

AIRPOL-4A

An Introduction and User's Guide

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(The opinions, findings, and conclusions expressed in this report are those of the authors and not necessarily those of the sponsoring agencies.)

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ABSTRACT

This report details the mechanics of implementing the computer program AIRPOL-4A. AIRPOL-4A supersedes AIRPOL-4. The upgrade from version 4 to version 4A is a result of the new emissions guidelines contained in Supplement 5 to AP-42, April 1975, by the Environmental Protection Agency. Appendix A details the mechanics of implementing the computer program EMISSION, which has been designed to meet these new guidelines.

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The authors thank all those individuals who contributed to this report by utilizing their energies and talents to gather data, type the manuscript, and prepare the drawings. The success of this project has been largely a result of their contributions.

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LIST OF ABBREVIATIONS

gm/veh/km	grams (CO) per vehicle per kilometer
gm/veh/mi	grams (CO) per vehicle per mile
ft	feet
kft	thousands of feet
km	thousands of meters (kilometers)
m	meters
mph	miles per hour
m/s	meters per second
% gc	percent gasoline powered passenger cars
% hdgt	percent heavy duty gasoline powered trucks
vph	vehicles per hour

2010

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INTRODUCTION

This report details the philosophy and techniques for using AIRPOL-4A, a Gaussian dispersion model for predicting the impact of a roadway on carbon monoxide, CO, levels within the microscale environment of the roadway. As discussed in reference 1, AIRPOL-4, and consequently AIRPOL-4A, has been designed to predict the air quality impact of a highway over a wide range of geometric, meteorological, and traffic conditions. AIRPOL-4A can predict CO levels for receptors at any positive elevation on either the upwind or downwind side of at-grade, elevated, or depressed (receptor either inside or outside of the cut) roadways; and it can automatically superimpose CO levels from any desired number of roadways. It can process any positive wind speed, any road-wind orientation, and any of the stability classes A through F.

AIRPOL-4A allows the user to determine CO levels for up to three prediction years (each with its own representative emission factor), two stability classes, six wind speeds, two receptor elevations, and eight receptor distances, or up to a total of 576 predictions, using only two input cards and producing only two output pages. Thus, AIRPOL-4A can provide a complete analysis of a highway site with a minimum of effort since there is no duplication of input parameters to achieve a complete analysis.

AIRPOL-4A also includes elaborate data verification procedures to assist the user and help prevent abnormal job

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termination due to erroneous input. Under the AIRPOL-4A data check/correct process, every input datum is examined for validity and corrected if necessary. Furthermore, the program echoes all inputs, flags all errors, and itemizes all changes it has made. Thus, the AIRPOL-4A output serves as a complete document of the analyses that AIRPOL-4A has performed.

The next section describes the input structure of AIRPOL-4A.

INPUT

Deck Structure

The basic function of AIRPOL-4A is to predict CO levels produced by a lane group, that is, a group of contiguous roadway lanes having homogeneous traffic and geometric parameters. The geometric, emission, and receptor location parameters for a lane group are specified on a single DATA card. The program is designed to automatically superimpose the CO levels generated by any number of lane groups. Thus to analyze a site the user simply inputs a DATA card for each lane group in the area. The last DATA card for a site analysis must be followed by an ENS (end of site) card, which instructs the program to print out the superimposed CO levels and look for the next site to be analyzed. Additional site analysis inputs, consisting of one or more DATA cards (lane groups) and terminated by ENS cards, simply follow.

AIRPOL-4A organizes sets of site analyses having common meteorological parameters into divisions. Each division consists of a single HEADER card, which specifies the meteorological parameters common to the sites in the division, followed by one or more site analysis inputs followed by a single END (end of division) card, which instructs the program to look for the next division. An AIRPOL-4A job may consist of any number of divisions placed one after the other. The total input structure for an AIRPOL-4A job is illustrated in Figure 1.

