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User's Guide to the Rough Terrain Diffusion Model (RTDM) (Rev. 3.20)

Prepared by:

Robert J. Paine
Bruce A. Egan

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PREFACE

This manual describes a sequential version of the Rough Terrain Diffusion Model (RTDM, version 3.20), developed by Environmental Research & Technology, Inc. (ERT). RTDM has its origins in the modeling technologies ERT had developed and applied over a period of several years as part of its consulting services to both public and private sectors. In response to the March 1980 Federal Register "Call for Models," ERT submitted RTDM.WC, a case-study version of the model, for consideration by EPA. ERT felt that this model would fill an interim need for realistic assessments of pollutant dispersion in complex terrain settings.

RTDM version 3.20 retains the basic algorithms and features of RTDM.WC, including the unique way in which the model simulates plume behavior near terrain features by limiting reflection from the ground in accordance with the second law of thermodynamics. However, provisions have been made in this sequential version of RTDM to incorporate on-site hourly measurements of turbulence intensity, vertical temperature gradient, horizontal wind shear, and the vertical wind speed profile. In addition, a critical height (H_{crit}) is defined such that in stable conditions, plumes at heights less than H_{crit} will impinge upon terrain. Hourly values of stack emission parameters can also be accommodated by the sequential version of RTDM.

RTDM possesses several features not present in other air quality models routinely used for regulatory applications. Proper application of RTDM requires that the user be thoroughly familiar with the basic modeling concepts applied in the model, and follow the guidance provided in this user's guide for selecting the meteorological and source inputs to be used in the computer calculations. Because the model user must specify the parameter switches and meteorological data, care should be used to avoid inconsistent and physically unrealistic combinations of inputs. The use of incorrect parameter or meteorological input values as well as improper application of RTDM can result in serious calculation errors. Also, because the model provides many input and output options, the user should anticipate the necessity for making a number of trial program runs to become familiar with the various features of RTDM.

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ABSTRACT

The Rough Terrain Diffusion Model (RTDM) version 3.20 is a sequential Gaussian plume model designed to estimate ground-level concentrations in rough (or flat) terrain in the vicinity of one or more co-located point sources. It is specifically designed for applications involving chemically stable atmospheric pollutants and is best suited for evaluation of buoyant plume behavior within about 15 km from the source(s). Model results for receptors beyond about 15 km can be used with caution to 50 km, and RTDM can be used as a screening model for distances beyond 50 km. RTDM has special algorithms to deal with plume behavior in complex terrain, and is especially suited for rough terrain applications.

While RTDM version 3.20 is specifically designed for use with sequential data sets, it can also be run in a case-study mode. Various optional features of the model make it useful for either research/sensitivity applications or routine evaluations of source compliance. RTDM has the ability to use hourly on-site measurements of turbulence intensity, vertical temperature difference, horizontal wind shear, and wind speed profile exponents. However, RTDM version 3.20 retains sufficient flexibility in the specification of model inputs to enable the user to obtain results similar to many other Gaussian point source models. The ability of RTDM to read hourly emissions data makes it useful for site-specific model evaluation studies.

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EXECUTIVE SUMMARY

The Rough Terrain Diffusion Model (RTDM) computer code provides a method to estimate air pollutant concentrations from multiple co-located sources in a rural environment. RTDM can be used in flat or complex terrain, but it is especially suited for use in complex terrain.

Special features employed by RTDM in estimating ground-level concentrations are listed below. For applications of the model in a mode approved for general use by the U.S. EPA, certain features are not used (see Section 5 for additional information).

- Reflection of plume mass from the ground is limited by the second law of thermodynamics, so that the maximum concentrations cannot increase with distance downwind.
- In stable conditions, a critical height (H_{crit}) is computed from the wind speed, the terrain height and the strength of the inversion. Plumes below this height are allowed to impinge on the terrain.
- The effects of buoyant entrainment can be accounted for in calculating plume size.
- Momentum effects on plume are ignored; only buoyancy-dominated sources should be modeled with RTDM version 3.2.
- Horizontal wind shear data can be used to make refined estimates of the horizontal extent of the plume.
- On-site turbulence intensity data (I_y, I_z), can be used as estimates of ambient dispersion for input to the model.
- The user can supply hourly values of the wind speed profile exponent.
- On-site values of vertical temperature gradients can be used to better estimate plume rise and H_{crit} values.
- In the presence of a mixing lid, the fraction of the plume that penetrates the lid can be calculated following Briggs (1975), rather than allowing either zero or total penetration of the lid.

- Transitional plume rise may be employed in model computations until the downwind distance to equilibrium plume height is reached by the plume.
- During neutral and unstable conditions or above H_{crit} in stable conditions, a "half-height" correction simulates the effect of terrain-induced plume modifications on ground-level concentrations.
- Decrease in plume rise due to stack-tip downwash can be accounted for.

RTDM can calculate ground-level concentrations at a maximum of 400 receptors from a maximum of 35 co-located point sources. Sources that are not co-located can be modeled separately with the same receptor grid (but different downwind distances to terrain), and the results can then be added using the postprocessor ANALYSIS program. RTDM calculates one-hour average concentrations, considering each hour as an individual steady-state period. The user can input hourly emissions parameters to the model. The resulting one-hour concentrations can be summed to obtain multiple-hour averages.

When the "partial reflection" option is employed in RTDM, the concentration at a receptor point depends upon the travel path of the plume (the upwind concentrations) as well as the location of the receptor itself. This is a feature found in few Gaussian models, and it requires the RTDM user to supply detailed terrain information in each of 36 directions (at 10° intervals). This terrain data consists of downwind distances to successive contour heights (at constant height intervals), starting below stack-top elevation and ending at the highest point within the distance from the source under consideration (e.g., 15 km). This terrain information is summarized in a table as well as presented in map form in the RTDM output.

1. INTRODUCTION

1.1 Model Features

RTDM version 3.20 is a sequential version of the ERT Rough Terrain Diffusion Model, and is based upon the case-study model, RTDM.WC, submitted to EPA in August 1980. The model can be used in flat or complex terrain, but it has features especially suited for simulating plume dispersion in complex terrain.

RTDM is a Gaussian, point-source model which has many parameters and optional features that allow for a wide variety of applications. These features are listed below:

- Wind Speed Determination:

  - Input of anemometer height
  - Adjustment of wind speed to stack top to compute plume rise
  - Use of a wind speed value at either stack-top or plume height for dilution
  - Use of an alternate observed wind speed value for dilution
  - Input of wind speed profile exponents: hourly or as a function of stability class

- Plume path adjustment as a function of Pasquill-Turner stability class
- Calculation of a dividing streamline height in stable conditions
- A choice of transitional or final plume rise
- A choice of dispersion parameters:

  - Pasquill-Gifford,
  - Briggs (1973)/ASME (1979),
  - User-supplied in the form $ax^b + c$

- Buoyancy-induced dispersion
- Stack-Tip downwash
- Multiple reflection from a mixing lid

- Partial plume penetration of a mixing lid
- An option to set the height of the mixing lid to 10,000 meters in stable conditions
- Optional meteorological input:

  - I_y, I_z to compute on-site σ_y, σ_z values
  - On-site vertical temperature difference data used to calculate stable plume rise and the height of the dividing streamline in stable conditions
  - Horizontal wind shear data to provide better estimates of σ_y

- In rough terrain, calculation of the maximum crosswind-integrated plume concentration upstream from each receptor location. The plume concentration is not allowed to increase with distance from the source. Reflection of the plume from the ground is limited to account for this effect.
- Use of hourly stack emissions data
- Maxima of 400 receptors and 35 co-located sources
- Transportable receptor grid of any configuration
- Sector-averaged or centerline concentrations calculated
- Detailed information can be supplied concerning plume behavior and dispersion in "case-study" mode
- Statistical and descriptive information supplied by postprocessor for various averaging times.

1.2 Steps Required to Run RTDM

Input Data

Use of RTDM requires the presence of the following input files:

- a file containing hourly meteorological data;
- optionally, a file containing hourly emissions data;
- a run stream file that specifies model options and gives source, receptor, and terrain information.

If both hourly meteorological data and hourly emissions data are used they must match chronologically for each hour modeled. Successive records of data that are not in an hourly sequence are flagged with a warning, but execution continues. Any number of data hours may be input to RTDM.

Model Execution Modes

RTDM version 3.20 can run in two modes: one with detailed printout for each receptor for each hour (verbose or case-study mode) and one without. In either case, concentrations are written to a disk file for postprocessing. The verbose mode produces a large volume of output, and it is recommended for short RTDM runs only.

Output Files

RTDM produces an output file to be printed that contains

1) a list of program options selected;
2) a list of key program parameters and their initialized values;
3) a description of the source characteristics;
4) a description of the receptor characteristics;
5) a description of the terrain surrounding the source (if using partial reflection).

The case-study mode also produces descriptive information about plume behavior for each hour for each source - receptor combination producing non-zero concentrations.

A disk file of computed ground-level concentrations is always produced. This disk file can be examined with the postprocessor ANALYSIS program.

1.3 Model Assumptions

Major assumptions in RTDM include:

1) The mean stack-top wind speed and direction are uniform in space and constant throughout the period of each concentration calculation (one hour).

2) When the effluent plume enters the atmosphere, it rises until it reaches an equilibrium altitude H.

3) At any downwind distance the distribution of concentration values away from the centerline is given by the product of two Gaussian distributions, one in the y direction (crosswind) and one in the z direction (vertical). A top-hat (sector-averaged) profile can be selected for the horizontal distribution.

4) The concentration profiles described by the Gaussian form are not "instantaneous" plume profiles; instead they represent concentrations averaged over a 1-hour period.

5) If the "partial reflection" option is not employed, it is assumed that all material in the plume is reflected by the ground. If the partial reflection option is used, the effect of full ground reflection is tracked along the plume up to the receptor point of interest. The maximum crosswind-integrated (MCWI) concentration is not allowed to increase with distance downwind. If the MCWI concentration starts to increase with full reflection, the "reflection factor" is "frozen" to prevent downwind increases. More details are provided in subsection 2.6.

6) The effluent rate and the meteorological parameters determining plume geometry are constant during each hour modeled.

7) Plume rise from point sources is calculated with Briggs' plume rise equations (Briggs 1969, 1973, 1975).

8) The effect of momentum (in the plume rise calculation) is ignored, as this is usually small compared to the effect of buoyancy. In this version of RTDM, only buoyancy-dominated sources may be used.

9) It is assumed that dispersion begins from a fictitious height above the actual source (effective stack height) instead of rising and dispersing simultaneously.

10) There are no provisions for building downwash or the merging of nearby buoyant plumes.

11) Both transitional and equilibrium plume rise are calculated.

12) The atmosphere is considered a single layer in the vertical (except for stable layers aloft) in which the rates of horizontal and vertical dispersion are independent of height.

13) The plume is completely reflected at the mixing height, as well as at the ground (except for partial reflection, if applicable) if the plume centerline is calculated to be below the mixing height.

14) Multiple reflection is simulated by means of a trapping model equivalent to that listed in the Turner Workbook, Equation 5-8, Page 36 (Turner 1969).

15) All of the plume mass is assumed to have punched through the mixing lid and to be in the stable layer aloft if the effective plume height is above the mixing lid (unless the partial plume penetration option is specified).

16) If the partial plume penetration option is used, then a fraction of the plume, P, (Briggs 1975) penetrates the mixing lid, and the Gaussian model equation is modified by multiplying the source emission rate by (1-P).

17) If the partial plume penetration option is specified and the penetration fraction P is $\geq$ .5, the final plume height is placed at the base of the elevated stable layer.

18) The simulation of buoyancy-enhanced dispersion is an option. (See subsection 2.7).

19) The simulation of stack-tip downwash is an option. (See subsection 2.9).

20) Although wind speed is measured at anemometer height, it is extrapolated to stack top for plume rise calculations by using a power-law wind speed profile. The dilution wind speed is taken to be either the stack-top speed or the speed at plume height. Extrapolation of wind speed with height levels off at a constant speed at or above 0.1 times the mixing height for unstable conditions, and at a height in meters of 200 multiplied by the 10-m wind speed (in m/sec) in neutral and stable conditions.

21) Hourly wind speeds below 1.0 meters per second (m/sec) are set to 1.0 m/sec. This precludes the possibility of concentration values approaching infinity as the wind speed approaches 0 and represents a lower wind speed limit to organized transport.

22) For calm conditions where there is no measured wind direction, the wind direction from the previous non-calm hour persists.
(<u>NOTE</u> - this can cause the model to overestimate pollutant concentrations for multiple-hour averaging times if conditions persist for several hours.)

23) Although RTDM defaults to the ASME (1979) dispersion parameters, the Pasquill-Gifford dispersion parameters or any parameters of the form $ax^b + c$ may be used.

24) If the distance from the source to a receptor is less than 10 meters, it is set to 10 meters for dispersion calculations.

25) Concentrations for a given hour are calculated independently of conditions for the preceding hours.

26) The total concentration determined for any receptor for one hour is the sum of the calculated concentrations for each source.

27) Average concentrations for time periods greater than one hour (as determined by the postprocessing program ANALYSIS) are computed by averaging the appropriate number of hourly concentrations.

28) RTDM can use hourly pollutant emission rate information as well as hourly stack temperature and exit velocity values.

29) Information concerning directional wind shear with height can be used to refine estimates of σ_y.

1.4 Applications and Limits of Use

RTDM has been designed for sensitivity studies, investigations, or for more routine applications, such as the determination of compliance with applicable air quality standards. It incorporates sufficient flexibility in its input specifications so that it can approximate the results of other Gaussian source models, such as EPA models used for complex terrain. It is best suited for applications at distances up to 15 km from the source, but may be used with caution out to 50 km, and as a screening model beyond 50 km.

RTDM has many options desirable for use in flat terrain, but it has special features suitable for use in complex terrain as well. The model can accept up to 35 sources, and is suitable for many routine multiple or single-source applications such as evaluation of control technology, stack-design investigations, prevention of significant deterioration, new source review, and source permitting applications.

RTDM may be run in a case-study mode, which allows the computation of concentrations for any number of selected one-hour periods, such as case-study hours for model validation, a set of hypothetical "worst-case conditions", or cases chosen to investigate the sensitivity of the model to variations in some input parameters or optional features of the model.

RTDM is quite useful for studies for which hourly monitoring data or hourly stack parameters (emission rates, temperature and exit velocity) are available. It can also use values of on-site meteorological data that improve estimates of σ_y and σ_z. RTDM version 3.20 is not able to simulate the behavior of momentum-dominated plumes. Also, it is not equipped to portray situations with complex aerodynamic effects due to nearby tall buildings.

This model assumes that the pollutants of interest disperse as non-reactive gases. There is no provision in RTDM version 3.20 for chemical transformation of plume constituents. No gravitational effects or depletion mechanisms, such as rain-out, wash-out or dry deposition, are considered.

In RTDM, the consideration of large downwind distances may involve a series of terrain obstacles in a given direction. Flow structure on the lee side of terrain obstacles can be more complicated than that on the windward side (Rowe, 1980). Thus, model calculations obtained for receptors on the leeward side of terrain should be interpreted with caution.

2. PHYSICAL PROCESSES MODELED BY RTDM

2.1 Gaussian Dispersion

The fundamental formula used in the model to estimate ground-level pollutant concentrations from a point source is the bi-variate Gaussian plume equation, as presented in the Workbook of Atmospheric Dispersion Estimates (Turner 1969). The general form of the equation is:

$$\chi(x,y,z) = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right] \cdot$$

$$\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] + \right. \tag{1}$$

$$\sum_{N=1}^{\infty}\left\{\exp\left[-\frac{1}{2}\left(\frac{z-H-2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H-2Nz_i}{\sigma_z}\right)^2\right]\right.$$

$$\left.\left. + \exp\left[-\frac{1}{2}\left(\frac{z-H+2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H+2Nz_i}{\sigma_z}\right)^2\right]\right\}\right\}$$

where

(x,y,z)	are the (downwind, crosswind, and vertical) coordinates of a receptor point in a Cartesian coordinate system, with the origin at the source location.
$\chi(x,y,z)$	is the pollutant concentration at receptor location (x,y,z) (mass/length^3);
H	is the effective height (stack height plus plume rise) of emission; that is, the centerline height of the plume (length);
Q	is the source strength (mass/time);

σ_y, σ_z are dispersion coefficients that are measures of cross-wind and vertical plume spread, respectively. These two parameters are functions of downwind distance and atmospheric stability (length);

u is the average dilution wind speed (length/time); and

z_i is the height of the mixing lid (length).

In the model calculations, the downwind distance (x) and the crosswind distance (y) from the source to the receptor are determined as a function of the hourly wind direction, as well as source and receptor coordinates. The height of receptor points (z) above the ground is assumed to be zero in RTDM. However, non-zero values of z are employed in Equation 1 for the calculation of the maximum crosswind integrated concentration within the plume, which, in general, can occur at any point between the plume centerline height and the ground.

The source base is at z = 0 in the coordinate system. The most important assumptions on which the Gaussian plume formula is based are the following:

1) The mean stack-top wind speed and direction are uniform in space and constant throughout the one-hour period of each concentration calculation.
2) When the effluent plume enters the atmosphere, it rises until it reaches an equilibrium altitude H.
3) At any downwind distance, the distribution of concentration values off the centerline is given by the product of two Gaussian distributions, one in the y direction (crosswind) and one in the z direction (vertical).
4) The concentration profiles described by the Gaussian form are not "instantaneous" plume profiles; instead they represent concentrations averaged over an hour. Consequently, they incorporate the normal variability of wind flow for this time period.
5) In Equation 1, all material in the plume is totally reflected by the ground and the mixing lid. One model option, discussed in Section 2.6, involves a partial

reflection by these surfaces in order to prevent increases in the maximum crosswind-integrated plume concentration as the distance downwind increases.

6) The effluent rate and the meteorological parameters determining plume geometry are constant during the period of interest (that is, the equation represents steady-state conditions).

Equation 1 can be rewritten as

$$\chi(x,y,z) = \frac{Q}{u} \cdot \text{HDF} \cdot \text{VDF}, \tag{2}$$

where HDF, the horizontal distribution factor, is

$$\text{HDF} = \frac{1}{\sqrt{2\pi}\sigma_y} \exp\left[-\frac{1}{2}\left(\frac{y}{\sigma_y}\right)^2\right], \tag{3}$$

and VDF, the vertical distribution factor, is

$$\begin{aligned} \text{VDF} = \frac{1}{\sqrt{2\pi}\sigma_z} \Bigg\{ & \exp\left[-\frac{1}{2}\left(\frac{z-H}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H}{\sigma_z}\right)^2\right] + \\ & \sum_{N=1}^{J} \Bigg\{ \exp\left[-\frac{1}{2}\left(\frac{z-H-2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H-2Nz_i}{\sigma_z}\right)^2\right] \\ & + \exp\left[-\frac{1}{2}\left(\frac{z-H+2Nz_i}{\sigma_z}\right)^2\right] + \exp\left[-\frac{1}{2}\left(\frac{z+H+2Nz_i}{\sigma_z}\right)^2\right] \Bigg\}\Bigg\} \end{aligned} \tag{4}$$

where J is large enough to specify VDF to single precision computer accuracy (about 8 decimal digits). In RTDM, the multiple reflection part of VDF is expressed by a Fourier series, with only 2 terms required in the worst case to provide the desired accuracy.

Equation 3 represents the formulation of HDF for "off-centerline" calculations of the ground-level concentration. If sector averaging is used, HDF becomes 1/SW, where SW is the sector width at the downwind distance of the receptor.

If σ_θ data are to be used for the direct computation of σ_y, then the preferred choice for HDF is the off-centerline option. Sector averaging is an option for use with complex terrain applications. The use of sector averaging (conventionally 22.5 or 45°) accounts for the increased lateral turbulence often observed in the vicinity of high terrain. The horizontal distribution of concentrations is modeled as a top-hat shape rather than a Gaussian shape.

The wind speed, u, used in Equations 1 and 2, represents a dilution factor. Many Gaussian models use the wind speed at stack-top height to dilute the plume, but this practice may be inappropriate for buoyant plumes with a large rise distance. With RTDM, the user has the option to use the wind speed extrapolated to equilibrium plume height for dilution. This option is discussed in Section 2.3.

2.2 Plume Rise

The behavior of an effluent plume in the atmosphere is a complicated process, varying with conditions of release, wind, turbulence and numerous other factors associated with terrain and aerodynamics.

The typical stack plume is warmer than the surrounding air and the plume rise tends to be dominated by buoyancy. In this model, plume rise from point sources is calculated using the Briggs' plume rise equations (Briggs 1969, 1973, 1975). The effects of momentum are ignored because the rise due to momentum is usually small compared to that due to buoyancy. RTDM provides the capability of optionally including stack-tip downwash (see Section 2.8). However, there is no provision for building downwash or the merging of nearby buoyant plumes. Both transitional and equilibrium plume rise values are calculated. To simplify dispersion simulation, it is assumed that dispersion begins from a fictitious height above the actual source. This height, or 'effective stack height' is the sum of the actual stack height (h_s) and the plume rise from emission (Δh). For unstable and neutral conditions (stability classes 1, 2, 3, and 4), plume rise above stack top is computed by:

$$\Delta h = \frac{1.6F^{1/3}x^{2/3}}{u}, \qquad x < 3.5x^*$$

$$\Delta h = \frac{1.6F^{1/3}(3.5x^*)^{2/3}}{u}, \qquad x \geq 3.5x^* \tag{5}$$

where

F is the buoyancy flux of stack emissions in m^4/sec^3 = $gv_s d^2(T_s - T_a)/4T_s$,

where

v_s is exit velocity, d is stack diameter,
T_s is stack temperature, T_a is ambient temperature, and
x^* is the downwind distance at which atmospheric turbulence dominates entrainment in plume rise (m), given by,

$$x^* = 34.\ F^{2/5}, \qquad \text{if} \qquad F > 55\ m^4/sec^3;$$
$$x^* = 14.\ F^{5/8}, \qquad \text{if} \qquad F \leq 55\ m^4/sec^3;$$

$3.5x^*$ is the approximate downwind distance at which the plume becomes level (m).

For stable conditions (stability class 5 or 6):

$$\Delta h = \frac{1.6F^{1/3}x^{2/3}}{u}, \qquad x < 2.07us^{-1/2}$$

$$\Delta h = 2.6\left(\frac{F}{us}\right)^{1/3}, \qquad x \geq 2.07us^{-1/2} \tag{6}$$

where

s is the stability parameter based on atmospheric lapse rate:

$$s = \frac{\partial\theta}{\partial z}\frac{g}{T_a} \tag{7}$$

and

$\partial\theta/\partial z$ is the rate of change of potential temperature with height ($°Km^{-1}$),

g is the acceleration due to gravity ($9.8\ m\ s^{-2}$), and

T_a is the ambient temperature (°K).

For low wind speeds, the plume rise computed using

$$\Delta h = 5.0F^{1/4}s^{-3/8} \tag{8}$$

is used if the Δh value is lower than that obtained from Equation 6.

For stable conditions RTDM calculates plume rise using both the stable (equations 6 and 8) and the neutral (equation 5) formulas, and the conservative assumption is made (following Briggs, 1975) that the effective plume rise is the smallest value given by the various formulas.

2.3 Wind Speed Determination

The wind speed at stack-top elevation is used in the calculation of plume rise. Since the surface wind speed measurements are commonly taken at lower elevations than stack top, an adjustment is made in the model by the following power law relationship:

$$u(z) = u_r\left(\frac{z}{z_r}\right)^p \tag{9}$$

where

$u(z)$ is the adjusted wind speed at stack height z;
u_r is the wind speed measured at a reference height z_r;
p is the wind profile exponent.

The profile exponent p is a function of stability class and has the default values given in Table 2-1 (DeMarrais, 1959).

In equation 9, the values of z and z_r are specified relative to a height, denoted here as z_a, from which the wind speed profile originates (the wind speed at height z_a is zero). In flat or gently rolling terrain, z_a is at the same height as the stack base elevation. In some rough terrain applications, however, the stack may protrude from a narrow valley or canyon. The wind profile above the canyon walls is often of primary interest for simulating plume transport and dispersion, and is often much different than the wind profile in the valley itself. If all of the model receptors are located on high terrain above the valley walls, use of a wind profile based upon a starting elevation some distance above the stack base elevation may be appropriate if actual wind measurements are taken at an elevation above plant grade. This height, z_a, must be at or above the common stack base used in RTDM, and should not be higher than the elevation of the top of the shortest stack (to prevent an undefined or negative stack-top wind speed). In the RTDM input parameter section, the origin height for the wind speed profile, z_a, is specified relative to its height above stack base. Its default value is zero.

As discussed in Section 2.1, the dilution wind speed can be chosen to be that at stack-top height or at plume height. The user should choose stack-top height if plume rise is typically low compared to the height of the stack. Otherwise, choice of the equilibrium plume height for the dilution wind speed may be more appropriate. RTDM can compute the dilution wind speed at plume height by

TABLE 2-1

WIND SPEED PROFILE EXPONENTS - DEFAULT VALUES

Stability Class	Wind Speed Profile Exponent, p
1	0.09
2	0.11
3	0.12
4	0.14
5	0.20
6	0.30

extrapolating the same wind speed value used to compute the stack-top speed. An alternative wind speed value (located at a height closer to equilibrium rise height, such as on a hill) can be used for extrapolation to plume height for the dilution calculation.

If multiple levels of wind speed on a tower are available, the user can choose to input hourly values of the wind speed profile exponent to RTDM. For many applications, a least-squares fit for the wind speed profile exponent is desired, such that the resulting profile matches the observations with a minimum of error. Of the measurement heights available, one should be selected as a reference height such that it is at or slightly above the stack-top height. If no measurements are taken as high as the stack-top height, the highest available wind speed data level should be designated as the reference level.

It is possible to apply the least-squares fit so as not to alter the wind speed measurement at the reference height. This option should be used if the data are reliable at the reference level and its position relative to other tower levels is superior for use in calculating plume rise. If, however, some data at the reference level are missing or that level is not clearly superior to other levels, then the reference level speed should be determined from all available measurements. The procedures to be used for calculating hourly wind speed profile exponents according to the two methods are explained below.

If the reference level wind speed measurement is to be retained, define p, the wind speed profile exponent, as follows:

$$p = \frac{\sum_{i=1}^{N} \left[\ln\left(\frac{u_i}{u_r}\right) \cdot \ln\left(\frac{z_i}{z_r}\right) \right]}{\sum_{i=1}^{N} \left[\ln\left(\frac{z_i}{z_r}\right) \right]^2} \tag{10}$$

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where

- i refers to individual height levels
- N is the number of levels,
- u_i is the wind speed at the i^{th} level,
- z_i is the height of the i^{th} level, relative to height z_a
- r refers to the reference level.

If the reference level wind speed measurement is to be estimated from all available data, define p as:

$$p = \frac{N \sum_{i=1}^{N} \left[\ln (u_i) \cdot \ln\left(\frac{z_i}{z_r}\right) \right] - \left[\sum_{i=1}^{N} \ln(u_i) \right] \cdot \left[\sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right) \right]}{N \sum_{i=1}^{N} \left[\ln \left(\frac{z_i}{z_r}\right) \right]^2 - \left[\sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right) \right]^2} \qquad (11)$$

and redefine u_r (used as input to RTDM in the hourly meteorological data) as

$$u_r = \exp \left[\frac{\sum_{i=1}^{N} \ln(u_i) - p \sum_{i=1}^{N} \ln\left(\frac{z_i}{z_r}\right)}{N} \right] \qquad (12)$$

An example of the application of both methods to the same data set is given in Table 2-2.

Several observers (Arya, 1982; Kaimal et al., 1976; Pennell and Le Mone, 1974; Clarke, 1970; Izumi and Barad, 1963) have noted that the wind speed does not obey a power law (Equation 9) throughout the entire boundary layer, whose height is defined by the mixing lid. Instead, the increase of wind speed with height is found to level off or even slightly decrease above a certain height, depending upon the mixing height in unstable conditions or the surface layer friction velocity, u_*, in neutral and stable conditions. The calculation of height limits above which the wind speed is assumed to be constant is a feature that has been incorporated into RTDM. In unstable conditions, the height limit is 0.1 times the mixing height. Arya

TABLE 2-2

EXAMPLE OF LEAST-SQUARE DETERMINATION OF WIND SPEED PROFILE EXPONENT

Wind Speed Measurement Levels (m)	Measured Wind Speeds (m/sec)	Calculated Wind Speeds, Method 1*	Calculated Wind Speeds, Method 2*
10	2.0	1.96	1.97
50	4.0	4.05	4.11
80 (reference level)	5.0	5.00	5.09
150	7.0	6.63	6.79
75**	–	4.86	4.94
		p=0.4497	p=0.4570

*Method 1 retains the wind speed measurement at the reference level (80 m), Method 2 does not impose this restriction.

**In this example, 75 m is the stack-top level, for which a calculated wind speed is desired.

(1981) shows that in neutral and stable conditions, the approximate height of the wind speed maximum (H_{max}) is given by

$$H_{max} = 0.142 \frac{u_*}{f}, \tag{13}$$

where u_* is the friction velocity, and f is the Coriolis parameter.

For general application, H_{max} can be specified approximately using a 10-m wind speed with assumptions for typical values of surface roughness length in complex terrain (1 meter) and the Coriolis parameter ($10^{-4}sec^{-1}$). The resulting values of H_{max} as a function of stability are:

$$\begin{aligned} H_{max} &= 0.1 \cdot \text{mixing height for unstable conditions} \\ H_{max}\ (\text{meters}) &= 200 \cdot \text{10-m wind speed (m/sec) for} \\ &\qquad \text{neutral and stable conditions} \end{aligned} \tag{14}$$

Equation 9 is therefore modified for RTDM as follows:

$$u(z) = u_r \left(\frac{z_{max}}{z_r} \right)^p, \tag{15}$$

where $z_{max} = z$ if $z < z_r$,

~~$z_{max} = \min(z, H_{max})$ if $z > z_r$.~~

Pollutant concentrations estimated by the Gaussian plume equation used in the model are inversely proportional to average wind speed. This relationship implies that concentrations would approach infinity as the wind speed approaches zero, which is clearly not the case. To simulate the effects of very low wind speed cases, hourly wind speeds that are below 1.0 m/sec are set at 1.0 m/sec. This precludes an invalid application of the model. For calm conditions where there is no measured wind direction, the wind direction from the previous non-calm hour persists. This assumption can cause the model to overestimate pollutant concentrations for multiple hour averaging times if calms persist for several hours.

2.4 Stability Category

The user must specify a stability category for each hour of meteorological input. Stability category values range from 1 to 6 and represent the following conditions:

1 - Very unstable
2 - Moderately unstable
3 - Slightly unstable
4 - Neutral
5 - Slightly stable
6 - Moderately to very stable

In RTDM, the stability category can be used for several computations:

1) The formula for plume rise is a function of stability class. Different calculations take place for stable and non-stable hours. However, if on-site vertical temperature difference data exist, the use of stability class can be completely eliminated. In such a case, neutral/unstable rise is assumed for negative or zero vertical potential temperature gradients (VPTG). For positive (stable) values of VPTG, both neutral and stable rise formulas are evaluated, and the lower rise is chosen.
2) The behavior of a plume encountering terrain is a function of the stability class. The choice of the plume path correction factor is usually different for stable versus non-stable conditions. However, if hourly vertical potential temperature gradient values (for determining H_{crit}) are available, these data values can be used to distinguish between stable and nonstable conditions. In stable conditions, the VPTG value is used to calculate

H_{crit}, which is used to determine whether or not the plume is allowed to impinge upon the terrain.

