APPENDIX D

Revisions to VF and PEF Equations (EQ, 1994b)

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

MEMORANDUM

TO:	Ms. Janine Dinan	**DATE:**	July 11, 1994
SUBJECT:	Revisions to VF and PEF Equations	**FROM:**	Craig Mann
FILE:	5099-3	**cc:**	

Subsequent to the evaluation of the dispersion equations in the RAGS - Part B performed by Environmental Quality Management, Inc. (EQ,1993), questions have arisen as to the accuracy of the modeling protocol used to derive the dispersion coefficient (Q/C) used in the volatilization factor (VF) and the particulate emission factor (PEF) presently employed to calculate the air pathway Soil Screening Levels (SSLs).

EQ, 1993 used the Industrial Source Complex model (ISC2-ST) to derive a normalized concentration (kg/m^3 per g/m^2-s) for a series of square and rectangular area sources of differing size. This modeling protocol employed a source subdivision scheme similar to that recommended in the ISC2-ST Model User's Manual (EPA, 1992) whereby the source was subdivided into smaller sources closest to the center of the area. The center of the area was found to represent the point of maximum annual average concentration for all source shapes analyzed. Consecutive model runs were performed whereby source subdivision was increased between runs. Final source subdivision was reached when the model results converged within a factor of three percent or less.

From these data, a simple linear regression was used to evaluate the nature of the relationship between the normalized concentration and the size of the area. Preliminary plots of the data indicated that the relationship was exponential. Therefore, the relationship was linearized by taking the natural logarithms (ln) of each variable. The resulting linear regression for a square area of 0.5 acres resulted in a normalized concentration (C/Q) of 0.0098 kg/m^3 per g/m^2-s; the inverse of the normalized concentration resulted in a dispersion coefficient (Q/C) of 101.8 g/m^2-s per kg/m^3.

On May 5, 1994 a teleconference was held between representatives of the Toxics Integration Branch of the Office of Emergency and Remedial Response (OERR) and the Source Receptor Analysis Branch of the Office of Air Quality Planning Standards (OAQPS) to discuss the relative merits of the available area source algorithms as applied to nearfield and on-site receptors exposed to ground-level nonbuoyant emissions. The conclusions drawn from this teleconference were that a new algorithm recently developed by OAQPS would yield more accurate results for the exposure scenario in question.

The new algorithm is incorporated into the ISC2 model platform in both short-term mode (AREA-ST) and long-term mode (AREA-LT). Both models employ a double numerical integration over the area source in the upwind and crosswind directions as follows:

$$\chi = \frac{Q_A K}{2\pi u_s} \int_x \frac{VD}{\sigma_y \sigma_z} \left(\int_y \exp\left[-0.5 \left(\frac{Y}{\sigma_y} \right)^2 \right] dy \right) dx \qquad (1)$$

where Q_A = Area source emission rate (g/m^2-s)

K = Units scaling coefficient

V = Vertical term

D = Decay term.

The integral in the lateral (i.e., crosswind or y) direction is solved analytically as:

$$\int_y \exp\left[-0.5\left(\frac{Y}{\sigma_y}\right)^2\right] dy = \text{erfc}\left(\frac{Y}{\sigma_y}\right) \qquad (2)$$

where erfc is the complementary error function.

The integral in the longitudinal (i.e., upwind or x) direction is solved by using a weighted average of successive estimates of the integral using a trapezoidal approximation. The model uses three separate criteria to determine convergence of the upwind integral. The result of these numerical methods is an estimate of the full integral that is essentially equivalent to, but much more efficient than, the method of estimating the integral as a series of line sources, such as the method used by the Point, Area, Line (PAL 2.0) model. Wind tunnel tests have also shown that the new algorithm performs well with on-site and near-field receptors.

Because the new algorithm provides better concentration estimates and does not require source subdivision, a revised dispersion analysis was performed for both volatile and particulate matter contaminants using the new algorithm.

The first part of the analysis involved a determination of the relationship between concentration and source size. In addition, this part of the analysis included a determination of the point of maximum annual average concentration for a square area source. This assessment employed the AREA-ST model as acquired from the OAQPS Technology Transfer Network, Support Center for Regulatory Air Models (SCRAM) Bulletin Board.

Meteorological data used for this analysis were 1989 hourly data for the Los Angeles National Weather Service (NWS) surface station, upper air data were from the Oakland NWS station for the same year. Rural dispersion coefficients were employed and all regulatory default options used. Modeling assumed flat terrain with no flagpole receptors; source rotation angle was set equal to zero.