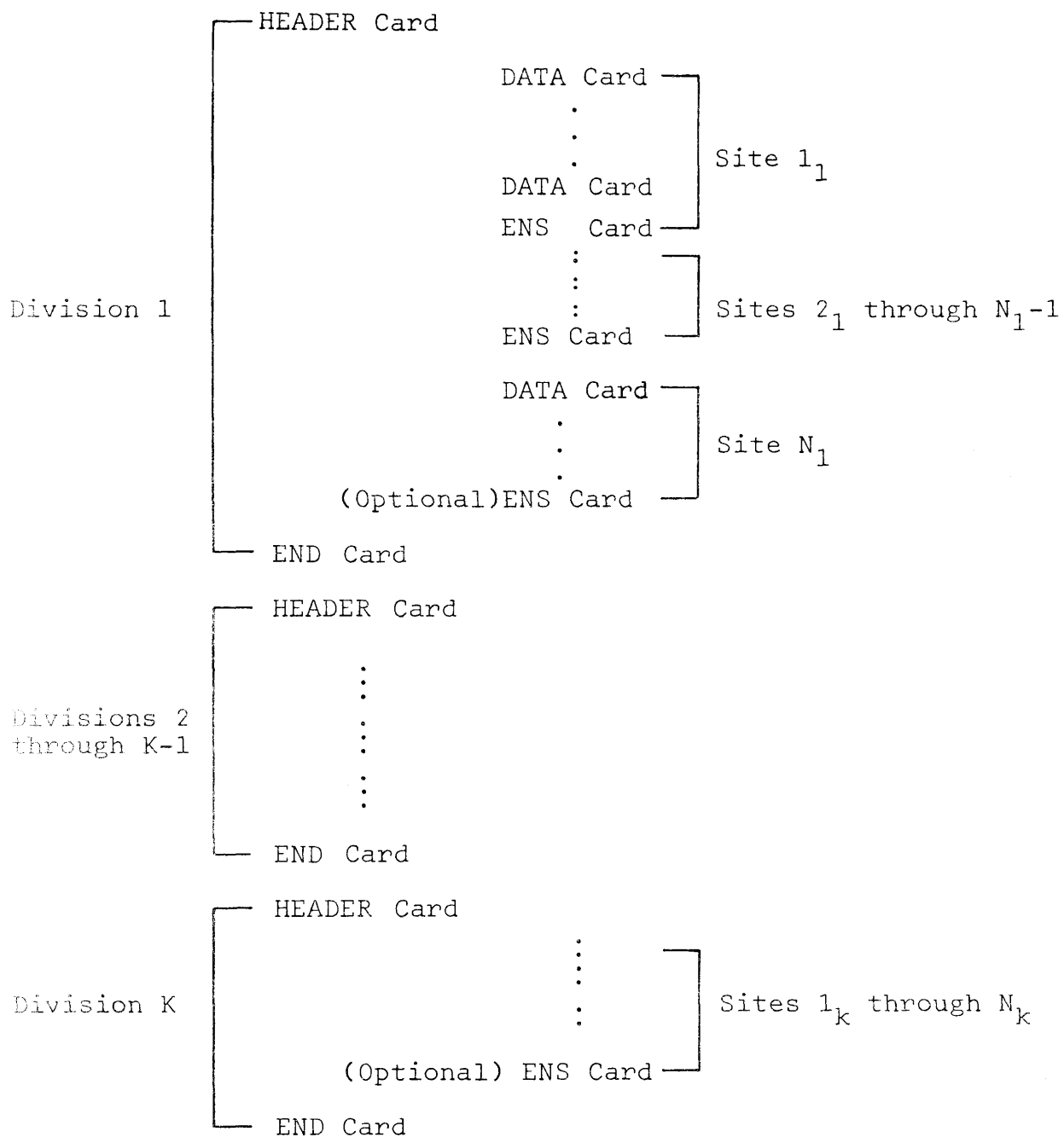


Figure 1. AIRPOL-4A Input Deck Structure.

Input Parameters

This section describes the AIRPOL-4A input parameters. Figure 2, which is an input coding form for AIRPOL-4A, should be consulted throughout this section. Those unfamiliar with FORTRAN terminology should consult Appendix B for an explanation of format specifications.

HEADER Card

The first card of every division must be a HEADER card and each division may contain only one HEADER card. A HEADER card contains information relevant to all the sites contained in a division. This common information will remain unchanged until a new division is encountered. The HEADER card parameters are discussed below.

COMPUTER JOB NUMBER

Columns 1-4, format (A4), contain the computer job number, an identifier to be supplied by the Data Processing Division (DPD). The job number is printed in the upper right-hand corner of each output page.

HEADING

Columns 5-37, format (8A4, A1), contain descriptive information about the division, which is used to document the output. It is suggested that the information be centered in this field to achieve report-quality output.

PREDICTION INTERVAL

Columns 39-41, format (I3), contain the prediction interval in minutes. The prediction interval is the length of time over which continuous, instantaneous CO levels are to be averaged. If the field is blank or ≤ 0 , the prediction interval will default to 60 minutes.

FIGURE 2

DP 77-A

VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
AIRPOL -- VERSION 4A
DATA PROCESSING INPUT
NOVEMBER 1975

PAGE ___ OF ___

INPUT SUBMITTED BY: _____

DATE SUBMITTED: _____

PHONE EXT: _____

ROOM NO. _____

PROJECT CHARGE NO: _____

CO. ROUTE CITY Co. SECT. TYPE ACT.

WS-1	mph (m/s)	58-60	F3.1
WS-2	mph (m/s)	62-64	F3.1
WS-3	mph (m/s)	66-68	F3.1
WS-4	mph (m/s)	70-72	F3.1
WS-5	mph (m/s)	74-76	F3.1
WS-6	mph (m/s)	78-80	F3.1

PREDICTION INTERVAL (minutes)

YR 1 45-46 I 2

YR 2 48-49 I 2

YR 3 51-52 I 2

CLASS 1 54 I 2

CLASS 2 56 I 2

METRIC 43 L 1

HEADING

(Information should be centered in these 33 columns)

5-37
8A4,A1

COMPUTER JOB NUMBER

1-4
A4

NOTE: DUPLICATE COMPUTER JOB NO. ON ALL CARDS

TFVOL yr 1 veh/hr

TFVOL yr 2 veh/hr

TFVOL yr 3 veh/hr

EF yr 1 gm/veh/mi (gm/veh/km)

EF yr 2 gm/veh/mi (gm/veh/km)

EF yr 3 gm/veh/mi (gm/veh/km)

CUT LOC 44 I 1

SOURCE HT ft (m)

SOURCE LENGTH up wind kft (km) | down wind kft (km)

CWIDTH ft (m)

CLENGTH kft (km)

CASE 66 A1

ALPHA degrees

OBS HT-2 ft (m)

OBS D-1 ft (m)

OBS INC ft (m)

5-7 A3

9 A1

14 F 4.0

16 F 4.0

19 F 4.0

21 F 4.0

24 F 4.0

26 F 5.2

30 F 5.2

32 F 5.2

36 F 5.2

38 F 5.2

42 F 5.2

44 I 1

46 F 3.0

50 F 3.2 | 54 F 3.2

58 F 3.0

62 F 3.2

66 A1

68 F 2.0

70 F 2.0

74 F 3.0

78 F 3.0

METRIC

Column 43, format (L1), contains a logical parameter specifying the system of units to be used for all subsequent inputs. A "T" in this field signifies that metric units must be used for all subsequent inputs in this division, while either a blank or an "F" signifies that American Engineering units must be used for all subsequent inputs in this division.