3) Values of σ_y and σ_z are conventionally a function of stability class. This dependence upon stability class can be eliminated (except for selection of a formula for computing the growth of σ_z as a function of distance) by supplying turbulence intensity data (I_y, I_z). The turbulence intensity data (or sigma-theta/ sigma-phi values) can then be used to calculate σ_y and σ_z directly (Hanna et al. 1977).

4) The determination of the wind speed profile exponent is a function of stability class if hourly values are not supplied. The specification of hourly values (Section 2.3) is not a function of stability. However, determination of H_{max} (Equation 14) is weakly dependent upon the stability class.

Depending upon the availability of on-site meteorological measurements and the options selected, the RTDM user may rely heavily or very little upon stability class values in the calculation of ground-level concentrations. The use of as much on-site data as possible in the model computations (Strimaitis et al. 1980) decreases reliance upon the accurate specification of stability class values.

2.5 Dispersion Parameters

The parameters σ_y and σ_z, which represent the crosswind and vertical standard deviations of the dispersing plume, are functions of x and are related to meteorological conditions. These two variables provide the Gaussian equation with some flexibility, as σ_y and σ_z may be obtained by various methods without altering the original computation scheme.

In RTDM, values of σ_y and σ_z may be determined from stability class or from hourly values of the vertical and horizontal components of the turbulence intensity. If the stability class method is used, the user can choose to calculate σ_y and σ_z in one of the following ways:

- by using Pasquill-Gifford dispersion coefficients,
- by using Briggs rural (ASME, 1979) dispersion coefficients,
- by using dispersion coefficients supplied in the form $ax^b + c$, which may vary as a function of stability class and downwind distance ranges.

RTDM has been designed to accommodate the use of on-site turbulence intensity data (or sigma-theta, sigma-phi values), if available. The formulation of σ_y and σ_z from these data closely follows Briggs (1973):

$$\sigma_y = I_y \cdot x \cdot (1 + 0.0001\, x)^{-1/2}, \; x < 10{,}000 \text{ m}, \qquad (16)$$
$$\sigma_y = I_y \cdot x \cdot (1/\sqrt{2}), \; x \geq 10{,}000 \text{ m}$$

where σ_y and x are in meters, I_y is the horizontal component of the turbulence intensity (or sigma-theta expressed in radians). The formula for σ_z depends upon stability category:

$$\sigma_z = I_z \cdot x \text{ for unstable conditions,}$$
$$\sigma_z = I_z \cdot x \cdot (1 + 0.0015x)^{-1/2} \text{ for neutral conditions,} \qquad (17)$$
$$\sigma_z = I_z \cdot x \cdot (1 + 0.0003x)^{-1} \text{ for stable conditions,}$$

where σ_z and x are in meters, I_z is the vertical component of the turbulence intensity (or sigma-phi expressed in radians).

If only one of either I_y or I_z is available, RTDM can still be run with the observed turbulence values to determine σ_y or σ_z (whichever is appropriate), and the stability class can be used to determine the other sigma value. The Pasquill-Gifford and ASME curves are based upon Pasquill-Turner stability classes. In general, the authors recommend for "refined" modeling that if either sigma-theta or sigma-phi values near stack-top height are available and determined to be of acceptable quality, those data should be used in the direct calculation of σ_y or σ_z. However, a "default mode" version recommended by EPA for general use as a screening model determines σ_y and σ_z indirectly using the stability class.

Instrumentation used to obtain σ_θ and especially σ_w measurements must be given careful attention in terms of maintenance and quality assurance. Use of poor quality turbulence data in RTDM can be worse than indirect calculation of σ_y and σ_z from stability class values. These turbulence input parameters require careful checking. The siting of the tower to obtain turbulence behavior representative of that experienced by the plume is important as well as following EPA recommendations regarding on-site instrumentation (Strimaitis et al, 1980 and EPA, 1987).

2.6 Partial Plume Reflection from Sloping Terrain

As an elevated plume flows over flat terrain, material within the plume diffuses in all directions. The presence of the ground surface prevents the diffusion of inert gaseous materials through the surface. This has been conventionally modeled by assuming an "image source" below the surface. At the surface itself, the mathematical result is a doubling of ground-level concentrations due to "reflection" of material associated with the image source, a reasonable approach for flat terrain.

In contrast, when an elevated plume flows toward high terrain, the application of a Gaussian plume model with full reflection may not be appropriate. For example, consider the extreme case of a plume approaching a vertical surface: a short distance upwind of the vertical surface, the effects of ground reflection on the peak concentrations which occur <u>along the plume axis</u> may be minimal. However, when the plume impacts the vertical surface, the conventional reflection algorithm doubles the plume axis concentrations over those slightly upwind.

This conventional algorithm is inadequate in such a situation because concentrations within a plume cannot double over values that exist immediately upwind: diffusion processes must always act to dilute the maximum concentrations within a plume, and therefore, the peak concentrations in the plume cannot increase simply by approaching a surface. Such an increase would violate the second law of thermodynamics, which states, in effect, that if the flow conserves mass, concentrations cannot increase with increasing time of transport.

The principle that the peak concentrations within a plume cannot increase with increasing travel time (assuming a constant emission rate) provides a framework for estimating the maximum effect of reflection for a plume approaching a terrain slope. The effect of reflection is independent of dispersion in the crosswind direction. If the flow is not systematically converging or diverging in the region of interest, it is appropriate to consider the behavior of the crosswind integrated concentration values as a plume approaches a terrain slope.

Figure 2-1 illustrates a vertical cross-section of a plume approaching a terrain slope. In the absence of the surface, the maximum crosswind integrated concentration (MCWI) within the plume will occur at the plume axis and will continuously decrease with downwind distance (solid line). An overestimate of the effect of reflection can be made by calculating the maximum crosswind integrated concentration as a function of downwind distance (denoted by MCWI(x)), assuming full reflection from the terrain surface below the plume. As a conservative approach, the model assumes that the plume trajectory is unaltered by the presence of the terrain. For sufficiently steep slopes, the MCWI(x) so calculated will reach a minimum value upwind of the impact location ($x = x_o$) and will increase with further distance downwind (dotted line). This increase is prohibited, however, as discussed above, by the second law of thermodynamics. Therefore, this minimum value of the MCWI(x) provides a value that cannot be exceeded further downwind (i.e., at the point of impact). The ratio of this minimum value of the MCWI(x) to the CWI at the location of impact or the closest plume approach to the terrain ($x = x_o$) evaluated for the plume centerline in the absence of the terrain effects is called R, the reflection factor. This value of R depends on the given slope of the terrain and the plume growth rate. The estimate of MCWI(x) must consider that the maximum concentration within the plume is not necessarily at the original position of plume centerline: as reflection effects become more important, the maximum approaches the surface.

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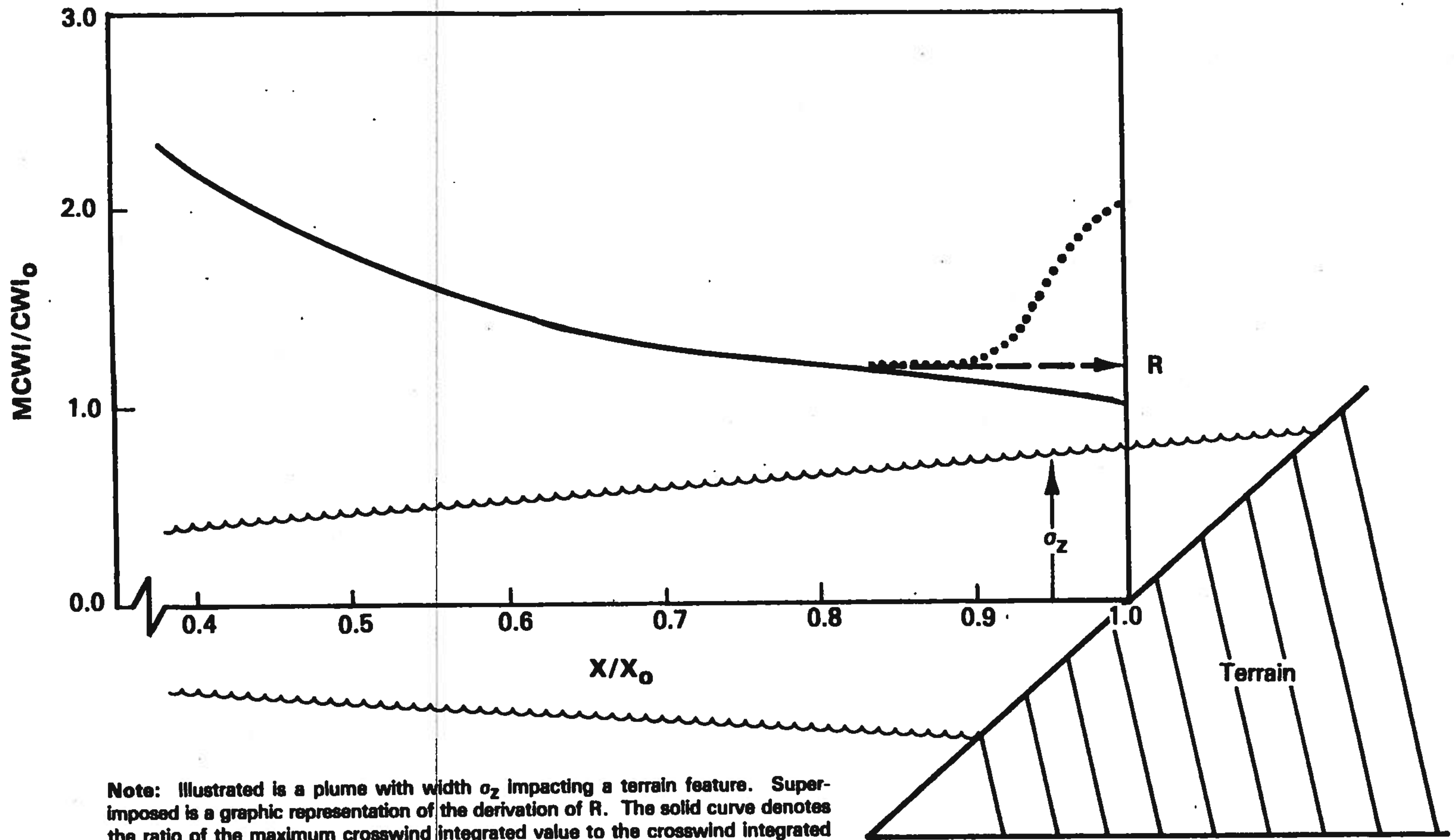

Note: Illustrated is a plume with width σ_z impacting a terrain feature. Superimposed is a graphic representation of the derivation of R. The solid curve denotes the ratio of the maximum crosswind integrated value to the crosswind integrated concentration at $x = x_o$ for a plume unaffected by terrain. The calculated effects of reflection cause the MCWI/CWI$_o$ to increase as the plume approaches the slope (dotted curve) to a value of 2.0. The second law of thermodynamics limits the actual increase possible to the minimum value of the dotted curve (dashed line to ordinate value). The ratio at this point is the value of R.

Figure 2-1 Derivation of Reflection Factor, R, for a Level Plume Impacting Sloping Terrain

From the Gaussian plume formula and assuming full reflection effect from the terrain immediately below, CWI(x,z) can be calculated from:

$$CWI(x,z) = (Q/u) \cdot VDF \tag{18}$$

To find MCWI(x), the maximum value of CWI(x,z) at each downwind location must be determined. In practice, RTDM does not evaluate reflection effects until the plume centerline is less than 2.15 σ_z from the terrain surface (Turner, 1969, Chapter 3). From that point on, the CWI(x,z) is calculated at between the ground and the plume centerline at 5 height intervals. At each downwind distance, the maximum CWI value (MCWI) is obtained. The MCWI is evaluated at 10 or fewer downwind distance increments between the point where the plume is within 2.15 σ_z of the surface and the location of the plume impact or closest approach (or the receptor point in question, if it is encountered first). The minimum value of MCWI is determined and the reflection factor, R, is calculated as shown in Figure 2-1 ($R = \sqrt{2\pi}\sigma_z \cdot MCWI$).

RTDM incorporates this method to estimate the reflection factor. The RTDM code currently sets a minimum value of 1.00 for R. Ground-level concentrations are then determined by the smaller of (a) the centerline concentration at the specified downwind distance, with the calculated reflection factor or (b) the ground-level concentration with full reflection at the same downwind location. The value of VDF in Equation 2 is set to the lesser of $R/(\sqrt{2\pi}\sigma_z)$ or the full reflection value given by Equation 4. For receptors where the plume encounters little or no terrain, the full reflection result will be used by the model.

2.7 Buoyancy-Enhanced Dispersion

For strongly buoyant plumes, the dominant contributions to their growth as they rise to stabilization height is often the entrainment of ambient air induced by the vertical motion of the plume relative to the ambient air. The buoyancy effect is supported by both the photographic data and the theoretical considerations on which the turbulence (σ_{ya}), buoyancy-enhanced dispersion (σ_{yb}) and horizontal wind shear (σ_{ys}) is

$$\sigma_y = (\sigma_{ya}^2 + \sigma_{yb}^2 + \sigma_{ys}^2)^{1/2} \tag{21}$$

Meteorological data used to compute horizontal wind shear involves two levels of wind direction measurements. These levels should be as close to plume height as possible. The user should avoid measurement heights that are either a) too low or b) too close together (these could result in an overestimate of the shear at the plume level). This model feature is designed for use in refined modeling applications, and is not included in screening modes.

2.9 Stack-Tip Downwash

The aerodynamic flow near the top of a stack can depress the initial plume height by an amount that depends on the ratio of wind speed to exit velocity. The subsequent rise computed by some methods is that part of the rise occurring from x* to 3.5x*, where x* is the downwind distance at which ambient turbulence exceeds plume-penetrated turbulence. Since x* only depends on the buoyancy flux (see Equation 5), and the initial plume depression is only a few meters at most, the final plume height is essentially independent of the ratio of wind speed to exit velocity in stack downwash conditions and is abruptly discontinuous at the threshold ratio. A more realistic approach contains the following principal points:

1) The degree of downwash is a continuous function of wind speed once a threshold value of the ratio of plume exit velocity to wind speed at stack height is reached.
2) The loss of plume rise is associated with: (1) a physical downward displacement caused by the stack (after Briggs 1975) and (2) an increase of the plume cross sectional area caused by downwash that reduces the initial rate of rise.

Briggs (1975) gave the following expression for the initial depression of the plume centerline ($\Delta h'$) below stack top during downwash conditions

$$\Delta h' = 2(1.5 - \frac{W}{U})\ D \text{ for } \frac{W}{U} \leq 1.5 \tag{22}$$

where D is the stack diameter, W is the plume exit velocity, and U is the horizontal wind speed. This equation suggests that the initial depth of the plume under downwash conditions is $4(1.5 - W/U)D$. If the initial plume width is given by D, the initial cross sectional area of the plume may be approximated by $4(1.5 - W/U)D^2$.

The Briggs plume rise formulas incorporate the empirical evidence that indicates that plume rise for a point source is equal to plume depth. This is the basis for Briggs entrainment coefficient of 0.5. A downwashing plume has an initial cross section, i.e., it can no longer be considered to emanate from a point source. Since no rise is associated with the initial plume depth, some means to reduce the predicted plume rise correspondingly is desirable. Briggs' observation of the equivalence between plume rise and plume depth may be invoked to estimate the necessary correction. A non-downwashing plume from a virtual source upwind of the stack would rise a distance $\Delta h''$ during the time required to attain a cross sectional area of $4(1.5 - W/U)D^2$. Assuming a circular cross section, $\Delta h''$ can be estimated from the diameter of this cross section, i.e.,

$$\Delta h'' = \left(\frac{8AD}{\pi}\right)^{1/2} \tag{23}$$

where

$$A = 2(1.5 - W/U)D \quad \text{if} \quad W/U \leq 1.5$$
$$A = 0 \quad \text{if} \quad W/U > 1.5$$

Thus, the plume rise formula used in RTDM during downwash conditions is given by:

$$\Delta h = \Delta h_o = \Delta h' - \Delta h''$$

$$= \Delta h_o - A - \left[\frac{8AD}{\pi}\right]^{1/2} \qquad (24)$$

where Δh_o is the plume rise without downwash.

Since this option affects final plume rise, it has an effect upon other options, such as buoyancy enhancement of plume dimensions, partial plume penetration, and behavior of the plume in terrain.

2.10 Plume Path Correction Near Terrain

To account for the possible distortion of the plume trajectory as the plume approaches terrain, RTDM uses a "plume-path coefficient", C, to modify the height of the plume above the ground. The value of C can conceivably range from 0, for a level plume, to 1 for a plume that remains the same distance above the ground in all terrain. The plume-path coefficient is set by default to 0.5 for all stabilities, but it is a site-specific parameter which ideally would be determined on the basis of meteorological conditions and terrain shape.

In stable conditions, the plume may not have enough kinetic energy to climb over a terrain obstacle. As discussed by Hunt et al., (1979), Snyder et al., (1979) and Rowe (1980), a critical height, H_{crit}, can be defined such that only the air above this level will move over a terrain feature. Plumes at or below this height will impinge upon the terrain. H_{crit} is defined as:

$$H_{crit} = H (1-F_r), \qquad (25)$$

where

H is the height of the terrain obstacle (above stack base elevation),

F_r is the Froude number $= u/(Hs^{1/2})$; (26)

u = the stack-top wind speed,

T_a = ambient temperature,

s = $\frac{g}{T_a}\frac{d\theta}{dz}$, and

$\frac{d\theta}{dz}$ = VPTG = vertical potential temperature gradient.

The computation of Froude number is simplified here by assuming constant values for u and s between the stack top and the top of the hill.

The value of VPTG used for calculations of H_{crit} may be different than the value of VPTG used for plume rise, due to the different locations of the stack and the terrain obstacle. RTDM allows the user to specify hourly values of these values of VPTG separately, if such data are available.

In unstable and neutral conditons, H_{crit} is zero. For stable conditions, the air below H_{crit} stagnates and moves around rather than over a terrain obstacle. Air parcels just above H_{crit} have barely sufficient kinetic energy to reach the crest of the terrain. Accordingly, the adjustment of the plume height above terrain is formulated in RTDM as follows:

$H_a = C \cdot H_{pc}$ if plume height is less than or equal to local terrain height, (27)

$H_a = H_{pc} - (1-C)\, H_{tc}$ if plume height is above local terrain height,

where

H_a is the adjusted plume height above local terrain,

H_{pc} is the height of the plume above H_{crit}

H_{tc} is the height of the local terrain above H_{crit}

C is specified plume path coefficient as a function of stability class, set to zero on an hour-by-hour basis if $H_{pc} < 0$.

If the plume is above H_{crit} and the receptor is below H_{crit}, the use of a nonzero value of C would result in the plume dropping below its final height at the receptor location because H_{tc} is negative. To avoid an artificial plume depression, RTDM assumes a level plume (C = 0) for cases in which the plume is above H_{crit} and the receptor is below H_{crit}.

Examples of the terrain adjustment in stable conditions are shown in Figure 2-2. Default values for C are 0.5 for all stability classes.

To avoid an inconsistent adjustment of plume height and mixing height, RTDM adjusts the mixing height z_i in terrain as follows:

$$z_i^* = C \cdot (z_i - H_{crit}) \text{ if } z_i < \text{local terrain height,}$$

$$z_i^* = (z_i - H_{crit}) - (1 - C)(H_{tc}) \text{ if } z_i > \text{local terrain height} \quad (28)$$

where z_i* is the adjusted mixing height.

If the hill height changes rapidly as a function of azimuth relative to the source, H_{crit} can vary rapidly as well. Therefore, if sector averaging is used and changes in wind direction alter the receptor position within the sector, calculated concentrations will change if H_{crit} changes at the plume centerline. RTDM uses a "unified" plume treatment (the central H_{crit} applies for all receptors), assuming that the plume is controlled by H_{crit} along the centerline until it gets close to the hill. In the absence of turbulence measurements in the vicinity of terrain, the sector averaging treatment accounts for increased lateral turbulence near the terrain features that is not incorporated in the σ_y formulas.

2.11 Partial Plume Penetration of an Elevated Inversion

Most present Gaussian air quality models treat the stable stratification above the mixing layer as either a perfect reflector or perfect absorber of a rising plume. If the predicted final plume height in a neutral atmosphere is higher than the mixing height, the entire plume is assumed to penetrate the stable lid, thus not contributing to ground-level concentrations. Otherwise, final plume height is limited by the mixing depth and the plume is reflected at that height. This binary mode of modeling of plume behavior is not a

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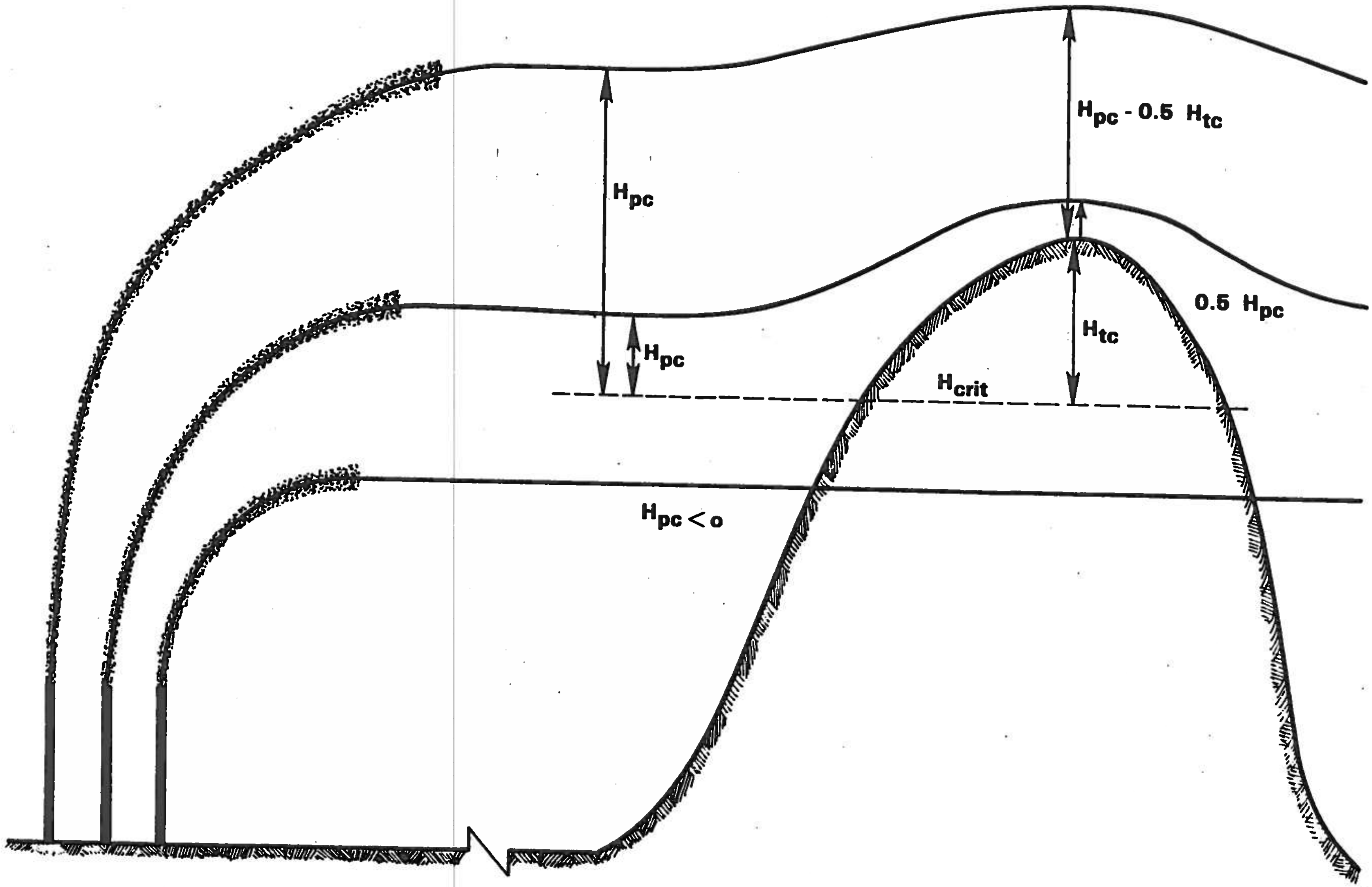


Figure 2-2 Plume - Terrain Interaction Under Stable Conditions Assuming Plume Path Coefficient = 0.5

very realistic approximation and in some cases can lead to serious errors in concentration predictions.

RTDM allows for the simulation of a more intermediate situation with the selection of the partial plume penetration option. This is based on the work of Briggs (1975), who proposed a more physically realistic approximation of plume interaction with the stable lid based on solutions to the buoyancy flux equation for a bent-over plume. The lapse rate of the stable layer is accounted for in the Briggs scheme.

Briggs defines the fraction of the total plume mass to penetrate the stable layer as the penetration factor

$$P = (\text{depth of plume above } z_i)/(\text{total plume depth})$$
$$P = (1.5\ z_e - z_i)/(1.5\ z_e - 0.5\ z_e) \qquad (29)$$

where z_i is the height of the mixing lid above stack height and z_e the equilibrium plume rise. The equilibrium plume rise is the height at which the plume buoyancy flux, F_z, equals zero. The plume depth (after Briggs [1969]) is assumed to equal the plume rise. The parameter, s, is taken as a measure of the stability of the elevated inversion:

$$s = g/T_a \cdot VPTG = \text{constant in that layer.}$$

For a neutral mixed layer, s = 0. During plume penetration, s is not constant over the whole depth of the plume. The mathematics dictate that for this case the magnitude of s at any given level in the buoyancy flux equation is weighted by the total upward flow within the plume at the level. Briggs assumes a simple rectangular approximation as the weighting function of s, which is equivalent to assuming a rectangular top-hat plume profile with a constant upward velocity inside.

Following Briggs and integrating through the traverse of z_i by the plume to find the centerline height at which $F_z = 0$, the result is

$$\left(\frac{z_e}{z_b}\right)^2\left(\frac{z_e}{z_b}\right) - 1 = \frac{2F}{\beta^2 U s z_b^3}\left(\frac{M_{eff}}{M}\right) - \frac{4}{27} \qquad (30)$$

where U is the constant horizontal wind speed determined at stack height, M_{eff}/M, the ratio of the effective vertical momentum flux to the internal vertical momentum of the plume, and β, the factor that when multiplied by plume rise yields the radius of an equivalent circular plume. The value of β is assumed equal to 0.6. The effective vertical momentum flux includes the effects of the air displaced by the plume. On the basis of observations of streamlines around two dimensional thermals, Briggs assumes M_{eff}/M has the value 2.25. The above equation can be rewritten as:

$$\left(\frac{z_e}{z_i}\right)^3 - \left(\frac{z_e}{z_i}\right)^2 - \left(C - \frac{4}{27}\right) = 0 \qquad (31)$$

This is now a cubic in (z_e/z_i), and the quantity (z_e/z_i) can be solved by using the standard analytic solution. The plume penetration factor is then calculated from (27).

After computing the penetration factor P, the multiply reflecting Gaussian model equation is modified by multiplying the source emission rate, Q, by the factor (1-P). If $P \geq 0.5$ $(z_e \geq z_i)$, then the final plume height is placed at the base of the stable layer for computing the ground level concentrations caused by the non-penetrating portion of the plume. If $P > 0.5$, then final plume height is below z_i and the usual Gaussian computations apply for the (1-P) fraction of the plume. The portion of the plume predicted to penetrate the stable layer, P, is ignored.

If the option for partial plume penetration is not selected, either total penetration or no penetration is simulated. The plume is assumed to completely penetrate the inversion if the plume centerline height is greater than the mixing height. With full penetration, the penetration factor, P, is set to 1. If the plume centerline height is less than the mixing height, then it is assumed that no penetration occurs (P = 0). The use of the partial penetration algorithm does not affect any plume rise calculations.

The choice of a unique VPTG for the elevated inversion is required by RTDM. A value of 0.006 °K/m, suggested by Carson (1973) and Tennekes (1973), is recommended.

2.12 Use of On-Site Values of Vertical Temperature Difference

RTDM will accept hourly values of the vertical potential temperature gradient (VPTG) for use in computing plume rise and the value of H_{crit}. These two values of VPTG need not be the same. For plume rise, measurements of ΔT near stack top are desired. For H_{crit}, values obtained near the terrain of interest are useful. If neither value is supplied, stability-dependent default values are used for each hour modeled.

Measured values of ΔT from towers much shorter than the stacks to be modeled can lead to significant overestimates of VPTG, because the most intense temperature gradients are found near the surface. For example, Egan et al. (1985) examined site data where a comparison of airborne vs. tower measurements was conducted. They found that temperatures near the valley sides were cooler than those at the same elevations at a location away from the valley walls, a radiation-caused phenomenon. This led to overestimates of VPTG if a single short tower were used, even on elevated terrain. Therefore, ΔT data obtained from relatively short towers or from low heights (less than perhaps 30 m) on meteorological towers should not be used.

2.13 Source/Receptor Relationships

RTDM allows the user to specify up to 35 point sources, which must be co-located (or nearly so) with the same stack base height. Sources that are not co-located can be run separately, and the resulting concentrations subsequently added by the postprocessor.

The steady-state assumption and dispersion coefficients used by RTDM and other Gaussian air quality models are generally most valid for transport distances up to 15 km from a source. However, these models can be applied for distances up to 50 km with caution (see

Guideline on Air Quality Models (Revised), 1986). Steady-state Gaussian models such as RTDM are conservative at distances beyond 50 km, and therefore may be used for screening purposes.

The user may specify any number of receptors up to a maximum of 400. These may be placed in any desired configuration and are identified by their X and Y coordinates, usually given in UTM. (An input factor exists to scale any input units to meters). It is important to realize that input limitations may affect receptor specification. For instance, if input wind direction values are given to the nearest 5°, the predicted concentration values are most reliable at receptors placed on 5° radials from the source location. However, if wind direction is input to every degree, any receptor coordinates are reasonable.

2.14 Specification of Terrain Surrounding the Source Location

If the (recommended) partial reflection option is used, RTDM must be informed of terrain heights and their downwind distances from the source locations in each of 36 directions, 10° apart. RTDM chooses the nearest multiple of 10° each hour from the wind direction data to estimate the terrain profile experienced by the plume. The terrain heights are obtained from a topographic map, as shown in Figure 2-3 and as tabulated in Figure 2-4.

The procedure used to select receptor heights should be consistent with that for obtaining terrain profiles. If, for example, the highest terrain along a 10° arc is used for specifying terrain heights for rings of 36 receptors each, then the same procedure (maximum on an arc) should be used to specify terrain profiles.

The recommended procedure for obtaining the terrain information is as follows:

1) Start at a convenient elevation contour that is at or below the lowest stack top, so that no plume impacts will occur at or below this elevation.