Five source sizes were included in the assessment: 0.5, 5, 30, 200, and 600 acres. A coarse Cartesian receptor grid was employed within and extending beyond the source perimeter; a discrete receptor was also placed at the center of each source (x,y = 0,0). Emissions from each source were set equal to 1.0 g/m^2-s; concentrations were calculated in units of kg/m^3.

Figure 1 shows the relationship between source size (acres) and annual average concentration (kg/m3) for the five source sizes modeled. In each case, the point of maximum concentration was located at the center of the source. As an example, Attachment A is the model run sheets for the 0.5 acre source. As can be seen from Figure 1, the relationship between concentration and source size is exponential. Results also show that the maximum concentration representing the 600 acre source is 2.9 times higher than that of the 0.5 acre source.

Having established that when using the AREA-ST model the point of maximum concentration for a square area source is the center receptor, the second part of the analysis was to determine which of the 29 meteorological sites from EQ, 1993 best represents the average exposure and the high end exposure to volatile and particulate matter emissions. It was determined that the average exposure case should be represented by the 50th percentile site concentration, while the high end exposure is best represented by the 90th percentile site concentration.

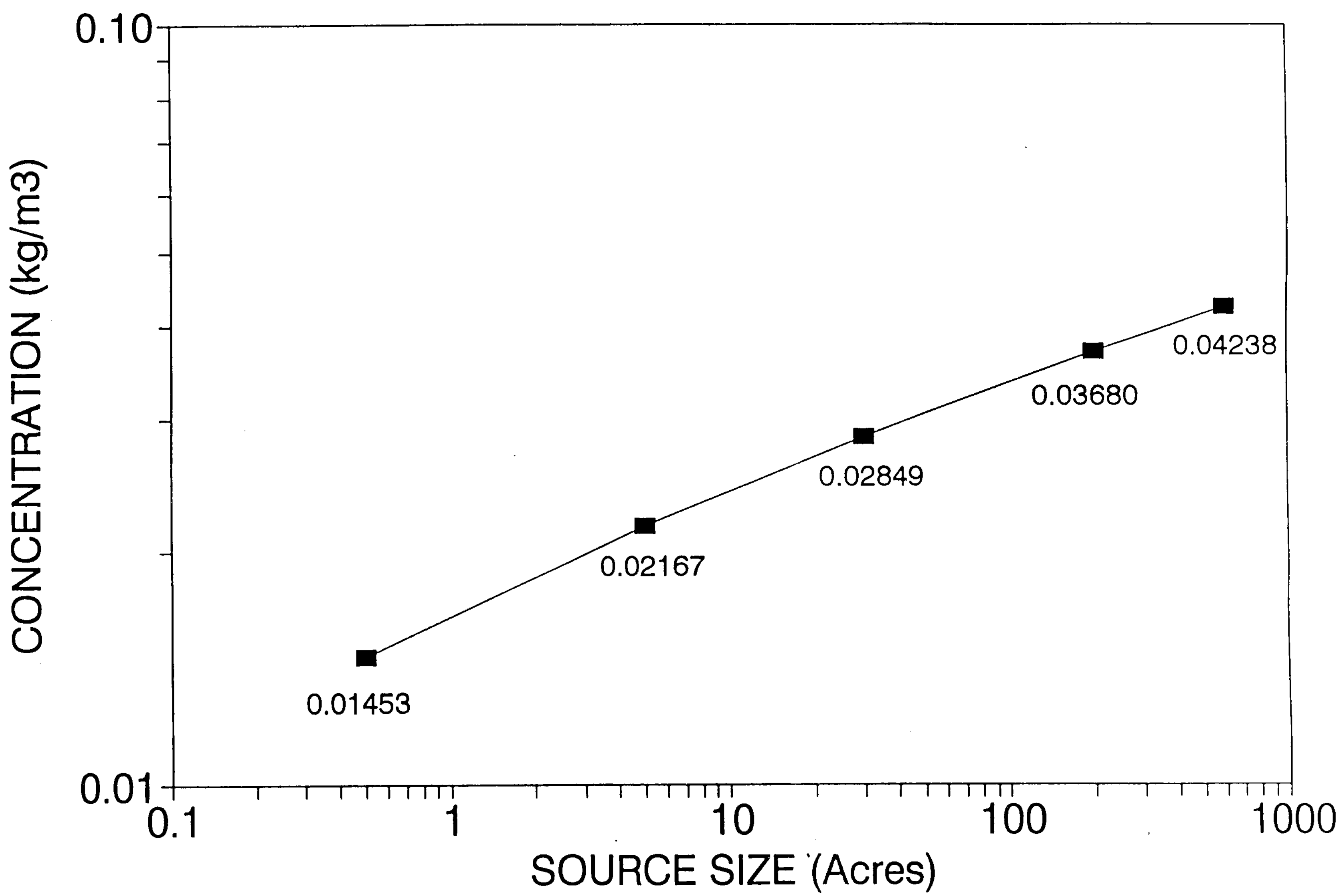

Figure 1
Normalized Annual Average Concentration Versus Source Size

Each of the 29 sites from EQ, 1993 were subsequently modeled at an emission rate of 1.0 g/m^2-s with a single discrete receptor at the center of the square area source. Source sizes modeled were 0.5 acres and 30 acres. Hourly meteorological data for each site were from EQ, 1993. From the set of SS normalized annual average concentrations, the 50th percentile site was determined to be Salt Lake City, Utah; Los Angeles, California (89th percentile site) was determined to be the closest approximation of the 90th percentile site. Table 1 shows the resulting dispersion coefficients for the two source sizes and the percentile ranking of each site.

In order to determine the average and high end sites for particulate matter exposures resulting from wind erosion, a normalized concentration could not be used because meteorological conditions other than simple dispersion (i.e., wind velocity and frequency) influence emissions and therefore actual concentrations. For this reason, actual concentrations were calculated for each site using the existing PEF equation as follows:

