	0.15	1.50	10.0	287.2	2.0			
0.18070E+03	105.00	-5.43	160	Winter	330-0	10011412	4.75	0.185	0.600	0.020	1604.	183.	-117.1	0.305	0.85	0.15	1.50	10.0	287.2	2.0			
0.19976E+03	125.00	-5.69	210	Summer	30-60	10012812	11.90	0.117	0.600	0.020	698.	92.	-12.9	0.022	0.36	0.15	1.50	10.0	313.1	2.0			
0.19948E+03	150.00	-5.73	210	Summer	30-60	10012812	11.90	0.117	0.600	0.020	698.	92.	-12.9	0.022	0.36	0.15	1.50	10.0	313.1	2.0			
* 0.21555E+03	171.00	-6.12	160	Winter	330-0	10011412	4.72	0.200	0.600	0.020	1615.	205.	-148.4	0.405	0.84	0.15	1.50	10.0	287.2	2.0			
0.20123E+03	175.00	-5.95	160	Winter	330-0	10011412	4.75	0.185	0.600	0.020	1604.	183.	-117.1	0.305	0.85	0.15	1.50	10.0	287.2	2.0			
0.19380E+03	200.00	-6.47	220	Winter	30-60	10011412	4.75	0.100	0.600	0.020	1604.	73.	-18.6	0.011	0.85	0.15	1.50	10.0	287.2	2.0			
0.19380E+03	201.00	-6.47	220	Winter	30-60	10011412	4.75	0.100	0.600	0.020	1604.	73.	-18.6	0.011	0.85	0.15	1.50	10.0	287.2	2.0			
0.12648E+03	225.00	-6.50	220	Winter	30-60	10012301	-0.43	0.082	-9.000	0.020	-999.	54.	102.6	0.011	0.85	0.15	1.50	10.0	261.4	2.0			
0.11743E+03	250.00	-5.87	210	Winter	30-60	10012301	-0.43	0.082	-9.000	0.020	-999.	54.	102.6	0.011	0.85	0.15	1.50	10.0	261.4	2.0			
0.11541E+03	275.00	-5.92	210	Winter	30-60	10012301	-0.43	0.082	-9.000	0.020	-999.	54.	102.6	0.011	0.85	0.15	1.50	10.0	261.4	2.0			
0.11313E+03	300.00	-6.01	210	Winter	30-60	10012301	-0.43	0.082	-9.000	0.020	-999.	54.	102.6	0.011	0.85	0.15	1.50	10.0	261.4	2.0			
0.11075E+03	325.00	-6.13	210	Winter	30-60	10012301	-0.43	0.082	-9.000	0.020	-999.	54.	102.6	0.011	0.85	0.15	1.50	10.0	261.4	2.0			
0.10857E+03	350.00	-13.95	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.11220E+03	375.00	-15.03	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.11611E+03	400.00	-14.10	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12050E+03	425.00	-11.78	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12498E+03	450.00	-9.54	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.13014E+03	475.00	-7.34	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.13197E+03	500.00	-6.94	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.13213E+03	503.00	-6.91	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.13175E+03	525.00	-7.24	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.13025E+03	550.00	-7.94	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12848E+03	575.00	-8.66	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12741E+03	600.00	-8.91	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12347E+03	625.00	-10.77	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12298E+03	650.00	-10.40	360	Summer	180-210	10012501	-2.31	0.056	-9.000	0.020	-999.	30.	7.1	0.045	0.36	0.15	1.50	10.0	313.1	2.0			
0.12457E+03	675.00	-8.89	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.12637E+03	700.00	-7.54	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.12624E+03	702.00	-7.55	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.12479E+03	725.00	-7.63	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.12125E+03	750.00	-8.42	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.11656E+03	775.00	-9.28	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.11257E+03	800.00	-9.90	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.10888E+03	825.00	-10.43	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.10522E+03	850.00	-11.04	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.10171E+03	875.00	-11.64	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.97014E+02	900.00	-13.40	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.92219E+02	925.00	-16.03	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.88779E+02	950.00	-17.60	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.86548E+02	975.00	-17.23	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			
0.84328E+02	1000.00	-16.96	360	Spring	180-210	10012501	-2.21	0.054	-9.000	0.020	-999.	29.	6.8	0.038	0.63	0.14	1.50	10.0	313.1	2.0			

Figure 72. Output of aeroscreen_example_max_conc_distance.txt.