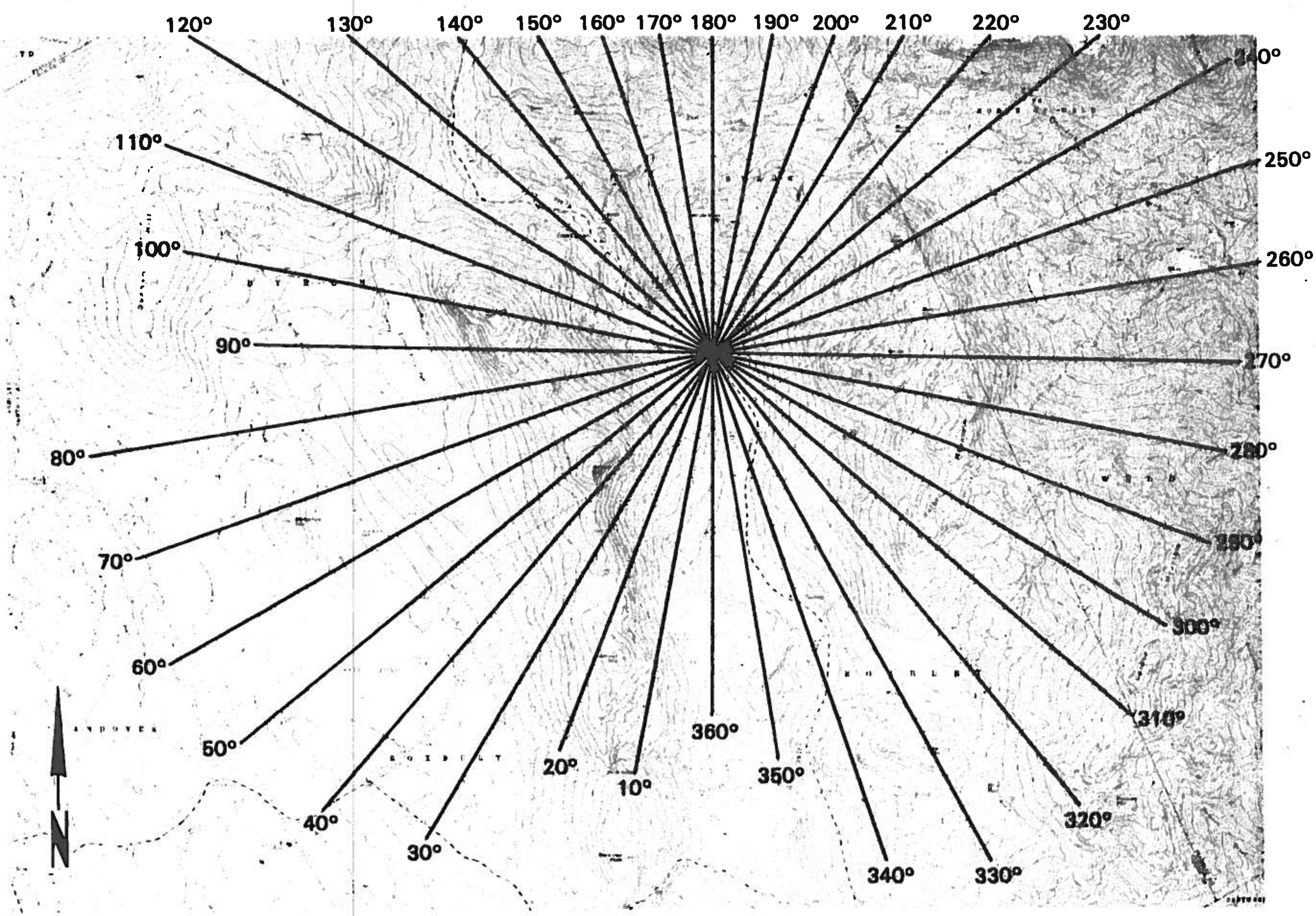


Figure 2-3 Terrain is Defined at 10° Intervals Surrounding the Source Location

ROUGH TERRAIN DIFFUSION MODEL VERSION 3.2 LEVEL 861130 PAGE 4

TERRAIN INFORMATION:

TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

ELEVATION IN USER UNITS:

WIND DIR.	1100.	1200.	1300.	1400.	1500.	1600.	1700.	1800.	1900.	2000.	2100.	2200.	2300.	2400.	2500.	2600.	2700.	2800.	2900.	3000.
10	4.46	4.78	5.01	7.00	7.38															
20	1.50	3.35	3.45	3.75	3.85	3.95	4.05	4.20	4.60	4.70	4.80									
30	1.40	1.50	1.65	3.00	3.10	3.16	3.24	3.31	3.50											
40	1.28	1.40	1.46	1.53	1.61	1.74	1.88	1.98	2.72											
50	1.15	1.30	1.39	1.49	1.60	1.69	1.75	1.82	1.94	2.06	2.13	2.22	2.34							
60	1.18	1.29	1.40	1.48	1.58	1.69	1.80	1.94	2.10	2.24	2.58									
70	1.25	1.47	1.60	1.72	1.87	2.03	2.20	2.32	2.47											
80	1.41	1.58	1.70	1.87	2.00	2.12	2.24	2.38	2.44	2.49	2.59									
90	1.64	1.75	1.88	1.99	2.09	2.20	2.39	2.59	2.76	2.94	3.08									
100	1.99	2.09	2.18	2.30	2.52	2.59	2.66	2.71	2.81	2.95	3.09	3.18	3.29							
110	2.02	2.28	2.40	2.52	2.63	2.72	3.00	3.19	3.55											
120	2.21	2.41	2.52	2.63	5.75	5.90	6.01	6.18	6.30	6.50	6.73	6.85	7.07							
130	2.75	5.47	5.62	5.92	6.01	6.70	6.90	7.37	7.48	7.79										
140	1.22	1.29	6.70	6.80	6.90	7.00														
150	1.11	1.19	1.24	1.29	1.32															
160	1.08	1.15	1.21	1.28	1.38	1.42	5.13	5.32	5.51											
170	1.01	1.12	1.23	1.34	1.48	1.53	4.98													
180	.81	1.04	1.18	1.38	1.51	1.66	1.82	2.10	2.23	2.31	4.79	4.92	5.05							
190	.79	.90	1.07	1.23	1.37	1.50	1.71	1.81	1.91	2.01										
200	.68	.82	1.00	1.16	1.30	1.50	1.68	1.95	2.52											
210	.71	.83	1.03	1.20	1.43	1.58	1.81	2.15	2.30	2.52	2.62	2.73								
220	.82	.99	1.25	1.32	1.49	1.70	2.04	2.22	2.50	2.86	5.58	5.75	6.05	6.11	6.16	6.19	6.21	6.23	6.27	6.29
230	1.05	1.21	1.48	1.61	2.02	2.17	2.28	2.42	2.54	2.67	2.84	3.01	3.17	3.21	3.28	3.32	7.42	7.49		
240	1.05	1.20	1.41	1.61	1.78	1.90	2.04	2.16	2.38	2.52	2.68	2.80	2.91	3.14	3.31	3.39	3.45			
250	1.00	1.23	1.31	1.40	1.56	1.70	1.86	1.97	2.08	2.17	2.30	2.45	2.57	2.80						
260	1.00	1.11	1.27	1.36	1.49	1.60	1.78	2.09	2.27	2.45	2.56	2.63	2.73	2.84						
270	1.03	1.16	1.28	1.38	1.48	1.53	1.66	1.73	1.88	2.09	2.26	2.49	2.61							
280	1.09	1.22	1.34	1.43	1.54	1.63	1.71	1.76	1.82	1.89	1.97	2.10	3.50	3.58	3.70					
290	1.16	1.28	1.43	1.57	1.67	1.76	1.83	1.98	2.13	3.26	3.34	3.50	3.65	3.79	3.90	4.05				
300	1.28	1.41	1.60	1.74	1.89	2.10	2.90	3.01	3.16	3.24	3.33	3.96	4.03	4.17						
310	1.46	1.60	1.75	1.90	2.90	3.04	3.42	3.59	3.75	3.90	3.98	4.08	4.20	8.25	8.35					
320	1.65	1.85	2.00	3.12	3.36	3.49	4.05	4.20	4.42	8.55	8.65									
330	2.18	2.97	4.42	4.61	4.78															
340	6.23	6.42	6.58																	
350	4.69	4.90																		
360	4.31	6.80																		

Figure 2-4 RTDM Tabulation of Terrain Information in 36 Directions Surrounding the Source Location

2) Determine the "hill top" elevation for each 10° radial. In general, the highest terrain along the radial on the specific local hill (or hills) where concentrations are to be predicted in each direction should be used. If some receptors lie on a hill or hills in the lee of the closest hill to the source, separate model runs are recommended for receptors on the more distant hills if these lee hills are higher than the first in elevation. This strategy assigns the proper hill height to receptors on the first hill if the first hill is run separately from higher hills behind it. If a lee hill is shorter than the first hill, then the top of the first hill should be used to define the "hill top" elevation for both hills.

   The user should keep in mind that RTDM has not been designed or extensively tested for predicting concentrations in the lee of hills closest to the source of interest. The consideration of large downwind distances may involve a series of terrain obstacles in a given direction. Flow structures on the lee side of terrain obstacles are often more complicated than that on the windward side.

3) Determine a convenient contour increment between the lowest and highest elevations (obtained from steps 1 and 2) such that 19 or fewer increments span the interval between lowest and highest elevations.

   Example (see Figures 2-3, 2-4):

   Stack-top elevation is 1165 feet, so choose 1100 feet as the first contour. Highest contour of interest in any direction is 3,000 feet. Choose 100 feet as the contour increment.

4) Along each of 36 directions about the source location (in even multiples of 10 degrees), tabulate the downwind distances in kilometers to each contour level to be considered. In each direction, stop at the hill top, determined as discussed above (see Figure 2-4). If the terrain does not steadily increase away from the source in a

given direction, then tabulate the closest distance of a given contour level, and ignore successive occurrences of that same level, searching instead for the closest distance to the next highest contour of interest.

5) RTDM will print a crude map (see Figure 2-5) of the terrain that the user specifies, and will also denote the location of any model receptors on the map. Check this map to verify that the representation of terrain in the model is correct. On the RTDM map, codes for some contours may be overwritten in very steep terrain locations where two contours would occupy the same printing position.

6) IMPORTANT NOTE: It is necessary to specify terrain <u>beyond</u> actual receptor locations until the hill top is reached so that the <u>hill height</u> is accurately known. Terrain need not be specified where no receptors exist. However, off-centerline or sector averaging calculations require terrain input for sectors <u>adjacent</u> to those where receptors are located as well as those <u>occupied</u> by receptors.

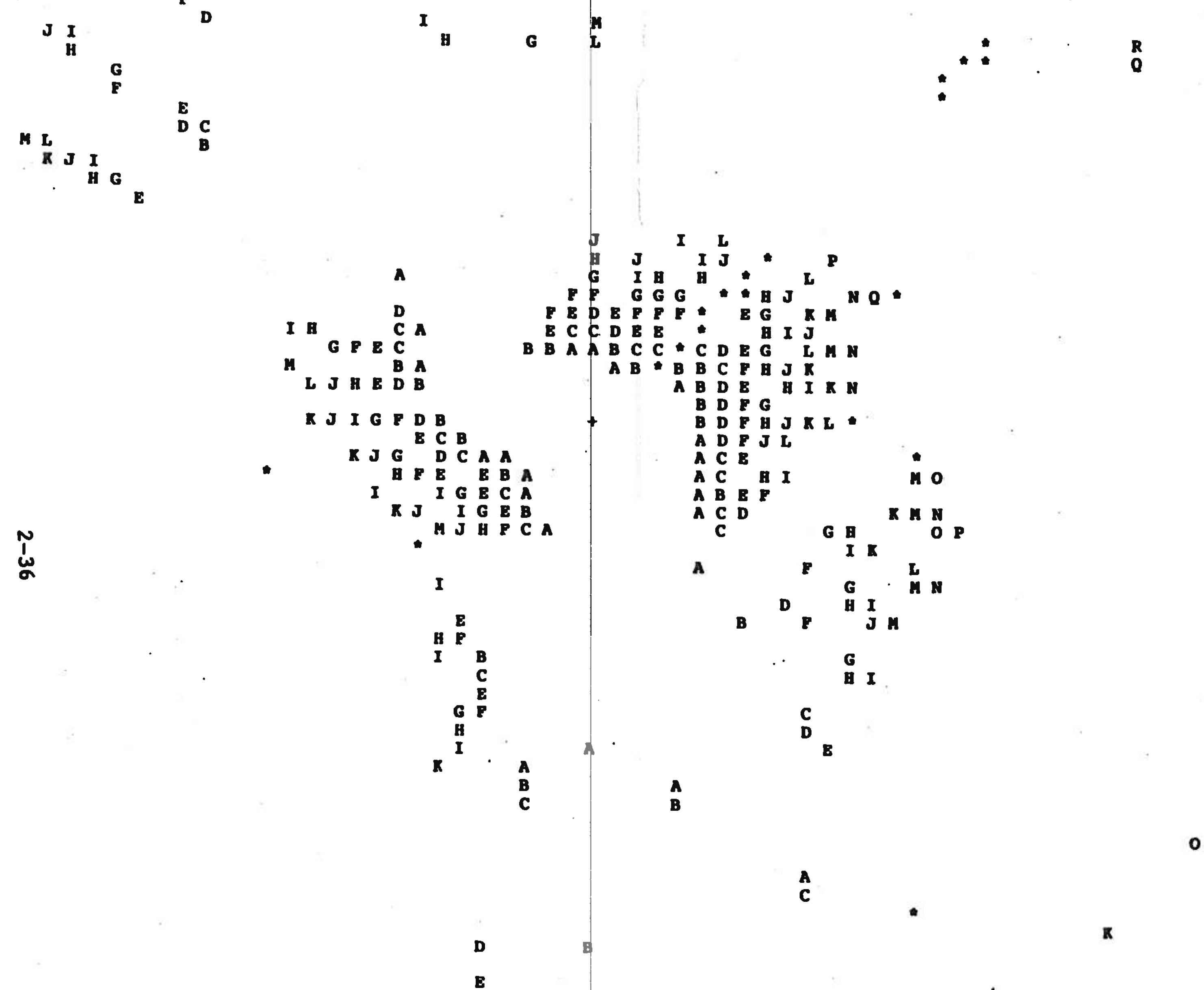
2.15 Multiple-Hour Averages

In both the case-study and the sequential modes, RTDM produces hourly concentration values for each hour included in the input data set. Concentrations for averaging times greater than one hour are computed by the postprocessing program ANALYSIS (see Section 6). This program uses the disk file of concentrations written by RTDM and can create

1) n-hour non-overlapping averages (n from 1 to 24)
2) n-hour running averages (n from 1 to 24)
3) annual averages

as well as detailed output concerning peak concentrations. The current version of the ANALYSIS postprocessor does not handle calm winds in a special manner. However, use of on-site wind data rather than airport wind data causes calm winds to be quite rare in most cases.

AP OF USER-SPECIFIED TERRAIN: LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
DISTANCES FROM SOURCE (0,0): XMIN = -6122.79 M, XMAX = 6396.47 M, YMIN = -7267.88 M, YMAX = 5362.32 M



CONTOUR CODES

A	1100.00
B	1200.00
C	1300.00
D	1400.00
E	1500.00
F	1600.00
G	1700.00
H	1800.00
I	1900.00
J	2000.00
K	2100.00
L	2200.00
M	2300.00
N	2400.00
O	2500.00
P	2600.00
Q	2700.00
R	2800.00
S	2900.00
T	3000.00

Figure 2-5 RTDM Crude Map of Terrain and Receptor Locations Based Upon User Input

In summary, the ANALYSIS output may include:

1) The X highest average concentrations at each receptor together with day and hour of occurrence for n-hour (non-overlapping) averages.
2) The cumulative frequency distribution of n-hour (non-overlapping) average concentrations at each receptor (n can be as high as 24). Annual average concentration values are also given.
3) Tabulation for each receptor of all n-hour (non-overlapping) averages which exceed a specified concentration threshold. The summary output includes a table by receptor of maximum n-hour average concentrations.
4) The production of sequential concentrations of running averages from an input concentration sequence. This sequence can be processed to provide any of the statistics described in 1-3 above for running averages.
5) The production of sequential concentrations that result from adding concentrations from 2 to 5 separate files (source groups). These concentrations may be multiplied by a scale factor before summing.

3. MODEL INPUT DATA

3.1 Meteorological Data

RTDM reads a text file of meteorological data with each line in the file representing one hour. Each line begins with year, Julian day, and hour information. Any number of hours may be run, but RTDM checks each line for chronological sequence. If the hourly sequence is broken, a non-fatal warning message is printed.

The format of each line in the meteorological input file is described in Table 3-1. Wind direction, wind speed, mixing height, stability class, and ambient temperature values must be specified for each hour. The other variables are optional and their inclusion depends upon the availability of the on-site data involved and the decision of the RTDM user concerning what model parameters to use. <u>Missing values should be specified as -999. in the input file</u>. If a missing value is encountered, the last non-missing value for that parameter is used. Initial persistence values are specified by the user in case the first hour is missing for a parameter. The initial values are designed to be used to specify a constant value of any parameter for the entire RTDM run (with all hourly values set to -999.). <u>It is recommended that the user replace missing data with alternate values to prevent persistence of meteorological quantities that normally change frequently throughout the day</u>. An example of an RTDM meteorological input file is shown in Figure 3-1.

3.2 Emissions Data

Hourly emissions data need not be supplied by the RTDM user if constant stack emissions are to be modeled. The constant emissions values are specified in the STACKS section of the RTDM input run stream. If hourly emissions values are to be used, they must be input for all stacks. However, since the initialized values are the constant emissions values specified in the STACKS section, use of -999. (missing) values for all hours for a stack reverts to constant emissions for that stack.

TABLE 3-1

FORMAT* OF RTDM HOURLY METEOROLOGICAL INPUT

Parameter	Columns	Comments
Year	1-2	Last 2 digits (1982=82)
Julian Day	3-5	1-366
Hour	6-7	Time at end of hour (01-24)
Wind Direction	9-14	In degrees, direction from which wind is blowing
Wind Speed (#1)	15-20	Units converted to m/sec with USCALE
Mixing Height	21-26	In meters
Stability Class	27-32	Turner (1964) method recommended
Ambient Temperature	33-38	Degrees Fahrenheit
Turbulence Intensity, y-component	39-44	Convert σ_θ to radians, or use I_y directly
Turbulence Intensity, z-component	45-50	Convert σ_ϕ to radians , or use I_z directly
VPTG, plume rise	51-56	Use data near stack-top location and elevation, °C/m
VPTG, H_{crit}	57-62	Use data near terrain obstacle of interest, °C/m
Horizontal wind shear	63-68	Use data as close to typical plume height as possible, degrees/meter
Wind Speed Profile exponent	69-74	See subsection 2.4
Alternate Wind Speed	75-80	Used for plume dilution, if available (in user units)

*Year, Julian Day, Hour are in fixed point format; other variable are in floating point format

7636524	220.	1.0	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	0.07	2.0
7636601	220.	1.5	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	0.07	3.0
7636602	220.	2.0	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	0.07	4.0
7636603	220.	2.5	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	0.07	5.0
7636604	220.	3.0	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	0.07	6.0
7636607	220.	1.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	2.0
7636608	220.	1.5	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	3.0
7636609	220.	2.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	4.0
7636610	220.	2.5	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	5.0
7636611	220.	3.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	6.0
7636612	220.	4.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	7.0
7636613	220.	5.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	0.09	8.5
7636614	220.	2.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	4.0
7636615	220.	2.5	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	5.0
7636616	220.	3.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	6.0
7636617	220.	4.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	8.0
7636618	220.	5.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	10.0
7636619	220.	7.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	14.0
7636620	220.	10.	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	18.0
7636621	220.	12.	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	21.0
7636622	220.	15.	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	0.12	25.0
7700101	220.	1.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	2.0
7700102	220.	1.5	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	3.0
7700103	220.	2.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	4.0
7700104	220.	2.5	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	5.0
7700105	220.	3.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	6.0
7700106	220.	4.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	8.0
7700107	220.	5.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	10.0
7700108	220.	7.0	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	14.0
7700109	220.	10.	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	20.0
7700110	220.	12.	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	24.0
7700111	220.	15.	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	30.0
7700112	220.	20.	3000.	4.	68.	0.08	0.06	0.0	0.0	0.20	0.14	35.0
7700113	220.	2.0	3000.	5.	68.	0.06	0.03	0.02	0.02	0.30	0.25	5.0
7700114	220.	2.5	3000.	5.	68.	0.06	0.03	0.006	0.02	0.30	0.25	7.0
7700115	220.	3.0	3000.	5.	68.	0.06	0.03	0.001	0.001	0.30	0.25	9.0
7700116	220.	4.0	3000.	5.	68.	0.06	0.03	0.0	0.0	0.30	0.25	10.0
7700117	220.	5.0	3000.	5.	68.	0.06	0.03	0.04	0.006	0.30	0.25	12.0
7700118	220.	2.0	3000.	6.	68.	0.04	0.016	0.035	0.035	0.40	0.35	5.0
7700119	220.	2.5	3000.	6.	68.	0.04	0.016	0.006	0.02	0.40	0.35	7.0
7700120	220.	3.0	3000.	6.	68.	0.04	0.016	0.001	0.001	0.40	0.35	9.0
7700121	220.	4.0	3000.	6.	68.	0.04	0.016	0.0	0.0	0.40	0.35	10.0
7700122	220.	5.0	3000.	6.	68.	0.04	0.016	0.04	0.006	0.40	0.35	12.0

Figure 3-1 Sample RTDM Hourly Meteorological Input File

The format of each line in the emissions input file is described in Table 3-2. Values of emissions, exit velocity, and stack gas temperature must be supplied each hour. If a value is missing, the previous good value is used. If the first hour is missing, the constant value specified in the STACKS section is used.

One line per stack must be supplied each hour, in the order that the stacks are listed in the STACKS section. The times specified by the meteorological and emissions input files must agree, or RTDM signals a fatal runtime error. An example of an RTDM hourly emissions file is shown in Figure 3-2.

TABLE 3-2

FORMAT* OF RTDM HOURLY EMISSIONS INPUT**

Parameter	Columns	Comments
Year	1-2	Last 2 digits (1982=82)
Julian Day	3-5	1-366
Hour	6-7	Time at end of hour (01-24)
Emission rate of pollutant	11-20	g/sec
Stack gas exit velocity	21-30	m/sec
Stack gas temperature	31-40	°K

*Year, Julian Day, Hour in fixed point format; other variables in floating point format.

**One line per stack for each hour, in the order listed in the STACKS section.

7636522	1000.	20.	370.
7636522	1500.	18.	380.
7636523	2000.	20.	370.
7636523	1500.	18.	380.
7636524	1000.	20.	370.
7636524	3000.	18.	380.
7636601	1000.	10.	370.
7636601	1500.	10.	380.
7636602	1000.	10.	370.
7636602	1500.	10.	380.
7636603	1000.	20.	420.
7636603	1500.	18.	420.
7636604	2000.	20.	370.
7636604	3000.	18.	380.
7636605	2000.	20.	370.
7636605	3000.	18.	380.
7636606	2000.	20.	370.
7636606	3000.	18.	380.
7636607	2000.	20.	370.
7636607	3000.	18.	380.
7636608	2000.	20.	370.
7636608	3000.	18.	380.
7636609	2000.	20.	370.
7636609	3000.	18.	380.
7636610	2000.	20.	370.
7636610	3000.	18.	380.
7636611	2000.	20.	370.
7636611	3000.	18.	380.
7636612	2000.	20.	370.
7636612	3000.	18.	380.
7636613	2000.	20.	370.
7636613	3000.	18.	380.
7636614	2000.	20.	370.
7636614	3000.	18.	380.
7636615	2000.	20.	370.
7636615	3000.	18.	380.
7636616	2000.	20.	370.
7636616	3000.	18.	380.
7636617	2000.	20.	370.
7636617	3000.	18.	380.
7636618	2000.	20.	370.
7636618	3000.	18.	380.
7636619	2000.	20.	370.
7636619	3000.	18.	380.
7636620	2000.	20.	370.
7636620	3000.	18.	380.
7636621	2000.	20.	370.
7636621	3000.	18.	380.
7636622	2000.	20.	370.
7636622	3000.	18.	380.

Figure 3-2 Sample RTDM Hourly Emissions File for Two Stacks

7636623	2000.	20.	370.
7636623	3000.	18.	380.
7636624	2000.	20.	370.
7636624	3000.	18.	380.
7700101	1000.	10.	370.
7700101	1500.	10.	380.
7700102	1000.	10.	370.
7700102	1500.	10.	380.
7700103	1000.	20.	420.
7700103	1500.	18.	420.
7700104	2000.	20.	370.
7700104	3000.	18.	380.
7700105	2000.	20.	370.
7700105	3000.	18.	380.
7700106	2000.	20.	370.
7700106	3000.	18.	380.
7700107	2000.	20.	370.
7700107	3000.	18.	380.
7700108	2000.	20.	370.
7700108	3000.	18.	380.
7700109	2000.	20.	370.
7700109	3000.	18.	380.
7700110	2000.	20.	370.
7700110	3000.	18.	380.
7700111	2000.	20.	370.
7700111	3000.	18.	380.
7700112	2000.	20.	370.
7700112	3000.	18.	380.
7700113	2000.	20.	370.
7700113	3000.	18.	380.
7700114	2000.	20.	370.
7700114	3000.	18.	380.
7700115	2000.	20.	370.
7700115	3000.	18.	380.
7700116	2000.	20.	370.
7700116	3000.	18.	380.
7700117	2000.	20.	370.
7700117	3000.	18.	380.
7700118	2000.	20.	370.
7700118	3000.	18.	380.
7700119	2000.	20.	370.
7700119	3000.	18.	380.
7700120	2000.	20.	370.
7700120	3000.	18.	380.
7700121	2000.	20.	370.
7700121	3000.	18.	380.
7700122	2000.	20.	370.
7700122	3000.	18.	380.

Figure 3-2 (Continued)

4. USE OF PREPRO - A METEOROLOGICAL PREPROCESSOR

4.1 Input Requirements

Two input files are required:

FILE 1 - This is a binary meteorological file from the EPA preprocessor RAMMET. This binary file has a header which indicates the station and year for surface and upper air data. This header is skipped when input into PREPRO, and the subsequent data are read in the following sequence:

- Year
- Month
- Day
- Stability Class each hour (24)
- Wind Speed each hour (24)
- Temperature each hour (24)
- Wind direction each hour - not randomized (24)
- Wind direction each hour - randomized (24)
- Mixing height each hour:
  - Rural (24)
  - Urban (24)

FILE 2 - This is a 1-line user assembled text file containing the following:

Columns 1-5: The number of days in FILE 1 to skip before processing
Columns 1-10: The number of days in FILE 1 to process into RTDM input format

4.2 Output Description

The output file is in the format described for the RTDM meteorological input file (see subsection 3.1). Rural mixing heights, rather than urban values, are used. Each day of the data in FILE 1 is converted into 24 lines in the output file. The resulting output file has the minimum number of input parameters necessary for running RTDM; no optional values are supplied.

4.3 Computer Job Control Considerations

The input data is a binary meteorological data file which has been processed by RAMMET. This input data is read in by PREPRO from unit 2. The one-line user-assembled text file is read from unit 1. The output file is written to unit 3.

On computers with disk file name assignments in the FORTRAN "OPEN" commands, suggested file names associated with units 1, 2, and 3 are "PREPRO.IN", "@DATA", and "@LIST", respectively.

5. USE OF RTDM

5.1 Input Run Stream

The RTDM input run stream consists of several distinct sections, in the following order of keywords:

PARAMETERS
STACKS
POINTS
TERRAIN
EXECUTE

Each of these sections encompasses one group of input data necessary to define an RTDM run, and is identified by listing the section name (i.e. PARAMETERS, STACKS, etc.) as the first line of the section. These section names are referred to as keywords. Each section is concluded with a line containing only '99999' in columns 1-5.

Of the keywords, PARAMETERS must be specified first followed by STACKS, POINTS, TERRAIN and EXECUTE, in that order. Table 5-1 contains a keyword summary. A sample input stream is shown in Figure 5-1.

5.1.1 PARAMETERS Keyword

The PARAMETERS keyword marks the beginning of that portion of the input stream which serves to override the default options and specify specific program options to be used.

There are 25 parameter groups which may be specified by the user. A parameter group need be included in the parameter package only if the default value is not the one that the user wishes to select. The 25 parameter groups are listed in Table 5-2.

TABLE 5-1

SUMMARY OF KEYWORDS USED IN AN RTDM INPUT STREAM

PARAMETERS	This keyword is used to override default values of model constants and control parameters.
STACKS	This keyword is used to describe the locations and fixed physical characteristics of the point sources.
POINTS	This keyword is used to describe receptor locations.
TERRAIN	This keyword is used to input terrain height information and distances of height contours from the source location. If the partial reflection option is not used, this keyword is still needed to define hill height values for computation of H_{crit}.
EXECUTE	This keyword terminates the reading of the input run stream and initiates program execution.

```
PARAMETERS
PR003    1.
PR004    10.0                 0.       0.
PR022    1.
PR018    1.
PR019    1.
PR020    1.       .17
PR021    1.
PR023    1.
         22.5     22.5     22.5     22.5     22.5     22.5
PR025    1.
99999
STACKS
600.      800.       765.       SO2
STK1      121.92     5.0        20.0       370.       1000.
99999
POINTS
          603.16     801.61     2782.      WEST MT.
          602.75     799.90     2430.      BRUSH MT.
          603.46     799.41     2520.      WALKER MT.
          600.53     800.63     1100.
          600.64     800.76     1200.
          600.80     800.96     1300.
          600.85     801.01     1400.
          600.96     801.14     1500.
          601.09     801.30     1600.
          601.31     801.56     1700.
          601.43     801.70     1800.
          601.61     801.92     1900.
          601.84     802.19     2000.
          603.59     804.27     2100.
          603.70     804.40     2200.
          603.89     804.63     2300.
          603.93     804.68     2400.
          603.96     804.72     2500.
          603.98     804.74     2600.
          603.99     804.76     2700.
          604.00     804.77     2800.
          604.03     804.80     2900.
          604.04     804.82     3000.      TUMBLEDOWN MT.
          603.35     793.70     1631.      BUNKER MT.
          598.10     798.23     2440.      RECORD HILL
          596.53     799.26     2440.      OLD TURK MT.
99999
TERRAIN
1100.     100.
010       4.46   4.78   5.01   7.00   7.38   -999.

020       1.50   3.35   3.45   3.75   3.85   3.95   4.05   4.20   4.60   4.70
          4.80   -999.
030       1.40   1.50   1.65   3.00   3.10   3.16   3.24   3.31   3.50   -999.

040       1.28   1.40   1.46   1.53   1.61   1.74   1.88   1.98   2.72   -999.

050       1.15   1.30   1.39   1.49   1.60   1.69   1.75   1.82   1.94   2.06
          2.13   2.22   2.34   -999.
060       1.18   1.29   1.40   1.48   1.58   1.69   1.80   1.94   2.10   2.24
```

Figure 5-1

	2.58	-999.								
070	1.25	1.47	1.60	1.72	1.87	2.03	2.20	2.32	2.47	-999.
080	1.41	1.58	1.70	1.87	2.00	2.12	2.24	2.38	2.44	2.49
	2.59	-999.								
090	1.64	1.75	1.88	1.99	2.09	2.20	2.39	2.59	2.76	2.94
	3.08	-999.								
100	1.99	2.09	2.18	2.30	2.52	2.59	2.66	2.71	2.81	2.95
	3.09	3.18	3.29	-999.						
110	2.02	2.28	2.40	2.52	2.63	2.72	3.00	3.19	3.55	-999.
120	2.21	2.41	2.52	2.63	5.75	5.90	6.01	6.18	6.30	6.50
	6.73	6.85	7.07	-999.						
130	2.75	5.47	5.62	5.92	6.01	6.70	6.90	7.37	7.48	7.79
	-999.									
140	1.22	1.29	6.70	6.80	6.90	7.00	-999.			
150	1.11	1.19	1.24	1.29	1.32	-999.				
160	1.08	1.15	1.21	1.28	1.38	1.42	5.13	5.32	5.51	-999.
170	1.01	1.12	1.23	1.34	1.48	1.53	4.98	-999.		
180	0.81	1.04	1.18	1.38	1.51	1.66	1.82	2.10	2.23	2.31
	4.79	4.92	5.05	-999.						
190	0.79	0.90	1.07	1.23	1.37	1.50	1.71	1.81	1.91	2.01
	-999.									
200	0.68	0.82	1.00	1.16	1.30	1.50	1.68	1.95	2.52	-999.
210	0.71	0.83	1.03	1.20	1.43	1.58	1.81	2.15	2.30	2.52
	2.62	2.73	-999.							
220	0.82	0.99	1.25	1.32	1.49	1.70	2.04	2.22	2.50	2.86
	5.58	5.75	6.05	6.11	6.16	6.19	6.21	6.23	6.27	6.29
230	1.05	1.21	1.48	1.61	2.02	2.17	2.28	2.42	2.54	2.67
	2.84	3.01	3.17	3.21	3.28	3.32	7.42	7.49	-999.	
240	1.05	1.20	1.41	1.61	1.78	1.90	2.04	2.16	2.38	2.52
	2.68	2.80	2.91	3.14	3.31	3.39	3.45	-999.		
250	1.00	1.23	1.31	1.40	1.56	1.70	1.86	1.97	2.08	2.17
	2.30	2.45	2.57	2.80	-999.					
260	1.00	1.11	1.27	1.36	1.49	1.60	1.78	2.09	2.27	2.45
	2.56	2.63	2.73	2.84	-999.					
270	1.03	1.16	1.28	1.38	1.48	1.53	1.66	1.73	1.88	2.09
	2.26	2.49	2.61	-999.						
280	1.09	1.22	1.34	1.43	1.54	1.63	1.71	1.76	1.82	1.89
	1.97	2.10	3.50	3.58	3.70	-999.				
290	1.16	1.28	1.43	1.57	1.67	1.76	1.83	1.98	2.13	3.26
	3.34	3.50	3.65	3.79	3.90	4.05	-999.			
300	1.28	1.41	1.60	1.74	1.89	2.10	2.90	3.01	3.16	3.24
	3.33	3.96	4.03	4.17	-999.					
310	1.46	1.60	1.75	1.90	2.90	3.04	3.42	3.59	3.75	3.90
	3.98	4.08	4.20	8.25	8.35	-999.				
320	1.65	1.85	2.00	3.12	3.36	3.49	4.05	4.20	4.42	8.55
	8.65	-999.								
330	2.18	2.97	4.42	4.61	4.78	-999.				
340	6.23	6.42	6.58	-999.						