$$C = (C/Q)\left[\frac{0.036\,(1-V)\ \mathrm{x}\ (U_m/U_{t\text{-}7})^3\ \mathrm{x}\ F(x)}{3600\ \mathrm{s/h}}\right] \qquad (3)$$

where C = Annual average PM_{10} concentration, kg/m^3

(C/Q) = Normalized annual average concentration (kg/m^3 per g/m^2 -s)

V = Fraction of continuous vegetative cover

U_m = Mean annual windspeed, m/s

U_{t-7} = Equivalent threshold value of windspeed at 7 m, m/s

F(x) = Windspeed distribution function from Cowherd, 1985.

The value of (C/Q) for each site was the normalized concentration previously estimated for volatile emissions (i.e., the inverse of each dispersion coefficient in Table 1). The value of V was set equal to 0.5. The mean annual windspeed (U_m) for each site was taken from Weather of U.S. Cities, Second Edition, Volume 2 by J. A. Ruffner and F. E. Bair, Gale Research Co., Detroit, Michigan. The value of F(x) was estimated for each site from Figure 4-3 or calculated from Appendix B of Cowherd 1985, as appropriate.

The value of U_{t-7} was calculated as follows:

$$U_{t-7} = \frac{U_t}{0.4}\ \ln\left(\frac{700}{z_0}\right) \qquad (4)$$

where U_{t-7} = Equivalent threshold value of windspeed at 7 m, m/s

Z_o = Surface roughness height, cm (z_o = 0.5 cm for open terrain)

U_t = Threshold friction velocity, m/s (U_t = 0.625 m/s).

Table 2 gives the results of this analysis and shows the relative PM_{10} concentrations for each site by source size and the percentile rankings. As can be seen from Table 2, the 50th percentile site was Salt Lake City, Utah, while the 89th percentile site was Minneapolis, Minnesota.

TABLE 1.
VOLATILE DISPERSION SITE RANKINGS

City	NWS Surface Station Number	0.5 Acre (Q/C) (g/m^2-s per kg/m^3)	30 Acre (Q/C) (g/m^2-s per kg/m^3)	Site Ranking Percentile (%)
Huntington	13860	52.77	27.08	100
Fresno	93193	62.00	31.85	96
Phoenix	23183	64.06	32.63	93
Los Angeles	**24174**	**68.82**	**35.10**	**89**
Winnemucca	24128	69.25	35.49	86
Boise	24131	69.40	35.69	82
Hartford	14740	71.33	36.64	79
Little Rock	13963	73.37	37.68	75
Portland	14764	74.24	37.86	71
Salem	24232	73.42	37.88	68
Charleston	13880	74.91	38.42	64
Denver	23062	75.59	38.80	61
Atlanta	13874	77.16	39.68	57
Raleigh-Durham	13722	77.46	39.87	54
Salt Lake City	**24127**	**78.06**	**40.14**	**50**
Houston	12960	79.24	40.70	46
Lincoln	14939	81.63	41.56	43
Harrisburg	14751	81.90	42.34	39
Bismarck	24011	83.40	42.72	36
Seattle	24233	82.71	42.81	32
Cleveland	14820	83.19	43.03	29
Albuquerque	23050	84.18	43.31	25
Miami	12839	85.40	43.57	21
San Francisco	23234	89.53	46.06	18
Philadelphia	13739	90.09	46.38	14
Minneapolis	14922	90.74	46.84	11
Las Vegas	23169	95.51	49.48	7
Chicago	94846	97.75	50.45	4
Casper	24089	100.00	51.68	0