Concentration	Distance	Elevation	Flow	Season/Month	Zo	sector	Date	HO	U*	W*	DT/DZ	ZICNV	ZIMCH	M-O	LEN	ZO	BOWEN	ALBEDO	REF	WS	HT	REF	TA	HT
0.12767E+03	30.00	-7.06	10	Winter	180-210	10080512	80.98	0.308	1.800	0.020	2770.	393.	-34.6	0.031	0.85	0.15	4.00	10.0	313.1	2.0				
0.11768E+03	30.00	-6.27	20	Winter	180-210	10080512	80.98	0.308	1.800	0.020	2770.	393.	-34.6	0.031	0.85	0.15	4.00	10.0	313.1	2.0				
0.83517E+02	30.00	-5.90	30	Winter	210-240	10032501	-21.38	0.198	-9.000	0.020	-999.	203.	35.0	0.013	0.85	0.15	4.00	10.0	313.1	2.0				
0.42414E+02	30.00	-5.65	40	Winter	210-240	10110912	286.89	0.632	1.800	0.020	782.	1157.	-84.8	0.013	0.85	0.15	10.00	10.0	313.1	2.0				
0.39925E+02	30.00	-5.43	50	Winter	210-240	10011001	-2.39	0.045	-9.000	0.020	-999.	110.	3.7	0.013	0.85	0.15	1.50	10.0	313.1	2.0				
0.49116E+02	30.00	-5.25	60	Winter	240-270	10011812	40.89	0.172	0.600	0.020	203.	165.	-12.0	0.115	0.85	0.15	1.50	10.0	313.1	2.0				
0.46231E+02	30.00	-5.17	70	Winter	240-270	10010812	45.67	0.174	0.600	0.020	182.	167.	-11.2	0.115	0.85	0.15	1.50	10.0	313.1	2.0				
0.11514E+03	30.00	-5.10	80	Winter	240-270	10021712	286.89	0.212	1.800	0.020	782.	225.	-3.2	0.115	0.85	0.15	1.50	10.0	313.1	2.0				
0.77764E+01	30.00	-5.05	90	Winter	270-300	10011612	54.56	0.210	0.600	0.020	140.	222.	-15.1	0.244	0.85	0.15	1.50	10.0	287.2	2.0				
0.77789E+01	30.00	-5.01	100	Winter	270-300	10011612	54.56	0.210	0.600	0.020	140.	222.	-15.1	0.244	0.85	0.15	1.50	10.0	287.2	2.0				
0.77802E+01	30.00	-4.99	110	Winter	270-300	10011612	54.56	0.210	0.600	0.020	140.	222.	-15.1	0.244	0.85	0.15	1.50	10.0	287.2	2.0				
0.68684E+02	30.00	-4.98	120	Winter	300-330	10020312	24.98	0.220	1.200	0.020	2441.	237.	-37.7	0.391	0.85	0.15	1.50	10.0	287.2	2.0				
0.69684E+02	30.00	-5.00	130	Winter	300-330	10020612	40.89	0.228	1.200	0.020	1626.	250.	-27.8	0.391	0.85	0.15	1.50	10.0	313.1	2.0				