YR-1, YR-2, YR-3

Columns 45-46, 48-49, and 51-52 format for each field (I2), are used to specify the last two digits of the calendar years (1900 to 1999) for which predictions are desired. AIRPOL-4A processes only those years for which there are corresponding emission parameters on the DATA cards. Thus the user can generate predictions for one, two, or all three years depending on the DATA card parameters. Furthermore, the program does not require that all three prediction years be different. Thus the user could, for instance, examine up to three alternatives for a particular calendar year (such as adding lanes, including bus express lanes, or no improvement of the facility) to determine the impact of each. For such an analysis, all three fields should, of course, contain the same calendar year. Similarly, the user could examine two alternatives for one calendar year and one alternative for another calendar year. Other possibilities are left to the imagination of the user.

CLASS 1, CLASS 2

Columns 54 and 56, format for each field (Z1), contain the Pasquill* stability classes for which analyses are desired. Valid inputs for these fields are "A", "B", "C", "D", "E", or "F" or "1", "2", "3", "4", "5", or "6", where stability class A or 1 signifies the least stable atmospheric condition. If one of these fields is blank or contains an invalid entry, AIRPOL-4A will perform analyses for the other stability class only. If both entries are blank or invalid, the program will perform analyses for stability class B or 2 only. If both entries are equivalent stability classes, the program will perform analyses for the first entry only.

*AIRPOL-4 performs significantly better using the Pasquill stability class than it does using the Turner class. See references 1, 2, and 4. Class F is, of course, relative to the Turner specification only. There is no Pasquill class F obtainable from the algorithm in reference 4.

WS-1, WS-2, WS-3, WS-4, WS-5, WS-6

Columns 58-60, 62-64, 66-68, 70-72, 74-76, and 78-80, format for each field (F3.1), are used to specify up to six wind speeds to be used in the site analyses. Wind speeds must be given in either miles per hour or meters per second as dictated by the entry, METRIC. Valid entries are wind speeds >0.0 . Any entry which is blank or ≤ 0.0 will be ignored by the program. If all entries are blank or ≤ 0.0 , AIRPOL-4A will assign six default wind speeds of 0.0, 0.2, 0.7, 1.2, 2.3, and 3.8 mph (0.0, 0.1, 0.3, 0.5, 1.0, and 1.7 m/s). Notice that the only way to get a 0.0 mph (0.0 m/s) prediction is to allow the program to default to the above six wind speeds.

DATA Card

A DATA card is required to specify the traffic, geometric, and receptor location parameters for a lane group. (Recall that the meteorological parameters for an entire division are contained on the division's HEADER card.) Any number of DATA cards (lane groups) may constitute a site. The DATA card parameters are discussed below.

COMPUTER JOB NUMBER

Columns 1-4, format (A4), contain the computer job number, an identifier to be supplied by the Data Processing Division. The job number is printed in the upper right-hand corner of each output page.

SITE ID

Columns 5-7, format (A3), contain a three-character designation of the site being analyzed. The program outputs the contents of this field from the first DATA card in a site to identify the output by site. Any three-character designation except "END", "ENS", OR "ADD", any of which will cause either a job abort or erroneous results, may be used in this field. (For the curious, an ADD card is identical in function to an ENS card.)

LGID

Column 9, format (A1), contains a single-character designation for the lane group represented by the current DATA card. Any alphanumeric character may be used in this field.

TFVOL (yr-1), TFOVOL (yr-2), TFOVOL (yr-3)

Columns 11-14, 16-19, 21-24, format for each field (F4.0), are used to specify the traffic volumes for the subject lane group for the three prediction years specified on the HEADER card. AIRPOL-4A will omit the analysis for the i th year for the subject lane group if the traffic volume entry for the i th year for the subject lane group is blank or ≤ 0 . These fields (and the prediction year fields on the HEADER card) give the user considerable flexibility. Consider for example a traffic corridor containing a four-lane roadway which will be expanded to an eight-lane roadway, and assume that each pair of lanes constitutes a lane group. A user could do a current year/future year analysis of this corridor by using four DATA cards (one for each lane group) such that the two DATA cards representing the existing roadway would have positive traffic volumes for both the current year and the future year while the two DATA cards representing the planned lane groups would have positive traffic volumes for only the future year. Furthermore, since none of the lane groups for this site analysis would have had positive traffic volumes for the third possible year, that analysis would be omitted for this site. Other sites within this division could, of course, use all three years, or any two, or any one. Many other possible situations may be realized by the judicious use of traffic volume and prediction year combinations. The only rules to remember are that sites are independent of each other, and that within sites the CO levels from different lane groups are superimposed under the control of positive traffic volumes. Each traffic volume must be given in vehicles per hour.

EF (yr-1), EF (yr-2), EF (yr-3)

Columns 26-30, 32-36, 38-42, format for each field (F 5.2), are used to specify the average per vehicle emission factors for the subject lane group for each of the three possible prediction years. AIRPOL-4A will omit the analysis for the i th year for the subject lane group if EF (yr- i) is blank or ≤ 0 . (See TFOVOL above.) Emission factors must be given in grams/vehicle/mile or grams/vehicle/kilometer as dictated by the entry, METRIC, on the HEADER card.

CUT LOC

Column 44, format (I1), is used to specify the receptor location relative to a cut in which the subject lane group is located. The entry = 1 if the receptor is in the cut with the source lane group. The entry = 2 if the receptor is on the plateau above the cut. If the source lane group is at or above grade, this field should be left blank.

SOURCE HT

Columns 46-48, format (F3.0), are used to specify the elevation of the source lane group relative to the surrounding terrain. Source elevations must be given in either feet or meters as dictated by the entry, METRIC, on the HEADER card. If the lane group is in a cut, this entry must be < 0 . Otherwise, this entry must be ≥ 0 .