TABLE 2. PEF.CALCULATIONS AND SITE RANKINGS

City	NWS surface station number	Mean annual wind-speed (mph)	Mean annual wind-speed (m/s)	Roughness height, Zo t (cm)	Threshold friction velocity at surface (m/s)	Threshold friction velocity at 7m (m/s)	x	F(x), x<=2	F(x), x>2	Vegetative cover (fraction)	PM10 emission flux (g/m2-s)	0.5 Acre (Q/C) (g/m2-s per kg/m3)	0.5 Acre annual average conc. (ug/m3)	30 Acre (Q/C) (g/m2-s per kg/ m3)	30 Acre annual average conc. (ug/ m3)	Site ranking percentile (%)
Casper	24089	12.9	5.77	0.5	0.625	11.32	1.74	0.57	NA	0.50	3.77E-07	100.00	3.77	51.68	7.29	100
Cleveland	14820	10.8	4.83	0.5	0.625	11.32	2.08	NA	2.32E-01	0.50	9.01E-08	83.19	1.08	43.03	2.09	96
Lincoln	14939	10.4	4.65	0.5.	0.625	11.32	2.16	NA	1.82E-01	0.50	6.30E-08	81.63	077	41.56	1.52	93
Minneapolis	**14922**	**10.5**	**4.69**	**0.5**	**0.625**	**11.32**	**2.14**	**NA**	**1.94E-01**	**0.50**	**6.92E-08**	**90.74**	**0.76**	**46.84**	**1.48**	**89**
Bismarck	24011	10.3	4.60	0.5	0.625	11.3Z	2.18	NA	1.70E-01	0.50	5.73E-08	83.40	0.69	42.72	1.34	86
Chicago	94846	10.4	4.65	0.5	0.625	11.32	2.16	NA	1.82E-01	0.50	6.30E-08	97.75	0.64	50.45	1.25	82
Philadelphia	13739	9.6	4.29	0.5	0.625	11.32	2.34	NA	9.93E-02	0.50	2.71E-08	90.09	0.30	46.38	0.58	79
Miami	12835	9.2	4.11	0.5	0.625	11.32	2.44	NA	6.82E-02	0.50	1.64E-08	85.40	0.19	43.57	0.38	75
Altanta	13874	9.1	4.07	0.5	0.625	11.32	2.47	NA	6.16E-02	0.50	1.43E-08	77.16	0.19	39.68	0.36	71
Seattle	24233	9.1	4.07	0.5	0.625	11.32	2.47	NA	6.16E-02	0.50	1.43E-08	82.71	0.17	42.81	0.33	68
Boise	24131	8.9	3.98	0.5	0.625	11.32	2.52	NA	4.95E-02	0.50	1.07E-08	69.40	0.15	35.69	0.30	64
Las Vegas	23165	9.1	4.07	0.5	0.625	11.32	2.47	NA	6.16E-02	0.50	1.43E-08	95.51	0.15	49.48	0.29	61
Albuquerque	23050	9.0	4.02	0.5	0.625	11.32	2.49	NA	5.53E-02	0.50	1.24E-08	84.18	0.15	43.31	0.29	57
Denver	23062	8.8	3.93	0.5	0.625	11.32	2.55	NA	4.41E-02	0.50	9.25E-09	75.59	0.12	38.80	0.24	54
Salt Lake City	**24127**	**8.8**	**3.93**	**0.5**	**0.625**	**11.32**	**2.55**	**NA**	**4.41E-02**	**0.50**	**9.25E-09**	**78.06**	**0.12**	**40.14**	**0.23**	**50**
Portland	14762	8.7	3.89	0.5	0.625	11.32	2.58	NA	3.91E-02	0.50	7.93E-09	74.24	0.11	37.86	0.21	46
Charleston	13880	8.7	3.89	0.5	0.625	11.32	2.58	NA	3.91E-02	0.50	7.93E-09	74.91	0.11	38.42	0.21	43
Hartford	14764	8.6	3.84	0.5	0.625	11.32	2.61	NA	3.45E-02	0.50	6.76E-09	71.33	0.095	36.64	0.18	39
San Francisco	23234	8.7	3.89	0.5	0.625	11.32	2.58	NA	3.91E-02	0.50	7.93E-09	89.53	0.089	46.06	0.17	36
Little Rock	13963	8.0	3.58	0.5	0.625	11.32	2.80	NA	1.45E-02	0.50	2.29E-09	73.37	0.031	37.68	0.061	32
Winnemucca	24128	7.9	3.53	0.5	0.625	11.32	2.84	NA	1.23E-02	0.50	1.86E-09	69.25	0.027	35.49	0.052	29
Houston	12960	7.8	3.49	0.5	0.625	11.32	2.88	NA	1.03E-02	0.50	1.51E-09	79.24	0.019	40.70	0.037	25
Raleigh-Durham	13722	7.7	3.44	0.5	0.625	11.32	2.91	NA	8.60E-03	0.50	1.21E-09	77.461	0.016	39.87	0.030	21
Harrisburg	14751	7.7	3.44	0.5	0.625	11.32	2.91	NA	8.60E-03	0.50	1.21E-09	81.90	0.015	42.34	0.029	18
LosAngeles	24174	7.4	3.31	0.5	0.625	11.32	3.03	NA	4.74E-03	0.50	5.92E-10	68.82	8.60E-03	35.10	0.017	14
Salem	2423 2	7.0	3.13	0.5	0.625	11.32	3.21	NA	1.87E-03	0.50	1.98E-10	73.42	2.69E-03	37.88	5.22E-03	11
Huntington	13860	6.5	2.91	0.5	0.625	11.32	3.45	NA	4.45E-04	0.50	3.76E-11	52.77	7.13E-04	27.08	1.39E-03	7
Fresno	93193	6.4	2.86	0.5	0.625	11.32	3.51	NA	3.19E-04	0.50	2.58E-11	62.00	4.16E-04	31.85	8.09E-04	4
Phoenix	23183	6.3	2.82	0.5	0.625	11.32	3.56	NA	2.25E-04	0.50	1.73E-11	64.06	2.71E-04	32.63	5.31E-04	0