Figure 5-1 (cont.)

```
350        4.69   4.90   -999.

360        4.31   6.80   -999.

99999
EXECUTE
       220.  5.0   3000. 4.    68.   0.08  0.06  0.0   0.0   0.20  0.14 10.
ENDJOB
```

Figure 5-1 (cont.)

TABLE 5-2

LIST OF PARAMETER GROUPS INCLUDED IN RTDM

Parameter Group No.	Parameter Group Description
1	Horizontal scale (# of meters per user unit)
2	Vertical scale (# of meters per user unit)
3	Wind speed scale (# of m/sec per user unit)
4	Anemometer heights for wind speed #1 (mandatory), wind speed #2 (optional), and a switch determining the wind speed used for plume dilution, and the height of the origin of the wind speed profile
5	Default, stability-dependent wind speed profile exponents
6	Switch determining type of stability-dependent dispersion coefficients used (P-G, ASME or user-supplied)
7	User-supplied y-component dispersion coefficients
8	User-supplied z-component dispersion coefficients
9	Switch for use of partial plume penetration option, and VPTG value to be used for the strength of the elevated inversion
10	Switch for use of buoyancy-enhanced dispersion, plus value α used for determining its magnitude: $\Delta H/\alpha$
11	Switch for specifying unlimited mixing height for stable conditions
12	Switch for use of transitional plume rise
13	Stability-dependent values of plume path correction factor
14	Default, stability-dependent values of VPTG, applies to stable conditions only

TABLE 5-2 (Continued)

Parameter Group No.	Parameter Group Description
15	Switch for use of stack-tip downwash
16	Switch for use of hourly I_y values
17	Switch for use of hourly I_z values
18	Switch for use of hourly VPTG values for computing stable plume rise
19	Switch for use of hourly VPTG values for computing H_{crit}
20	Switch for use of horizontal wind shear to improve calculations of $_y$; specification of coefficient for that calculation
21	Switch for use of hourly wind speed profile exponent values
22	Switch for use of partial reflection factor
23	Switch for determination of the type of horizontal averaging (sector averaged or off-centerline); specification of stability-dependent sector widths
24	Switch for use of hourly emissions data
25	Switch for case-study printout

PARAMETERS Input Format

First Line - The keyword PARAMETERS, is placed in columns 1 to 10.

Successive Lines - The standard format has up to six data fields on each line. The first line in each parameter group contains the group name in the first five (5) columns. All group names are of the form PRnnn, where nnn is a group number, from 001 to 025. Unless otherwise noted, the parameter values are held in six fields per line, floating point format, beginning in column 9. Parameter groups may be input in any order.

The general format for a PARAMETERS input line is:

Columns	Variable	Format	Meaning
1-5	PGNAM	A2, I3	Parameter group names, 'PRNNN' for the first card of the group. Blank for following cards.
9-16	VAR1	E8.0	First parameter value
17-24	VAR2	E8.0	Second parameter value
25-32	VAR3	E8.0	Third parameter value
33-40	VAR4	E8.0	Fourth parameter value
41-48	VAR5	E8.0	Fifth parameter value
49-56	VAR6	E8.0	Sixth parameter value

Input among parameter groups will differ in format, in general. Any parameter group to be specified will require at least one line, and more if there are more than six values to be specified. If a parameter group contains less than seven values, then only one line is needed to characterize the new values. This is true for all except the following parameters: PR007, PR008, PR023.

If a parameter group contains more than six values, then more than one line will be necessary to specify the group. This situation exists with parameters PR007, PR008 (10 lines each) and PR023 (2 lines).

Parameter groups may not be partially input; if some data lines from a group are omitted, results are unpredictable.

Table 5-3 contains a detailed description of the input format for all parameter groups, as well as the default values for all variables. Recommended choices for parameters for general use of RTDM in a screening mode are described in Table 5-4.

Last Line

The PARAMETERS section is terminated by a standard 99999 delimiter. The 99999 must be placed in columns 1-5.

A sample PARAMETERS section is shown as part of Figure 5-1.

5.1.2 STACKS Keyword

The STACKS section is used to describe the dimensions and emission characteristics of each input source. This keyword also specifies the identity of the pollutant being considered in the model run. Data required for the STACKS keyword include:

For all stacks:

1) the name of the pollutant whose dispersion is being simulated (e.g. SO_2, TSP).
2) the stack coordinates x, y (all must be co-located with a common stack base elevation).
3) the stack base elevation in user units
4) the stack height (m)
5) the stack diameter (m)

TABLE 5-3

FORMATS AND DEFAULT VALUES OF VARIABLES USED IN PARAMETERS

Name	Variable	Dimension	Default	Format	Description
PR001	HSCALE	1	1000.	(A2,I3,3X,E8.0)	Scale factor to convert user horizontal units to meters. Default converts km to m.
PR002	VSCALE	1	0.3048	(A2,I3,3X,E8.0)	Scale factor to convert user vertical units to meters. Default converts feet to meters.
PR003	USCALE	1	0.4471	(A2,I3,3X,E8.0)	Scale factor to convert user wind speed units to m/sec. Default converts mph to m/sec.
PR004	ZWIND1, ZWIND2, IDILUT ZA	1 1 1 1	10. 10. 0 0	(A2,I3,3X,4E8.0)	Anemometer height for mandatory wind speed (#1), and meter height for optional wind speed (#2), dilution switch (0 = use wind speed #1 at stack top height, 1 = use wind speed #1 at plume height, 2 = use wind speed #2 at plume height) height above stack base elevation (m) where wind profile is assumed to originate
PR005	EXPON	6	.09, .11, .12, .14, .20, .30	(A2,I3,3X,6E8.0)	Default, stability-dependent wind speed profile exponents.
PR006	ICOEF	1	3	(A2,I3,3X,E8.0)	Switch for specifying type of stability-dependent dispersion parameters (1 = user-specified, 2 = P-G, 3 = ASME, 1979)
PR007	XY1,XY2, AY,BY,CY	1,1 (6,3),(6,3) (6,3)	best fit to ASME, 1979	line 1:(A2,I3, 3X,2E8.0) lines 2-10: (8X, 6E8.0)	XY1,XY2 are crossover distances (m) for σ_y, such that (for stability class i): 1) for $x < XY1$, σ_y = AY(i,1)*BY(i,1)**CY(i,1) 2) for $XY1 < x \leq XY2$, σ_y = AY(i,2)*BY(i,2)**CY(i,2) 3) for $XY2 < x$, σ_y = AY(i,3)*BY(i,3)**CY(i,3)
PR008	XZ1, XZ2 AZ,BZ,CZ	1,1 (6,3),(6,3), (6,3)	best fit to ASME, 1979	line 1: (A2,I3 3X,2E8.0) lines 2-10: (8X, 6E8.0)	XZ1, XZ2 are crossover distances (m) for σ_z, such that (for stability class i): 1) for $x \leq XZ1$, σ_z = AZ(i,1)*BZ(i,1)**CZ(i,1) 2) for $XZ1 < x \leq XZ2$, σ_z = AZ(i,2)*BZ(i,2)**CZ(i,2) 3) for $XZ2 < X$, σ_z = AZ(i,3)*BZ(i,3)**CZ(i,3)
PR009	IPPP,PPVPTG	1,1	0,0.006	(A2,I3,3X,2E8.0)	Switch for use of partial penetration algorithm (0 = do not use, 1 = use); PPVPTG is vertical potential temperature gradient above inversion to be used in partial penetration algorithm
PR010	IBUOY,ALPHA	1,1	1,3.162	(A2,I3,3X,2E8.0)	Switch for use of buoyancy-enhanced dispersion option (0 = do not use, 1 = use); ALPHA is constant used in the algorithm, plume rise/ALPHA = σ_y, σ_z contribution

TABLE 5-3 (Continued)

Name	Variable	Dimension	Default	Format	Description
PRO11	IDMX	1	1	(A2,I3,3X,E8.0)	Switch for use of unlimited mixing height in stable conditions (0 = do not use, 1 = use)
PRO12	ITRANS	1	1	(A2,I3,3X,E8.0)	Switch for use of transitional plume rise (0 = do not use, 1 = use)
PRO13	TERCOR	6	6*0.5	(A2,I3,3X,6E8.0)	Stability-dependent values of plume path correction factor
PRO14	RVPTG	2	0.02,0.035	(A2,I3,3X,2E8.0)	Default vertical potential temperature gradient values for stabilities 5 and 6
PRO15	ITIPD	1	0	(A2,I3,3X,E8.0)	Switch for use of stack-tip downwash algorithm (0 = do not use, 1 = use)
PRO16	IY	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly turbulence intensity data to compute σ_y (0 = do not use, 1 = use)
PRO17	IZ	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly turbulence intensity data to compute σ_z (0 = do not use, 1 = use)
PRO18	IRVPTG	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly VPTG data for plume rise calculations (0 = do not use, 1 = use)
PRO19	IHVPTG	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly VPTG data for H_{crit} calculations (0 = do not use, 1 = use)
PRO20	ISHEAR,SHCOEF	1,1	0,0.17	(A2,I3,3X,E8.0)	Switch for use of hourly horizontal wind shear data for σ_y calculations (0 = do not use,1 = use)
PRO21	IEPS	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly wind speed profile exponents (0 = do not use, 1 = use)
PRO22	IREFL	1	1	(A2,I3,3X,E8.0)	Switch for use of partial reflection algorithm (0 = do not use, 1 = use)
PRO23	IHORIZ,SECTOR	1 6	2 6*22.5	line 1: (A2,I3, 3X,E8.0) line 2: (8X,6E8.0)	Switch for use of a horizontal distribution function (1 = off-centerline for all stabilities, 2 = sector averaging for all stabilities, 3 = sector averaging for stable hours, off-centerline for non-stable hours); stability dependent sector widths (deg)
PRO24	IEMIS	1	0	(A2,I3,3X,E8.0)	Switch for use of hourly stack emissions data (0 = use constant values, 1 = use hourly values)
PRO25	IVERB	1	0	(A2,I3,3X,E8.0)	Switch for use of verbose, case-study output (0 = do not use, 1 = use)

TABLE 5-4

RECOMMENDED RTDM PARAMETERS FOR GENERAL USE ("DEFAULT MODE")

Parameter	Recommendation
PR001	Application-specific
PR002	Application-specific
PR003	Application-specific
PR004	ZWIND1 (height of wind measurements): set to height of anemometer above tower base. ZWIND2 (height of a second anemometer): ignore; use 0. IDILUTE: set to 1. Wind speed will be extrapolated to plume height. ZA (effective displacement of meteorological tower base above stack base elevation): set to 0.0 if the elevation of the tower base is close to that of plant grade or is in a flat area somewhat distant from the site (e.g., at an airport). Nonzero values of ZA are possible: 1) Negative values for anemometers at heights below plant grade or is "sheltered" locations; 2) Positive values for anemometers at heights well above plant grade. Determination of nonzero values of ZA must be done on a case-by-case basis.
PR005	Stability-dependent wind speed profile exponents: if no on-site or other relevant profile data are available, use default values.
PR006	Stability-dependent dispersion parameters: use default value (3, for ASME) if no on-site turbulence data are available to supercede this selection. The use of ASME (after Briggs) dispersion parameters as default values is consistent with the use made of turbulent intensity data in RTDM if such data were available. This is because the functional dependence of calculated sigmas with downwind distance that is coded in RTDM, and which is used in the computation of sigmas from turbulent intensity data, is based on the Briggs curves.
PR007 and PR008	Dispersion parameters: use defaults (these are user-supplied default power law coefficients for sigma-y and sigma-z and are ignored if PR006 is set to 3).

TABLE 5-4 (continued)

Parameter	Recommendation
PR009	Partial penetration: use default value of 0 (which will bypass this option).
PR010	Buoyancy-induced dispersion: use default values which will employ this option.
PR011	Unlimited mixing height: use default value of 1 which will specify an unlimited height for stable conditions.
PR012	Transitional plume rise: use default value of 1 which will cause this feature to be used.
PR013	Stability-dependent values of the plume path correction factor: use default values (0.5 for all stability classes). In stable conditions, RTDM will use 0.0 on an hourly basis if the plume is below the critical dividing streamline height.
PR014	Stable vertical potential temperature gradient values: use default values if data not available to override.
PR015	Stack-tip downwash: set to 1 which will cause this feature to be used.
PR016	Use of hourly turbulence intensity data, horizontal components: set this option value to 0 if no I_y (or σ_θ) data are available near stack-top height. Note: See caution in Section 2-5 concerning use of on-site turbulence data.
PR017	Use of hourly turbulence intensity data, vertical component: set this option value to 0 if no I_z (or σ_ϕ) data are available near stack-top height. Note: See caution in Section 2-5 concerning use of on-site turbulence data.
PR018	Use of hourly vertical potential temperature gradient data for plume rise calculations: set to 0 if vertical temperature difference data are not available. Note: See caution in Section 2-12 concerning use of on-site VPTG data.
PR019	Use of hourly VPTG data for H_{crit} computations: set to 0 if vertical temperature difference data are not available. Note: See caution in Section 2-12 concerning use of on-site VPTG data.

TABLE 5-4 (continued)

Parameter	Recommendation
PR020	Use of hourly horizontal wind shear data: specify 0 if multiple levels of wind direction data are not available. Note: See caution in Section 2.8 concerning use of horizontal wind shear.
PR021	Use of hourly wind speed profile exponents: specify 0 if no data are available or 1 (use) if two or more wind speed levels are available. This specification requires user computation of hourly profile exponents; details are provided in the RTDM manual and must take into account the choice of ZA (PR004).
PR022	Use of the partial reflection algorithm: specify 1 which will cause this algorithm to be used.
PR023	Mode of horizontal distribution function: use an option value of 2 (sector average distribution for all stabilities) and use 22.5° for sector width if PR016 is set to 0 (no I_y data).
PR024	Use of hourly stack emissions data: application specific.
PR025	Case-study printout: application specific.

6) pollution emission rate (g/sec)
7) stack gas exit velocity (m/sec)
8) stack gas exit temperature (°K)

A maximum of 35 sources can be input to RTDM.

As described in Section 3.2, constant emission parameter values specified in the STACKS section can be overridden by use of hourly emissions data. If hourly data exist for some stacks but not others, the hourly values for the stacks with modeled constant emissions should be set to -999. Intermittent missing values in the hourly data are replaced by the last good hourly value.

STACKS Input Format

First Line - The keyword STACKS, is placed in columns 1 to 6.

Second Line - The common x, y, and base elevation coordinates of all stacks are placed in columns 1-10, 11-20, and 21-30, respectively. A 4-character pollutant name is left-justified in columns 31-34.

Successive Lines - Specific stack information is included in one line per stack, as follows:

Columns	Data
1-4	Stack name
11-20	Stack height above common stack base, m
21-30	Stack top diameter, m
31-40	Stack gas exit velocity, m/sec
41-50	Stack gas temperature, °K
51-60	Emission rate, g/sec

Last Line - The list of stacks characteristics is terminated by a line with 99999 in columns 1 to 5.

An example of a STACKS section is shown as part of Figure 5-1.

5.1.3 POINTS Keyword

Locations of receptor points are specified in the POINTS section. The x, y, and elevation coordinates of the receptors are input in user units. Up to 400 receptors may be used in a single RTDM run, and they may be placed in an arbitrary geometric pattern. All receptors are assumed to be at ground level.

<u>POINTS Input Format</u>

<u>First Line</u> - The keyword POINTS is placed in columns 1 to 6 of this line.

<u>Successive Lines</u> - One line is allocated for each receptor location.

The receptor data is specified as follows:

Columns	Data
11-20	x coordinate, user units
21-30	y coordinate, user units
31-40	elevation, user units
41-72	optional receptor name or code

<u>Last Line</u> - The list of receptor information is terminated by a line with 99999 in columns 1 to 5.

An example of a POINTS section is shown as part of Figure 5-1.

5.1.4 TERRAIN Keyword

The TERRAIN section is used to inform RTDM of the local terrain height in all directions from the source location. This keyword must be used even if the partial reflection option is not employed in order to define hill heights in all directions. If partial reflection is used, RTDM must examine concentrations along the path of the plume from the source to the receptor, and it is necessary to use information about terrain heights along this path.

The procedure used to obtain the terrain heights is shown in Figures 2-3 and 2-4. On a topographic map that includes the location of the source and all surrounding terrain points of interest, radial lines should be drawn from the source in each of 36 directions at 10° intervals. The directions referred to in the figures follow meteorological convention; they are the directions from which the wind would blow to transport a plume from the source along the designated radial. A minimum contour level should be selected that is slightly lower than the lowest stack-top elevation. This selection insures that all terrain for plume path calculations is input to RTDM. A maximum hill height to be considered among all directions should be selected to determine the maximum range between the highest and lowest elevations to be specified. A convenient terrain contour interval is then selected so that a total of 20 or fewer equally spaced elevations (19 or fewer intervals) will span the elevation difference between the minimum and maximum values to be specified. In the example shown in Figures 2-3 and 2-4, an interval of 100 feet was chosen for a maximum elevation span between 1100 and 3000 feet. The contour interval should be chosen to make it easy for the user to find the location of each contour on the map, starting at the minimum elevation.

Starting at the lowest contour interval common to all directions, the RTDM user should record the distance in kilometers from the source location to the contour line. The shortest distance to each contour is recorded if the contour is encountered more than once due to dips in elevation along any radial. The user should ordinarily stop at the contour interval just below the hill top in each direction. RTDM will assume that the terrain slope of the last reported interval is similar to the slope between the last contour and the actual top of the hill if a model receptor is located above the last reported contour level. If fewer than 20 terrain heights are referred to in any direction, a -999. value should be added after the last distance to a real terrain contour.

TERRAIN Input Format

First Line - The keyword TERRAIN is placed in columns 1 to 7 of this line.

Second Line - The second line contains the elevation of the starting contour (columns 1-10) and the contour increment (columns 11-20), both in user units.

Next 72 Lines - Each direction requires 2 lines of data, even if not all contour increments are entered. The wind direction required to transport a plume to the terrain in question (see Figure 2-3) is specified in columns 1-3 of the first line, starting with 10°. Downwind distances (km) to the first 10 contour heights are entered in columns 11-17, 18-24, 25-31, ..., 74-80 (7 columns per value). Downwind distances to the last 10 contour heights are entered in the same columns of the second line. A -999. value signals that terrain top has been reached, and all values beyond that point for that direction are ignored (the user should have that space blank).

Last Line - The last line should contain 99999 in columns 1 to 5.

An example of a TERRAIN section is shown as part of Figure 5-1.

5.1.5 EXECUTE Keyword

The EXECUTE keyword should be placed after the PARAMETERS, STACKS, POINTS, and TERRAIN sections. RTDM starts to read the input data files at this point and processes each hour of data until an end-of-file is encountered in the input data.

EXECUTE Input Format

First Line - The keyword EXECUTE is placed in columns 1-7 of this line.

Second Line - The second line contains initial persistence values for each meteorological input parameter. These values are used only if the first hour(s) of data indicates a missing value for any parameter. The format of each data item matches that described in Section 3.1.

Columns	Initial Persistence Parameter
9-14	wind direction
15-20	wind speed (#1), user units
21-26	mixing height, m
27-32	stability class
33-38	ambient temperature, °F
39-44	turbulence intensity, y-component
45-50	turbulence intensity, z-component
51-56	VPTG, plume rise (°C/m)
57-62	VPTG, H_{crit} (°C/m)
63-68	horizontal wind shear (deg/meter)
69-74	wind speed profile exponent
75-80	alternate wind speed, user units

The RTDM user can force an input value to stay constant throughout the entire run by inserting -999. for that value for each hour in the meteorological input file. The value specified in the EXECUTE section is then used for all hours modeled.

Optional Last Line - The user may insert a line with ENDJOB in columns 1 to 6 as the last line in the input run stream.

5.2 RTDM Output

The information input by the user in the PARAMETERS, STACKS, POINTS and TERRAIN sections is displayed in the RTDM output. The specifications of each of the 25 RTDM parameter groups is displayed, whether altered by the user from the default values or not. All stack characteristics and receptor location information are also displayed. The table of distances to terrain contours in each of 36 directions is given. The terrain information is accompanied by a computer-plotted map with letter codes for terrain contours, and specification of the location of the source and receptors. An example of RTDM output is given in Figure 5-2.

It is recommended that the user execute a short run with the case-study output option employed prior to a long run with this

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ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                    PAGE  1

     MODEL PARAMETERS:

     PR001:  HORIZONTAL SCALE IS 1000.000 METERS PER USER UNIT

     PR002:  VERTICAL SCALE IS     .305 METERS PER USER UNIT

     PR003:  WIND SPEED SCALE IS    1.000 M/SEC PER USER UNIT

     PR004:  ANEMOMETER #1 HEIGHT ABOVE ZA (USED FOR PLUME RISE) IS  10.0 M
             IF AVAILABLE, ANEMOMETER #2 HEIGHT ABOVE ZA (USED FOR PLUME DILUTION) IS    .0 M
             DILUTION WIND SPEED OPTION IS 0      (IF 0, ONE WIND SPEED--AT STACK HEIGHT--IS USED FOR PLUME RISE AND DILUTION
             IF 1, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE AND TO PLUME HEIGHT FOR DILUTION
             IF 2, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE,
             AND THE SPEED AT LEVEL #2 IS EXTRAPOLATED TO PLUME HEIGHT FOR DILUTION)
             ZA (HEIGHT IN METERS ABOVE STACK BASE ELEVATION WHERE THE WIND SPEED PROFILE IS ASSUMED TO ORIGINATE) =     .000

     PR005:  DEFAULT WIND SPEED PROFILE EXPONENTS AS A FUNCTION OF STABILITY CLASS (1-6, RESPECTIVELY):
                          .0900   .1100   .1200   .1400   .2000   .3000

     PR006:  DISPERSION COEFFICIENTS ARE BRIGGS RURAL/ASME-1979 (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).

     PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS IS NOT BEING USED.

     PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS USED; PARAMETER ALPHA IS    3.162

     PR011:  UNLIMITED MIXING HEIGHT USED FOR STABLE CONDITIONS

     PR012:  TRANSITIONAL PLUME RISE IS USED.

     PR013:  PLUME PATH COEFFICIENTS FOR STABILITY CLASSES 1-6:   .500  .500  .500  .500  .500  .500

     PR014:  DEFAULT VERTICAL POTENTIAL TEMPERATURE GRADIENTS USED FOR STABLE PLUME RISE (CLASSES 5 & 6):   .0200  .0350

     PR015:  STACK-TIP DOWNWASH IS NOT USED.

     PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Y.

     PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Z.

     PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING STABLE PLUME RISE.

     PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING HCRIT.

     PR020:  WIND DIRECTION SHEAR IS USED IN COMPUTATION OF SIGMA-Y; COEFFICIENT =   .17

     PR021:  HOURLY VALUES OF WIND SPEED PROFILE EXPONENT ARE PROVIDED.

     PR022:  PARTIAL REFLECTION ALGORITHM IS BEING USED; KEYWORD TERRAIN MUST BE USED TO READ IN TERRAIN.

     PR023:  OFF-CENTERLINE CONCENTRATIONS ARE COMPUTED FOR ALL STABILITIES; NO SECTOR AVERAGING IS USED.

     PR024:  HOURLY EMISSIONS DATA ARE NOT AVAILABLE; CONSTANT VALUES SPECIFIED IN THE STACKS SECTION ARE USED.

     PR025:  DETAILED INFORMATION ABOUT EACH CASE WILL BE PRINTED.
```

Figure 5-2

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ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                         PAGE   2

      MODELED STACK PARAMETERS:

      X,Y COORDINATE OF ALL SOURCES (USER UNITS) IS (    600.00 ,     800.00 )  OR  ( 600000.00 ,  800000.00) METERS
      BASE HEIGHT OF ALL SOURCES (USER UNITS) IS    765.000 OR    233.172 METERS
      POLLUTANT IS SO2

      CODE NAME   STACK HT (M)   DIAMETER (M)   EXIT VEL (M/SEC)  STACK TEMP (K)  EMISSION RATE (G/SEC)
     1  STK1        121.920         5.000           20.000           370.000           1000.000
```

Figure 5-2 (cont.)

ROUGH TERRAIN DIFFUSION MODEL VERSION 3.2 LEVEL 861130 PAGE 3

RECEPTOR POINT INFORMATION (ALL COORDINATES IN USER UNITS):

RECEPTOR	X-COORD	Y-COORD	HEIGHT	NAME
1	603.16	801.61	2782.00**	WEST MT.
2	602.75	799.90	2430.00**	BRUSH MT.
3	603.46	799.41	2520.00**	WALKER MT.
4	600.53	800.63	1100.00	
5	600.64	800.76	1200.00**	
6	600.80	800.96	1300.00**	
7	600.85	801.01	1400.00**	
8	600.96	801.14	1500.00**	
9	601.09	801.30	1600.00**	
10	601.31	801.56	1700.00**	
11	601.43	801.70	1800.00**	
12	601.61	801.92	1900.00**	
13	601.84	802.19	2000.00**	
14	603.59	804.27	2100.00**	
15	603.70	804.40	2200.00**	
16	603.89	804.63	2300.00**	
17	603.93	804.68	2400.00**	
18	603.96	804.72	2500.00**	
19	603.98	804.74	2600.00**	
20	603.99	804.76	2700.00**	
21	604.00	804.77	2800.00**	
22	604.03	804.80	2900.00**	
23	604.04	804.82	3000.00**	TUMBLEDOWN MT.
24	603.35	793.70	1631.00**	BUNKER MT.
25	598.10	798.23	2440.00**	RECORD HILL
26	596.53	799.26	2440.00**	OLD TURK MT.

** THIS RECEPTOR IS HIGHER IN ELEVATION THAN THAT OF THE LOWEST STACK TOP.
SPECIAL ALGORITHMS CONCERNING PLUME IMPINGEMENT AND REFLECTION MAY INFLENCE CONCENTRATIONS MODELED AT THIS RECEPTOR.

Figure 5-2 (cont.)

