UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: JAN 18 1991

SUBJECT: New Jersey Department of Environmental Protection's Comments On The Valley Model

FROM: Raymond Werner, Chief [signature] for
Impact Assessment Section, 2AWM-AP

TO: Dean Wilson
Source Receptor Analysis Branch, OAQPS

Pursuant to your discussion with Annamaria Colecchia of my staff, please review New Jersey Department of Environmental Protection's (NJDEP) concerns regarding the discrepancies in the Valley Model. As seen in the enclosure, this issue has been raised previously but not addressed. At present, NJDEP is running a version of the Valley model which they "corrected", however, this raises the question of whether this is a reference model and the question of whether the "uncorrected" model is appropriate.

Please call Annamaria Colecchia if you have any questions at FTS 264-4939. You should be aware that the NJDEP is concerned that their review may be challenged because of the problem.

Enclosure

cc: J. Rees, NJDEP

Let's protect our earth

State of New Jersey
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF ENVIRONMENTAL QUALITY
CN 027
TRENTON, N.J. 08625

February 9, 1989

U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

Central Docket Section
(South Conference Center, Room 4)
Attention: Docket A-88-04

Dear Sir:

re: Fourth Conference on Air Quality Modeling

Attached are written comments by the New Jersey Department of Environmental Protection, Division of Environmental Quality, Bureau of Air Quality Planning and Evaluation on new modeling techniques and potential revisions to the "Guideline on Air Quality Models".

Comments are provided first on the eleven topics listed in the August 23, 1988 Federal Register notice for the conference and second on additional issues related to air quality modeling of interest to the Bureau. Where possible, comments are referenced to the appropriate section in the Guideline.

The Bureau would like to note its disappointment in the poor availability of the technical support documents in the Docket for the eleven topics noted above. Copies of many of these documents were requested but never received from the EPA.

Sincerely,

Joseph Laznow, Chief
Bureau of Air Quality Planning and Evaluation

Attachment

c: R. Werner (EPA Region II)

Comments by the New Jersey Department of Environmental Protection
Division of Environmental Quality
Bureau of Air Quality Planning and Evaluation
in Regard to EPA's Fourth Conference on Air Quality Modeling

Comments on the Eleven Primary Issues

A. Complex Terrain Dispersion Model (CTDM)

The Bureau believes the Complex Terrain Dispersion Model is technically valid and that the model validation and sensitivity studies done to date warrant its adoption as a refined model for complex terrain. An unstable module, based on algorithms in the Rough Terrain Diffusion Model (RTDM), should be added to improve the performance of CTDM in unstable conditions.

The Bureau does not support the use of CTDM in a screening mode with assumed "worst case" meteorological conditions where more sophisticated on-site data are not available. The first, second and third level screening techniques already contained in the Guideline are sufficient for this purpose.

B. Ozone Precursor Point Source Modeling

The Bureau supports the development of a technique for predicting the impact on ambient ozone due to proposed point sources of ozone precursor emissions but cannot comment on the technical validity of the Reactive Plume Model (RPM-II) for this purpose. The Bureau did not have the docket item available for review.

The Bureau also questions how the significance of impacts predicted with RPM-II would be judged given the uncertainty associated with screening models and that a "significant" contribution to an ozone non-attainment area is currently undefined.

C. Mobile Source Modeling at Signalized Intersections

The Bureau supports the effort to develop a modeling procedure acceptable to both EPA and FHWA for determining carbon monoxide concentrations at intersections. Techniques for air quality modeling of over-capacity situations should also be developed as soon as practicable.

D. Emissions and Dispersion Modeling Systems for Airports

The Bureau has no comment on the Emissions and Dispersion Modeling System (EDMS). Our experience is that noise, not air pollution, is the current environmental concern with airports.

E. Long-Range Transport Models

The Bureau recommends the adoption of a long range transport model for screening short term air quality impacts on Class I PSD areas beyond 50 kilometers from a source. The Bureau cannot recommend the adoption of a particular model as the Bureau did not have the evaluation studies in the docket available for review.

F. Models for Estimating Visibility Impact of Specific Sources

The Bureau has no comment. The EPA Office of Research and Development recommendations and the revised "Workbook for Estimating Visibility Impairment" were not readily available for the Bureau to review. The Bureau would find a personal computer (PC) based visibility screening model helpful.