F(x) <= 2 from Cowherd (1985), Figure 4-3.
F(x) > 2 from Cowherd (1985), Appendix B.
NA = Not Appilcable.

Table 3 summarizes the results of the dispersion coefficient analysis for both the VF and PEF equations. In addition, Table 3 also gives the default values of the PEF variables for both average and high end exposures.

TABLE 3.
VF AND PEF VALUES OF (Q/C) FOR AVERAGE AND HIGH END EXPOSURES

Site size	Average annual conc., PM10 (ug/m^3)	High End annual conc., PM10 (ug/m^3)	PEF Average (Q/C), (g/m^2-s per kg/m^3)	PEF High End (Q/C), (g/m^2-s per kg/m^3)	VF Average (Q/C), (g/m^2-s per kg/m^3)	VF High End (Q/C), (g/m^2-s per kg/m^3)
0.5 Acres	0.12	0.76	78.06	90.74	78.06	68.82
30 Acres	0.23	1.48	40.14	46.84	40.14	35.10

Average Site for PM10= Salt Lake City
Average Site for Volatiles = Salt Lake City
High End Site for PM10 = Minneapolis
High End Site for Volatiles = Los Angeles

Average Site for PM10: Mean annual windspeed (U_m) = 3.93 m/s; F(x) = 0.044, at x = 2.55.
High End Site for PM10: U_m = 4.69 m/s; F(x) = 0.194, at x = 2.14.
Where:
Vegetative cover (V) = 0.5.
Surface roughness height (Z_o) = 0.5 cm.
Threshold friction velocity (U_t) = 0.625 m/s at surface.
Threshold windspeed at 7 meters (U_t-7) = U_t/0.4 x In(700/Z_o) = 11.32 m/s.