ROUGH TERRAIN DIFFUSION MODEL VERSION 3.2 LEVEL 861130 PAGE 4

TERRAIN INFORMATION:

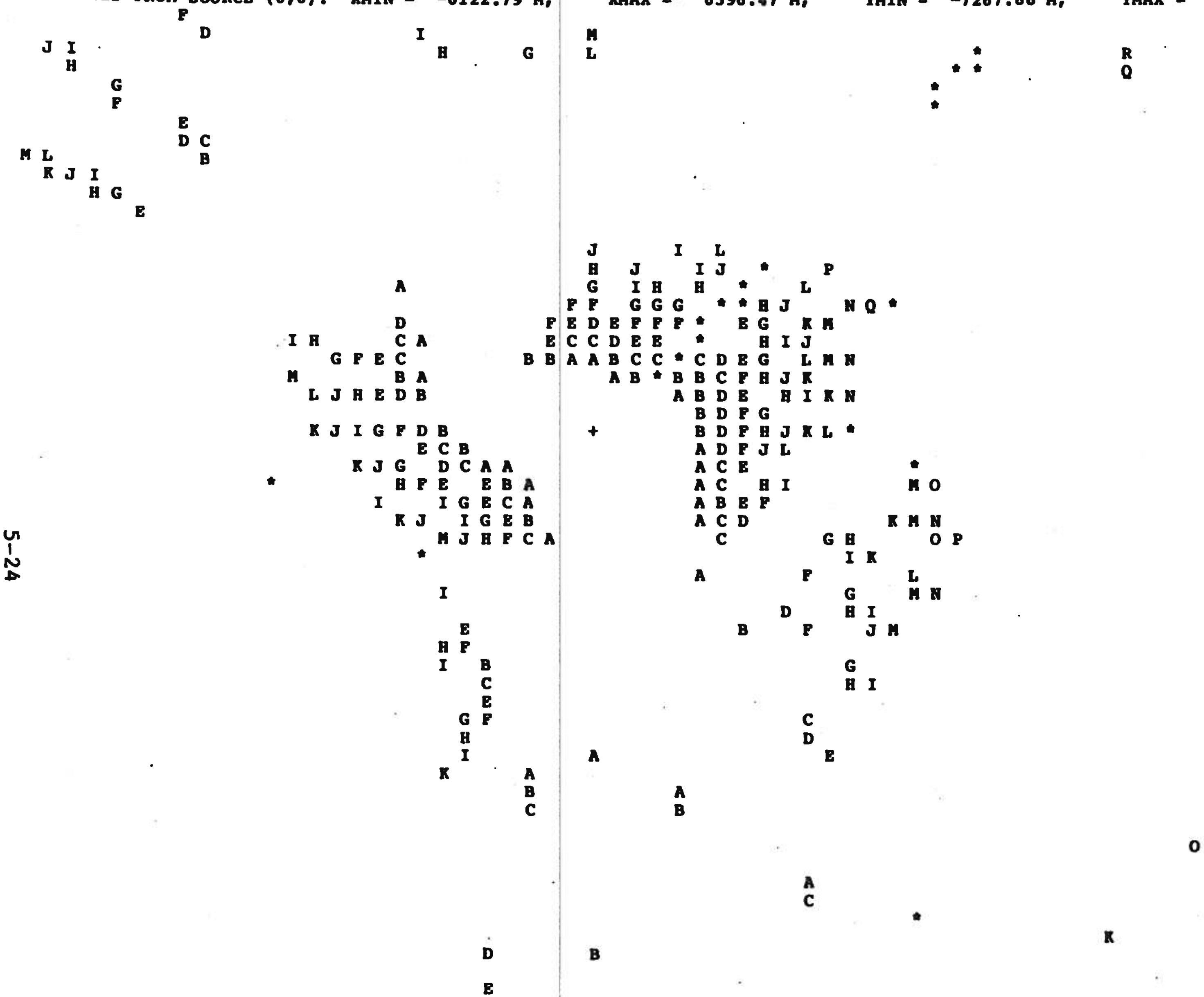
TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

ELEVATION IN USER UNITS:

WIND DIR.	1100.	1200.	1300.	1400.	1500.	1600.	1700.	1800.	1900.	2000.	2100.	2200.	2300.	2400.	2500.	2600.	2700.	2800.	2900.	3000.
10	4.46	4.78	5.01	7.00	7.38															
20	1.50	3.35	3.45	3.75	3.85	3.95	4.05	4.20	4.60	4.70	4.80									
30	1.40	1.50	1.65	3.00	3.10	3.16	3.24	3.31	3.50											
40	1.28	1.40	1.46	1.53	1.61	1.74	1.88	1.98	2.72											
50	1.15	1.30	1.39	1.49	1.60	1.69	1.75	1.82	1.94	2.06	2.13	2.22	2.34							
60	1.18	1.29	1.40	1.48	1.58	1.69	1.80	1.94	2.10	2.24	2.58									
70	1.25	1.47	1.60	1.72	1.87	2.03	2.20	2.32	2.47											
80	1.41	1.58	1.70	1.87	2.00	2.12	2.24	2.38	2.44	2.49	2.59									
90	1.64	1.75	1.88	1.99	2.09	2.20	2.39	2.59	2.76	2.94	3.08									
100	1.99	2.09	2.18	2.30	2.52	2.59	2.66	2.71	2.81	2.95	3.09	3.18	3.29							
110	2.02	2.28	2.40	2.52	2.63	2.72	3.00	3.19	3.55											
120	2.21	2.41	2.52	2.63	5.75	5.90	6.01	6.18	6.30	6.50	6.73	6.85	7.07							
130	2.75	5.47	5.62	5.92	6.01	6.70	6.90	7.37	7.48	7.79										
140	1.22	1.29	6.70	6.80	6.90	7.00														
150	1.11	1.19	1.24	1.29	1.32															
160	1.08	1.15	1.21	1.28	1.38	1.42	5.13	5.32	5.51											
170	1.01	1.12	1.23	1.34	1.48	1.53	4.98													
180	.81	1.04	1.18	1.38	1.51	1.66	1.82	2.10	2.23	2.31	4.79	4.92	5.05							
190	.79	.90	1.07	1.23	1.37	1.50	1.71	1.81	1.91	2.01										
200	.68	.82	1.00	1.16	1.30	1.50	1.68	1.95	2.52											
210	.71	.83	1.03	1.20	1.43	1.58	1.81	2.15	2.30	2.52	2.62	2.73								
220	.82	.99	1.25	1.32	1.49	1.70	2.04	2.22	2.50	2.86	5.58	5.75	6.05	6.11	6.16	6.19	6.21	6.23	6.27	6.29
230	1.05	1.21	1.48	1.61	2.02	2.17	2.28	2.42	2.54	2.67	2.84	3.01	3.17	3.21	3.28	3.32	7.42	7.49		
240	1.05	1.20	1.41	1.61	1.78	1.90	2.04	2.16	2.38	2.52	2.68	2.80	2.91	3.14	3.31	3.39	3.45			
250	1.00	1.23	1.31	1.40	1.56	1.70	1.86	1.97	2.08	2.17	2.30	2.45	2.57	2.80						
260	1.00	1.11	1.27	1.36	1.49	1.60	1.78	2.09	2.27	2.45	2.56	2.63	2.73	2.84						
270	1.03	1.16	1.28	1.38	1.48	1.53	1.66	1.73	1.88	2.09	2.26	2.49	2.61							
280	1.09	1.22	1.34	1.43	1.54	1.63	1.71	1.76	1.82	1.89	1.97	2.10	3.50	3.58	3.70					
290	1.16	1.28	1.43	1.57	1.67	1.76	1.83	1.98	2.13	3.26	3.34	3.50	3.65	3.79	3.90	4.05				
300	1.28	1.41	1.60	1.74	1.89	2.10	2.90	3.01	3.16	3.24	3.33	3.96	4.03	4.17						
310	1.46	1.60	1.75	1.90	2.90	3.04	3.42	3.59	3.75	3.90	3.98	4.08	4.20	8.25	8.35					
320	1.65	1.85	2.00	3.12	3.36	3.49	4.05	4.20	4.42	8.55	8.65									
330	2.18	2.97	4.42	4.61	4.78															
340	6.23	6.42	6.58																	
350	4.69	4.90																		
360	4.31	6.80																		

Figure 5-2 (cont.)

MAP OF USER-SPECIFIED TERRAIN: LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
DISTANCES FROM SOURCE (0,0): XMIN = -6122.79 M, XMAX = 6396.47 M, YMIN = -7267.88 M, YMAX = 5362.32 M



CONTOUR CODES

A	1100.00
B	1200.00
C	1300.00
D	1400.00
E	1500.00
F	1600.00
G	1700.00
H	1800.00
I	1900.00
J	2000.00
K	2100.00
L	2200.00
M	2300.00
N	2400.00
O	2500.00
P	2600.00
Q	2700.00
R	2800.00
S	2900.00
T	3000.00

Figure 5-2 (cont.)

THE CODE FOR MISSING DATA IS PRESENTED AS FOLLOWS:
A "1" IS INCLUDED IF WIND DIRECTION IS MISSING,
A "2" IS INCLUDED IF WIND SPEED IS MISSING,
A "3" IS INCLUDED IF MIXING HEIGHT IS MISSING,
A "4" IS INCLUDED IF STABILITY CLASS IS MISSING,
A "5" IS INCLUDED IF AMBIENT TEMPERATURE IS MISSING.
IF THERE IS MISSING DATA FOR ANY OF THESE PARAMETERS, THE PREVIOUS GOOD VALUE IS USED.
IF THERE IS MISSING DATA FOR OPTIONAL PARAMETERS, THE DEFAULT VALUE (OBTAINED FROM THE STABILITY CLASS) IS USED.

CASE-HOUR # 1 YEAR, DAY, HOUR: 76 365 24

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	1.00	3000.	1	293.15	.2200*	.2000*	.0000	.0000	.1000	.0900	2.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 1.25 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 858.18 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	980.10	672.71	623.6	271.4	831.	1073.9	652.9	271.4	707.1	.00016	.71766E-03	.71766E-03	1.27	93.
2	1.69	-2.17	507.	980.10	726.36	344.1	271.4	430.	614.3	338.2	271.4	433.6	.00000	.45240E-03	.92340E-03	1.00	0.
4	.82	.00	102.	833.12	782.06	174.1	224.9	174.	333.2	164.6	224.9	278.7	.00120	.55868E-04	.14313E-02	1.00	53.
5	.99	.00	133.	928.10	861.81	208.5	254.9	238.	406.1	198.7	254.9	323.2	.00098	.70586E-04	.12343E-02	1.00	55.
6	1.25	.00	163.	980.10	898.57	259.2	271.4	318.	492.0	249.9	271.4	368.9	.00081	.11139E-03	.10813E-02	1.00	72.
7	1.32	.00	194.	980.10	883.33	273.0	271.4	336.	511.0	264.0	271.4	378.6	.00078	.13863E-03	.10536E-02	1.00	86.
8	1.49	.00	224.	980.10	868.09	305.9	271.4	379.	557.8	298.0	271.4	403.1	.00072	.19472E-03	.98972E-03	1.00	111.
9	1.70	.00	255.	980.10	852.85	345.1	271.4	432.	615.9	339.3	271.4	434.5	.00065	.26750E-03	.91859E-03	1.00	138.
10	2.04	.00	285.	980.10	837.61	408.5	271.4	519.	713.8	407.4	271.4	489.5	.00056	.37709E-03	.81727E-03	1.00	168.
11	2.22	.00	315.	980.10	822.37	442.1	271.4	566.	767.4	444.3	271.4	520.6	.00052	.44014E-03	.77152E-03	1.01	183.
12	2.51	.00	346.	980.10	807.13	492.9	271.4	638.	850.6	501.1	271.4	569.9	.00047	.51356E-03	.71269E-03	1.02	192.
13	2.86	.00	376.	980.10	791.89	554.9	271.4	728.	954.9	572.1	271.4	633.2	.00042	.57645E-03	.66065E-03	1.05	192.
14	5.58	-.01	407.	980.10	776.65	983.3	271.4	1420.	1748.6	1115.7	271.4	1148.3	.00023	.55289E-03	.55289E-03	1.59	101.
15	5.75	-.01	437.	980.10	761.41	1007.8	271.4	1464.	1797.6	1149.8	271.4	1181.3	.00022	.54890E-03	.54887E-03	1.63	97.
16	6.05	.00	468.	980.10	746.17	1050.2	271.4	1539.	1883.2	1209.4	271.4	1239.5	.00021	.53741E-03	.53741E-03	1.67	91.
17	6.11	.00	498.	980.10	730.93	1059.2	271.4	1556.	1901.6	1222.2	271.4	1252.0	.00021	.53788E-03	.53784E-03	1.69	90.
18	6.16	.00	529.	980.10	715.69	1066.2	271.4	1568.	1915.9	1232.2	271.4	1261.8	.00021	.53892E-03	.52714E-03	1.67	88.
19	6.19	.00	559.	980.10	700.45	1070.2	271.4	1576.	1924.0	1237.9	271.4	1267.3	.00021	.54100E-03	.52485E-03	1.67	87.
20	6.21	.00	590.	980.10	685.21	1073.2	271.4	1581.	1930.2	1242.2	271.4	1271.5	.00021	.54333E-03	.52310E-03	1.67	86.
21	6.23	.00	620.	980.10	669.97	1075.2	271.4	1585.	1934.2	1245.0	271.4	1274.3	.00021	.54600E-03	.52197E-03	1.67	86.
22	6.27	.00	651.	980.10	654.73	1081.1	271.4	1596.	1946.3	1253.5	271.4	1282.5	.00020	.54688E-03	.51860E-03	1.67	85.
23	6.29	.00	681.	980.10	639.49	1084.1	271.4	1601.	1952.6	1257.9	271.4	1286.8	.00020	.54886E-03	.51688E-03	1.67	84.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 4

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printout option. The output of the short run can then be examined to verify that all input data read by RTDM is correct.

For each hour processed, RTDM writes the input meteorology and the receptor concentrations to a disk file. The ANALYSIS post-processor reads this file and produces summary statistics (see Section 6). The user can also obtain printouts of plume characteristics and plume-receptor geometry for each hour by activating the verbose mode (parameter group 25). An example of this printout is shown in Figure 5-2.

Errors made by the user in entering data in the PARAMETERS, STACKS, POINTS, TERRAIN, or EXECUTE sections are identified by self-explanatory error messages. In most cases, the errors are fatal and the program execution terminates.

5.3 Computer Job Control Considerations

Several input/output files are involved in an RTDM run. They are described below, along with suggested file names associated with FORTRAN "OPEN" statements.

Unit #	File Name	File Description
5	"@DATA"	Input run stream (see Section 5.1)
6	"@LIST"	Output file to be printed (see Section 5.2)
9	"CONC.TP"	Output disk file containing receptor concentrations and input meteorology for each hour
7	"METFILE"	Hourly meteorological data (see Section 3.1)
8	"EMISFILE"	Optional hourly emissions data (see Section 3.2)

The RTDM program consists of 22 routines. The flow of the program and routines involved in each step are described in Table 5-5.

TABLE 5-5

FUNCTIONS OF RTDM ROUTINES

Routine Group	Descriptions of Functions
RTDM	Main program; reads keywords and calls subroutines
BLKFIX, INPAR, WRPAR	Sets defaults in parameter groups, reads user-specified parameter values and prints parameter settings
STACKS	Reads and prints stack information
POINTS	Reads and prints receptor information
TERRAIN	Reads and prints terrain information, prints a terrain receptor map.
RTXEQ	Reads hourly meteorological and emissions data
CONC	Calculates hourly concentrations, calls several subroutine groups listed below
PRISE, PENETRATE	Computes plume rise, determines fraction of the plume that penetrates the mixing lid
PSRCE	Computes horizontal position of plume relative to receptor
SIGMAY, SIGMAZ, BRIGGS, PGYZ	Calculates σ_y, σ_z
VERT, DOWNWD, VDF	Determines plume behavior near terrain, partial reflection factor
WRCONC, PAGE, LINES	Writes concentrations to disk file, creates file for printout

6. GUIDE TO THE USE OF THE POSTPROCESSOR PROGRAM - "ANALYSIS"

6.1 General Description

After RTDM is run, the resultant disk file of concentration values can be processed by one or more of the subroutines in the program ANALYSIS. The five subroutines are as follows:

Keyword	Function
TOPVAL	Displays, by receptor, the top n-hour average concentrations together with the day and hour of occurrence.
CUMFREQ	Reads a sequence of hourly concentrations and tabulates the average concentrations and cumulative frequencies of n-hour averages for each receptor.
PEAK	Reads a sequence of hourly concentrations and tabulates for each receptor all (non-overlapping) n-hour averages which exceed a specified ambient air quality standard.
AVERAGES	Reads a sequential concentration data set and averages these values, where "n" is any integer greater than 1 up to 24. Results are stored in a binary file as running (overlapping) n-hour averages.
SEQADD	Reads up to 5 sequential concentration files and adds hourly concentrations from each. A scale factor can be applied to

each data set independently. The hourly sum is written to a new concentration file.

6.2 TOPVAL

6.2.1 Description

The analytical tool TOPVAL is used to display the highest average concentrations which are predicted to occur at each receptor. The number of top values calculated is user-specified; however, the number of receptors (NR) multiplied by the number of top concentration levels (NM) must be $\leq$ 2,500. For example, if concentrations were calculated at 250 receptors, then:

$$NM = \frac{2{,}500}{NR}$$

$$= \frac{2{,}500}{250}$$

$$NM = 10$$

Thus, the maximum number of top values which can be specified in this instance is ten. The number of receptors to be processed is specified in the TOPVAL input.

The averaging period for which TOPVAL calculates concentrations is also user specified for any period of hours up to 24. TOPVAL will then calculate blocks of n-hour average concentrations from the first hour to the last, arrange these values from the highest to lowest for each receptor, and display the concentrations with the corresponding day and hour of occurrence. This day and hour specify the ending hour of the time period. The first hour in the file is referenced as day one and hour one. In addition, TOPVAL lists the 25 highest and highest, second-highest concentrations over the entire field of receptors.

If desired, it is possible to process only the beginning segment of the hourly concentration file by using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

For example, if only the highest concentrations for Julian days 1-100 are needed from a complete 1-year disk file (which begins on the first hour of January 1st), the following values should be used:

(hours processed) = 24 * (100) + 0 = 2400

If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours. The total number of processed hours are printed on the output.

6.2.2 Input Stream

This keyword requires 2 data lines.

Line 1:

LP (I5)	(Cols. 11-15):	the number of hours in the averaging period. If omitted or 0, LP is set to 1.
NH (I5)	(Cols. 16-20)	the number of hours represented by each record of the input binary file (default = 1).

NM (I5) (Cols. 21-25): the number of topmost average values to be printed for each receptor. NM must always be specified and must satisfy

$$0 < NM \text{ and}$$
$$NM*NR \leq 2{,}500$$

where NR is the number of receptors.

DAYSIN (F10.0) (Cols. 26-35): the number of days to be read (if omitted or 0, the file is read from hour = 1 to end-of-file). Defaults to 0.

HOURSIN (F10.0) (Cols. 36-45): the number of hours to be read (if omitted or 0, the file is read from hour = 1 to the end-of-file). Defaults to 0.

DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours) = 24 * DAYSIN + HOURSIN.

If (hours) = 0 then the file is read to end-of-file. Default values are 0.

Line 2:

NR (I10) (Cols. 11-20): the number of receptors to be processed; must satisfy

$$1 \leq NR \leq 400$$

or program aborts (no default value).

RFACT (F10.1) (Cols. 21-30): the factor to convert internal concentration units (gm/m^3) to external units for printing (default is for $\mu g/m^3$).

See Figure 6-1 for example input.

6.2.3 Input Data

Input data for TOPVAL is composed of the sequential output of RTDM which is stored on disk. TOPVAL will read this binary file using unit 8.

6.2.4 Output

TOPVAL will generate a table with one row for each receptor, where each row represents an ordered sequence of the top NM average values encountered in the file for that receptor. Below each top value, the day and hour of occurrence are printed. The day and hour represent the time of the last hour used in the printed average. The first hour in the file is referenced as day one and hour one. See Figure 6-2 for a sample output.

In the analysis program TOPVAL, this output is designated to a specific output unit (IPUT). This unit is set to 6.

6.2.5 Diagnostics

Four error messages are associated with TOPVAL. These messages are:

"NR OUT OF RANGE" Indicates that the number of user-specified receptors is < 1 or > 400.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

TOPVAL
              1    1    4
                  30  1000000.
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-1 Example of TOPVAL Input Stream

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

TOPVAL

LP	NH	NM	DAYSIN	HOURIN
1	1	4	0.	0.

NR	RFACT
30	1000000.

Figure 6-2 Example of TOPVAL Output

TOP 4 CONCENTRATIONS OF 1-HOUR AVERAGES FOR 4. HOURS

RECEPTOR	TOP 1	TOP 2	TOP 3	TOP 4	TOP
1	103.9480	.0018	.0017	.0000	
DAY/HOUR	1 4	1 1	1 3	1 2	
2	7.4715	.0000	.0000	.0000	
DAY/HOUR	1 4	1 1	1 3	0 0	
3	163.4984	.0091	.0001	.0000	
DAY/HOUR	1 4	1 1	1 3	1 2	
4	131.7615	.0440	.0046	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
5	279.1396	11.7389	2.9620	.0131	
DAY/HOUR	1 4	1 2	1 3	1 1	
6	253.2820	.1103	.0304	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
7	171.1372	.0098	.0010	.0000	
DAY/HOUR	1 4	1 1	1 3	1 2	
8	554.8120	252.9272	1.2858	.0132	
DAY/HOUR	1 2	1 4	1 3	1 1	
9	345.8530	39.0648	.0000	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
10	359.9045	74.2378	.0000	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
11	322.7112	45.8592	.0000	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
12	356.3389	21.2265	.0005	.0000	
DAY/HOUR	1 4	1 3	1 1	1 2	
13	337.1736	10.1307	6.4003	.0043	
DAY/HOUR	1 4	1 2	1 3	1 1	
14	303.9636	7.8294	.0018	.0017	
DAY/HOUR	1 4	1 3	1 2	1 1	
15	314.2187	120.3929	.0000	.0000	
DAY/HOUR	1 4	1 3	1 1	0 0	
16	349.0750	110.2221	.0000	.0000	
DAY/HOUR	1 4	1 3	1 1	0 0	

Figure 6-2 (Continued)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

TOP 4 CONCENTRATIONS OF 1-HOUR AVERAGES FOR 4. HOURS

RECEPTOR	TOP 1		TOP 2		TOP 3		TOP 4		TOP
17	329.5166		83.7689		.0000		.0000		
DAY/HOUR	1	4	1	3	1	1	0	0	
18	366.8562		85.3995		.0000		.0000		
DAY/HOUR	1	4	1	3	1	1	0	0	
19	303.7729		63.0033		.0000		.0000		
DAY/HOUR	1	4	1	3	1	1	0	0	
20	187.7819		6.9033		.0169		.0007		
DAY/HOUR	1	4	1	3	1	1	1	2	
21	88.7205		.0008		.0000		.0000		
DAY/HOUR	1	4	1	1	1	3	0	0	
22	265.0759		1.1402		.0202		.0003		
DAY/HOUR	1	4	1	3	1	1	1	2	
23	346.9060		106.5185		.0000		.0000		
DAY/HOUR	1	4	1	3	1	1	0	0	
24	193.8985		4.2444		.0152		.0000		
DAY/HOUR	1	4	1	3	1	1	1	2	
25	.0000		.0000		.0000		.0000		
DAY/HOUR	0	0	0	0	0	0	0	0	
26	.0000		.0000		.0000		.0000		
DAY/HOUR	0	0	0	0	0	0	0	0	
27	.0000		.0000		.0000		.0000		
DAY/HOUR	1	3	0	0	0	0	0	0	
28	.0032		.0029		.0000		.0000		
DAY/HOUR	1	4	1	3	0	0	0	0	
29	.0000		.0000		.0000		.0000		
DAY/HOUR	0	0	0	0	0	0	0	0	
30	.0000		.0000		.0000		.0000		
DAY/HOUR	0	0	0	0	0	0	0	0	

Figure 6-2 (Continued)

TOP 25 HIGHEST AND SECOND-HIGHEST CONCENTRATIONS

	HIGHEST		SECOND-HIGHEST	
RANK	RECEPTOR	CONCENTRATION	RECEPTOR	CONCENTRATION
1	8	554.812	8	252.927
2	18	366.856	15	120.393
3	10	359.905	16	110.222
4	12	356.339	23	106.519
5	16	349.075	18	85.400
6	23	346.906	17	83.769
7	9	345.853	10	74.238
8	13	337.174	19	63.003
9	17	329.517	11	45.859
10	11	322.711	9	39.065
11	15	314.219	12	21.226
12	14	303.964	5	11.739
13	19	303.773	13	10.131
14	5	279.140	14	7.829
15	22	265.076	20	6.903
16	6	253.282	24	4.244
17	24	193.899	22	1.140
18	20	187.782	6	.110
19	7	171.137	4	.044
20	3	163.498	7	.010
21	4	131.761	3	.009
22	1	103.948	28	.003
23	21	88.721	1	.002
24	2	7.471	21	.001
25	28	.003	2	.000

Figure 6-2 (Continued)

"NM * NR OUT OF RANGE" Indicates that the number of user specified top concentrations requested is greater than $\frac{2,500}{NR}$ where NR = the number of receptors.

"ILLEGAL DATA LINE" Indicates an error was found in the TOPVAL input stream.

"UNEXPECTED END OF CONCENTRATION FILE" Indicates that a premature end-of-file was found in the binary concentration file.

6.3 CUMFREQ

6.3.1 Description

CUMFREQ can be used to tabulate the average concentrations and cumulative frequencies of occurrence for any averaging period for each receptor. A maximum of 400 receptors and 20 frequency levels can be specified. Each frequency level which is input denotes an upper bound, such that the program calculates the percentage of concentrations less than or equal to that level.

The analysis also includes:

all remaining occurrences > NLEV (last)

If desired, only the beginning of the input hourly concentration file can be processed using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

It should be noted that the first hour in the hourly concentration file is referenced as day one and hour one. (See example in Section 6.2.1.) If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours. The total number of processed hours are printed on the output. The CUMFREQ program will also output average concentration values for the user-specified averaging time period. When a partial concentration file is specified for analysis, the concentrations are averaged for that portion of the file only.

6.3.2 Input Stream

Input:

This keyword requires a first input line and may have up to 5 additional lines.

Line 1:

HOURSIN (F10.0) (Cols. 21-30):	the number of hours to be read (if omitted or 0, the file is read from hour = 1 to end of file). Defaults to 0.
DAYSIN (F10.0) (Cols. 31-40):	the number of days to be read (if omitted or 0, the file is read from hour = 1 to end of file). Defaults to 0.

DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

If (hours) = 0 then the file is read to end of file. Default values are 0.

RFACT (F10.0)	(Cols. 51-60):	the factor which converts internal units (gm/m^3) to external units (which default is $\mu g/m^3$). The levels for frequency tabulations must be in these external units.
NHR (I10)	(Cols. 61-70):	the number of hours in the averaging period (if omitted or 0, NHR = 1 is assumed).
NLEV (I5)	(Cols. 71-75):	the number of levels (where $0 < NLEV \leq 20$). A zero indicates that only averages will be calculated.
NR (I5)	(Cols. 75-80):	the number of receptors must satisfy $1 < NR \leq 400$.

Lines 2-5 (10X, 6F10.1):

The next input line (and as many others as are needed) contain NLEV levels, 6 per line, in the 10 column fields beginning in column 11 and ignoring columns 71 to 80. See Figure 6-3 for a sample CUMFREQ package.

6.3.3 Input Data

The input data for CUMFREQ is composed of the sequential output from RTDM which is stored on disk. CUMFREQ will read this binary file from unit 8.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

CUMFREQ
                                                    1000000.         1    3   30
                100.      200.      500.
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

Figure 6-3 Example of CUMFREQ Input Stream

6.3.4 Output

This keyword produces a table, by receptor and level, giving the observed frequency of occurrence as well as the cumulative frequency of occurrence. The final column gives, by receptor, the average concentrations for the entire time period analyzed. See Figure 6-4 for a sample of the output.

In the analysis program CUMFREQ, the output is designated to unit 6.

6.3.5 Diagnostics

The error messages for CUMFREQ are as follows:

"NLEV OUT OF RANGE"	Indicates that the number of user-specified levels is < 0 or > 20.
"NR OUT OF RANGE"	Indicates that the number of user-specified receptors is < 1 or > 400.
"INPUT FILE TOO SHORT"	Indicates that a premature end-of-file was encountered in the binary concentration file.
"FIRST DATA LINE FORMAT ERROR"	Indicates that an error was found in the CUMFREQ input stream.

6.4 PEAK

6.4.1 Description

The analysis program PEAK is used to read a sequence of hourly concentrations. All non-overlapping n-hour averages which exceed a specified ambient air quality threshold (e.g., standard) are tabulated for each receptor. The output from PEAK presents a detailed breakdown of concentrations for each hour contained in the averaging period

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CUMFREQ

HOURIN	DAYSIN	RFACT	NHR	NLEV	NR
0.	0.	1000000.	1	3	30

CUMULATIVE LEVELS:

100.0	200.0	500.0

Figure 6-4 Example of CUMFREQ Output

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 4. OBSERVATIONS

RECEPTOR	LEVEL 100.0	LEVEL 200.0	LEVEL 500.0	LEVEL **********	AVG:# OBS= 4.0
1	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	25.9879
2	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.8679
3	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	40.8769
4	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	32.9525
5	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	73.4634
6	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	63.3557
7	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	42.7870
8	.5000	.0000	.2500	.2500	.0000
CUM FREQ	.5000	.5000	.7500	1.0000	202.2595
9	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	96.2294
10	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	108.5356
11	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	92.1426
12	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	94.3915
13	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	88.4272
14	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	77.9492
15	.5000	.2500	.2500	.0000	.0000
CUM FREQ	.5000	.7500	1.0000	1.0000	108.6529
16	.5000	.2500	.2500	.0000	.0000
CUM FREQ	.5000	.7500	1.0000	1.0000	114.8243

Figure 6-4 (Continued)

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 4. OBSERVATIONS

RECEPTOR	LEVEL 100.0	LEVEL 200.0	LEVEL 500.0	LEVEL **********	AVG:# OBS= 4.0
17	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	103.3214
18	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	113.0639
19	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	91.6941
20	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	48.6757
21	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	22.1803
22	.7500	.0000	.2500	.0000	.0000
CUM FREQ	.7500	.7500	1.0000	1.0000	66.5591
23	.5000	.2500	.2500	.0000	.0000
CUM FREQ	.5000	.7500	1.0000	1.0000	113.3561
24	.7500	.2500	.0000	.0000	.0000
CUM FREQ	.7500	1.0000	1.0000	1.0000	49.5396
25	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0000
26	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0000
27	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0000
28	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0015
29	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0000
30	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	.0000

Figure 6-4 (Continued)

along with the corresponding hourly weather conditions (wind direction wind speed, mixing depth and stability). A table of maximum n-hour concentrations and a table of threshold exceedances is also obtained.

Any threshold value (THR) greater than zero may be input. The program will, thus, provide information for any average concentrations equal to or exceeding the specified value. To limit output, the threshold should be chosen with care. A value which is low in relation to the averaged concentrations will result in massive output, since the concentration and meteorological parameters are printed for each hour in the averaged time period for each exceedance of the threshold. As a screening tool for the determination of an appropriate threshold value, the results from CUMFREQ can be used. The output from CUMFREQ which is run with a corresponding averaging period will present the frequency of concentrations at or above a specified level. In addition, the logical variable LPRINT in PEAK can be set to FALSE which will produce only a summary of case-by-case output.

The user may specify any hourly averaging period up to and including 24. If desired, it is possible to process only the beginning segment of the hourly concentration file by using the variables DAYSIN and HOURSIN. DAYSIN and HOURSIN are used to compute the hours to be processed by the rule:

(hours processed) = 24 * DAYSIN + HOURSIN

It should be noted that the first hour in the hourly concentration file is referenced as day one and hour one (see example in Section 6.2.1). If the averaging time does not divide evenly into the hours to be processed, the program will automatically complete the period by including the next available hours. If no following hours are found, the program will end at the last complete time period and ignore the remaining hours.

6.4.2 Input Stream

This keyword requires two data lines. The alphabetic characters in LPRINT and IUNITS must be left-justified. (See Figure 6-5.)

Line 1:

NHR (I5)	(Cols. 11-15):	Number of hours in the averaging period; must satisfy $1 \leq NHR \leq 24$ (if omitted or 0, NHR = 1 is assumed).
THR (F10.0)	(Cols. 16-25):	Threshold; must satisfy THR 0. Defaults to 0.
HOURSIN (F10.0)	(Cols. 26-35):	The number of hours to be read (if omitted or 0, the file is read from hour = 1 end-of-file). Defaults to 0.
DAYSIN (F10.0)	(Cols. 36-45):	The number of days to be read (if omitted or 0, the file is read from hour = 1 to EOF). Defaults to 0.
NH (I10)	(Cols. 46-55):	The number of hours represented by each record of the input binary file.

Line 2:

RFACT (F10.0)	(Cols. 11-20):	The factor to convert internal concentrations for printing. Default changes gm/m^3 to $\mu g/m^3$.
UNITS (L4)	(Cols. 21-28):	Units for labeling. Defaults to "µG/M**3" Left justify.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

PEAK
              1  250.
                              TRUE         30
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-5. Example of PEAK Input Stream

LPRINT (L10)	(Cols. 31-40):	Logical variable to control the amount of output. If it is 'TRUE', a detailed breakdown for threshold violations is obtained. If 'FALSE', a summary of violations is obtained. Default = TRUE. Left justify.
NR (I5)	(Cols. 41-45):	The number of receptors to be processed; must satisfy $1 \leq NR \leq 400$ or program aborts (no default value).
SCALE (F10.0)	(Cols. 46-55):	Scale factor for input concentrations. Defaults to 1.0.