G. Model for Shoreline Dispersion

The Bureau supports the adoption of a preferred model for predicting plume dispersion and fumigation for elevated sources located on the coastline. Protection of the environment (air quality and water quality) along the New Jersey coast is a very real concern to the public. The Bureau cannot comment on the technical validity of any of the recommended techniques as the evaluation studies in the docket were not readily available for review.

H. Valley Stagnation

The Bureau does not have sufficient information to comment on the technical validity of the WYNDvalley model but supports the need for a simple modeling technique applicable to valley stagnation and recirculation conditions.

I. On-Site Meteorological Program Guidance

The Bureau recommends the formal adoption in the Guideline of the EPA document "On-site Meteorological Program Guidance for Regulatory Modeling Applications". The Bureau has already used recommendations in this document to judge the representativeness of off-site meteorological data proposed by permit applicants for use in dispersion modeling analyses.

The Bureau has no experience with the Meteorological Processor for Regulatory Models (MPRM) but recommends the adoption of a standard technique for processing meteorological data for input to the EPA regulatory dispersion models. A personal computer (PC) based processor would be particularly useful.

J. Method for Evaluating Models

The Bureau recommends that the methodology described in the EPA report "Protocol for Determining the Best Performing Model" (docket item II-I-19) be expanded to consider more than just the highest observed and predicted 25 concentrations. While these extreme values are of most use in regulatory model applications, more data should be examined in judging the performance of a model.

K. Other Issues

Volume 10 R:

The Bureau cannot comment on the technical validity of the screening techniques in the proposed revisions to Volume 10 of the Guidelines for Air Quality Maintenance Planning and Analysis as it has only just received the first public draft. The Bureau requests that the comment period for this document be divorced from the February 13, 1989 deadline for formal comment on revisions to the Guideline to allow more time for technical review.

The Bureau applauds the incorporation of the techniques in this document into a personal computer (PC) based system. The SCREEN model will be widely used in the day to day permit review process in our Bureau.

ROM and RADM:

The Bureau has no comment on the potential usefulness of these models to our current regulatory programs.

Toxics:

The Bureau agrees with the importance of developing new modeling techniques to handle toxic air pollutants. In particular, methods are needed that can handle non-point sources such as lagoons, wastewater treatment plants, landfills and other fugitive emission sources. Some of these models will require input parameters that may not always be available for specific sources. Recommendations concerning representative values to choose in the absence of real data would be valuable.

The Bureau also sees the need for improved techniques for examining emissions from short stacks (less than 20-30 feet). Toxic emissions from these low points are inevitably caught in building wakes, resulting in extremely high predicted concentrations. More precise models would help us to make better risk management decisions.

Comments on Other Issues of Interest to the Bureau

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1. Guideline Reference: Section 3.3.1 The Model Clearinghouse

COMMENT: The availability of model clearinghouse decisions and recommendations needs to be improved. The current fiscal year summary reports do not provide sufficient background on what the modeling issues are and the reasoning behind the particular Clearinghouse recommendations. There is still the perception that Clearinghouse recommendations are not being consistently applied amongst the EPA Regions.

2. Guideline Reference: Section 5.2.1 Screening Techniques

COMMENT: An initial screening technique is needed to determine annual average concentrations in complex terrain without the need for collection of on-site meteorological data. The Bureau has reviewed a number of new source applications involving gas turbines where nitrogen dioxide, with only an annual average NAAQS, is the primary pollutant. Our current practice is to use the VALLEY model with annual STAR data from the nearest representative National Weather Service Station.

Further guidance is needed on an initial screening technique for urban areas. The VALLEY model user's guide (p.2-17) notes that VALLEY output for the urban area option is based on the assumption of flat terrain. The Bureau believes the VALLEY model should not be recommended as an initial screening technique for urban areas. Rather a simple terrain model, such as ISC, should be used with receptor elevations cut off at stack top.

3. Guideline Reference: Section 6.2.3 Models for Nitrogen Dioxide

COMMENT: The Bureau believes the use of the Ozone Limiting Method as a second and third level screen for estimating annual average nitrogen dioxide impacts from point sources should be limited to rural areas. The density of industrial, commercial and mobile sources of hydrocarbons in urban areas would significantly enhance the rate of NO to NO2 conversion, negating the assumptions implicit in the Ozone Limiting Procedure.

The "NO2/NOx ratio method" outlined in this section of the Guideline should become the recommended second level screen for estimating annual average nitrogen dioxide impacts of proposed and existing point sources in urban areas.