ATTACHMENT A

AREA-ST MODEL RUN SHEETS FOR A 0.5 ACRE SQUARE AREA SOURCE

```
CO      STARTING
CO      TITLEONE       AREA    SOURCES--- 1/2 acre    run
CO      MODELOPT       DFAULT  CONC     RURAL
CO      AVERTIME       PERIOD
CO      POLLUTID       PM10
CO      RUNORNOT       RUN
CO      ERRORFIL       AREA1.ERR
CO      FINISHED


SO STARTING
                SRCID       SRCTYP      XS          YS          ZS
SO LOCATION     A1/2        AREA        -22.5       -22.5       .0000
                SRCID       QS          HS          XINIT       YINIT
SO SRCPARAH     A1/2        1.0         0.0         45.         45.

SO      EHISUNIT       .100000E-02    (GRAMS/(SEC-M**2))    KILOGRAMS/CUBIC-METER

SO      SRCGROUP       AREA1   A1/2

SO      FINISHED

RE      STARTING
RE      DISCCART       0.             o.
RE      DISCCART       25.            0.
RE      DISCCART       -25.           o.
RE      DISCCART       25.            25.
RE      DISCCART       25.            -25.
RE      DISCCART       -25.           -25.
RE      DISCCART       -25.           25.
RE      DISCCART       50.            0.
RE      DISCCART       -50.           0.
RE      DISCCART       50.            50.
RE      DISCCART       50.            -50.
RE      DISCCART       -50.           -50.
RE      DISCCART       -50.           50.
RE      DSSCCART       75.            0.
RE      DISCCART       -75.           0.
RE      DISCCART       75.            75.
RE      DISCCART       75.            -75.
RE      DISCCART       -75.           -75.
RE      DISCCART       -75.           75.
RE      DISCCART       100.           0.
RE      DISCCART       -100.          0.
RE      DISCCART       100.           100.
RE      DISCCART       100.           -100.
RE      DISCCART       -100.          -100.
RE      DISCCART       -100.          100.

RE      FINISHED

ME      STARTING
ME      INPUTFIL       C:\CRAIG\23174-89.ASC
ME      ANEHHGHT       10.0 METERS
ME      SURFDATA       23174   1989    LOS ANGELES
ME      UAIRDATA       23230   1989    OAKLAND
```

```
ME      WINDCATS       1.54   3.09   5.14   8.23   10.80
ME      FINISHED

OU      STARTING
OU      RECTABLE       ALLAVE FIRST
OU      FINISHED

*****************************************************
*** SETUP Finishes Successfully ***
*****************************************************
```

```
*** AREAST - VERSION TESTA ***   *** AREA SOURCES---1/2 acre run***
TEST OF ST AREA SOURCE ALGORITHM ***                            ***

*** MODELING OPTIONS USED: CONC RURAL FLAT DFAULT

                            *** MODEL SETUP OPTIONS SUMMARY     ***
```

```
**Model Is Setup For Calculation of Average CONCentration Values.

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:
       1. Final Plume Rise.
       2. Stack-tip Downwash.
       3. Buoyancy-induced Dispersion.
       4. Use Calms Processing Routine.
       5. Not Use Missing Data Processing Routine.
       6. Default Wind Profile Exponents.
       7. Default Vertical Potential Temperature Gradients.
       8. "Upper Bound" Values for Supersquat Buildings.
       9. No Exponential Decay for RURAL Mode

**Model Assumes Receptors on FLAT Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates PERIOD Averages Only

**This Run Includes: 1 Source(s); 1 Source Group(s); and 25 Receptore(s)

**The Model Assumes A Pollutant Type of: PM10

**Model Set To Continue RUNning After the Setup Testing.ff

**Output Options Selected:
Model Outputs Tables of PERIOD Averages by Receptor
Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values:
       c for Calm Hours
       m for Hissing Hours
       b for Both Calm and Missing Hours

**Misc. Inputs:
       Anem. Hgt. (m) = 10.00 ; Decay Coef. =.0000 ; Rot. Angle = .0
       Emission Units = (GRAMS/(SEC-M**2)); Emission Rate Unit Factor = .lOOOOE-02
       Output Units = KILOGRAMS/CUBIC-METER

**input Runstream File: area1.dat,                  **Output Print File: area1.out
**Detailed Error/Message File: AREA1.ERR
```

```
*** AREAST - VERSION TESTA ***   *** AREA SOURCES--- 1/2 acre run                              ***
TEST OF ST AREA SOURCE ALGORITHM ***                                                           ***

*** MODELING OPTIONS USED: CONC RURAL FLAT          DFAULT
```