6.4.3 Input Data

The input data for PEAK is composed of the sequential output from RTDM which is stored on disk. PEAK will read this binary file from unit 8.

6.4.4 Output

There are three forms of output:

- A detailed breakdown of concentrations, their averages, and weather conditions for each receptor where the n-hour average concentration exceeded the threshold.
- A tabulation of the maximum n-hour average concentrations with the day and hour of occurrence for each receptor. (Maximums are independent of the threshold level.)
- A tabulation of threshold exceedances of n-hour averages by receptor.

The tables of maximums and exceedances report predicted concentrations by receptor. These values are arranged in rows each containing 8 receptors in order of their input into RTDM. The first row lists receptors 1-8, the second row lists receptors 9-16, the third row lists receptors 17-24, etc., up to the last receptor. See Figure 6-6 for a sample of the output.

In the analysis program PEAK, the output is designated to unit 6.

6.4.5 Diagnostics

The error messages for PEAK are as follows:

"NR IS OUT OF RANGE"	Indicates that the number of receptors is < 1 or > 400.
"NHR IS OUT OF RANGE"	Indicates that the user-specified number of averaging hours is > 24 or < 1.
"THR IS OUT OF BOUNDS"	Indicates that the user-specified threshold level is < 0.
"ILLEGAL DATA LINE"	Indicates that an error was found in the PEAK input stream.
"UNEXPECTED END OF FILE"	Indicates that a premature end-of-file was found in the binary concentration file.

6.5 AVERAGES

6.5.1 Description

The analytical tool AVERAGES is applied to a binary RTDM concentration file and results in a binary concentration file of running averages for a user-specified hourly averaging period (maximum of 24 hours). The maximum number of receptors processed by AVERAGES is 400. The resulting file can be processed by the other post-processing programs, such as CUMFREQ, TOPVAL, and PEAK.

```
POST-PROCESSING ANALYSIS PROGRAM     VERSION 2.30      LEVEL 851125


PEAK


      NHR        THR       HOURIN     DAYSIN        NH
        1       250.          0.         0.          1


       RFACT    UNITS          LPRINT    NR   SCALE
      1000000.                      T    30           1.
```

Figure 6-6. Example of PEAK Output

```
 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  2  AT RECEPTOR   8
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       554.8120                 2140  190    4   13
MEAN       554.8120

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   5
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       279.1396                  773  210    2    1
MEAN       279.1396

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   6
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       253.2820                  773  210    2    1
MEAN       253.2820

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   8
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       252.9272                  773  210    2    1
MEAN       252.9272

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR   9
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       345.8530                  773  210    2    1
MEAN       345.8530

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  10
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       359.9045                  773  210    2    1
MEAN       359.9045

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  11
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       322.7112                  773  210    2    1
MEAN       322.7112

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  12
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       356.3389                  773  210    2    1
MEAN       356.3389

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  13
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       337.1736                  773  210    2    1
MEAN       337.1736

 250.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  4  AT RECEPTOR  14
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL                  MIX  DIR  STAB SPD
   1       303.9636                  773  210    2    1
MEAN       303.9636
```

Figure 6-6 (cont.)

```
  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  15
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        314.2187                773  210    2    1
MEAN         314.2187

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  16
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        349.0750                773  210    2    1
MEAN         349.0750

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  17
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        329.5166                773  210    2    1
MEAN         329.5166

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  18
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        366.8562                773  210    2    1
MEAN         366.8562

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  19
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        303.7729                773  210    2    1
MEAN         303.7729

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  22
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        265.0759                773  210    2    1
MEAN         265.0759

  250.0000 uG/M**3   EXCEEDED AT DAY     1 HOUR   4   AT RECEPTOR  23
**** CONCENTRATIONS (uG/M**3 )             WEATHER
RECORD         TOTAL                 MIX  DIR  STAB SPD
    1        346.9060                773  210    2    1
MEAN         346.9060
```

Figure 6-6 (Continued)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

TOTAL MAXIMUM CONCENTRATIONS (uG/M**3) FOR 4 (1-HOUR) AVERAGING PERIOD

RECEP	1	2	3	4	5	6	7	8
CONC	103.948	7.471	163.498	131.761	279.140	253.282	171.137	554
DAY/HR	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1

RECEP	9	10	11	12	13	14	15	1
CONC	345.853	359.905	322.711	356.339	337.174	303.964	314.219	349.
DAY/HR	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1

RECEP	17	18	19	20	21	22	23	24
CONC	329.517	366.856	303.773	187.782	88.721	265.076	346.906	193
DAY/HR	1 4	1 4	1 4	1 4	1 4	1 4	1 4	1

RECEP	25	26	27	28	29	30
CONC	.000	.000	.000	.003	.000	.000
DAY/HR	0 0	0 0	1 3	1 4	0 0	0 0

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

NUMBER OF 1-HOUR AVERAGES ABOVE 250.0000 uG/M**3 FOR 4 HOURS

RECEPTORS:

1- 8	0	0	0	0	1	1	0	
9- 16	1	1	1	1	1	1	1	
17- 24	1	1	1	0	0	1	1	
25- 30	0	0	0	0	0	0		

Figure 6-6 (Continued)

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------

AVERAGE
    3    30
99999

---------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-7 Example of AVERAGE Input Stream entries. Thus, a request for 1-hour averaged values by the other postprocessing programs will result in the proper retrieval of data created by AVERAGES. The variables to specify partial files of data (DAYSIN and HOURSIN) should also be manipulated as if each averaging period used by AVERAGES is 1 hour in length.

The output from the postprocessing programs will indicate the beginning rather than the last hour of each running average concentration. In the detailed output from PEAK, the meteorological data and concentration levels listed for each threshold violation will refer to the conditions which had occurred during the last hour of the averaging period, although the hour listed is the first hour of the averaging period.

6.5.6 Diagnostics

The error messages associated with AVERAGES are as follows:

"ILLEGAL CARD FORMAT FOR DATA"	Indicates that an error was found in the AVERAGES input stream.
"NUMBER OF HOURS TOO SMALL"	Indicates that the user-specified averaging period is < 1.
"UNEXPECTED END OF FILE"	Indicates that a premature end-of-file was found in the binary concentration file.

6.6 SEQADD

6.6.1 Description

The SEQADD keyword is used to scale concentrations from a single concentration file, or to add the concentrations from up to 5 input files to create a new file. Individual user-specified scale factors are applied to the hourly concentrations from each file before the results are added. The maximum member of receptors that can be processed by SEQADD is 400. The newly created file can be used as input to other postprocessing keywrods, such as CUMFREQ, TOPVAL, PEAK, and AVERAGES.

6.6.2 Input Stream

The card image input required for the SEQADD after the "SEQADD" keyword is as follows (see Figure 6-8 for an example):

Line 1 (free format):

N:	The number of concentration files to be scaled and added.
NRECP:	The number of receptors in each fiel (NOTE: each file must represent the same receptors for the same time period).

Line 2 (free format):

SCALE(I), I=1,N:	Scale factors for each respective file. Concentrations are multiplied by the scale factor for that file before being added.

6.6.3 Input Data

The input concentration data for SEQADD is comprised of from 1 to 5 output files from RTDM. These files are read via channels 11 through 15.

6.6.4 Output

The input specifications to SEQADD are echoed in printed output. A concentration file that results from scaling and adding the input concentration data is written to unit 10.

```
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
--------- --------- --------- --------- --------- --------- --------- ---------

SEQADD
2  30
1.0  1.0
99999

--------- --------- --------- --------- --------- --------- --------- ---------
12345678901234567890123456789012345678901234567890123456789012345678901234567890
         1         2         3         4         5         6         7         8
```

Figure 6-8 Example of SEQADD Input Stream

6.6.5 Processing of SEQADD Results

The new concentration file that results from the SEQADD run can be used as input to any other ANALYSIS keyword, including SEQADD itself. The file structure is the same as that of a concentration file produced directly by RTDM.

6.6.6 Diagnostics

The possible error messages associated with SEQADD are as follows:

"FORMAT ERROR IN READING NUMBER OF FILES, RECEPTOR"	Indicates non-integer data found on the first input line.
"FORMAT ERROR IN READING SCALE FACTORS"	A non-numeric character was encountered on the second input line.
"# OF INPUT FILES NOT BETWEEN 1 and 5"	Correct the first value on the first input line.
"# OF RECEPTORS NOT BETWEEN 1 AND 400:	Correct the second value on the first input line.

6.7 Computer Job Control Considerations

For ANALYSIS, the input run stream file is associated with unit 5, and the output with unit 6. For keywords PEAK, TOPVAL, and CUMFREQ, unit 8 is associated with the disk file of concentrations to be read (disk filename is "CONCFILE"). For keyword AVERAGES, unit 8 is associated with the concentration file to be read ("CONCFILE1") and unit 9 is associated with the concentration file to be written ("CONCFILE2")

7. SAMPLE RTDM RUN

A sample run of RTDM that can be used to determine whether the model has been properly installed on a user's computer system is shown in this section. The meteorological input file consists of 2 cases for each of 6 stability classes, and is shown in Figure 7-1. The input run stream chosen for this example is shown in Figure 7-2. Constant stack emissions are used, so an hourly emissions input file is not read by RTDM in this example. The RTDM output (case-study mode) is shown in Figure 7-3. Examples of postprocessor (ANALYSIS) runs consistent with the sample RTDM run are shown in Figure 7-4, using keywords TOPVAL, CUMFREQ, and PEAK.

7636524	220.	1.0	3000.	1.	68.	0.22	0.20	0.0	0.0	0.1	.09	2.0
7636604	220.	3.0	1000.	1.	68.	0.22	0.20	0.0	0.0	0.1	-.09	6.0
7636609	220.	2.0	3000.	2.	68.	0.16	0.12	0.0	0.0	0.12	.11	4.0
7636612	220.	4.0	700.	2.	68.	0.16	0.12	0.0	0.0	0.12	-.11	7.0
7636614	220.	2.0	3000.	3.	68.	0.11	0.08	0.0	0.0	0.15	.12	4.0
7636619	220.	7.0	550.	3.	68.	0.11	0.08	0.0	0.0	0.15	-.12	14.0
7700105	220.	3.0	1000.	4.	68.	0.08	0.06	0.0	0.0	0.20	.14	6.0
7700111	220.	15.	450.	4.	68.	0.08	0.06	0.0	0.0	0.20	-.14	30.0
7700113	220.	2.0	3000.	5.	68.	0.06	0.03	0.02	0.02	0.30	.20	5.0
7700116	220.	4.0	700.	5.	68.	0.06	0.03	0.003	0.005	0.30	-.20	10.0
7700119	220.	2.5	2000.	6.	68.	0.04	0.016	0.006	0.02	0.40	0.30	7.0
7700122	220.	4.0	650.	6.	68.	0.04	0.016	0.04	0.006	0.40	-.30	12.0

Figure 7-1   RTDM Input Meteorology Used for Sample Run

```
PARAMETERS
PR003   1.
PR004   10.0                0.      0.
PR022   1.
PR018   1.
PR019   1.
PR020   1.      .17
PR021   1.
PR023   1.
        22.5    22.5    22.5    22.5    22.5    22.5
PR025   1.
99999
STACKS
600.      800.      765.      SO2
STK1      121.92    5.0       20.0      370.      1000.
99999
POINTS
          603.16    801.61    2782.     WEST MT.
          602.75    799.90    2430.     BRUSH MT.
          603.46    799.41    2520.     WALKER MT.
          600.53    800.63    1100.
          600.64    800.76    1200.
          600.80    800.96    1300.
          600.85    801.01    1400.
          600.96    801.14    1500.
          601.09    801.30    1600.
          601.31    801.56    1700.
          601.43    801.70    1800.
          601.61    801.92    1900.
          601.84    802.19    2000.
          603.59    804.27    2100.
          603.70    804.40    2200.
          603.89    804.63    2300.
          603.93    804.68    2400.
          603.96    804.72    2500.
          603.98    804.74    2600.
          603.99    804.76    2700.
          604.00    804.77    2800.
          604.03    804.80    2900.
          604.04    804.82    3000.     TUMBLEDOWN MT.
          603.35    793.70    1631.     BUNKER MT.
          598.10    798.23    2440.     RECORD HILL
          596.53    799.26    2440.     OLD TURK MT.
99999
TERRAIN
1100.     100.
010       4.46   4.78   5.01   7.00   7.38   -999.

020       1.50   3.35   3.45   3.75   3.85   3.95   4.05   4.20   4.60   4.70
          4.80   -999.
030       1.40   1.50   1.65   3.00   3.10   3.16   3.24   3.31   3.50   -999.

040       1.28   1.40   1.46   1.53   1.61   1.74   1.88   1.98   2.72   -999.

050       1.15   1.30   1.39   1.49   1.60   1.69   1.75   1.82   1.94   2.06
          2.13   2.22   2.34   -999.
060       1.18   1.29   1.40   1.48   1.58   1.69   1.80   1.94   2.10   2.24
```

Figure 7-2   RTDM Input Run Stream Used for Sample Run

	2.58	-999.								
070	1.25	1.47	1.60	1.72	1.87	2.03	2.20	2.32	2.47	-999.
080	1.41	1.58	1.70	1.87	2.00	2.12	2.24	2.38	2.44	2.49
	2.59	-999.								
090	1.64	1.75	1.88	1.99	2.09	2.20	2.39	2.59	2.76	2.94
	3.08	-999.								
100	1.99	2.09	2.18	2.30	2.52	2.59	2.66	2.71	2.81	2.95
	3.09	3.18	3.29	-999.						
110	2.02	2.28	2.40	2.52	2.63	2.72	3.00	3.19	3.55	-999.
120	2.21	2.41	2.52	2.63	5.75	5.90	6.01	6.18	6.30	6.50
	6.73	6.85	7.07	-999.						
130	2.75	5.47	5.62	5.92	6.01	6.70	6.90	7.37	7.48	7.79
	-999.									
140	1.22	1.29	6.70	6.80	6.90	7.00	-999.			
150	1.11	1.19	1.24	1.29	1.32	-999.				
160	1.08	1.15	1.21	1.28	1.38	1.42	5.13	5.32	5.51	-999.
170	1.01	1.12	1.23	1.34	1.48	1.53	4.98	-999.		
180	0.81	1.04	1.18	1.38	1.51	1.66	1.82	2.10	2.23	2.31
	4.79	4.92	5.05	-999.						
190	0.79	0.90	1.07	1.23	1.37	1.50	1.71	1.81	1.91	2.01
	-999.									
200	0.68	0.82	1.00	1.16	1.30	1.50	1.68	1.95	2.52	-999.
210	0.71	0.83	1.03	1.20	1.43	1.58	1.81	2.15	2.30	2.52
	2.62	2.73	-999.							
220	0.82	0.99	1.25	1.32	1.49	1.70	2.04	2.22	2.50	2.86
	5.58	5.75	6.05	6.11	6.16	6.19	6.21	6.23	6.27	6.29
230	1.05	1.21	1.48	1.61	2.02	2.17	2.28	2.42	2.54	2.67
	2.84	3.01	3.17	3.21	3.28	3.32	7.42	7.49	-999.	
240	1.05	1.20	1.41	1.61	1.78	1.90	2.04	2.16	2.38	2.52
	2.68	2.80	2.91	3.14	3.31	3.39	3.45	-999.		
250	1.00	1.23	1.31	1.40	1.56	1.70	1.86	1.97	2.08	2.17
	2.30	2.45	2.57	2.80	-999.					
260	1.00	1.11	1.27	1.36	1.49	1.60	1.78	2.09	2.27	2.45
	2.56	2.63	2.73	2.84	-999.					
270	1.03	1.16	1.28	1.38	1.48	1.53	1.66	1.73	1.88	2.09
	2.26	2.49	2.61	-999.						
280	1.09	1.22	1.34	1.43	1.54	1.63	1.71	1.76	1.82	1.89
	1.97	2.10	3.50	3.58	3.70	-999.				
290	1.16	1.28	1.43	1.57	1.67	1.76	1.83	1.98	2.13	3.26
	3.34	3.50	3.65	3.79	3.90	4.05	-999.			
300	1.28	1.41	1.60	1.74	1.89	2.10	2.90	3.01	3.16	3.24
	3.33	3.96	4.03	4.17	-999.					
310	1.46	1.60	1.75	1.90	2.90	3.04	3.42	3.59	3.75	3.90
	3.98	4.08	4.20	8.25	8.35	-999.				
320	1.65	1.85	2.00	3.12	3.36	3.49	4.05	4.20	4.42	8.55
	8.65	-999.								
330	2.18	2.97	4.42	4.61	4.78	-999.				
340	6.23	6.42	6.58	-999.						

Figure 7-2 (cont.)

```
350        4.69   4.90   -999.

360        4.31   6.80   -999.

99999
EXECUTE
       220.  5.0   3000. 4.    68.   0.08  0.06  0.0   0.0   0.20  0.14 10.
ENDJOB
```

Figure 7-2 (cont.)

```
ROUGH TERRAIN DIFFUSION MODEL   VERSION 3.2   LEVEL 861130                    PAGE   1

     MODEL PARAMETERS:

     PR001:  HORIZONTAL SCALE IS 1000.000 METERS PER USER UNIT

     PR002:  VERTICAL SCALE IS     .305 METERS PER USER UNIT

     PR003:  WIND SPEED SCALE IS    1.000 M/SEC PER USER UNIT

     PR004:  ANEMOMETER #1 HEIGHT ABOVE ZA (USED FOR PLUME RISE) IS  10.0 M
             IF AVAILABLE, ANEMOMETER #2 HEIGHT ABOVE ZA (USED FOR PLUME DILUTION) IS    .0 M
             DILUTION WIND SPEED OPTION IS 0      (IF 0, ONE WIND SPEED--AT STACK HEIGHT--IS USED FOR PLUME RISE AND DILUTION
             IF 1, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE AND TO PLUME HEIGHT FOR DILUTION
             IF 2, WIND SPEED AT LEVEL #1 IS EXTRAPOLATED TO STACK-TOP HEIGHT FOR PLUME RISE,
             AND THE SPEED AT LEVEL #2 IS EXTRAPOLATED TO PLUME HEIGHT FOR DILUTION)
             ZA (HEIGHT IN METERS ABOVE STACK BASE ELEVATION WHERE THE WIND SPEED PROFILE IS ASSUMED TO ORIGINATE) =     .000

     PR005:  DEFAULT WIND SPEED PROFILE EXPONENTS AS A FUNCTION OF STABILITY CLASS (1-6, RESPECTIVELY):
                        .0900   .1100   .1200   .1400   .2000   .3000

     PR006:  DISPERSION COEFFICIENTS ARE BRIGGS RURAL/ASME-1979 (UNLESS REPLACED BY ON-SITE TURBULENCE DATA).

     PR009:  PARTIAL PLUME PENETRATION OF MIXING LIDS IS NOT BEING USED.

     PR010:  BUOYANCY-ENHANCED PLUME DISPERSION IS USED; PARAMETER ALPHA IS    3.162

     PR011:  UNLIMITED MIXING HEIGHT USED FOR STABLE CONDITIONS

     PR012:  TRANSITIONAL PLUME RISE IS USED.

     PR013:  PLUME PATH COEFFICIENTS FOR STABILITY CLASSES 1-6:   .500  .500  .500  .500  .500  .500

     PR014:  DEFAULT VERTICAL POTENTIAL TEMPERATURE GRADIENTS USED FOR STABLE PLUME RISE (CLASSES 5 & 6):   .0200  .0350

     PR015:  STACK-TIP DOWNWASH IS NOT USED.

     PR016:  Y-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Y.

     PR017:  Z-COMPONENT TURBULENCE INTENSITY VALUES ARE NOT PROVIDED; STABILITY CLASS IS USED TO OBTAIN SIGMA-Z.

     PR018:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING STABLE PLUME RISE.

     PR019:  HOURLY VERTICAL POTENTIAL TEMPERATURE GRADIENTS ARE PROVIDED FOR COMPUTING HCRIT.

     PR020:  WIND DIRECTION SHEAR IS USED IN COMPUTATION OF SIGMA-Y; COEFFICIENT =   .17

     PR021:  HOURLY VALUES OF WIND SPEED PROFILE EXPONENT ARE PROVIDED.

     PR022:  PARTIAL REFLECTION ALGORITHM IS BEING USED; KEYWORD TERRAIN MUST BE USED TO READ IN TERRAIN.

     PR023:  OFF-CENTERLINE CONCENTRATIONS ARE COMPUTED FOR ALL STABILITIES; NO SECTOR AVERAGING IS USED.

     PR024:  HOURLY EMISSIONS DATA ARE NOT AVAILABLE; CONSTANT VALUES SPECIFIED IN THE STACKS SECTION ARE USED.

     PR025:  DETAILED INFORMATION ABOUT EACH CASE WILL BE PRINTED.
```

Figure 7-3   RTDM Output from Sample Run

MODELED STACK PARAMETERS:

X,Y COORDINATE OF ALL SOURCES (USER UNITS) IS (600.00 , 800.00) OR (600000.00 , 800000.00) METERS
BASE HEIGHT OF ALL SOURCES (USER UNITS) IS 765.000 OR 233.172 METERS
POLLUTANT IS SO2

	CODE NAME	STACK HT (M)	DIAMETER (M)	EXIT VEL (M/SEC)	STACK TEMP (K)	EMISSION RATE (G/SEC)
1	STK1	121.920	5.000	20.000	370.000	1000.000

Figure 7-3 (Page 2 of 14)

RECEPTOR POINT INFORMATION (ALL COORDINATES IN USER UNITS):

RECEPTOR	X-COORD	Y-COORD	HEIGHT	NAME
1	603.16	801.61	2782.00**	WEST MT.
2	602.75	799.90	2430.00**	BRUSH MT.
3	603.46	799.41	2520.00**	WALKER MT.
4	600.53	800.63	1100.00	
5	600.64	800.76	1200.00**	
6	600.80	800.96	1300.00**	
7	600.85	801.01	1400.00**	
8	600.96	801.14	1500.00**	
9	601.09	801.30	1600.00**	
10	601.31	801.56	1700.00**	
11	601.43	801.70	1800.00**	
12	601.61	801.92	1900.00**	
13	601.84	802.19	2000.00**	
14	603.59	804.27	2100.00**	
15	603.70	804.40	2200.00**	
16	603.89	804.63	2300.00**	
17	603.93	804.68	2400.00**	
18	603.96	804.72	2500.00**	
19	603.98	804.74	2600.00**	
20	603.99	804.76	2700.00**	
21	604.00	804.77	2800.00**	
22	604.03	804.80	2900.00**	
23	604.04	804.82	3000.00**	TUMBLEDOWN MT.
24	603.35	793.70	1631.00**	BUNKER MT.
25	598.10	798.23	2440.00**	RECORD HILL
26	596.53	799.26	2440.00**	OLD TURK MT.

** THIS RECEPTOR IS HIGHER IN ELEVATION THAN THAT OF THE LOWEST STACK TOP.
SPECIAL ALGORITHMS CONCERNING PLUME IMPINGEMENT AND REFLECTION MAY INFLENCE CONCENTRATIONS MODELED AT THIS RECEPTOR.

Figure 7-3 (Page 3 of 14)

TERRAIN INFORMATION:

TABLE OF DISTANCES (KM) FROM THE SOURCE TO ELEVATION CONTOURS AS A FUNCTION OF WIND DIRECTION

	ELEVATION IN USER UNITS:																			
WIND DIR.	1100.	1200.	1300.	1400.	1500.	1600.	1700.	1800.	1900.	2000.	2100.	2200.	2300.	2400.	2500.	2600.	2700.	2800.	2900.	3000.
10	4.46	4.78	5.01	7.00	7.38															
20	1.50	3.35	3.45	3.75	3.85	3.95	4.05	4.20	4.60	4.70	4.80									
30	1.40	1.50	1.65	3.00	3.10	3.16	3.24	3.31	3.50											
40	1.28	1.40	1.46	1.53	1.61	1.74	1.88	1.98	2.72											
50	1.15	1.30	1.39	1.49	1.60	1.69	1.75	1.82	1.94	2.06	2.13	2.22	2.34							
60	1.18	1.29	1.40	1.48	1.58	1.69	1.80	1.94	2.10	2.24	2.58									
70	1.25	1.47	1.60	1.72	1.87	2.03	2.20	2.32	2.47											
80	1.41	1.58	1.70	1.87	2.00	2.12	2.24	2.38	2.44	2.49	2.59									
90	1.64	1.75	1.88	1.99	2.09	2.20	2.39	2.59	2.76	2.94	3.08									
100	1.99	2.09	2.18	2.30	2.52	2.59	2.66	2.71	2.81	2.95	3.09	3.18	3.29							
110	2.02	2.28	2.40	2.52	2.63	2.72	3.00	3.19	3.55											
120	2.21	2.41	2.52	2.63	5.75	5.90	6.01	6.18	6.30	6.50	6.73	6.85	7.07							
130	2.75	5.47	5.62	5.92	6.01	6.70	6.90	7.37	7.48	7.79										
140	1.22	1.29	6.70	6.80	6.90	7.00														
150	1.11	1.19	1.24	1.29	1.32															
160	1.08	1.15	1.21	1.28	1.38	1.42	5.13	5.32	5.51											
170	1.01	1.12	1.23	1.34	1.48	1.53	4.98													
180	.81	1.04	1.18	1.38	1.51	1.66	1.82	2.10	2.23	2.31	4.79	4.92	5.05							
190	.79	.90	1.07	1.23	1.37	1.50	1.71	1.81	1.91	2.01										
200	.68	.82	1.00	1.16	1.30	1.50	1.68	1.95	2.52											
210	.71	.83	1.03	1.20	1.43	1.58	1.81	2.15	2.30	2.52	2.62	2.73								
220	.82	.99	1.25	1.32	1.49	1.70	2.04	2.22	2.50	2.86	5.58	5.75	6.05	6.11	6.16	6.19	6.21	6.23	6.27	6.29
230	1.05	1.21	1.48	1.61	2.02	2.17	2.28	2.42	2.54	2.67	2.84	3.01	3.17	3.21	3.28	3.32	7.42	7.49		
240	1.05	1.20	1.41	1.61	1.78	1.90	2.04	2.16	2.38	2.52	2.68	2.80	2.91	3.14	3.31	3.39	3.45			
250	1.00	1.23	1.31	1.40	1.56	1.70	1.86	1.97	2.08	2.17	2.30	2.45	2.57	2.80						
260	1.00	1.11	1.27	1.36	1.49	1.60	1.78	2.09	2.27	2.45	2.56	2.63	2.73	2.84						
270	1.03	1.16	1.28	1.38	1.48	1.53	1.66	1.73	1.88	2.09	2.26	2.49	2.61							
280	1.09	1.22	1.34	1.43	1.54	1.63	1.71	1.76	1.82	1.89	1.97	2.10	3.50	3.58	3.70					
290	1.16	1.28	1.43	1.57	1.67	1.76	1.83	1.98	2.13	3.26	3.34	3.50	3.65	3.79	3.90	4.05				
300	1.28	1.41	1.60	1.74	1.89	2.10	2.90	3.01	3.16	3.24	3.33	3.96	4.03	4.17						
310	1.46	1.60	1.75	1.90	2.90	3.04	3.42	3.59	3.75	3.90	3.98	4.08	4.20	8.25	8.35					
320	1.65	1.85	2.00	3.12	3.36	3.49	4.05	4.20	4.42	8.55	8.65									
330	2.18	2.97	4.42	4.61	4.78															
340	6.23	6.42	6.58																	
350	4.69	4.90																		
360	4.31	6.80																		

Figure 7-3 (Page 4 of 14)

MAP OF USER-SPECIFIED TERRAIN: LETTERS (SOME OVERWRITTEN) DENOTE ELEVATIONS (SEE TABLE); "+" = SOURCE; "*" = A RECEPTOR POINT
DISTANCES FROM SOURCE (0,0): XMIN = -6122.79 M, XMAX = 6396.47 M, YMIN = -7267.88 M, YMAX = 5362.32 M

CONTOUR CODES

A	1100.00
B	1200.00
C	1300.00
D	1400.00
E	1500.00
F	1600.00
G	1700.00
H	1800.00
I	1900.00
J	2000.00
K	2100.00
L	2200.00
M	2300.00
N	2400.00
O	2500.00
P	2600.00
Q	2700.00
R	2800.00
S	2900.00
T	3000.00

Figure 7-3 (Page 5 of 14)

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THE CODE FOR MISSING DATA IS PRESENTED AS FOLLOWS:
  A "1" IS INCLUDED IF WIND DIRECTION IS MISSING,
  A "2" IS INCLUDED IF WIND SPEED IS MISSING,
  A "3" IS INCLUDED IF MIXING HEIGHT IS MISSING,
  A "4" IS INCLUDED IF STABILITY CLASS IS MISSING,
  A "5" IS INCLUDED IF AMBIENT TEMPERATURE IS MISSING.
  IF THERE IS MISSING DATA FOR ANY OF THESE PARAMETERS, THE PREVIOUS GOOD VALUE IS USED.
  IF THERE IS MISSING DATA FOR OPTIONAL PARAMETERS, THE DEFAULT VALUE (OBTAINED FROM THE STABILITY CLASS) IS USED.
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CASE-HOUR # 1 YEAR, DAY, HOUR: 76 365 24