4. Guideline Reference: Section 8.8.1 Design Concentrations

COMMENTS: Design concentrations for demonstrating compliance with short term National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments should be based on running average concentrations, not block average concentrations. New Jersey requires running average concentrations for model demonstrations of compliance with both state and federal ambient air quality standards. Post-processing programs (RUNAVG and CHAVG) currently exist which compute running average concentrations with regulatory models.

Model output should be consistent with the reporting of ambient monitoring data (non-overlapping moving averages for 8-hr CO, 3 and 24-hr SO2) (block averages for 24-hr TSP and PM10) and even more importantly should be consistent with how people breathe.

5. Guideline Reference: Section 8.2.3 Dispersion Coefficients

COMMENT: A middle ground is sorely needed between the Pasquill-Gifford rural dispersion coefficients and the McElroy-Pooler urban dispersion coefficients. In practice there can be a factor of three to four difference in model predicted concentrations for the same set of input data but with rural vs urban coefficients.

While there clearly is a distinct difference in the dispersion environment between large metropolitan areas and undeveloped rural areas, many point sources are located in areas of mixed land use, particularly with the ever increasing suburban development. In many of these cases, neither the urban nor rural coefficients are truly appropriate.

The conservative approach is to model in the urban mode when in doubt. However, because the urban coefficients generally always give substantially higher predicted source impacts, pre-construction monitoring (when PSD de minimis concentrations are exceeded), multi-source modeling (when significant impact concentrations are exceeded), and even more restrictive emission limitations (to prevent significant contributions to modeled or designated non-attainment areas) may be required when not truly necessary.

The Bureau strongly recommends that the EPA begin a program to develop dispersion coefficients for the regulatory models suitable for land use which is not clearly urban or rural.

6. Guideline Reference: Section 8.2.8 Urban/Rural Classification

COMMENT: The Bureau believes it is not appropriate to assign an arbitrary break point of 50 percent (land use typed as I1, I2, C1, R2 and R3) to determine whether urban or rural dispersion coefficients should be used to model a specific application. The "Auer" methodology cannot be either accurate or precise to a few percentage points. There are too many variables and too much room for subjective judgement for this method to be of any use within a range of plus or minus five to ten percent.

For example, a source located within a major oil refining complex located in a rural area according to the "Auer" technique, should be modeled with urban coefficients rather than rural because of the large heat flux at the facility.

The Bureau believes that the EPA should find a better method to determine which set of dispersion coefficients are more appropriate for a particular application, or as noted above, develop coefficients appropriate for land use which is clearly not urban or rural.

Comments on Other Issues Not Specifically Referenced to the Guideline

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1. The VALLEY model

COMMENT: The Bureau frequently uses the VALLEY model as an initial screening technique for complex terrain. However this model is especially frustrating to use. Many model input parameters are not clearly explained in the User's Guide (particularly the GRID factor) and the model output is difficult to interpret. Also the Bureau has found the results from the model to be at times inconsistent with what would be expected based on theory.

For your information, the Bureau has attached an evaluation of problems we have encountered with the VALLEY model. The Bureau recommends that this model and its user's guide be updated or better yet, replaced with a more convenient and consistent screening tool.

2. The Industrial Source Complex (ISC) model

COMMENT: The Bureau protests the continuing problems found with the downwash algorithms in the short term and long term version of ISC. It has been well over two years since the modifications to this model were first proposed in the Federal Register (September 9, 1986). Models should not be released for regulatory use without strict testing. Important modifications to the models should be released early in draft form to the modeling community for testing, not limited in availability to the EPA Regional Offices.

Valley Model Evaluation

Chris N. Salmi
New Jersey Department of Environmental Protection
Air Quality Management and Surveillance

September 1988

The goal of this project is to determine why the results for a screening analysis using the Valley model were inconsistent with the expected results based on model theory. This document describes the evaluation process, the problem isolated, and proposes a solution to fix the Valley model.

Summary

The Valley model has 112 built in receptors. The receptors are located along the sixteen wind direction radials with seven rings. When a screening analysis was performed specifying the same height for the receptors along the same ring, significantly different predicted impacts were computed for the same meteorological conditions, see Table I. For these conditions, the predicted impacts are expected to be the same. Thus, the Valley model was found to have a problem (bug).

The problem was isolated. The receptors along a "ring" were found not be equidistant from a source. Since the predicted concentration is a function of downwind distance, it is not surprising the predicted impacts were different.

A solution to fix the problem is proposed.