0.69040E+02	30.00	-5.02	140	Winter	300-330	10011412	4.75	0.198	0.600	0.020	1604.	202.	-143.2	0.391	0.85	0.15	1.50	10.0	287.2	2.0				
0.69988E+02	30.00	-5.05	150	Winter	330-0	10011412	4.75	0.185	0.600	0.020	1604.	183.	-117.1	0.305	0.85	0.15	1.50	10.0	287.2	2.0				
0.61306E+02	30.00	-5.10	160	Winter	330-0	10011412	4.75	0.185	0.600	0.020	1604.	183.	-117.1	0.305	0.85	0.15	1.50	10.0	287.2	2.0				
0.33467E+02	30.00	-5.19	170	Winter	330-0	10020612	40.89	0.214	1.200	0.020	1626.	227.	-23.0	0.305	0.85	0.15	1.50	10.0	313.1	2.0				
0.19780E+00	30.00	-5.29	180	Winter	330-0	10010812	45.67	0.216	0.600	0.020	182.	231.	-21.2	0.305	0.85	0.15	1.50	10.0	313.1	2.0				
0.10403E+02	30.00	-5.40	190	Winter	0-30	10010412	4.75	0.140	0.300	0.020	201.	121.	-51.3	0.089	0.85	0.15	1.50	10.0	287.2	2.0				
0.18922E+02	30.00	-5.51	200	Winter	0-30	10011412	4.75	0.140	0.600	0.020	1604.	121.	-51.3	0.089	0.85	0.15	1.50	10.0	287.2	2.0				
0.33730E+02	30.00	-5.64	210	Winter	30-60	10011412	4.75	0.100	0.600	0.020	1604.	73.	-18.6	0.011	0.85	0.15	1.50	10.0	287.2	2.0				
0.42504E+02	30.00	-5.79	220	Winter	30-60	10011412	4.75	0.100	0.600	0.020	1604.	73.	-18.6	0.011	0.85	0.15	1.50	10.0	287.2	2.0				
0.48038E+02	30.00	-5.92	230	Winter	30-60	10010312	1.95	0.096	0.300	0.020	445.	68.	-36.5	0.011	0.85	0.15	1.50	10.0	261.4	2.0				
0.47331E+02	30.00	-6.31	240	Winter	60-90	10010312	1.95	0.108	0.300	0.020	445.	82.	-52.3	0.025	0.85	0.15	1.50	10.0	261.4	2.0				
0.47690E+02	30.00	-7.11	250	Winter	60-90	10011412	4.75	0.113	0.600	0.020	1604.	87.	-26.6	0.025	0.85	0.15	1.50	10.0	287.2	2.0				
0.47666E+02	30.00	-8.02	260	Winter	60-90	10011412	4.75	0.113	0.600	0.020	1604.	87.	-26.6	0.025	0.85	0.15	1.50	10.0	287.2	2.0				
0.49551E+01	30.00	-8.91	270	Winter	90-120	10011612	54.56	0.140	0.600	0.020	140.	120.	-4.4	0.029	0.85	0.15	1.50	10.0	287.2	2.0				
0.49548E+01	30.00	-9.64	280	Winter	90-120	10011612	54.56	0.140	0.600	0.020	140.	120.	-4.4	0.029	0.85	0.15	1.50	10.0	287.2	2.0				