SOURCE LENGTH (Upwind)

Columns 50-52, format (F3.2), are used to specify the distance that the source lane group extends in a straight line upwind from the perpendicular intersection of the centerline of the source lane group and a line through the receptors. This distance must be given in either kilofeet or kilometers as dictated by the entry, METRIC, on the HEADER card. This entry will generally be ≥ 0 . However, if the upwind-most end of the source lane group is actually downwind of the above defined perpendicular intersection, then this entry will be < 0 .

SOURCE LENGTH (Downwind)

Columns 54-56, format (F3.2), are used to specify the distance that the source lane group extends in a straight line downwind from the perpendicular intersection of the centerline of the source lane group and a line through the receptors. This distance must be given in either kilofeet or kilometers as dictated by the entry, METRIC, on the HEADER card. This entry will generally be ≥ 0 . However, if the downwind-most end of the source lane group is actually upwind of the above defined perpendicular intersection, then this entry will be < 0 .

CWIDTH

Columns 58-60, format (F3.0), are used to specify the average width of the cut in which the subject lane group is located. The cut width must be specified in either feet or meters as dictated by the entry, METRIC, on the HEADER card. If the source lane group is not in a cut, the program ignores this field. If the source lane group is in a cut and this field is blank or = 0, it defaults to 328 ft (100 m). Similarly, if the field contains a negative value, it defaults to the absolute value. It is the user's responsibility to ensure that the specified cut width is large enough to accommodate all lane groups and receptors.

CLENTH

Columns 62-64, format (F3.2), are used to specify the upwind length of the cut in which both the receptors and the subject

lane group are located. The cut length must be specified in either kilofeet or kilometers as dictated by the entry, METRIC, on the HEADER card. If the source lane group and the receptors are not both in the cut, the program ignores this field. If the receptors and the source lane group are both in the cut and this field is blank or = 0, it defaults to the upwind source length (columns 50-52). Similarly, if the field contains a negative entry, it defaults to the absolute value of the entry.

CASE

Column 66, format (A1), is used to specify the source/receptor alignment relative to the wind direction. The entry should be "D" if the receptors are on the downwind side of the source lane group. The entry should be "U" if the receptors are on the upwind side of the source lane group. The default value for this field is "D".

ALPHA

Columns 68-69, format (F2.0), are used to specify the acute angle between the subject lane group and the wind direction vector in degrees. The default value for this entry is 90°.

OBS HT-2

Columns 71-72, format (F2.0), are used to specify the receptor elevation relative to the surrounding terrain. For the case placing both the source and the receptor in a cut, the "surrounding terrain" is assumed to be the bottom of the cut. For the case of only the source in a cut, the "surrounding terrain" is assumed to be the top of the cut. For elevated sources, the "surrounding terrain" is assumed to be at the bottom of the fill section or at the bottom of the structural supports. For at-grade sources, the "surrounding terrain" is, of course, at grade. The receptor elevation must be specified in either feet or meters as dictated by the entry, METRIC, on the HEADER card. The receptor elevation must be ≥ 0 . Negative entries will default to 10 ft (3.0 m). AIRPOL-4A analyzes all receptors at two different elevations. (Notice that Figure 2 identifies this field as the input field for the second receptor height.) The program always performs one analysis for receptors at 5 ft (1.5 m) above the surrounding terrain. Therefore, the user is allowed to specify only the second elevation using this input field. To avoid redundancy, AIRPOL-4A does not allow the user to specify a receptor height of 5 ft (1.5 m). Such an entry will default to 10 ft (3.0 m).

AIRPOL-4A performs automatic superpositions of CO levels from all lane groups constituting a site. This implies that receptors specified with each lane group constituting a site must physically coincide. Thus, for all lane groups after the first in any particular multiple lane-group site, AIRPOL-4 will force the receptor height specification to coincide with that for the first lane group in that site.

OBS D-1

Columns 74-76, format (F3.0), are used to specify the perpendicular distance from the nearest edge of pavement of the subject lane group to the first receptor point. (There are eight receptor distances per analysis.) This entry must be ≥ 0 . Negative or blank entries will default to 0. This distance must be specified in either feet or meters as dictated by the entry, METRIC, on the HEADER card.

OBS INC

Columns 78-80, format (F3.0), are used to specify the incremental distance between receptors. This entry must be specified in either feet or meters as dictated by the entry, METRIC, on the HEADER card. Positive, negative, and zero or blank entries are allowed in this field under the restraint that none of the eight receptor points be negative. Thus, this entry will default to 0 if $(\text{OBS D-1}) + 7 \times (\text{OBS INC}) < 0$.

AIRPOL-4A performs automatic superposition of CO levels from all the lane groups constituting a site. It is the user's responsibility to guarantee that the sets of receptors specified with each lane group comprising a site physically coincide. AIRPOL-4A cannot check these specifications given the data it receives. Thus, the user must exercise caution in specifying OBS D-1 and OBS INC for each lane group comprising a multiple lane-group site.

ENS Card

An ENS (end of site) card must be the last card of every set of lane-group DATA cards constituting a site. (See exception noted under END Card.) The ENS card signals AIRPOL-4A to superimpose the results of all the DATA cards in the site, output the superposed results, and look for the next site to be processed. The ENS card parameters are discussed below.

COMPUTER JOB NUMBER

Columns 1-4, format (A4), contain the computer job number, an identifier to be supplied by the Data Processing Division. The job number is printed in the upper right-hand corner of each output page.

SITE ID

Columns 5-7, format (A3), must contain the character string "ENS".

COMMENTS

Columns 8-80, format (None), are ignored by AIRPOL-4A. They may contain any form of alphanumeric information desired by the user for card identification or other purposes. This information is not output by AIRPOL-4A.

END Card

The last card of every division must be an END (end of division) card. The END card signals the program to output the superposed results of the last site, if they have not already been output by an ENS control, and to look for the next division to be processed. Since the END card guarantees that the results of the last site in the division are properly disposed of, the ENS card immediately preceding an END card may be omitted.