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (USER UNITS /METERS**2)	COORD X (METERS)	(SW CORNER) Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	EMISSION RATE SCALAR VARY BY
A1/2	0	.10000E+01	-22.5	-22.5	.0	.00	45.00	45.00	.00	

```
*** AREAST - VERSION TESTA ***    *** AREA SOURCES--- 1/2 acre run                             ***
TEST OF ST AREA SOURCE ALGORITHM  ***                                                          ***

*** MODELING OPTIONS USED: CONC RURAL FLAT DFAULT
```

*** SOURCE IDs DEFINING SOURCE GROUPS ***

```
GROUP ID                                  SOURCE IDs

AREA1 A1/2
```

```
*** AREAST - VERSION TESTA *** *** AREA SOURCES--- 1/2 acre run
TEST OF ST AREA SOURCE ALGORITHM ***        ***

*** MODELING OPTIONS USED: CONC RURAL FLAT DFAULT


                    *** DISCRETE CARTESIAN RECEPTORS ***
                  (X-COORD, Y-C00RD, ZELEV, ZFLAG) (METERS)

    (      .0,      .0,   .0,     .0);  (      25.0,      .0,   .0,     .0);
    (   -25.0,      .0,   .0,     .0);  (      25.0,    25.0,   .0,     .0);
    (    25.0   -25.0,   .0,     .0);  (     -25.0,   -25.0,   .0,     .0);
    (   -25.0    25.0,   .0,     .0);  (      50.0,      .0,   .0,     .0);
    (   -50.0,      .0,   .0,     .0);  (      50.0,    50.0,   .0,     .0);
    (    50.0   -50.0,   .0,     .0);  (     -50.0,   -50.0,   .0,     .0);
    (   -50.0    50.0,   .0,     .0);  (      75.0,      .0,   .0,     .0);
    (   -75.0,      .0,   .0,     .0);  (      75.0,    75.0,   .0,     .0);
    (    75.0,   -75.0,   .0,     .0);  (     -75.0,   -75.0,   .0,     .0);
    (   -75.0,    75.0,   .0,     .0);  (     100.0,      .0,   .0,     .0);
    (  -100.0,      .0,   .0,     .0);  (     100.0,   100.0,   .0,     .0);
    (   100.0,   100.0,   .0,     .0);  (    -100.0,  -100.0,   .0,     .0);
    (  -100.0,   100.0,   .0,     .0);
```

*** AREAST - VERSION TESTA *** *** AREA SOURCES--- 1/2 acre run
TEST OF ST AREA SOURCE ALGORITHM *** ***

*** MODELING OPTIONS USED CONC RURAL FLAT DFAULT

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	1111111111	1111111111	1111111111	1111111111
1111111111	111111			

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WlLL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(HETERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

STABILITY	WlND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***
(DEGREES KELVIN PER METER)

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.00000E+00	.O0000E+00	.00000E+00	.00000E+00	.00000E+00	.O0000E+00
B	.00000E+00	.00000E+00	.00000t+00	.00000E+00	.00000E+OO	.00000E+OO
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.OO000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

*** AREAST - VERSION TESTA *** *** AREA SOURCES--- 1/2 acre run ***
TEST OF ST AREA SOURCE ALGORITHM *** ***

*** MODELING OPTIONS USED: CONC RURAL FLAT DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: C:\CRAIG\23174-89.ASC FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1)
SURFACE STATION NO : 23174 UPPER AIR STATION NO.: 23230
NAME: LOS NAME: OAKLAND
YEAR: 1989 YEAR: 1989

YEAR	MONTH	DAY	HOUR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING RURAL	HEIGHT (M) URBAN
89	1	1	1	251.0	3.09	282.6	4	533.0	533.0
89	1	1	2	228.0	3.09	282.0	4	568.6	568.6
89	1	1	3	194.0	2.57	282.0	4	604.1	604.1
89	1	1	4	143.0	4.63	282.0	4	639.6	639.6
89	1	1	5	173.0	2.06	282.0	5	675.2	151.0
89	1	1	6	272.0	3.09	280.4	6	710.7	151.0
89	1	1	7	265.0	2.06	280.4	6	746.3	151.0
89	1	1	8	233.0	2.06	282.0	5	134.9	265.4
89	1	1	9	257.0	2.06	283.7	4	278.2	387.0
89	1	1	10	261.0	.00	285.9	3	421.6	508.6
89	1	1	11	44.0	2.06	288.2	3	564.9	630.2
89	1	1	12	56.0	3.60	289.3	3	708.3	751.8
89	1	1	13	83.0	4.12	289.3	3	851.6	873.4
89	1	1	14	59.0	4.12	290.4	3	995.0	995.0
89	1	1	15	82.0	4.12	287.6	3	995.0	995.0
89	1	1	16	74.0	3.60	287.6	4	995.0	995.0
89	1	1	17	81.0	3.60	285.9	5	992.3	979.1
89	1	1	18	87.0	3.09	284.3	6	975.8	880.6
89	1	1	19	154.0	4.12	286.5	5	959.2	782.2
89	1	1	20	167.0	2.06	285.4	6	942.7	683.8
89	1	1	21	280.0	2.57	285.4	6	926.2	585.3
89	1	1	22	252.0	2.06	284.3	6	909.6	486.9
89	1	1	23	220.0	3.09	283.2	6	893.1	388.4
89	1	1	24	260.0	1.54	283.7	7	876.5	290.0