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	1.00	3000.	1	293.15	.2200*	.2000*	.0000	.0000	.1000	.0900	2.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 1.25 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 858.18 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	980.10	672.71	623.6	271.4	831.	1073.9	652.9	271.4	707.1	.00016	.71766E-03	.71766E-03	1.27	93.
2	1.69	-2.17	507.	980.10	726.36	344.1	271.4	430.	614.3	338.2	271.4	433.6	.00000	.45240E-03	.92340E-03	1.00	0.
4	.82	.00	102.	833.12	782.06	174.1	224.9	174.	333.2	164.6	224.9	278.7	.00120	.55868E-04	.14313E-02	1.00	53.
5	.99	.00	133.	928.10	861.81	208.5	254.9	238.	406.1	198.7	254.9	323.2	.00098	.70586E-04	.12343E-02	1.00	55.
6	1.25	.00	163.	980.10	898.57	259.2	271.4	318.	492.0	249.9	271.4	368.9	.00081	.11139E-03	.10813E-02	1.00	72.
7	1.32	.00	194.	980.10	883.33	273.0	271.4	336.	511.0	264.0	271.4	378.6	.00078	.13863E-03	.10536E-02	1.00	86.
8	1.49	.00	224.	980.10	868.09	305.9	271.4	379.	557.8	298.0	271.4	403.1	.00072	.19472E-03	.98972E-03	1.00	111.
9	1.70	.00	255.	980.10	852.85	345.1	271.4	432.	615.9	339.3	271.4	434.5	.00065	.26750E-03	.91859E-03	1.00	138.
10	2.04	.00	285.	980.10	837.61	408.5	271.4	519.	713.8	407.4	271.4	489.5	.00056	.37709E-03	.81727E-03	1.00	168.
11	2.22	.00	315.	980.10	822.37	442.1	271.4	566.	767.4	444.3	271.4	520.6	.00052	.44014E-03	.77152E-03	1.01	183.
12	2.51	.00	346.	980.10	807.13	492.9	271.4	638.	850.6	501.1	271.4	569.9	.00047	.51356E-03	.71269E-03	1.02	192.
13	2.86	.00	376.	980.10	791.89	554.9	271.4	728.	954.9	572.1	271.4	633.2	.00042	.57645E-03	.66065E-03	1.05	192.
14	5.58	-.01	407.	980.10	776.65	983.3	271.4	1420.	1748.6	1115.7	271.4	1148.3	.00023	.55289E-03	.55289E-03	1.59	101.
15	5.75	-.01	437.	980.10	761.41	1007.8	271.4	1464.	1797.6	1149.8	271.4	1181.3	.00022	.54890E-03	.54887E-03	1.63	97.
16	6.05	.00	468.	980.10	746.17	1050.2	271.4	1539.	1883.2	1209.4	271.4	1239.5	.00021	.53741E-03	.53741E-03	1.67	91.
17	6.11	.00	498.	980.10	730.93	1059.2	271.4	1556.	1901.6	1222.2	271.4	1252.0	.00021	.53788E-03	.53784E-03	1.69	90.
18	6.16	.00	529.	980.10	715.69	1066.2	271.4	1568.	1915.9	1232.2	271.4	1261.8	.00021	.53892E-03	.52714E-03	1.67	88.
19	6.19	.00	559.	980.10	700.45	1070.2	271.4	1576.	1924.0	1237.9	271.4	1267.3	.00021	.54100E-03	.52485E-03	1.67	87.
20	6.21	.00	590.	980.10	685.21	1073.2	271.4	1581.	1930.2	1242.2	271.4	1271.5	.00021	.54333E-03	.52310E-03	1.67	86.
21	6.23	.00	620.	980.10	669.97	1075.2	271.4	1585.	1934.2	1245.0	271.4	1274.3	.00021	.54600E-03	.52197E-03	1.67	86.
22	6.27	.00	651.	980.10	654.73	1081.1	271.4	1596.	1946.3	1253.5	271.4	1282.5	.00020	.54680E-03	.51860E-03	1.67	85.
23	6.29	.00	681.	980.10	639.49	1084.1	271.4	1601.	1952.6	1257.9	271.4	1286.8	.00020	.54886E-03	.51688E-03	1.67	84.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 4

Figure 7-3 (Page 6 of 14)

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CASE-HOUR #     2          YEAR, DAY, HOUR: 76 366   4
                WIND      MIXING                AIR      TURB.       TURB.       VPTG,       VPTG,      DELTA      WSPD        WIND
    WIND      SPEED #1    HEIGHT    STABILITY   TEMP   INTENSITY   INTENSITY     PLUME       HCRIT      THETA     PROFILE    SPEED #2
 DIRECTION    (M/SEC)      (M)        CLASS     (K)       (Y)         (Z)      (DEG K/M)   (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

    220.        3.00      1000.         1      293.15    .2200*      .2000*      .0000       .0000      .1000      -.0900      6.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  2.44 M/SEC,    FLUX =     254.59 M**4/S**3,  FINAL RISE =  440.76 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00
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REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	562.68	281.34	623.6	139.4	427.	768.4	652.9	139.4	667.6	.00010	.14524E-02	.71018E-03	1.19	30.
4	.82	.00	102.	487.19	436.14	174.1	115.5	89.	227.2	164.6	115.5	201.1	.00176	.37784E-03	.19836E-02	1.00	272.
5	.99	.00	133.	535.98	469.68	208.5	130.9	122.	274.8	198.7	130.9	238.0	.00145	.47805E-03	.16782E-02	1.00	285.
6	1.25	.00	163.	562.68	481.15	259.2	139.4	163.	336.6	249.9	139.4	286.2	.00119	.67834E-03	.14205E-02	1.02	330.
7	1.32	.00	194.	562.68	465.91	273.0	139.4	173.	351.8	264.0	139.4	298.6	.00113	.79099E-03	.13812E-02	1.03	368.
8	1.49	.00	224.	562.68	450.67	305.9	139.4	195.	388.5	298.0	139.4	329.0	.00103	.94985E-03	.12937E-02	1.07	400.
9	1.70	.00	255.	562.68	435.43	345.1	139.4	222.	433.3	339.3	139.4	366.8	.00092	.10790E-02	.12613E-02	1.16	407.
10	2.04	.00	285.	562.68	420.19	408.5	139.4	266.	507.2	407.4	139.4	430.6	.00079	.11712E-02	.12202E-02	1.32	378.
11	2.22	.00	315.	562.68	404.95	442.1	139.4	290.	547.0	444.3	139.4	465.6	.00073	.12133E-02	.11285E-02	1.32	338.
12	2.51	.00	346.	562.68	389.71	492.9	139.4	328.	608.1	501.1	139.4	520.2	.00066	.12392E-02	.10101E-02	1.32	272.
13	2.86	.00	376.	562.68	374.47	554.9	139.4	374.	683.5	572.1	139.4	588.8	.00058	.12541E-02	.89238E-03	1.32	214.
14	5.58	-.01	407.	562.68	359.23	983.3	139.4	729.	1232.2	1115.7	139.4	1124.4	.00032	.12554E-02	.46730E-03	1.32	62.
15	5.75	-.01	437.	562.68	343.99	1007.8	139.4	752.	1264.9	1149.8	139.4	1158.2	.00032	.12799E-02	.45368E-03	1.32	59.
16	6.05	.00	468.	562.68	328.75	1050.2	139.4	791.	1321.9	1209.4	139.4	1217.4	.00030	.13054E-02	.43160E-03	1.32	53.
17	6.11	.00	498.	562.68	313.51	1059.2	139.4	799.	1334.1	1222.2	139.4	1230.2	.00030	.13319E-02	.42713E-03	1.32	52.
18	6.16	.00	529.	562.68	298.27	1066.2	139.4	806.	1343.6	1232.2	139.4	1240.1	.00030	.13595E-02	.42371E-03	1.32	52.
19	6.19	.00	559.	562.68	283.03	1070.2	139.4	809.	1348.9	1237.9	139.4	1245.7	.00030	.13882E-02	.36039E-03	1.13	44.
20	6.21	.00	590.	562.68	281.34	1073.2	139.4	812.	1353.0	1242.2	139.4	1250.0	.00029	.14182E-02	.36904E-03	1.16	45.
21	6.23	.00	620.	562.68	281.34	1075.2	139.4	814.	1355.7	1245.0	139.4	1252.8	.00029	.14496E-02	.38177E-03	1.20	46.
22	6.27	.00	651.	562.68	281.34	1081.1	139.4	819.	1363.7	1253.5	139.4	1261.2	.00029	.14823E-02	.39905E-03	1.26	48.
23	6.29	.00	681.	562.68	281.34	1084.1	139.4	822.	1367.8	1257.9	139.4	1265.6	.00029	.15166E-02	.41985E-03	1.33	50.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366   9

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CASE-HOUR #     3          YEAR, DAY, HOUR: 76 366   9
                WIND      MIXING                AIR      TURB.       TURB.       VPTG,       VPTG,      DELTA      WSPD        WIND
    WIND      SPEED #1    HEIGHT    STABILITY   TEMP   INTENSITY   INTENSITY     PLUME       HCRIT      THETA     PROFILE    SPEED #2
 DIRECTION    (M/SEC)      (M)        CLASS     (K)       (Y)         (Z)      (DEG K/M)   (DEG K/M)   (DEG/M)    EXPONENT    (M/SEC)

    220.        2.00      3000.         2      293.15    .1600*      .1200*      .0000       .0000      .1200       .1100      4.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1:  EMISSIONS =  1000.00 G/SEC,  EXIT VELOCITY =  20.00 M/SEC,  STACK GAS TEMP =  370.00 DEG K,  HCRIT =      .00 M
UTOP =  2.63 M/SEC,    FLUX =     254.59 M**4/S**3,  FINAL RISE =  408.16 M,  DISTANCE TO FINAL RISE =  1091.15 M,  PEN. FRAC. =  .00
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REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)

Figure 7-3 (Page 7 of 14)

1	3.26	-1.39	615.	530.08	265.04	453.5	129.1	474.	668.8	391.8	129.1	412.5	.00007	.15736E-02	.10818E-02	1.12	29.
4	.82	.00	102.	460.17	409.12	126.6	107.0	99.	193.1	98.8	107.0	145.6	.00207	.10576E-03	.27400E-02	1.00	83.
5	.99	.00	133.	505.35	439.05	151.6	121.3	136.	236.8	119.2	121.3	170.0	.00168	.16739E-03	.23461E-02	1.00	107.
6	1.25	.00	163.	530.08	448.54	188.5	129.1	182.	291.8	150.0	129.1	197.9	.00137	.30872E-03	.20164E-02	1.00	160.
7	1.32	.00	194.	530.08	433.30	198.5	129.1	192.	304.7	158.4	129.1	204.3	.00131	.41228E-03	.19526E-02	1.00	205.
8	1.49	.00	224.	530.08	418.06	222.4	129.1	217.	336.2	178.8	129.1	220.5	.00119	.60001E-03	.18103E-02	1.00	270.
9	1.70	.00	255.	530.08	402.82	251.0	129.1	247.	374.7	203.6	129.1	241.1	.00106	.81929E-03	.16612E-02	1.00	331.
10	2.04	.00	285.	530.08	387.58	297.1	129.1	296.	438.8	244.5	129.1	276.4	.00091	.10802E-02	.14714E-02	1.02	373.
11	2.22	.00	315.	530.08	372.34	321.5	129.1	323.	473.5	266.6	129.1	296.2	.00084	.12223E-02	.14092E-02	1.05	391.
12	2.51	.00	346.	530.08	357.10	358.5	129.1	364.	527.0	300.7	129.1	327.2	.00076	.13442E-02	.13738E-02	1.13	386.
13	2.86	.00	376.	530.08	341.86	403.6	129.1	416.	593.5	343.2	129.1	366.7	.00067	.14090E-02	.13072E-02	1.20	334.
14	5.58	-.01	407.	530.08	326.62	715.1	129.1	811.	1088.6	669.4	129.1	681.8	.00037	.10434E-02	.10434E-02	1.78	145.
15	5.75	-.01	437.	530.08	311.38	732.9	129.1	835.	1118.7	689.9	129.1	701.8	.00036	.10303E-02	.10303E-02	1.81	140.
16	6.05	.00	468.	530.08	296.14	763.8	129.1	879.	1171.3	725.6	129.1	737.0	.00034	.99861E-03	.99861E-03	1.84	129.
17	6.11	.00	498.	530.08	280.90	770.3	129.1	888.	1182.6	733.3	129.1	744.6	.00034	.99795E-03	.99795E-03	1.86	128.
18	6.16	.00	529.	530.08	265.66	775.4	129.1	895.	1191.4	739.3	129.1	750.5	.00033	.99855E-03	.98444E-03	1.85	125.
19	6.19	.00	559.	530.08	265.04	778.3	129.1	899.	1196.3	742.7	129.1	753.9	.00033	.99498E-03	.99498E-03	1.88	126.
20	6.21	.00	590.	530.08	265.04	780.5	129.1	902.	1200.1	745.3	129.1	756.4	.00033	.99201E-03	.99201E-03	1.88	125.
21	6.23	.00	620.	530.08	265.04	781.9	129.1	904.	1202.6	747.0	129.1	758.1	.00033	.99010E-03	.99010E-03	1.88	125.
22	6.27	.00	651.	530.08	265.04	786.2	129.1	911.	1210.0	752.1	129.1	763.1	.00033	.98439E-03	.98439E-03	1.88	123.
23	6.29	.00	681.	530.08	265.04	788.4	129.1	914.	1213.8	754.7	129.1	765.7	.00033	.98147E-03	.98147E-03	1.88	123.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 12

CASE-HOUR # 4 YEAR, DAY, HOUR: 76 366 12

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	4.00	700.	2	293.15	.1600*	.1200*	.0000	.0000	.1200	-.1100	7.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 3.23 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 332.83 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/ M**3)
1	3.26	-1.39	615.	454.75	227.38	453.5	105.3	387.	605.3	391.8	105.3	405.6	.00005	.25406E-02	.13530E-02	1.38	20.
4	.82	.00	102.	397.75	346.69	126.6	87.2	81.	173.7	98.8	87.2	131.8	.00230	.19017E-03	.30273E-02	1.00	135.
5	.99	.00	133.	434.59	368.29	151.6	98.9	111.	212.1	119.2	98.9	154.9	.00188	.30489E-03	.25757E-02	1.00	178.
6	1.25	.00	163.	454.75	373.22	188.5	105.3	148.	261.8	150.0	105.3	183.2	.00152	.54687E-03	.22545E-02	1.04	258.
7	1.32	.00	194.	454.75	357.98	198.5	105.3	156.	273.8	158.4	105.3	190.2	.00146	.71385E-03	.21996E-02	1.05	322.
8	1.49	.00	224.	454.75	342.74	222.4	105.3	177.	302.9	178.8	105.3	207.5	.00132	.98406E-03	.21004E-02	1.09	401.
9	1.70	.00	255.	454.75	327.50	251.0	105.3	201.	338.4	203.6	105.3	229.2	.00118	.12601E-02	.20430E-02	1.17	460.
10	2.04	.00	285.	454.75	312.26	297.1	105.3	241.	397.0	244.5	105.3	266.2	.00100	.15380E-02	.20543E-02	1.37	479.
11	2.22	.00	315.	454.75	297.02	321.5	105.3	263.	428.6	266.6	105.3	286.6	.00093	.16910E-02	.21148E-02	1.52	487.
12	2.51	.00	346.	454.75	281.78	358.5	105.3	297.	477.2	300.7	105.3	318.6	.00084	.18268E-02	.15673E-02	1.25	406.
13	2.86	.00	376.	454.75	266.54	403.6	105.3	339.	537.4	343.2	105.3	359.0	.00074	.19312E-02	.13907E-02	1.25	320.
14	5.58	-.01	407.	454.75	251.30	715.1	105.3	661.	979.5	669.4	105.3	677.7	.00041	.20139E-02	.73679E-03	1.25	93.
15	5.75	-.01	437.	454.75	236.06	732.9	105.3	681.	1006.1	689.9	105.3	697.8	.00040	.20777E-02	.71549E-03	1.25	88.
16	6.05	.00	468.	454.75	227.38	763.8	105.3	716.	1052.5	725.6	105.3	733.2	.00038	.21456E-02	.70761E-03	1.30	83.
17	6.11	.00	498.	454.75	227.38	770.3	105.3	724.	1062.4	733.3	105.3	740.9	.00038	.22182E-02	.63564E-03	1.18	74.
18	6.16	.00	529.	454.75	227.38	775.4	105.3	730.	1070.2	739.3	105.3	746.8	.00037	.22958E-02	.64713E-03	1.21	75.
19	6.19	.00	559.	454.75	227.38	778.3	105.3	733.	1074.5	742.7	105.3	750.1	.00037	.23790E-02	.67006E-03	1.26	77.

Figure 7-3 (Page 8 of 14)

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
20	6.21	.00	590.	454.75	227.38	780.5	105.3	736.	1077.9	745.3	105.3	752.7	.00037	.24685E-02	.70009E-03	1.32	80.
21	6.23	.00	620.	454.75	227.38	781.9	105.3	738.	1080.1	747.0	105.3	754.4	.00037	.25650E-02	.73417E-03	1.39	84.
22	6.27	.00	651.	454.75	227.38	786.2	105.3	743.	1086.6	752.1	105.3	759.4	.00037	.26693E-02	.60997E-03	1.16	69.
23	6.29	.00	681.	454.75	227.38	788.4	105.3	745.	1090.0	754.7	105.3	762.0	.00037	.27825E-02	.61782E-03	1.18	70.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 14

CASE-HOUR # 5 YEAR, DAY, HOUR: 76 366 14

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	2.00	3000.	3	293.15	.1100*	.0800*	.0000	.0000	.1500	.1200	4.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 2.70 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 398.08 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	520.00	260.00	311.8	125.9	578.	668.9	203.1	125.9	239.0	.00007	.18474E-02	.16810E-02	1.01	43.
4	.82	.00	102.	451.82	400.76	87.0	104.3	121.	181.8	61.0	104.3	120.9	.00219	.27041E-04	.33009E-02	1.00	22.
5	.99	.00	133.	495.88	429.58	104.2	118.3	165.	228.4	72.6	118.3	138.8	.00175	.47691E-04	.28751E-02	1.00	31.
6	1.25	.00	163.	520.00	438.46	129.6	125.9	221.	285.7	89.4	125.9	154.4	.00140	.91689E-04	.25837E-02	1.00	47.
7	1.32	.00	194.	520.00	423.22	136.5	125.9	234.	298.6	93.9	125.9	157.1	.00134	.13467E-03	.25399E-02	1.00	67.
8	1.49	.00	224.	520.00	407.98	152.9	125.9	264.	330.0	104.6	125.9	163.7	.00121	.21829E-03	.24371E-02	1.00	98.
9	1.70	.00	255.	520.00	392.74	172.6	125.9	301.	368.7	117.3	125.9	172.0	.00108	.34258E-03	.23188E-02	1.00	137.
10	2.04	.00	285.	520.00	377.50	204.2	125.9	361.	433.3	137.4	125.9	186.3	.00092	.54996E-03	.21417E-02	1.00	188.
11	2.22	.00	315.	520.00	362.26	221.0	125.9	393.	468.5	147.9	125.9	194.2	.00085	.72120E-03	.20563E-02	1.00	227.
12	2.51	.00	346.	520.00	347.02	246.5	125.9	444.	523.1	163.6	125.9	206.4	.00076	.94086E-03	.19393E-02	1.00	266.
13	2.86	.00	376.	520.00	331.78	277.5	125.9	507.	591.2	182.5	125.9	221.7	.00067	.11745E-02	.18198E-02	1.01	294.
14	5.58	-.01	407.	520.00	316.54	491.7	125.9	988.	1110.9	306.8	125.9	331.6	.00036	.15256E-02	.15256E-02	1.27	203.
15	5.75	-.01	437.	520.00	301.30	503.9	125.9	1018.	1143.1	313.7	125.9	338.0	.00035	.15866E-02	.12862E-02	1.09	166.
16	6.05	.00	468.	520.00	286.06	525.1	125.9	1071.	1199.5	325.5	125.9	349.0	.00033	.16340E-02	.12457E-02	1.09	153.
17	6.11	.00	498.	520.00	270.82	529.6	125.9	1082.	1211.7	328.0	125.9	351.3	.00033	.16874E-02	.12375E-02	1.09	151.
18	6.16	.00	529.	520.00	260.00	533.1	125.9	1091.	1221.1	329.9	125.9	353.1	.00033	.17231E-02	.12311E-02	1.09	149.
19	6.19	.00	559.	520.00	260.00	535.1	125.9	1096.	1226.4	331.0	125.9	354.1	.00033	.17208E-02	.12276E-02	1.09	148.
20	6.21	.00	590.	520.00	260.00	536.6	125.9	1100.	1230.5	331.8	125.9	354.9	.00032	.17190E-02	.12249E-02	1.09	147.
21	6.23	.00	620.	520.00	260.00	537.6	125.9	1103.	1233.2	332.4	125.9	355.4	.00032	.17179E-02	.13328E-02	1.19	160.
22	6.27	.00	651.	520.00	260.00	540.5	125.9	1110.	1241.2	334.0	125.9	356.9	.00032	.17145E-02	.14361E-02	1.28	171.
23	6.29	.00	681.	520.00	260.00	542.1	125.9	1114.	1245.3	334.8	125.9	357.7	.00032	.17127E-02	.14670E-02	1.32	174.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 76 366 19

CASE-HOUR # 6 YEAR, DAY, HOUR: 76 366 19

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	7.00	550.	3	293.15	.1100*	.0800*	.0000	.0000	.1500	-.1200	14.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

Figure 7-3 (Page 9 of 14)

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 5.78 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 188.40 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	310.32	155.16	311.8	59.6	274.	419.1	203.1	59.6	211.7	.00000	.35579E-02	.20353E-02	1.08	1.
4	.82	.00	102.	278.05	226.99	87.0	49.4	57.	115.3	61.0	49.4	78.5	.00346	.15529E-03	.50824E-02	1.00	94.
5	.99	.00	133.	298.90	232.61	104.2	56.0	78.	141.8	72.6	56.0	91.7	.00281	.34787E-03	.43523E-02	1.00	171.
6	1.25	.00	163.	310.32	228.78	129.6	59.6	105.	177.0	89.4	59.6	107.4	.00225	.76961E-03	.37133E-02	1.00	304.
7	1.32	.00	194.	310.32	213.54	136.5	59.6	111.	185.5	93.9	59.6	111.2	.00215	.11362E-02	.35887E-02	1.00	428.
8	1.49	.00	224.	310.32	198.30	152.9	59.6	125.	206.3	104.6	59.6	120.4	.00193	.17074E-02	.33291E-02	1.00	579.
9	1.70	.00	255.	310.32	183.06	172.6	59.6	142.	231.4	117.3	59.6	131.5	.00172	.23032E-02	.31019E-02	1.02	696.
10	2.04	.00	285.	310.32	167.82	204.2	59.6	171.	272.8	137.4	59.6	149.7	.00146	.28439E-02	.29549E-02	1.11	729.
11	2.22	.00	315.	310.32	155.16	221.0	59.6	186.	295.1	147.9	59.6	159.4	.00135	.31188E-02	.27522E-02	1.10	652.
12	2.51	.00	346.	310.32	155.16	246.5	59.6	210.	329.3	163.6	59.6	174.1	.00121	.30932E-02	.25207E-02	1.10	535.
13	2.86	.00	376.	310.32	155.16	277.5	59.6	240.	371.5	182.5	59.6	192.0	.00107	.30500E-02	.22600E-02	1.09	425.
14	5.58	-.01	407.	310.32	155.16	491.7	59.6	468.	681.2	306.8	59.6	312.6	.00059	.29027E-02	.28213E-02	2.21	290.
15	5.75	-.01	437.	310.32	155.16	503.9	59.6	482.	699.8	313.7	59.6	319.3	.00057	.30245E-02	.28633E-02	2.29	286.
16	6.05	.00	468.	310.32	155.16	525.1	59.6	507.	732.3	325.5	59.6	330.9	.00054	.31647E-02	.25785E-02	2.14	246.
17	6.11	.00	498.	310.32	155.16	529.6	59.6	512.	739.3	328.0	59.6	333.3	.00054	.33234E-02	.21572E-02	1.80	204.
18	6.16	.00	529.	310.32	155.16	533.1	59.6	516.	744.7	329.9	59.6	335.2	.00054	.35005E-02	.27429E-02	2.30	258.
19	6.19	.00	559.	310.32	155.16	535.1	59.6	519.	747.7	331.0	59.6	336.3	.00053	.36355E-02	.21349E-02	1.80	200.
20	6.21	.00	590.	310.32	155.16	536.6	59.6	521.	750.1	331.8	59.6	337.1	.00053	.36355E-02	.27100E-02	2.29	253.
21	6.23	.00	620.	310.32	155.16	537.6	59.6	522.	751.6	332.4	59.6	337.7	.00053	.36355E-02	.12835E-02	1.09	119.
22	6.27	.00	651.	310.32	155.16	540.5	59.6	525.	756.2	334.0	59.6	339.3	.00053	.36356E-02	.22090E-02	1.88	204.
23	6.29	.00	681.	310.32	155.16	542.1	59.6	527.	758.5	334.8	59.6	340.1	.00053	.36356E-02	.26858E-02	2.29	248.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 5

CASE-HOUR # 7 YEAR, DAY, HOUR: 77 1 5

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	3.00	1000.	4	293.15	.0800*	.0600*	.0000	.0000	.2000	.1400	6.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 4.26 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 252.44 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	374.36	187.18	226.8	79.8	489.	544.8	80.7	79.8	113.5	.00003	.18041E-02	.35306E-02	1.00	12.
4	.82	.00	102.	331.12	280.07	63.3	66.2	102.	137.2	33.0	66.2	73.9	.00291	.82821E-05	.53950E-02	1.00	6.
5	.99	.00	133.	359.06	292.77	75.8	75.0	140.	175.8	37.8	75.0	84.0	.00227	.21776E-04	.47511E-02	1.00	12.
6	1.25	.00	163.	374.36	292.82	94.3	79.8	187.	224.2	44.2	79.8	91.3	.00178	.50810E-04	.43715E-02	1.00	21.
7	1.32	.00	194.	374.36	277.58	99.3	79.8	198.	235.2	45.9	79.8	92.1	.00170	.92083E-04	.43328E-02	1.00	37.
8	1.49	.00	224.	374.36	262.34	111.2	79.8	223.	261.8	49.7	79.8	94.0	.00152	.17326E-03	.42422E-02	1.00	62.
9	1.70	.00	255.	374.36	247.10	125.5	79.8	254.	294.4	54.1	79.8	96.4	.00135	.31004E-03	.41378E-02	1.00	99.
10	2.04	.00	285.	374.36	231.86	148.5	79.8	305.	348.6	60.7	79.8	100.3	.00114	.54934E-03	.39783E-02	1.00	148.

Figure 7-3 (Page 10 of 14)

11	2.22	.00	315.	374.36	216.62	160.8	79.8	333.	378.0	64.0	79.8	102.3	.00106	.82976E-03	.38988E-02	1.00	206.
12	2.51	.00	346.	374.36	201.38	179.3	79.8	375.	423.5	68.9	79.8	105.5	.00094	.12220E-02	.37853E-02	1.00	270.
13	2.86	.00	376.	374.36	187.18	201.8	79.8	428.	480.2	74.6	79.8	109.3	.00083	.16836E-02	.36613E-02	1.00	329.
14	5.58	-.01	407.	374.36	187.18	357.6	79.8	836.	912.3	109.4	79.8	135.4	.00044	.22663E-02	.30109E-02	1.02	233.
15	5.75	-.01	437.	374.36	187.18	366.5	79.8	861.	939.1	111.2	79.8	136.9	.00042	.22884E-02	.29838E-02	1.02	228.
16	6.05	.00	468.	374.36	187.18	381.9	79.8	906.	986.1	114.3	79.8	139.4	.00040	.23242E-02	.29389E-02	1.03	221.
17	6.11	.00	498.	374.36	187.18	385.2	79.8	915.	996.2	115.0	79.8	140.0	.00040	.23314E-02	.29296E-02	1.03	219.
18	6.16	.00	529.	374.36	187.18	387.7	79.8	923.	1004.1	115.5	79.8	140.4	.00040	.23369E-02	.29225E-02	1.03	218.
19	6.19	.00	559.	374.36	187.18	389.2	79.8	927.	1008.5	115.8	79.8	140.7	.00040	.23400E-02	.29185E-02	1.03	217.
20	6.21	.00	590.	374.36	187.18	390.3	79.8	930.	1011.9	116.0	79.8	140.8	.00039	.23424E-02	.29155E-02	1.03	217.
21	6.23	.00	620.	374.36	187.18	391.0	79.8	932.	1014.2	116.2	79.8	141.0	.00039	.23439E-02	.29135E-02	1.03	217.
22	6.27	.00	651.	374.36	187.18	393.1	79.8	939.	1020.8	116.6	79.8	141.3	.00039	.23484E-02	.29077E-02	1.03	216.
23	6.29	.00	681.	374.36	187.18	394.2	79.8	942.	1024.2	116.8	79.8	141.5	.00039	.23507E-02	.29047E-02	1.03	215.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 11

CASE-HOUR # 8 YEAR, DAY, HOUR: 77 1 11

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	15.00	450.	4	293.15	.0800*	.0600*	.0000	.0000	.2000	-.1400	30.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = .00 M
UTOP = 10.57 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 101.69 M, DISTANCE TO FINAL RISE = 1091.15 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
4	.82	.00	102.	206.19	155.14	63.3	26.6	41.	80.1	33.0	26.6	42.4	.00498	.23630E-04	.93984E-02	1.00	11.
5	.99	.00	133.	217.45	151.16	75.8	30.2	56.	99.1	37.8	30.2	48.4	.00402	.12493E-03	.82480E-02	1.00	48.
6	1.25	.00	163.	223.61	142.08	94.3	32.2	75.	124.9	44.2	32.2	54.7	.00319	.49893E-03	.72960E-02	1.00	151.
7	1.32	.00	194.	223.61	126.84	99.3	32.2	80.	131.3	45.9	32.2	56.0	.00304	.10983E-02	.71202E-02	1.00	316.
8	1.49	.00	224.	223.61	111.81	111.2	32.2	90.	146.6	49.7	32.2	59.2	.00272	.22656E-02	.67437E-02	1.00	583.
9	1.70	.00	255.	223.61	111.81	125.5	32.2	102.	165.1	54.1	32.2	62.9	.00242	.26140E-02	.63532E-02	1.00	598.
10	2.04	.00	285.	223.61	111.81	148.5	32.2	123.	195.5	60.7	32.2	68.7	.00204	.30882E-02	.58372E-02	1.00	596.
11	2.22	.00	315.	223.61	111.81	160.8	32.2	134.	211.7	64.0	32.2	71.7	.00188	.32964E-02	.56101E-02	1.01	588.
12	2.51	.00	346.	223.61	111.81	179.3	32.2	151.	236.7	68.9	32.2	76.1	.00169	.35606E-02	.53152E-02	1.01	568.
13	2.86	.00	376.	223.61	111.81	201.8	32.2	173.	267.5	74.6	32.2	81.2	.00149	.38100E-02	.50262E-02	1.02	538.
14	5.58	-.01	407.	223.61	111.81	357.6	32.2	337.	492.1	109.4	32.2	114.0	.00081	.43528E-02	.42866E-02	1.22	329.
15	5.75	-.01	437.	223.61	111.81	366.5	32.2	347.	505.6	111.2	32.2	115.7	.00079	.43931E-02	.44536E-02	1.29	328.
16	6.05	.00	468.	223.61	111.81	381.9	32.2	365.	529.1	114.3	32.2	118.8	.00075	.44298E-02	.43391E-02	1.29	310.
17	6.11	.00	498.	223.61	111.81	385.2	32.2	369.	534.2	115.0	32.2	119.4	.00075	.44316E-02	.42458E-02	1.27	300.
18	6.16	.00	529.	223.61	111.81	387.7	32.2	372.	538.1	115.5	32.2	119.9	.00074	.44329E-02	.37954E-02	1.14	266.
19	6.19	.00	559.	223.61	111.81	389.2	32.2	373.	540.3	115.8	32.2	120.2	.00074	.44336E-02	.42857E-02	1.29	299.
20	6.21	.00	590.	223.61	111.81	390.3	32.2	375.	542.0	116.0	32.2	120.4	.00074	.44341E-02	.36930E-02	1.11	257.
21	6.23	.00	620.	223.61	111.81	391.0	32.2	376.	543.1	116.2	32.2	120.5	.00073	.44344E-02	.42039E-02	1.27	292.
22	6.27	.00	651.	223.61	111.81	393.1	32.2	378.	546.4	116.6	32.2	121.0	.00073	.44354E-02	.43721E-02	1.33	302.
23	6.29	.00	681.	223.61	111.81	394.2	32.2	379.	548.1	116.8	32.2	121.2	.00073	.44359E-02	.35927E-02	1.09	247.