0.49547E+01	30.00	-10.10	290	Winter	90-120	10011612	54.56	0.140	0.600	0.020	140.	120.	-4.4	0.029	0.85	0.15	1.50	10.0	287.2	2.0				
0.69511E+02	30.00	-10.18	300	Winter	120-150	10020612	40.89	0.137	1.200	0.020	1626.	116.	-6.0	0.032	0.85	0.15	1.50	10.0	313.1	2.0				
0.65020E+02	30.00	-10.00	310	Winter	120-150	10012412	126.56	0.153	1.200	0.020	525.	137.	-2.7	0.032	0.85	0.15	1.50	10.0	313.1	2.0				
0.77417E+02	30.00	-9.74	320	Winter	120-150	10012412	126.56	0.153	1.200	0.020	525.	137.	-2.7	0.032	0.85	0.15	1.50	10.0	313.1	2.0				
0.61248E+02	30.00	-9.42	330	Winter	150-180	10010812	45.67	0.140	0.600	0.020	182.	120.	-5.8	0.034	0.85	0.15	1.50	10.0	313.1	2.0				
0.36388E+02	30.00	-9.11	340	Winter	150-180	10011001	-3.03	0.053	-9.000	0.020	-999.	139.	4.7	0.034	0.85	0.15	1.50	10.0	313.1	2.0				
0.10606E+03	30.00	-8.58	350	Winter	150-180	10080512	80.98	0.312	1.800	0.020	2770.	401.	-36.2	0.034	0.85	0.15	4.00	10.0	313.1	2.0				
0.13881E+03	30.00	-7.87	360	Winter	180-210	10030901	-7.46	0.138	-9.000	0.020	-999.	117.	33.6	0.031	0.85	0.15	2.50	10.0	313.1	2.0				
0.12608E+03	30.00	-7.06	10	Spring	180-210	10082512	92.36	0.320	1.800	0.020	2429.	417.	-34.2	0.038	0.63	0.14	4.00	10.0	313.1	2.0				
0.11738E+03	30.00	-6.27	20	Spring	180-210	10082512	92.36	0.320	1.800	0.020	2429.	417.	-34.2	0.038	0.63	0.14	4.00	10.0	313.1	2.0				
0.83710E+02	30.00	-5.90	30	Spring	210-240	10032401	-23.02	0.213	-9.000	0.020	-999.	227.	40.6	0.019	0.63	0.14	4.00	10.0	313.1	2.0				
0.42338E+02	30.00	-5.65	40	Spring	210-240	10121312	244.32	0.665	1.800	0.020	918.	1248.	-115.9	0.019	0.63	0.14	10.00	10.0	313.1	2.0				
0.39489E+02	30.00	-5.43	50	Spring	210-240	10011001	-2.61	0.048	-9.000	0.020	-999.	120.	4.0	0.019	0.63	0.14	1.50	10.0	313.1	2.0				
0.48878E+02	30.00	-5.25	60	Spring	240-270	10012212	34.75	0.177	0.600	0.020	239.	171.	-15.3	0.141	0.63	0.14	1.50	10.0	313.1	2.0				