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** AREAST - VERSION TESTA ***   *** AREA SOURCES--- 1/2 acre run ***
TEST OF ST AREA SOURCE ALGORITHM *** ***

*** MODELING OPTIONS USED: CONC RURAL FLAT DFAULT

*** THE PERIOD (8760 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: AREA1 ***
INCLUDING SOURCE(S): A1/2,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF PM10 IN KILOGRAMS/CUBIC-METER **

X-COORD (M)	Y-COORD (M)	CONE	X-COORD (M))	Y-COORD (M	CONC
.00	.00	.01453	25.00	.00	.00679
-25.00	.00	.00594	25.00	25.00	.00414
25.00	-25.00	.00104	-25.00	-25.00	.00220
-25.00	25.00	.00223	50.00	.00	.00175
-50.00	.00	.00158	50.00	50.00	.00060
50.00	-50.00	.00018	-50.00	-50.00	.00034
-50.00	50.00	.00037	75.00	.00	.00076
-75.00	.00	.00078	75.00	75 .00	.00024
75.00	-75.00	.00008	-75.00	-75.00	.00015
-75.00	75.00	.00016	100.00	.00	.00041
-100.00	.00	.00047	100.00	100.00	.00013
100.00	-100.00	.00005	-100.00	-100.00	.00009
-100.00	100.00	.00009			

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*** AREAST - VERSION TESTA ***   *** AREA SOURCES--- 1/2 acre run
TEST OF ST AREA SOURCE ALGORITHM ***

*** MODELING OPTIONS USED: CONC RURAL FLAT          DFAULT

                  *** THE SUMMARY OF MAXIMUM PERIOD ( 8760 HRS) RESULTS ***

                    ** CONC OF PM10IN    KILOGRAMS/CUBIC-METER          **

                                                                                 NETWORK
GROUP ID              AVERAGE CONC          RECEPTOR (XR, YR, ZELEV, ZFLAG) OF TYPE GRID-ID

AREA1   1ST HIGHEST VALUE IS  .01453 AT (       .00,        .00,   .00,      .00)     DC
        2ND HIGHEST VALUE IS  .00679 AT (     25.00,        .00,   .00,      .00)     DC
        3RD HIGHEST VALUE IS  .00594 AT (    -25.00,        .00,   .00,      .00)     DC
        4TH HIGHEST VALUE IS  .00414 AT (     25.00,      25.00,   .00,      .00)     DC
        5TH HIGHEST VALUE IS  .00223 AT (    -25.00,      25.00,   .00,      .00)     DC
        6TH HIGHEST VALUE IS  .00220 AT (    -25.00,     -25.00,   .00,      .00)     DC

*** RECEPTOR TYPES:
GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY
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*** AREAST - VERSION TESTA ***   *** AREA SOURCES--- 1/2 acre run                                ***
TEST OF ST AREA SOURCE ALGORITHM ***                                                             ***

*** MODELING OPTIONS USED: CONC RURAL FLAT       DFAULT

*** Message Summary For ISC2 Model Execution ***

 -------- Summary of Total Messages --------

A Total of       0 Fatal Error Message(s)
A Total of       0 Warning Message(s)
A Totat of     653 Informational Message(s)

A Total of     653 Calm Hours Identified


                            ******** FATAL ERROR MESSAGES ********
                                      *** NONE ***

                              ******** WARNING MESSAGES ********
                                      *** NONE ***

                         ********************************************
                          *** ISCST2 Finishes Successfully ***
                         ********************************************
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