History

In the process of evaluating a permit request, a screening analysis was performed using the Valley model by Phillip McIntyre, BAQP&E. The first indication of a problem was noticed when the predicted impact concentrations increased with increasing height from the plume center line. The simulation was performed specifying the receptors at different heights along the first ring utilizing STAR frequency values of 1.0 for F stability for all wind directions. The concentration profile, based on theory, is expected to increase to the plume center line and decrease with increasing height. The predicted profile fluxuated widely as shown in Table I. The input parameters used are shown in Table II.

Since the results did not agree with theory, John Rees, BAQP&E, used the VALSIM program to collaborate the results. The VALSIM program is a basic program developed by Jim Clary and Associates and sold to the NJ DEP with the Valley model. The concentration profile predicted was as expected, Table III, thereby indicating a problem with the Valley model.

The Guideline on Air Quality Models[1] states "only one wind direction should be used" for a screening analysis, pp 5-4,5-5. It is not clear if this is meant for single source analysis or multi-source analysis. The document cites the Valley User's Guide[2] page 2-15, in the same sentence. The citation refers to a multi-source analysis, where the total concentration at a given receptor is the sum for all sources. One could interpret the guidance to indicate one wind direction should be used for all screening analyses or for just multi-source analyses, given the citation. The ambiguity with the guidance does not assist in the resolution of the problem.

Evaluation

To determine the problem, I first ran the Valley model multiple times for various receptor heights, using one wind direction as indicated in the Guideline document. The results were as expected based on model theory and were comparable to the results obtained with the VALSIM model, Table III.

With the assistance of Steve Huber, BAQP&E, we obtained the Valley FORTRAN source code from the EPA NCC. The source code was found in the UNAMAP6.IMOD.FORT(VALLEY) data set on the IBM mainframe. It appears from the comments included in the beginning of the code, it was last updated in December 1980 to add the options for buoyancy induced dispersion. I added the appropriate OPEN statements and compiled the code using the Microsoft Fortran compiler for a DOS Personal Computer. To verify the results, I made an identical run with the newly compiled code and with the compiled model obtained by NJ DEP from Jim Clary and Associates. The results were identical. Thus I assumed, I was working with the latest version or at least an identical version of the Valley model.

Since the problem occurred when multiple receptors are used, I created a simulation using the input parameters prescribed in Table II, except I included receptors at the same height in all directions on the first receptor ring. The results were surprising, Table IV. One would expect the same impact concentration at all receptors, however this was not found.

After examination of the code, I was able to isolate the problem. The problem is due to the fact that the receptors are not equidistant from the source, i.e. the ring is not circular. The receptor distances are shown in Table V. The distances were computed using the formula, (line MA029000 in the code.)

```
GRID*( (SVER-RVER(M))*BCOS + (SHOR-RHOR(M))*BSIN) )
```

Where,

GRID is the grid factor input,
SVER, SHOR are the vertical and horizontal coordinates of the source
RVER(M),RHOR(M) are the vertical and horizontal coordinates of receptor M

BCOS	is the Cosine of the wind flow angle,
BSIN	is the Sin of the wind flow angle,

This formula is used to calculate the down wind distance of the receptor from the source. Since the down wind concentration is a function of the down wind distance, it is not surprising the predicted concentrations fluxuated.

Solution

To correct the location of the receptors, i.e. to place them on a circle equidistant from the source, I developed a subroutine to compute the new cartesian coordinates given the polar spacing, used by valley along each of the wind direction radial. The Valley model uses the spacing factors of 8, 16, 24, 32, 40, 48, and 56 for the rings. The subroutine is listed in Figure 1. The old and the new coordinates are shown in Table VI. I inserted a call to the subroutine in the main program, prior to the input of any data. When I ran this new version, using the sixteen receptors along the first receptor ring, the model predicted the same impact at all the receptors. Table VII compares the results of the modified model to the existing model for the input data using the first simulation described in the History section, that is where the receptor heights increased for each receptor. The predicted impacts are the same as those abtained in the one receptor, one wind direction simulations, Table III.

References

[1] U.S. Environmental Protection Agency, 1986. Guideline On Air Quality Models (Revised). EPA Publication No. EPA-450/2-78-027R. U.S. Environmental Protection Agency, Research Triangle Park, NC.

[2] Burt, E. W., 1977. Valley Model User's Guide. EPA Publication No. EPA-450/2-77-018. U. S. Environmental Protection Agency, Research Triangle Park, NC.