WARNING; HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 13

CASE-HOUR # 9 YEAR, DAY, HOUR: 77 1 13

Figure 7-3 (Page 11 of 14)

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	2.00	9999.	5	293.15	.0600*	.0300*	.0200	.0200	.3000	.2000	5.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = 553.72 M
UTOP = 3.30 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 126.55 M, DISTANCE TO FINAL RISE = 263.94 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	248.47	-366.31	170.1	40.0	368.	407.1	49.5	40.0	63.6	.00000	.80026E-09	.64045E-02	1.02	0.
4	.82	.00	102.	248.47	146.36	47.5	40.0	93.	111.6	19.8	40.0	44.7	.00358	.82971E-04	.89346E-02	1.00	90.
5	.99	.00	133.	248.47	115.88	56.9	40.0	112.	131.7	23.0	40.0	46.1	.00303	.73796E-03	.86467E-02	1.00	678.
6	1.25	.00	163.	248.47	85.40	70.7	40.0	141.	162.5	27.3	40.0	48.4	.00245	.34791E-02	.82547E-02	1.00	2589.
7	1.32	.00	194.	248.47	54.92	74.4	40.0	149.	171.0	28.4	40.0	49.1	.00233	.86906E-02	.81736E-02	1.01	5781.
8	1.49	.00	224.	248.47	24.44	83.4	40.0	168.	191.6	30.9	40.0	50.6	.00208	.14041E-01	.79311E-02	1.01	5006.
9	1.70	.00	255.	248.47	-6.04	94.1	40.0	191.	216.7	33.7	40.0	52.3	.00184	.15144E-01	.76608E-02	1.01	4276.
10	2.04	.00	285.	248.47	-36.52	111.4	40.0	229.	258.2	37.9	40.0	55.1	.00155	.11621E-01	.72500E-02	1.00	3397.
11	2.22	.00	315.	248.47	-67.00	120.6	40.0	250.	280.6	40.0	40.0	56.6	.00142	.69952E-02	.70864E-02	1.00	3016.
12	2.51	.00	346.	248.47	-97.48	134.4	40.0	282.	315.1	42.9	40.0	58.7	.00127	.34215E-02	.68745E-02	1.01	1313.
13	2.86	.00	376.	248.47	-127.96	151.3	40.0	322.	358.2	46.2	40.0	61.1	.00111	.14580E-02	.65330E-02	1.00	492.
14	5.58	-.01	407.	248.47	-158.44	268.2	40.0	628.	684.3	62.6	40.0	74.3	.00058	.11053E-02	.53761E-02	1.00	195.
15	5.75	-.01	437.	248.47	-188.92	274.9	40.0	647.	704.5	63.3	40.0	74.9	.00057	.44221E-03	.53380E-02	1.00	76.
16	6.05	.00	468.	248.47	-219.40	286.4	40.0	681.	739.9	64.5	40.0	75.9	.00054	.16081E-03	.52745E-02	1.00	26.
17	6.11	.00	498.	248.47	-249.88	288.9	40.0	688.	747.5	64.7	40.0	76.1	.00053	.47679E-04	.52692E-02	1.00	8.
18	6.16	.00	529.	248.47	-280.36	290.8	40.0	694.	753.4	64.9	40.0	76.2	.00053	.12116E-04	.52714E-02	1.01	2.
19	6.19	.00	559.	248.47	-310.84	291.9	40.0	697.	756.8	65.0	40.0	76.3	.00053	.26183E-05	.52841E-02	1.01	0.
20	6.21	.00	590.	248.47	-341.32	292.7	40.0	700.	759.3	65.1	40.0	76.4	.00053	.48359E-06	.53058E-02	1.02	0.
21	6.23	.00	620.	248.47	-371.80	293.2	40.0	701.	761.0	65.1	40.0	76.4	.00052	.76107E-07	.53392E-02	1.02	0.
22	6.27	.00	651.	248.47	-402.28	294.8	40.0	706.	766.0	65.3	40.0	76.6	.00052	.10578E-07	.53794E-02	1.03	0.
23	6.29	.00	681.	248.47	-432.76	295.7	40.0	708.	768.6	65.4	40.0	76.6	.00052	.12403E-08	.54692E-02	1.05	0.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 16

CASE-HOUR # 10 YEAR, DAY, HOUR: 77 1 16

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	4.00	9999.	5	293.15	.0600*	.0300*	.0030	.0050	.3000	-.2000	10.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = 493.66 M
UTOP = 2.43 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 263.84 M, DISTANCE TO FINAL RISE = 501.25 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)

Figure 7-3 (Page 12 of 14)

1	3.26	-1.39	615.	385.76	-229.02	170.1	83.4	767.	789.6	49.5	83.4	97.0	.00011	.50660E-03	.41275E-02	1.00	23.
4	.82	.00	102.	385.76	283.65	47.5	83.4	193.	215.8	19.8	83.4	85.8	.00185	.39151E-04	.46523E-02	1.00	30.
5	.99	.00	133.	385.76	253.17	56.9	83.4	233.	254.2	23.0	83.4	86.5	.00157	.12767E-03	.46102E-02	1.00	83.
6	1.25	.00	163.	385.76	222.69	70.7	83.4	293.	313.1	27.3	83.4	87.8	.00127	.36382E-03	.45450E-02	1.00	191.
7	1.32	.00	194.	385.76	192.21	74.4	83.4	310.	329.5	28.4	83.4	88.1	.00121	.83909E-03	.45271E-02	1.00	419.
8	1.49	.00	224.	385.76	161.73	83.4	83.4	350.	369.3	30.9	83.4	89.0	.00108	.17185E-02	.44901E-02	1.00	765.
9	1.70	.00	255.	385.76	131.25	94.1	83.4	398.	417.7	33.7	83.4	90.0	.00095	.30609E-02	.44687E-02	1.01	1205.
10	2.04	.00	285.	385.76	100.77	111.4	83.4	478.	498.2	37.9	83.4	91.7	.00080	.47566E-02	.43879E-02	1.01	1449.
11	2.22	.00	315.	385.76	70.29	120.6	83.4	522.	541.8	40.0	83.4	92.5	.00074	.64620E-02	.43466E-02	1.01	1319.
12	2.51	.00	346.	385.76	39.81	134.4	83.4	588.	609.3	42.9	83.4	93.8	.00065	.77721E-02	.42863E-02	1.01	1157.
13	2.86	.00	376.	385.76	9.33	151.3	83.4	672.	693.5	46.2	83.4	95.4	.00058	.83270E-02	.41931E-02	1.00	994.
14	5.58	-.01	407.	385.76	-21.15	268.2	83.4	1310.	1339.7	62.6	83.4	104.3	.00030	.74939E-02	.38392E-02	1.00	471.
15	5.75	-.01	437.	385.76	-51.63	274.9	83.4	1350.	1380.0	63.3	83.4	104.7	.00029	.67469E-02	.38323E-02	1.01	457.
16	6.05	.00	468.	385.76	-82.11	286.4	83.4	1420.	1450.9	64.5	83.4	105.4	.00027	.55880E-02	.38194E-02	1.01	433.
17	6.11	.00	498.	385.76	-112.59	288.9	83.4	1435.	1466.1	64.7	83.4	105.6	.00027	.42797E-02	.37836E-02	1.00	424.
18	6.16	.00	529.	385.76	-143.07	290.8	83.4	1447.	1477.9	64.9	83.4	105.7	.00027	.30201E-02	.37810E-02	1.00	336.
19	6.19	.00	559.	385.76	-173.55	291.9	83.4	1453.	1484.6	65.0	83.4	105.8	.00027	.19629E-02	.37807E-02	1.00	217.
20	6.21	.00	590.	385.76	-204.03	292.7	83.4	1458.	1489.8	65.1	83.4	105.8	.00027	.11749E-02	.37814E-02	1.00	130.
21	6.23	.00	620.	385.76	-234.51	293.2	83.4	1462.	1493.1	65.1	83.4	105.8	.00027	.64755E-03	.37833E-02	1.00	71.
22	6.27	.00	651.	385.76	-264.99	294.8	83.4	1472.	1503.2	65.3	83.4	105.9	.00027	.32976E-03	.37837E-02	1.00	36.
23	6.29	.00	681.	385.76	-295.47	295.7	83.4	1477.	1508.4	65.4	83.4	106.0	.00026	.15453E-03	.37867E-02	1.01	17.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 19

CASE-HOUR # 11 YEAR, DAY, HOUR: 77 1 19

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	2.50	9999.	6	293.15	.0400*	.0160*	.0060	.0200	.4000	.3000	7.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = 476.56 M
UTOP = 5.29 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 161.45 M, DISTANCE TO FINAL RISE = 773.49 M, PEN. FRAC. = .00

			HT			SIGMA-Y				SIGMA-Z				CONVENTIONAL	REFLECTION		
REC #	X (KM)	Y (KM)	ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	AMBIENT (M)	BUOY (M)	SHEAR (M)	TOTAL (M)	AMBIENT (M)	BUOY (M)	TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	VERTICAL DIST. FACTOR (1/M)	VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	283.37	-331.41	113.4	51.1	625.	637.7	26.4	51.1	57.5	.00006	.83536E-09	.69418E-02	1.00	0.
4	.82	.00	102.	283.37	181.26	31.7	51.1	158.	168.8	10.6	51.1	52.1	.00236	.36311E-04	.76519E-02	1.00	16.
5	.99	.00	133.	283.37	150.78	37.9	51.1	190.	200.7	12.2	51.1	52.5	.00199	.24592E-03	.75984E-02	1.00	92.
6	1.25	.00	163.	283.37	120.30	47.1	51.1	239.	249.3	14.5	51.1	53.1	.00160	.11528E-02	.75150E-02	1.00	348.
7	1.32	.00	194.	283.37	89.82	49.6	51.1	253.	262.7	15.1	51.1	53.3	.00152	.36121E-02	.74991E-02	1.00	1036.
8	1.49	.00	224.	283.37	59.34	55.6	51.1	285.	295.3	16.5	51.1	53.6	.00135	.80665E-02	.74435E-02	1.00	1899.
9	1.70	.00	255.	283.37	28.86	62.7	51.1	325.	334.9	18.0	51.1	54.1	.00119	.12786E-01	.73770E-02	1.00	1660.
10	2.04	.00	285.	283.37	-1.62	74.3	51.1	390.	400.5	20.2	51.1	54.9	.00100	.14522E-01	.72663E-02	1.00	1367.
11	2.22	.00	315.	283.37	-32.10	80.4	51.1	426.	436.1	21.3	51.1	55.3	.00091	.12187E-01	.72130E-02	1.00	1246.
12	2.51	.00	346.	283.37	-62.58	89.6	51.1	480.	491.0	22.9	51.1	56.0	.00081	.76298E-02	.71349E-02	1.00	1095.
13	2.86	.00	376.	283.37	-93.06	100.9	51.1	548.	559.5	24.6	51.1	56.7	.00071	.36583E-02	.70448E-02	1.00	493.
14	5.58	-.01	407.	283.37	-123.54	178.8	51.1	1069.	1084.8	33.4	51.1	61.0	.00037	.16829E-02	.65498E-02	1.00	117.
15	5.75	-.01	437.	283.37	-154.02	183.2	51.1	1101.	1117.6	33.8	51.1	61.2	.00036	.54979E-03	.65329E-02	1.00	37.
16	6.05	.00	468.	283.37	-184.50	190.9	51.1	1158.	1175.2	34.4	51.1	61.6	.00034	.14514E-03	.64816E-02	1.00	9.
17	6.11	.00	498.	283.37	-214.98	192.6	51.1	1171.	1187.6	34.5	51.1	61.6	.00034	.29485E-04	.64740E-02	1.00	2.
18	6.16	.00	529.	283.37	-245.46	193.9	51.1	1180.	1197.2	34.6	51.1	61.7	.00033	.47092E-05	.64682E-02	1.00	0.
19	6.19	.00	559.	283.37	-275.94	194.6	51.1	1186.	1202.7	34.7	51.1	61.7	.00033	.58889E-06	.64649E-02	1.00	0.
20	6.21	.00	590.	283.37	-306.42	195.1	51.1	1190.	1206.9	34.7	51.1	61.7	.00033	.57797E-07	.64624E-02	1.00	0.

Figure 7-3 (Page 13 of 14)

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
21	6.23	.00	620.	283.37	-336.90	195.5	51.1	1193.	1209.6	34.7	51.1	61.8	.00033	.44447E-08	.64600E-02	1.00	0.
22	6.27	.00	651.	283.37	-367.38	196.6	51.1	1201.	1217.8	34.8	51.1	61.8	.00033	.27324E-09	.64559E-02	1.00	0.
23	6.29	.00	681.	283.37	-397.86	197.1	51.1	1205.	1222.0	34.9	51.1	61.8	.00033	.13092E-10	.64535E-02	1.00	0.

WARNING: HOURLY SEQUENCE OF INPUT DATA HAS BEEN INTERRUPTED AT THE FOLLOWING YEAR/DAY/HOUR: 77 1 22

CASE-HOUR # 12 YEAR, DAY, HOUR: 77 1 22

WIND DIRECTION	WIND SPEED #1 (M/SEC)	MIXING HEIGHT (M)	STABILITY CLASS	AIR TEMP (K)	TURB. INTENSITY (Y)	TURB. INTENSITY (Z)	VPTG, PLUME (DEG K/M)	VPTG, HCRIT (DEG K/M)	DELTA THETA (DEG/M)	WSPD PROFILE EXPONENT	WIND SPEED #2 (M/SEC)
220.	4.00	9999.	6	293.15	.0400*	.0160*	.0400	.0060	.4000	-.3000	12.00*

* FLAGGED VALUES REPRESENT OPTIONAL METEOROLOGICAL INPUT NOT USED IN THIS RUN

STACK # 1: EMISSIONS = 1000.00 G/SEC, EXIT VELOCITY = 20.00 M/SEC, STACK GAS TEMP = 370.00 DEG K, HCRIT = 547.89 M
UTOP = 1.89 M/SEC, FLUX = 254.59 M**4/S**3, FINAL RISE = 120.95 M, DISTANCE TO FINAL RISE = 106.90 M, PEN. FRAC. = .00

REC #	X (KM)	Y (KM)	HT ABOVE STACK BASE (M)	PLUME HT BEFORE TERRAIN (M)	PLUME HT CORRECTED BY TERRAIN (M)	SIGMA-Y AMBIENT (M)	SIGMA-Y BUOY (M)	SIGMA-Y SHEAR (M)	SIGMA-Y TOTAL (M)	SIGMA-Z AMBIENT (M)	SIGMA-Z BUOY (M)	SIGMA-Z TOTAL (M)	HORIZ. DIST. FACTOR (1/M)	CONVENTIONAL VERTICAL DIST. FACTOR (1/M)	REFLECTION VERTICAL DIST. FACTOR (1/M)	R	CHI (UG/M**3)
1	3.26	-1.39	615.	242.87	-371.92	113.4	38.2	469.	483.6	26.4	38.2	46.5	.00001	.21085E-15	.86755E-02	1.01	0.
4	.82	.00	102.	242.87	140.76	31.7	38.2	118.	128.1	10.6	38.2	39.7	.00311	.37210E-04	.10054E-01	1.00	61.
5	.99	.00	133.	242.87	110.28	37.9	38.2	143.	152.4	12.2	38.2	40.2	.00262	.45785E-03	.99340E-02	1.00	634.
6	1.25	.00	163.	242.87	79.80	47.1	38.2	179.	189.3	14.5	38.2	40.9	.00211	.29117E-02	.97547E-02	1.00	3247.
7	1.32	.00	194.	242.87	49.32	49.6	38.2	189.	199.6	15.1	38.2	41.1	.00200	.94529E-02	.97060E-02	1.00	10004.
8	1.49	.00	224.	242.87	18.84	55.6	38.2	214.	224.3	16.5	38.2	41.6	.00178	.17296E-01	.95955E-02	1.00	9035.
9	1.70	.00	255.	242.87	-11.64	62.7	38.2	243.	254.3	18.0	38.2	42.3	.00157	.18175E-01	.94542E-02	1.00	7850.
10	2.04	.00	285.	242.87	-42.12	74.3	38.2	292.	304.1	20.2	38.2	43.3	.00131	.11481E-01	.92251E-02	1.00	6407.
11	2.22	.00	315.	242.87	-72.60	80.4	38.2	319.	331.0	21.3	38.2	43.8	.00121	.46100E-02	.91246E-02	1.00	2941.
12	2.51	.00	346.	242.87	-103.08	89.6	38.2	360.	372.6	22.9	38.2	44.6	.00107	.12343E-02	.89908E-02	1.00	700.
13	2.86	.00	376.	242.87	-133.56	100.9	38.2	411.	424.4	24.6	38.2	45.5	.00094	.23562E-03	.87709E-02	1.00	117.
14	5.58	-.01	407.	242.87	-164.04	178.8	38.2	801.	821.2	33.4	38.2	50.8	.00049	.84955E-04	.78603E-02	1.00	22.
15	5.75	-.01	437.	242.87	-194.52	183.2	38.2	825.	846.0	33.8	38.2	51.0	.00047	.10890E-04	.78242E-02	1.00	3.
16	6.05	.00	468.	242.87	-225.00	190.9	38.2	868.	889.4	34.4	38.2	51.4	.00045	.10822E-05	.77643E-02	1.00	0.
17	6.11	.00	498.	242.87	-255.48	192.6	38.2	877.	898.8	34.5	38.2	51.5	.00044	.70648E-07	.77564E-02	1.00	0.
18	6.16	.00	529.	242.87	-285.96	193.9	38.2	884.	906.0	34.6	38.2	51.6	.00044	.32762E-08	.77549E-02	1.00	0.
19	6.19	.00	559.	242.87	-316.44	194.6	38.2	888.	910.1	34.7	38.2	51.6	.00044	.10673E-09	.77629E-02	1.00	0.
20	6.21	.00	590.	242.87	-346.92	195.1	38.2	891.	913.3	34.7	38.2	51.6	.00044	.24605E-11	.77799E-02	1.01	0.
21	6.23	.00	620.	242.87	-377.40	195.5	38.2	893.	915.3	34.7	38.2	51.7	.00044	.39983E-13	.78095E-02	1.01	0.
22	6.27	.00	651.	242.87	-407.88	196.6	38.2	899.	921.5	34.8	38.2	51.7	.00043	.48206E-15	.78493E-02	1.02	0.
23	6.29	.00	681.	242.87	-438.36	197.1	38.2	903.	924.7	34.9	38.2	51.7	.00043	.40371E-17	.77093E-02	1.00	0.

Figure 7-3 (Page 14 of 14)

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POST-PROCESSING ANALYSIS PROGRAM    VERSION 2.30     LEVEL 851125


TOPVAL



        LP    NH    NM    DAYSIN    HOURIN
         3     1     5        0.        0.

              NR   RFACT
              26  1000000.
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Figure 7-4 ANALYSIS Output from Sample Run

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

TOP 5 CONCENTRATIONS OF 3-HOUR AVERAGES FOR 12. HOURS

RECEPTOR	TOP 1	TOP 2	TOP 3	TOP 4	TOP 5
1	50.3323	21.6594	7.5413	4.0747	.0000
DAY/HOUR	1 3	1 6	1 12	1 9	0 0
2	.1517	.0000	.0000	.0000	.0000
DAY/HOUR	1 3	0 0	0 0	0 0	0 0
3	.0000	.0000	.0000	.0000	.0000
DAY/HOUR	0 0	0 0	0 0	0 0	0 0
4	136.1632	83.8155	35.7903	35.5793	.0000
DAY/HOUR	1 3	1 6	1 12	1 9	0 0
5	269.7798	245.5842	149.0348	126.6413	.0000
DAY/HOUR	1 12	1 9	1 3	1 6	0 0
6	1262.2043	920.3296	203.1556	187.3455	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
7	3819.4370	2044.3994	272.3083	219.7519	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
8	3900.0288	1883.6309	359.3069	260.5178	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
9	3571.7375	1657.3567	431.1162	292.3269	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
10	3074.3245	1380.3132	465.0286	306.3379	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
11	1835.7200	1269.6245	455.6624	303.7664	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
12	983.9363	717.1672	402.2705	283.5063	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
13	534.7805	452.8689	346.2053	246.5181	.0000
DAY/HOUR	1 12	1 9	1 6	1 3	0 0
14	252.3053	203.3554	195.1604	102.6576	.0000
DAY/HOUR	1 9	1 12	1 6	1 3	0 0
15	210.7275	180.0722	165.4961	98.4878	.0000
DAY/HOUR	1 9	1 6	1 12	1 3	0 0
16	185.5509	160.9107	147.5036	91.1588	.0000
DAY/HOUR	1 9	1 6	1 12	1 3	0 0

Figure 7-4 (Page 2 of 14)

TOP 5 CONCENTRATIONS OF 3-HOUR AVERAGES FOR 12. HOURS

RECEPTOR	TOP 1	TOP 2	TOP 3	TOP 4	TOP 5
17	175.6718	142.9572	142.1077	90.1069	.0000
DAY/HOUR	1 9	1 6	1 12	1 3	0 0
18	162.0896	160.4165	112.1220	88.1413	.0000
DAY/HOUR	1 9	1 6	1 12	1 3	0 0
19	172.4082	141.5300	85.5362	72.4911	.0000
DAY/HOUR	1 9	1 6	1 3	1 12	0 0
20	159.9876	158.0484	85.3923	43.2357	.0000
DAY/HOUR	1 6	1 9	1 3	1 12	0 0
21	169.5784	121.0291	85.5868	23.7747	.0000
DAY/HOUR	1 9	1 6	1 3	1 12	0 0
22	172.5266	148.1988	85.3331	12.0263	.0000
DAY/HOUR	1 9	1 6	1 3	1 12	0 0
23	163.8979	154.1504	85.6801	5.6163	.0000
DAY/HOUR	1 6	1 9	1 3	1 12	0 0
24	.0000	.0000	.0000	.0000	.0000
DAY/HOUR	0 0	0 0	0 0	0 0	0 0
25	.0000	.0000	.0000	.0000	.0000
DAY/HOUR	0 0	0 0	0 0	0 0	0 0
26	.0000	.0000	.0000	.0000	.0000
DAY/HOUR	0 0	0 0	0 0	0 0	0 0

Figure 7-4 (Page 3 of 14)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

TOP 25 HIGHEST AND HIGHEST, SECOND-HIGHEST CONCENTRATIONS

	HIGHEST		HIGHEST, SECOND-HIGHEST	
RANK	RECEPTOR	CONCENTRATION	RECEPTOR	CONCENTRATION
1	8	3900.029	7	2044.399
2	7	3819.437	8	1883.631
3	9	3571.738	9	1657.357
4	10	3074.324	10	1380.313
5	11	1835.720	11	1269.625
6	6	1262.204	6	920.330
7	12	983.936	12	717.167
8	13	534.781	13	452.869
9	5	269.780	5	245.584
10	14	252.305	14	203.355
11	15	210.727	15	180.072
12	16	185.551	16	160.911
13	17	175.672	18	160.417
14	22	172.527	20	158.048
15	19	172.408	23	154.150
16	21	169.578	22	148.199
17	23	163.898	17	142.957
18	18	162.090	19	141.530
19	20	159.988	21	121.029
20	4	136.163	4	83.816
21	1	50.332	1	21.659
22	2	.152	22	.000
23	23	.000	23	.000
24	24	.000	24	.000
25	25	.000	25	.000

Figure 7-4 (Page 4 of 14)

CUMFREQ

HOURIN	DAYSIN	RFACT	NHR	NLEV	NR
0.	0.	1000000.	1	6	26

CUMULATIVE LEVELS:

100.0	200.0	500.0	1000.0	2000.0	3000.0

Figure 7-4 (Page 5 of 14)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 12. OBSERVATIONS

RECEPTOR	LEVEL 100.0	LEVEL 200.0	LEVEL 500.0	LEVEL 1000.0	LEVEL 2000.0
1	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000
2	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000
4	.8333	.0833	.0833	.0000	.0000
CUM FREQ	.8333	.9167	1.0000	1.0000	1.0000
5	.5000	.2500	.0833	.1667	.0000
CUM FREQ	.5000	.7500	.8333	1.0000	1.0000
6	.2500	.2500	.3333	.0000	.0000
CUM FREQ	.2500	.5000	.8333	.8333	.8333
7	.2500	.0000	.5000	.0000	.0833
CUM FREQ	.2500	.2500	.7500	.7500	.8333
8	.1667	.0833	.2500	.2500	.0833
CUM FREQ	.1667	.2500	.5000	.7500	.8333
9	.0833	.1667	.2500	.1667	.1667
CUM FREQ	.0833	.2500	.5000	.6667	.8333
10	.0000	.2500	.2500	.1667	.1667
CUM FREQ	.0000	.2500	.5000	.6667	.8333
11	.0000	.0833	.4167	.1667	.1667
CUM FREQ	.0000	.0833	.5000	.6667	.8333
12	.0000	.0833	.4167	.2500	.2500
CUM FREQ	.0000	.0833	.5000	.7500	1.0000
13	.0000	.1667	.6667	.1667	.0000
CUM FREQ	.0000	.1667	.8333	1.0000	1.0000
14	.2500	.3333	.4167	.0000	.0000
CUM FREQ	.2500	.5833	1.0000	1.0000	1.0000
15	.5000	.1667	.3333	.0000	.0000
CUM FREQ	.5000	.6667	1.0000	1.0000	1.0000
16	.5000	.1667	.3333	.0000	.0000
CUM FREQ	.5000	.6667	1.0000	1.0000	1.0000

Figure 7-4 (Page 6 of 14)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 12. OBSERVATIONS

RECEPTOR	LEVEL 3000.0	LEVEL **********	AVG:# OBS= 12.0
1	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	20.9019
2	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	.0379
3	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	.0000
4	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	72.8370
5	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	197.7600
6	.0833	.0833	.0000
CUM FREQ	.9167	1.0000	643.2588
7	.0000	.1667	.0000
CUM FREQ	.8333	1.0000	1588.9744
8	.0000	.1667	.0000
CUM FREQ	.8333	1.0000	1600.8711
9	.0000	.1667	.0000
CUM FREQ	.8333	1.0000	1488.1345
10	.0000	.1667	.0000
CUM FREQ	.8333	1.0000	1306.5010
11	.0833	.0833	.0000
CUM FREQ	.9167	1.0000	966.1931
12	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	596.7200
13	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	395.0935
14	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	188.3696
15	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	163.6959
16	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	146.2810

Figure 7-4 (Page 7 of 14)

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 12. OBSERVATIONS

RECEPTOR	LEVEL 100.0	LEVEL 200.0	LEVEL 500.0	LEVEL 1000.0	LEVEL 2000.0
17	.5000	.1667	.3333	.0000	.0000
CUM FREQ	.5000	.6667	1.0000	1.0000	1.0000
18	.5000	.1667	.3333	.0000	.0000
CUM FREQ	.5000	.6667	1.0000	1.0000	1.0000
19	.5000	.2500	.2500	.0000	.0000
CUM FREQ	.5000	.7500	1.0000	1.0000	1.0000
20	.5000	.2500	.2500	.0000	.0000
CUM FREQ	.5000	.7500	1.0000	1.0000	1.0000
21	.5833	.2500	.1667	.0000	.0000
CUM FREQ	.5833	.8333	1.0000	1.0000	1.0000
22	.5833	.1667	.2500	.0000	.0000
CUM FREQ	.5833	.7500	1.0000	1.0000	1.0000
23	.5833	.1667	.2500	.0000	.0000
CUM FREQ	.5833	.7500	1.0000	1.0000	1.0000
24	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000
25	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000
26	1.0000	.0000	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	1.0000	1.0000	1.0000

Figure 7-4 (Page 8 of 14)

POST-PROCESSING ANALYSIS PROGRAM VERSION 2.30 LEVEL 851125

CUMULATIVE FREQUENCIES OF 1-HOUR AVERAGES FOR 12. OBSERVATIONS

RECEPTOR	LEVEL 3000.0	LEVEL **********	IAVG:# OBS= 12.0
17	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	137.7110
18	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	130.6924
19	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	117.9913
20	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	111.6660
21	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	99.9922
22	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	104.5212
23	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	102.3362
24	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	.0000
25	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	.0000
26	.0000	.0000	.0000
CUM FREQ	1.0000	1.0000	.0000

Figure 7-4 (Page 9 of 14)

PEAK

NHR	THR	HOURIN	DAYSIN	NH
3	1300.	0.	0.	1

RFACT	UNITS	LPRINT	NR	SCALE
1000000.		T	26	1.

Figure 7-4 (Page 10 of 14)

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 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR   7
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1       36.6827               1000  220    4    3
    2      315.7881                450  220    4   15
    3     5780.7266               9999  220    5    2
MEAN      2044.3992

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR   8
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1       61.9990               1000  220    4    3
    2      583.2815                450  220    4   15
    3     5005.6133               9999  220    5    2
MEAN      1883.6313

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR   9
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1       98.6686               1000  220    4    3
    2      597.5732                450  220    4   15
    3     4275.8281               9999  220    5    2
MEAN      1657.3567

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR  9  AT RECEPTOR  10
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1      147.6522               1000  220    4    3
    2      596.3550                450  220    4   15
    3     3396.9314               9999  220    5    2
MEAN      1380.3130

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR   7
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1      418.7693               9999  220    5    4
    2     1035.9919               9999  220    6    3
    3    10003.5508               9999  220    6    4
MEAN      3819.4373

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR   8
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1      765.3591               9999  220    5    4
    2     1899.4578               9999  220    6    3
    3     9035.2695               9999  220    6    4
MEAN      3900.0288

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR   9
**** CONCENTRATIONS (uG/M**3 )         WEATHER
RECORD        TOTAL                MIX  DIR  STAB SPD
    1     1205.0320               9999  220    5    4
    2     1659.7881               9999  220    6    3
    3     7850.3945               9999  220    6    4
MEAN      3571.7380
```

Figure 7-4 (Page 11 of 14)

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 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR  10
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL               MIX  DIR  STAB SPD
    1      1448.5771              9999  220    5    4
    2      1367.1082              9999  220    6    3
    3      6407.2852              9999  220    6    4
MEAN       3074.3235

 1300.0000 uG/M**3  EXCEEDED AT DAY    1 HOUR 12  AT RECEPTOR  11
**** CONCENTRATIONS (uG/M**3 )          WEATHER
RECORD        TOTAL               MIX  DIR  STAB SPD
    1      1319.3792              9999  220    5    4
    2      1246.4692              9999  220    6    3
    3      2941.3101              9999  220    6    4
MEAN       1835.7195
```

Figure 7-4 (Page 12 of 14)

TOTAL MAXIMUM CONCENTRATIONS (uG/M**3) FOR 4 (3-HOUR) AVERAGING PERIOD(S

RECEP	1	2	3	4	5	6	7	8
CONC	50.332	.152	.000	136.163	269.780	1262.204	3819.437	3900.02
DAY/HR	1 3	1 3	0 0	1 3	1 12	1 12	1 12	1 1

RECEP	9	10	11	12	13	14	15	16
CONC	3571.738	3074.323	1835.719	983.936	534.781	252.305	210.727	185.551
DAY/HR	1 12	1 12	1 12	1 12	1 12	1 9	1 9	1

RECEP	17	18	19	20	21	22	23	24
CONC	175.672	162.090	172.408	159.988	169.578	172.527	163.898	.00
DAY/HR	1 9	1 9	1 9	1 6	1 9	1 9	1 6	0

RECEP	25	26
CONC	.000	.000
DAY/HR	0 0	0 0

Figure 7-4 (Page 13 of 14)

NUMBER OF 3-HOUR AVERAGES ABOVE 1300.0000 uG/M**3 FOR 12 HOURS

RECEPTORS:

1- 8	0	0	0	0	0	0	2	2
9- 16	2	2	1	0	0	0	0	0
17- 24	0	0	0	0	0	0	0	0
25- 26	0	0						

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