COMPUTER JOB NUMBER

Columns 1-4, format (A4), contain the computer job number, an identifier to be supplied by the Data Processing Division. The job number is printed in the upper right-hand corner of each output page.

SITE ID

Columns 5-7, format (A3), must contain the character string "END".

COMMENTS

Columns 8-80, format (None), are ignored by AIRPOL-4A. They may contain any form of alphanumeric information desired by the user for card identification or other purposes. This information is not output by AIRPOL-4A.

Input Errors

Under its check/correct process, AIRPOL-4A examines every input parameter and assigns default values to those that are either blank or out of range. Table 1 summarizes the valid inputs and default values for all AIRPOL-4A input parameters.

As indicated by the previous discussion and the contents of Table 1, AIRPOL-4A is very tolerant of input errors and will always attempt to rectify errors and continue processing. There is, however, one type of error over which AIRPOL-4A has no control. If the system detects an alpha input in a numeric field (I or F format specification), or a decimal point in an integer field (I format specification), or a character other than 0 through F in a hexadecimal field (Z format specification), it will provide the user with a detailed error diagnostic and replace the erroneous entry with a zero, which AIRPOL-4A will then process in normal fashion.

Table 1
Input Default Summary

Item	Valid Inputs	Default Values	Notes
COMPUTER JOB NUMBER	Any 4 character alphanumeric string	Blanks	
HEADING	Any 33 character alphanumeric string	Blanks	
PREDICTION INTERNAL	Any interger number I, $1 \leq I \leq 999$	60	
METRIC	T, F	F	
YR-1	Any integer number, $I, 0 \leq I \leq 99$	0	
CLASS	Any integer number, $I, 1 \leq I \leq 6$ or Any alpha character A through F	(B, ignored)	For classes 1 and 2, respectively. Also, if CLASS 1 = CLASS 2 the program ignores CLASS 2
WS-1	Any real number, $R, 0.1 \leq R \leq 99.9$	(0.0, 0.2, 0.7, 1.2, 2.3, and 3.8 mph) or (0.0, 0.1, 0.3, 0.5, 1.0, and 1.7 m/s)	Default occurs only if all WS;'s are blank or invalid
SITEID	Any 3 character alphanumeric string	Blanks	On data cards, the character strings END, EMS, and ADD are invalid.
LGID	Any single alphanumeric character	Blank	
TFVOL (yr-1)	Any real number, $R, 0. \leq R \leq 9999.$	0.	
LF (yr-1)	Any real number, $R, 0.00 \leq R \leq 999.99$	0.	
CUT LOC	1 or 2	Blank	
SOURCE HT	Any real number, $R, -99. \leq R \leq 999.$	0.	
SOURCE LENGTH (Upwind)	Any real number, $R, -.99 \leq R \leq 9.99$	0.	
SOURCE LENGTH (Downwind)	Any real number, $R, -.99 \leq R \leq 9.99$	0.	
CWIDTH	Any real number, $R, 0. < R \leq 999.$	328. ft or 100. m	Defaults to R , if $R < 0$
CLENGTH	Any real number, $R, 0.00 < R \leq 9.99$	Upwind Source Length	Defaults to R , if $R < 0$
CASE	U or D	D	
ALPHA	Any real number, $R, 0. \leq R \leq 90.$	90.	
OBS HT-2	Any real number, $R, 0. \leq R \leq 99.$	0.	Defaults to 10. ft (3.0 m) if $R < 0$ or if $R = 5$ ft. (1.5 m)
OBS D-1	Any real number, $R, 0. \leq R \leq 999.$	0.	
OBS INC	Any real number, $R, -99. \leq R \leq 999.$	0.	Also defaults to 0., if (OBS D-1) *7x(OBS INC) < 0.

OUTPUT

AIRPOL-4A produces two pages of output for each site analyzed. The first page for each site details the action taken by the program under its check/correct process, and the second page contains the results of the site analysis. Pages are numbered consecutively within each division.

Check/Correct Output

Samples of the Airpol-4A check/correct output are contained in the Examples section of this report. Labeled lane-group DATA card inputs with their appropriate metric or American Engineering units appear on the check/correct output page in the same order in which they are input. Any input parameter which is invalid is indicated by a question mark below the invalid input. The corrected values are shown below the question marks.

The default values employed in AIRPOL-4A have been chosen to maximize the probability that the resulting analysis will provide the user with an acceptable level of information. In fact, the AIRPOL-4A defaults are an asset to the user, since they provide a simple mechanism for reducing the level of effort required to prepare input forms and cards. However, when AIRPOL-4A employs a default value to an erroneous, rather than omitted, input parameter, the resulting analysis may not be that desired by the user. The user is therefore advised to carefully examine the AIRPOL-4A check/correct output for each site to ensure that the desired analysis was performed.

Analysis Output

Samples of the AIRPOL-4A analysis output are contained in the Examples section of this report. The site identification, heading, sampling time, and number of lane groups constituting the site are shown at the top of the analysis output page. The analysis output is arranged in tabular form with wind speeds and receptor elevations across the top, and stability classes, prediction years, and receptor distances from the first input lane group down the left-hand side. CO levels are output in this table in units of ppm. Wind speeds and receptor locations are specified in both American Engineering and metric units with the metric values being shown in parentheses.

The observant reader will note that although the HEADER card inputs are examined and, if necessary corrected, under the AIRPOL-4A check/correct process, they are not included in the check/correct output. The justification for this omission is that the HEADER card inputs all appear on the analysis output in their corrected forms and are thus highly visible to and verifiable by the user. The DATA card inputs, however, if not displayed on the check/correct output, would not be available to the user and therefore could not be verified.

SPECIAL CONSIDERATIONS

The reader who understands the preceding sections should be capable of using AIRPOL-4A. The remainder of this report is devoted to special considerations and examples designed to give the reader a working familiarity with the program.