Figure 73. Partial output of aerscreen_example_concentrations.txt.

With the debug option turned on, the fumigation debug file, `aerscreen_example_fumigate_debug.txt` was created. This file lists the iterative process used to calculate the effective plume height for each hour of meteorology that is used in the fumigation calculations (Figure 74). The file also lists the iterative process of calculating the distance X_{\max} for inversion break-up fumigation and subsequent concentration, X_f (Figure 75).

```
Calculating effective plume height for: 10010401

Stack height (adjusted):    20.00 m
Initial plume rise:        11.93 m

Iteration: 1
Plume height:              25.97 m
Plume rise:                 13.20 m

Iteration: 2
Plume height:              26.60 m
Plume rise:                 13.18 m

Final plume rise
Iteration: 2
Effective Plume height:    33.18 m
Plume rise:                13.18 m

Calculating effective plume height for: 10010501

Stack height (adjusted):    20.00 m
Initial plume rise:        11.93 m

Iteration: 1
Plume height:              25.97 m
Plume rise:                 13.20 m

Iteration: 2
Plume height:              26.60 m
Plume rise:                 13.18 m

Final plume rise
Iteration: 2
Effective Plume height:    33.18 m
Plume rise:                13.18 m
```

Figure 74. Partial output of `aerscreen_example_fumigate_debug.txt` showing effective plume height calculations.

```

#####
INVERSION BREAK-UP FUMIGATION CALCULATIONS FOR 10010401

Stack height: 20.00 m
Stack height wind speed 2.5 m
Stack-tip downwash adjusted stack height: 20.00 m
Effective stack height: 33.18 m
Initial distance: 5.000 km
temporal period: 1
spatial sector: 1

BASE METEOROLOGICAL VARIABLES
  H0      U*      W*  DT/DZ ZICNV ZIMCH  M-O LEN      Z0  BOWEN ALBEDO  REF WS
-----
-3.35  0.064 -9.000  0.020 -999.  37.      6.2 0.089   0.85  0.15  1.50

  HT  REF TA      HT
-----
 10.0 261.4  2.0

OTHER VARIABLES
  UMIX      UEFF  SIG-V  SIG-W  THETA  DT/DZ_2  BV      SIG-YB  SIGZ-B
-----
   3.2    3.1   0.20   0.06  266.3  0.0921  0.0582   3.7    3.7

Iteration 1

Sigma-y: 0.160E+03 m
Sigma-z: 0.872E+01 m
Distance: 0.408 km

Iteration 2

Sigma-y: 0.226E+02 m
Sigma-z: 0.428E+01 m
Distance: 0.253 km

Iteration 3

Sigma-y: 0.151E+02 m
Sigma-z: 0.406E+01 m
Distance: 0.247 km

Convergence found at iteration 3

Sigma-y: 0.148E+02 m
Sigma-z: 0.405E+01 m
Concentration: 0.205E+03

NEW MAX CONCENTRATION OF 0.205E+03 AT 0.247 KM FOR DATE 10010401
temporal period: 1
spatial sector: 1
.
.
FINAL MAX CONCENTRATION OF 0.760E+03 AT 0.100 KM FOR DATE 10010901
temporal period: 3
spatial sector: 7

```

Figure 75. Partial output of aerscreen_example_fumigate_debug.txt showing concentration calculations.

After processing, AERSCREEN creates a new AERSCREEN.INP file, with any user input changes added (Figure 76). Note that any options that are alphabetic have been set to uppercase. AERSCREEN sets all flags to uppercase internally for program efficiency. AERSCREEN will also output the surface characteristics for the maximum concentration as the user-entered values in the MAKEMET DATA section and lists the time, flow vector, and surface roughness sector of the overall maximum concentration. AERSCREEN also copies the new AERSCREEN.INP file to AERSCREEN_EXAMPLE.INP and AERSCREEN.LOG to AERSCREEN_EXAMPLE.LOG.

```

** Coordinates switched from geographic to UTM
** STACK DATA      Rate      Height      Temp.      Velocity      Diam.      Flow
**                0.1000E+01  20.0000  300.0000  15.0000      0.5000      6241.

** BUILDING DATA  BPIP      Height  Max dim.  Min dim.  Orient.  Direct.  Offset
**                Y          34.0000 120.0000  60.0000  90.0000  26.6000  67.0000

** MAKEMET DATA   MinT      MaxT  Speed  AnemHt  Surf Clim  Albedo  Bowen  Length  SC FILE
**                261.40  313.10  1.5   10.000  9    0    0.1500  0.8500  0.3050  "aersurface_12.out"

** ADJUST U*      N

** TERRAIN DATA   Terrain    UTM East  UTM North  Zone  Nada      Probe      PROFBASE  Use AERMAP elev
**                Y          700198.2  3974175.5  17    4          1000.0      126.80      N

** DISCRETE RECEPTORS  Discflag  Receptor file
**                Y          "discrete_receptors.txt"

** UNITS/POPULATION  Units    R/U  Population      Amb. dist.  Flagpole  Flagpole height
**                M    U    2400000.      30.000      N          0.00

** FUMIGATION      Inversion Break-up  Shoreline  Distance  Direct  Run AERSCREEN
**                Y          N          0.00      0.0    Y

** DEBUG OPTION    Debug
**                Y

** OUTPUT FILE "aerscreen_example.out"

** Temporal sector: Winter, flow vector: 160 degrees, spatial sector: 12

```

Figure 76. Header portion of new AERSCREEN.INP file.