Table I: Valley Model Predicted Impacts along the First Ring

Receptor Height (m)	Concentration (ug/m^3)	Trend based previous ht
580	35.06	
600	44.59	+
620	40.92	-
640	48.54	+
660	47.56	-
680	60.23	+
700	54.57	-
720	50.51	-
740	81.26	+
760	37.41	-
780	44.37	+
800	47.37	
850	41.83	-
900	70.97	+

Table II: The Valley Model Input Values Used in the Simulations

Source Parameters

Emission Rate: 20.31 g/s
Stack Height: 111.3 m
Stack Diameter: 3.17 m
Exit Velocity of the Stack Gas: 18.68 m/s
Temperature of the Stack Gas: 389 K
Base Elevation of the Stack: 37.99 ft

Model Parameters

Ambient Pressure: 960 mb
Ambient Temperature: 293 K
Convert Concentrations to STP: Yes
Scaling Factor: 285.
Afternoon Maximum Mixing Height: 1214 m
Nighttime Minimum Mixing Height: 100 m
Urban/Rural Mode Rural
Calculate Short Term Concentrations Yes
Include Buoyancy Induced Dispersion Yes
Constant for Stable Plume Rise: 2.6
Use Transitional Plume Rise Yes
Wind Speed for Class 1: 2.5 m/s

Table III: Comparison of Single Wind Direction Valley Simulations to VALSIM Simulations

Receptor Height (m)	Concentration (ug/m^3) Valley	Predicted by VALSIM
580	33.36	32.49
600	38.97	37.92
620	44.16	42.91
640	48.53	47.09
660	51.62	51.17
680	51.62	50.41
700	51.30	49.65
720	50.52	48.89
740	49.73	48.13
760	48.94	47.37
780	48.16	46.61
800	47.37	45.85
850	45.40	43.95
900	43.43	42.05

Table IV: Predicted Impacts using the Valley Model
All Receptors on the First Ring at 900 m

Receptor Number	Predicted Concentration (ug/m^3)
1	43.4
8	46.4
15	50.7
22	40.0
29	43.4
36	40.0
43	50.7
50	46.2
57	43.4
64	71.0
71	33.2
78	40.0
85	43.4

Note: One would expect these values to be the same.

Table V: Valley Model Receptor Distances

Ring #	Rcpt #	Horz. Coord.	Vert. Coord.	Distance (m)	Dist/Grid
1	64	458.0	55.0	1534.66	5.39
1	106	458.0	65.0	1534.66	5.39
1	43	465.0	55.0	2015.25	7.07
1	15	465.0	65.0	2015.26	7.07
1	50	463.0	53.0	2170.33	7.62
1	8	463.0	67.0	2170.33	7.62
1	57	460.0	52.0	2280.00	8.00
1	1	460.0	68.0	2280.00	8.00
1	85	452.0	60.0	2280.00	8.00
1	29	468.0	60.0	2280.00	8.00
1	92	452.0	63.0	2433.64	8.54
1	36	468.0	57.0	2433.64	8.54
1	22	468.0	63.0	2433.64	8.54
1	78	452.0	57.0	2433.64	8.54
1	71	453.0	53.0	2821.36	9.90
1	99	453.0	67.0	2821.36	9.90
2	51	466.0	47.0	4077.36	14.31
2	107	454.0	73.0	4077.36	14.31
2	65	454.0	47.0	4077.36	14.31
2	9	466.0	73.0	4077.36	14.31
2	58	460.0	45.0	4275.00	15.00
2	2	460.0	75.0	4275.00	15.00
2	30	476.0	60.0	4560.00	16.00
2	86	444.0	60.0	4560.00	16.00
2	72	448.0	48.0	4836.61	16.97
2	100	448.0	72.0	4836.61	16.97
2	44	472.0	48.0	4836.61	16.97
2	16	472.0	72.0	4836.61	16.97
2	93	444.0	66.0	4867.28	17.08
2	23	476.0	66.0	4867.28	17.08
2	79	444.0	53.0	4976.34	17.46
2	37	476.0	53.0	4976.35	17.46
3	59	460.0	37.0	6555.00	23.00
3	3	460.0	83.0	6555.00	23.00
3	10	469.0	82.0	6774.31	23.77
3	108	451.0	82.0	6774.31	23.77
3	66	451.0	38.0	6774.31	23.77
3	52	469.0	38.0	6774.31	23.77
3	31	484.0	60.0	6840.00	24.00
3	87	436.0	60.0	6840.00	24.00
3	101	443.0	77.0	6851.87	24.04
3	45	477.0	43.0	6851.87	24.04
3	17	477.0	77.0	6851.87	24.04
3	73	443.0	43.0	6851.87	24.04
3	24	483.0	70.0	7146.68	25.08
3	80	437.0	50.0	7146.68	25.08