Fills

As explained in references 1 and 2, no Gaussian model is capable of properly analyzing a fill section of roadway. Thus, the AIRPOL-4A model yields only a lower bound for CO levels from fills. The user should therefore additionally analyze all fill sections of roadway as if they were at-grade. In this manner, the user will obtain both upper and lower bounds on CO levels near highway fill sections. When these bounds are close to each other, the user will have a high quality estimate of expected CO levels. When these bounds are not close to each other, the user must exercise his own judgement as to the level of information supplied by these analyses.

Cuts

The input variable CLENGH, the upwind cut length, is applicable only to the condition where both the source and the receptor are in a cut, CUT LOC = 1. AIRPOL-4A ignores CLENGH when CUT LOC \neq 1. The user should also recall that when CUT LOC = 1, AIRPOL-4A will force $\alpha = 0^\circ$. As discussed in reference 1, $\alpha = 0^\circ$ is the only road/wind angle amenable to the condition placing both the source and the receptor in a cut.

Upwind and Downwind Source Lengths

Upwind and downwind source lengths should be correctly specified. The program will automatically modify these assumed upper bound inputs based on the road/wind angle, stability class, sampling time, and receptor distance from the edge of pavement to provide for an optimal analysis.

The modification of these inputs is part of the AIRPOL-4A prediction algorithm.⁽³⁾ It is not part of the check/correct process and is not, therefore, reflected on the output.

"Worst Case" Analyses

The concept of a "worst case" meteorological condition is a poorly conceived and ill-defined one. Given any non-singular range of meteorological conditions, determination of the worst condition for any particular receptor location is not, in general, an analytically solvable problem, and any nonarbitrary determination of a worst meteorological condition must vary as a function of receptor location, which further compounds the general problem.

It is impossible to produce an analytically explicit definition of a worst meteorological condition for an arbitrary receptor. Furthermore, any approximation to such a definition that did not depend functionally on wind speed, stability class, road/wind angle, sampling time, source elevation, receptor elevation, source/receptor distance, and relative upwind/downwind source/receptor orientation, would be arbitrary at best and nonsensical at worst.

Wind speed is the only meteorological variable independent of both geometry and all other meteorological variables. Thus, the only explicit characterization for a "worst case" is that CO levels increase monotonically as wind speeds decrease. There are no analogous characterizations for stability class, road/wind angle, sampling time, source elevation, receptor elevation, source/receptor distance, or relative upwind/downwind source/receptor orientation.

Based on these observations, the present authors recommend abandoning the "worst case" analysis in favor of a more reasonable approach. Such an approach would be to simply make percentile analyses based on wind speed for the prevailing wind direction and stability class. Thus one would use say the lower 5 percentile wind speed (that wind speed which is probabilistically exceeded 95% of the time) to generate the upper 5 percentile CO level (that CO level which would probabilistically be exceeded only 5% of the time) under the given stability class and road/wind angle.

The default wind speeds for AIRPOL-4A will yield the upper 0, 1, 5, 10, 25, and 50 percentile CO levels by generating predictions for 0.0, 0.2, 0.7, 1.2, 2.3, and 3.8 mph (0.0, 0.1, 0.3, 0.5, 1.0, and 1.7 m/s) wind speeds. These speeds were determined from the cumulative distribution function for observed roadside wind speeds in Virginia.⁽⁴⁾ Figure 3 illustrates this cumulative distribution for both peak and off-peak traffic hours. Figure 4 illustrates the distribution for peak traffic hours only. The reader should observe that the distribution for peak hours is skewed to the left with respect to that for a mixture of hours.

AIRPOL-4A has been based on Figure 3 since it represents a smoother and more general distribution, although it is slightly biased (not statistically significant) toward higher wind speeds.

Some readers may be concerned because the data in Figures 3 and 4 suggest that observed roadside wind speeds may be significantly lower than those reported by airport weather stations. However, some reflection on the matter should quickly alleviate any such apprehension. Airport weather stations are typically located on large open plains which offer little resistance to surface winds, while roadside areas in urban environments are typically surrounded by many topographical irregularities which hinder the movement of surface winds. Furthermore, the atmospheric stability near urban roadways will generally be lower than that at airports as a result of surface roughness, mechanical mixing, and heat island effects. Thus, it should not be surprising that observed roadside wind speeds in urban areas are significantly lower than observed airport wind speeds.

To illustrate this point, Figure 5 presents the data for 17 paired observations of hourly averaged wind speeds in the Washington, D. C., and Norfolk, Virginia, areas. The regression line in this figure was generated using a least-squares analysis and the hypothesis that the regression line must pass through the origin.