5. References

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Appendix A. Input parameters and invalid responses

Below, AERSCREEN input parameters are listed with invalid responses and actions taken by AERSCREEN when reading the data from the AERSCREEN.INP file or prompts. Some variables are only checked if the appropriate flags are set. Building dimensions are not checked if downwash is not included in AERSCREEN processing. Other variables such as urban population or flagpole heights are not checked if the source is not urban or flagpole receptors are not used.

As previously noted, when reading data from AERSCREEN.INP, if any of the data sections, emissions, building information, terrain information, meteorological information, and other parameters, is missing, AERSCREEN will alert the user and stop processing. If the emissions data is listed after the building, terrain, or other parameter data sections, AERSCREEN will alert the user and stop processing.

Source parameters and invalid values.

Parameter	Source type	Invalid response	AERSCREEN.INP	Prompts
Units flag	All	If prompts, response is not upper or lower case E or M. If input file, response is not upper or lowercase M.	Issue message and stop	Re-prompt
Source type	All	Response is not upper or lower-case: P, F, H, A, C, S, or V	Issue message and stop	Re-prompt
Emission rate	All	Negative or non-numeric	Issue message and stop	Re-prompt
Stack height	Point, capped stack, horizontal stack	Negative or non-numeric	Issue message and stop	Re-prompt
Stack diameter	Point, capped stack, horizontal stack	Negative or non-numeric	Issue message and stop	Re-prompt
Negative exit velocity	Point, capped stack, horizontal stack	Non-numeric	Issue message and reset to 1×10^{-5} m/s if negative	Issue message and reset to 1×10^{-5} m/s if negative
Flare height	Flare	Negative or non-numeric	Issue message and stop	Re-prompt
Heat release rate	Flare	Negative or non-numeric	Issue message and stop	Re-prompt
Heat loss fraction	Flare	Non-numeric	Issue message and reset to 0 if negative	Issue message and reset to 0 if negative
Release height	Area, volume, circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Initial vertical dimension	Area, volume, circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Initial lateral dimension	Volume	Negative or non-numeric	Issue message and stop	Re-prompt
Circular radius	Circular area	Negative or non-numeric	Issue message and stop	Re-prompt
Rectangular area source horizontal dimensions	Area	Negative or non-numeric	Issue message and stop	Re-prompt
Orientation angle	Area	Non-numeric or non-zero	Issue message and stop	N/A
Number of vertices	Circular area	Non-numeric or not equal to 20	Issue message and stop	N/A
Urban/rural flag	All	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Urban population	All	Non-numeric, negative or less than 100 people	Issue message and stop (if source is urban)	Re-prompt
Minimum ambient distance	All	Non-numeric, negative or if volume source, inside the volume.	Issue message and reset to minimum distance based on source type if negative. If non-numeric issue message and stop	Re-prompt if non-numeric
NO ₂ conversion method	All	“PVMRM” and “OLM” are both on MODELOPT card or POLLUTID is NO2 and neither PVMRM or OLM is on MODELOPT card	Issue message and stop	N/A
NO ₂ /NOX in-stack ratio	All	Non-numeric, negative, or exceeds 1.0	Issue message and stop	Re-prompt
Ozone background concentration	All	Non-numeric, negative, or exceeds 1.0	Issue message and stop	Re-prompt
Ozone background concentration units	All	Not upper or lower-case “PPB”, “PPM”, or “UG/M3”	Issue message and stop	Re-prompt
Pollutant ID	All	Not set to NO2 but MODELOPT includes PVMRM or OLM	Issue message and stop	N/A