Table V: Valley Model Receptor Distances (Continued)

Ring #	Rcpt #	Horz. Coord.	Vert. Coord.	Distance (m)	Dist/Grid
3	94	437.0	70.0	7146.68	25.08
3	38	483.0	50.0	7146.68	25.08
4	25	488.0	72.0	8681.34	30.46
4	81	432.0	48.0	8681.34	30.46
4	95	432.0	72.0	8681.34	30.46
4	39	488.0	48.0	8681.34	30.46
4	60	460.0	28.0	9120.00	32.00
4	32	492.0	60.0	9120.00	32.00
4	88	428.0	60.0	9120.00	32.00
4	4	460.0	92.0	9120.00	32.00
4	46	483.0	37.0	9270.17	32.53
4	74	437.0	37.0	9270.17	32.53
4	102	437.0	83.0	9270.17	32.53
4	18	483.0	83.0	9270.17	32.53
4	53	473.0	30.0	9317.01	32.69
4	109	447.0	90.0	9317.01	32.69
4	67	447.0	30.0	9317.01	32.69
4	11	473.0	90.0	9317.01	32.69
5	26	496.0	75.0	11114.98	39.00
5	96	424.0	75.0	11114.98	39.00
5	40	496.0	45.0	11114.98	39.00
5	82	424.0	45.0	11114.98	39.00
5	19	488.0	88.0	11285.42	39.60
5	75	432.0	32.0	11285.42	39.60
5	103	432.0	88.0	11285.42	39.60
5	47	488.0	32.0	11285.42	39.60
5	54	475.0	23.0	11378.28	39.92
5	110	445.0	97.0	11378.28	39.92
5	68	445.0	23.0	11378.28	39.92
5	61	460.0	20.0	11400.00	40.00
5	33	500.0	60.0	11400.00	40.00
5	5	460.0	100.0	11400.00	40.00
5	89	420.0	60.0	11400.00	40.00
5	12	476.0	97.0	11487.35	40.31
6	41	503.0	42.0	13285.31	46.62
6	111	442.0	103.0	13285.31	46.62
6	13	478.0	103.0	13285.31	46.62
6	55	478.0	17.0	13285.31	46.62
6	27	503.0	78.0	13285.31	46.62
6	97	417.0	78.0	13285.31	46.62
6	69	442.0	17.0	13285.31	46.62
6	83	417.0	42.0	13285.31	46.62
6	20	493.0	93.0	13300.68	46.67
6	48	493.0	27.0	13300.68	46.67

Table V: Valley Model Receptor Distances (Continued)

Ring #	Rcpt #	Horz. Coord.	Vert. Coord.	Distance (m)	Dist/Grid
6	76	427.0	27.0	13300.68	46.67
6	104	427.0	93.0	13300.68	46.67
6	90	412.0	60.0	13680.00	48.00
6	62	460.0	12.0	13680.00	48.00
6	34	508.0	60.0	13680.00	48.00
6	6	460.0	108.0	13680.00	48.00
7	105	422.0	98.0	15315.93	53.74
7	21	498.0	98.0	15315.93	53.74
7	49	498.0	22.0	15315.93	53.74
7	77	422.0	22.0	15315.93	53.74
7	56	481.0	10.0	15455.64	54.23
7	14	481.0	110.0	15455.64	54.23
7	70	439.0	10.0	15455.64	54.23
7	112	439.0	110.0	15455.64	54.23
7	35	516.0	60.0	15960.00	56.00
7	91	404.0	60.0	15960.00	56.00
7	28	512.0	82.0	16091.32	56.46
7	98	408.0	82.0	16091.32	56.46
7	42	512.0	38.0	16091.32	56.46
7	84	408.0	38.0	16091.32	56.46
7	63	460.0	3.0	16245.00	57.00
7	7	460.0	117.0	16245.00	57.00

Note: The data is sorted by ring number and then by the distance from the source.

The Distance/Grid field should be equal to the ring multipliers (8, 16, 24, 32, 40, 48, 56).