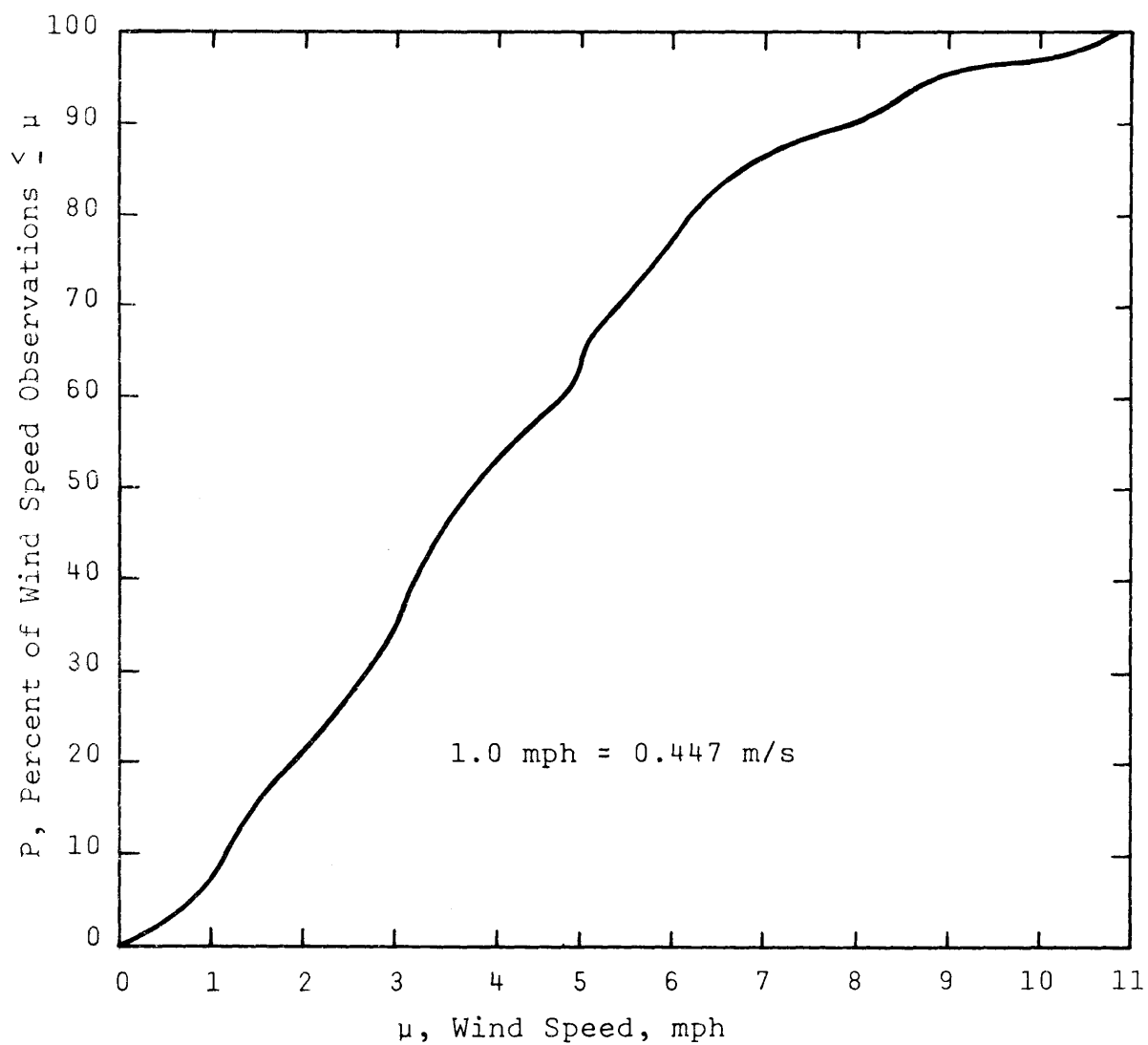


Figure 3. Cumulative daytime wind speed distribution during peak and off-peak traffic hours.