Invalid building parameter inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Downwash flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Building height	Negative or non-numeric	Issue message and stop	Re-prompt
Maximum building horizontal dimension	Negative or non-numeric	Issue message and stop	Re-prompt
Minimum building horizontal dimension	Non-numeric, negative or exceeds maximum horizontal dimension	Issue message and stop	Re-prompt
Angle of maximum horizontal dimension relative to North	Non-numeric, less than zero or exceeds 179 degrees	Issue message and stop	Re-prompt
Angle of stack location relative to North	Non-numeric, less than zero or exceeds 360 degrees	Issue message and stop	Re-prompt
Distance from stack to building center	Negative or non-numeric	Issue message and stop	Re-prompt
Use pre-existing BPIPRM input file	File does not exist	Issue message and stop	Re-prompt
	Processing flag in file incorrectly set for AERMOD or more than one stack listed in file.	Issue message and stop	Issue message and stop

Invalid meteorological data inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Minimum Temperature	Non-numeric, negative (if Kelvin), or minimum temperature is equal to or exceeds maximum temperature	Issue message and stop	Re-prompt for temperatures
Maximum Temperature			
Minimum wind speed	Negative or non-numeric	Issue message and stop	Re-prompt
Anemometer height	Negative or non-numeric	Issue message and stop	Re-prompt
Surface code	Non-numeric, negative or greater than 9	Issue message and stop	Re-prompt
Climatology code	Non-numeric, less than 1 or exceeds 4 if surface code between 1 and 8 inclusive	Issue message and stop	Re-prompt
User albedo	Non-numeric, negative, or exceeds 1.0	Issue message and stop if non-numeric. Issue message and stop if negative or exceeds 1.0 and surface code is 0	Re-prompt
User Bowen Ratio	Non-numeric	Issue message and stop if non-numeric.	Re-prompt
User surface roughness	Negative or non-numeric	Issue message and stop if non-numeric. Issue message and stop if negative and surface code is 0	Re-prompt
AERSURFACE output file	Does not exist (if surface code = 9)	Issue message and stop	Re-prompt for surface characteristics type
	Surface characteristics non-numeric, albedo is negative or exceeds 1.0 or surface roughness is negative	Issue message and stop if surface code is 9	Issue message and re-prompt for surface characteristics type
Adjust u*	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt

Invalid terrain data inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Terrain flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Latitude	Absolute value exceeds 90 degrees	N/A	Re-prompt
Longitude	Absolute value exceeds 180 degrees	N/A	Re-prompt
UTM Easting	N/A	N/A	N/A
UTM Northing	N/A	N/A	N/A
UTM zone	Negative	Issue message and stop	Re-prompt
NAD code	Not equal to 1 or 4	Issue message and stop	Re-prompt
Probe distance	Negative or less than minimum ambient distance	Issue message and stop	Re-prompt for probe distance and minimum ambient distance
Discrete receptor flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Discrete receptor file	File does not exist	Issue message and stop	Re-prompt
	The number of distances exceeds ten or negative distances found	Issue message and stop	Re-prompt
	Units line not included in file	Issue message and stop	Re-prompt
Flagpole receptor use flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Flagpole height	Negative or non-numeric	Issue message and stop (if flagpole receptors used)	Re-prompt
Source elevation	N/A	N/A	N/A
AERMAP use flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Demlist.txt	File is not in current folder	Issue message and stop	Issue message and stop
NADGRIDS directory or folder	No grid files are in directory or folder or NADGRIDS keyword not listed in demlist.txt	Issue message and stop	Issue message and stop

Invalid fumigation inputs.

Parameter	Invalid response	AERSCREEN.INP	Prompts
Inversion break-up fumigation flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Shoreline fumigation flag	Response is not upper or lower-case Y or N	Issue message and stop	Re-prompt
Distance to shoreline	Distance is greater than 3 km or less than 0 km	Issue message and stop	Re-prompt
Direction from source to shoreline	Direction greater than 360 or less than 0 but not equal to -9	Issue message and stop	Re-prompt
Run AERSCREEN flag	Response is not upper or lower-case Y or N; or if no fumigation requested response is not upper or lower-case Y	Issue message and stop	Re-prompt

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