Figure 1: Proposed Subroutine to Correct Receptor Locations

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      SUBROUTINE POLARC(RHOR,RVER,CNTRX,CNTRY)
C
C      THIS SUBROUTINE COMPUTES THE CARTESIAN COORDINATES FOR THE C       VALLEY
MODEL TO CORRECT THEIR SPACING ALONG THE RINGS.
C
C      PARAMETERS:
C
C           RHOR, RVER - HORIZONTAL AND VERTICAL COORDINATES OF
C                        RECEPTORS.  COMPUTED BY THIS ROUTINE.
C
C            CNTRX,CNTRY   -  THE   HORIZONTAL   AND  VERTICAL   COORDINATES   C
OF THE CENTER OF THE GRID (THE SOURCE).
C
C
      DIMENSION RHOR(112),RVER(112)
C
      I=0
      DO 10 J=1,16
        L=J+5
        IF (L.GT.16) L=L-16
        WDIR=(L-1)*0.392699
        DO 10 K=1,7
          DIST=K*8
          I=I+1
          RHOR(I)=CNTRX+DIST*COS(WDIR)
          RVER(I)=CNTRY+DIST*SIN(WDIR)
   10 CONTINUE
      RETURN
C
      END
```

Table VI: Comparison of the Receptor Coordinates from the Valley Model and the Modified Version of the Valley Model

Recpt #	Recpt. Coord. in Valley Horiz.	Recpt. Coord. in Valley Vert.	Recpt. Coord. in Modified Version Horiz.	Recpt. Coord. in Modified Version Vert.
1	460.0000	68.0000	467.3910	56.9385
2	460.0000	75.0000	474.7821	53.8771
3	460.0000	83.0000	482.1731	50.8156
4	460.0000	92.0000	489.5641	47.7541
5	460.0000	100.0000	496.9552	44.6927
6	460.0000	108.0000	504.3462	41.6312
7	460.0000	117.0000	511.7372	38.5697
8	463.0000	67.0000	467.3910	56.9385
9	466.0000	73.0000	474.7821	53.8771
10	469.0000	82.0000	482.1731	50.8156
11	473.0000	90.0000	489.5641	47.7541
12	476.0000	97.0000	496.9552	44.6927
13	478.0000	103.0000	504.3462	41.6312
14	481.0000	110.0000	511.7372	38.5697
15	465.0000	65.0000	467.3910	56.9385
16	472.0000	72.0000	474.7821	53.8771
17	477.0000	77.0000	482.1731	50.8156
18	483.0000	83.0000	489.5641	47.7541
19	488.0000	88.0000	496.9552	44.6927
20	493.0000	93.0000	504.3462	41.6312
21	498.0000	98.0000	511.7372	38.5697
22	468.0000	63.0000	467.3910	56.9385
23	476.0000	66.0000	474.7821	53.8771
24	483.0000	70.0000	482.1731	50.8156
25	488.0000	72.0000	489.5641	47.7541
26	496.0000	75.0000	496.9552	44.6927
27	503.0000	78.0000	504.3462	41.6312
28	512.0000	82.0000	511.7372	38.5697
29	468.0000	60.0000	467.3910	56.9385
30	476.0000	60.0000	474.7821	53.8771
31	484.0000	60.0000	482.1731	50.8156
32	492.0000	60.0000	489.5641	47.7541
33	500.0000	60.0000	496.9552	44.6927
34	508.0000	60.0000	504.3462	41.6312
35	516.0000	60.0000	511.7372	38.5697
36	468.0000	57.0000	467.3910	56.9385
37	476.0000	53.0000	474.7821	53.8771
38	483.0000	50.0000	482.1731	50.8156
39	488.0000	48.0000	489.5641	47.7541
40	496.0000	45.0000	496.9552	44.6927
41	503.0000	42.0000	504.3462	41.6312
42	512.0000	38.0000	511.7372	38.5697
43	465.0000	55.0000	467.3910	56.9385
44	472.0000	48.0000	474.7821	53.8771
45	477.0000	43.0000	482.1731	50.8156

Table VI: Comparison of the Receptor Coordinates from the Valley Model and the Modified Version of the Valley Model (Continued)

	Recpt. Coord. in Valley		Recpt. Coord. in Modified Version	
Recpt #	Horiz.	Vert.	Horiz.	Vert.
46	483.0000	37.0000	489.5641	47.7541
47	488.0000	32.0000	496.9552	44.6927
48	493.0000	27.0000	504.3462	41.6312
49	498.0000	22.0000	511.7372	38.5697
50	463.0000	53.0000	467.3910	56.9385
51	466.0000	47.0000	474.7821	53.8771
52	469.0000	38.0000	482.1731	50.8156
53	473.0000	30.0000	489.5641	47.7541
54	475.0000	23.0000	496.9552	44.6927
55	478.0000	17.0000	504.3462	41.6312
56	481.0000	10.0000	511.7372	38.5697
57	460.0000	52.0000	467.3910	56.9385
58	460.0000	45.0000	474.7821	53.8771
59	460.0000	37.0000	482.1731	50.8156
60	460.0000	28.0000	489.5641	47.7541
61	460.0000	20.0000	496.9552	44.6927
62	460.0000	12.0000	504.3462	41.6312
63	460.0000	3.0000	511.7372	38.5697
64	458.0000	55.0000	467.3910	56.9385
65	454.0000	47.0000	474.7821	53.8771
66	451.0000	38.0000	482.1731	50.8156
67	447.0000	30.0000	489.5641	47.7541
68	445.0000	23.0000	496.9552	44.6927
69	442.0000	17.0000	504.3462	41.6312
70	439.0000	10.0000	511.7372	38.5697
71	453.0000	53.0000	467.3910	56.9385
72	448.0000	48.0000	474.7821	53.8771
73	443.0000	43.0000	482.1731	50.8156
74	437.0000	37.0000	489.5641	47.7541
75	432.0000	32.0000	496.9552	44.6927
76	427.0000	27.0000	504.3462	41.6312
77	422.0000	22.0000	511.7372	38.5697
78	452.0000	57.0000	467.3910	56.9385
79	444.0000	53.0000	474.7821	53.8771
80	437.0000	50.0000	482.1731	50.8156
81	432.0000	48.0000	489.5641	47.7541
82	424.0000	45.0000	496.9552	44.6927
83	417.0000	42.0000	504.3462	41.6312
84	408.0000	38.0000	511.7372	38.5697
85	452.0000	60.0000	467.3910	56.9385
86	444.0000	60.0000	474.7821	53.8771
87	436.0000	60.0000	482.1731	50.8156
88	428.0000	60.0000	489.5641	47.7541
89	420.0000	60.0000	496.9552	44.6927
90	412.0000	60.0000	504.3462	41.6312

Table VI: Comparison of the Receptor Coordinates from the Valley Model and the Modified Version of the Valley Model (Continued)

	Recpt. Coord. in Valley		Recpt. Coord. in Modified Version	
Recpt #	Horiz.	Vert.	Horiz.	Vert.
91	404.0000	60.0000	511.7372	38.5697
92	452.0000	63.0000	467.3910	56.9385
93	444.0000	66.0000	474.7821	53.8771
94	437.0000	70.0000	482.1731	50.8156
95	432.0000	72.0000	489.5641	47.7541
96	424.0000	75.0000	496.9552	44.6927
97	417.0000	78.0000	504.3462	41.6312
98	408.0000	82.0000	511.7372	38.5697
99	453.0000	67.0000	467.3910	56.9385
100	448.0000	72.0000	474.7821	53.8771
101	443.0000	77.0000	482.1731	50.8156
102	437.0000	83.0000	489.5641	47.7541
103	432.0000	88.0000	496.9552	44.6927
104	427.0000	93.0000	504.3462	41.6312
105	422.0000	98.0000	511.7372	38.5697
106	458.0000	65.0000	467.3910	56.9385
107	454.0000	73.0000	474.7821	53.8771
108	451.0000	82.0000	482.1731	50.8156
109	447.0000	90.0000	489.5641	47.7541
110	445.0000	97.0000	496.9552	44.6927
111	442.0000	103.0000	504.3462	41.6312
112	439.0000	110.0000	511.7372	38.5697

Table VII: Comparison of the Predicted Impacts with the Valley Model and the Modified Version of the Valley Model

Receptor Height (m)	Concentration (ug/m^3) Predicted by Valley	Modified Version
580	35.06	33.36
600	44.59	38.97
620	40.92	44.16
640	48.54	48.54
660	47.56	51.62
680	60.23	51.62
700	54.57	51.30
720	50.51	50.51
740	81.26	49.73
760	37.34	48.94
780	44.37	48.15
800	47.37	47.37
850	41.83	45.40
900	70.97	43.43