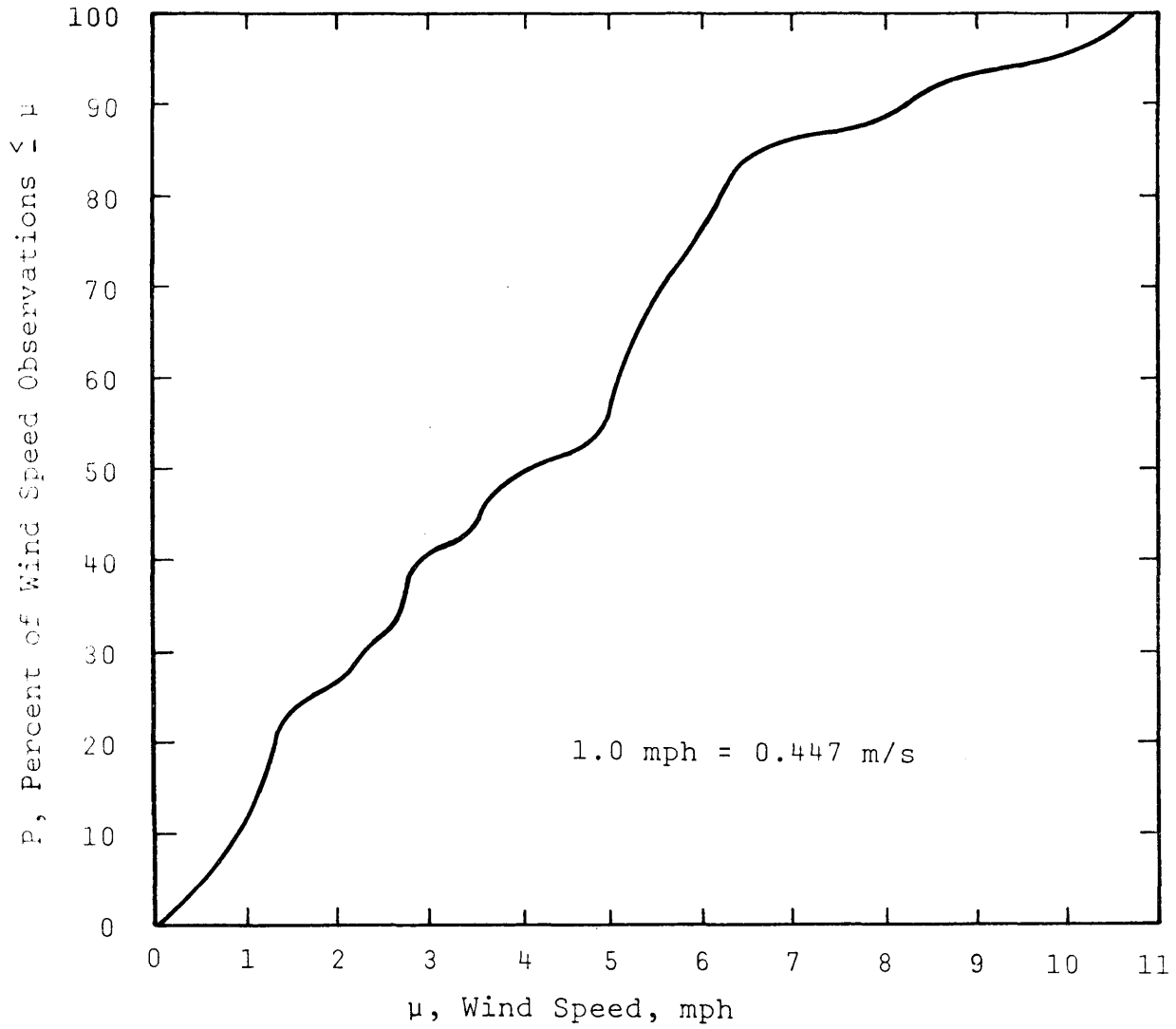
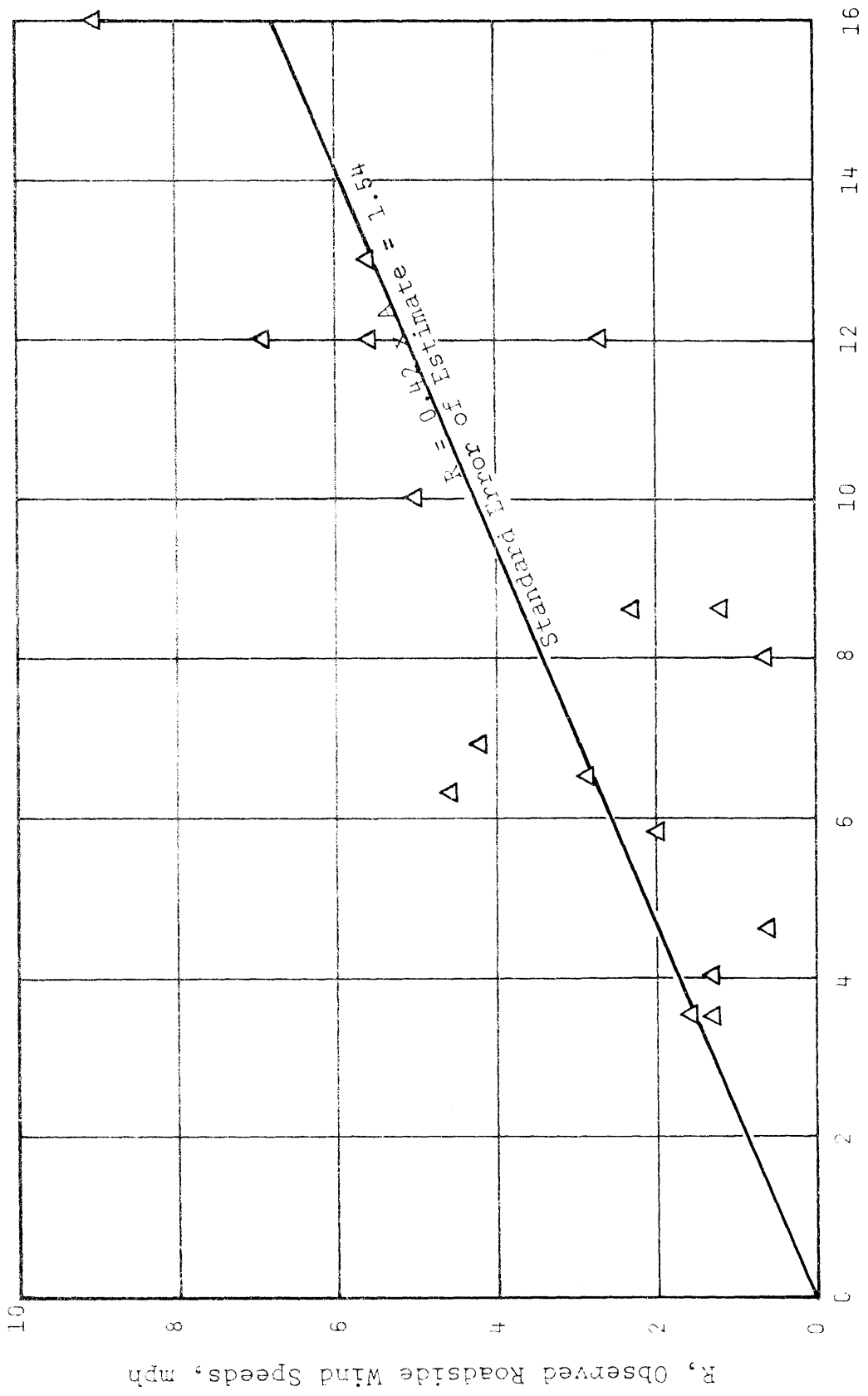


Figure 4. Cumulative daytime wind speed distribution during peak traffic hours.



A, Observed Airport Wind Speeds, mph

Figure 5. Relationship between roadside and airport wind speeds.

Stability Classes

The stability classes input to AIRPOL-4A must be determined according to the Pasquill method⁽⁵⁾ and not the Turner method. Reference 2 firmly establishes that the use of Pasquill determined stability classes produces significantly better predictions than does the use of Turner determined classes.

Data collected during the verification phase of the AIRPOL project indicate an (A, B, C, D, E) distribution of (0.10, 0.63, 0.17, 0.10, 0.00) for the Pasquill method and an (A, B, C, D, E, F) distribution of (0.06, 0.29, 0.17, 0.48, 0.00, 0.00) for the Turner method. The Turner distribution is in very good agreement with available historical results based on the Turner method when one considers the inherently more unstable characteristics of road-side meteorological conditions as compared to airport meteorological conditions. The Pasquill distribution should, therefore, be in good agreement with historical data analyzed by Pasquill's method. Thus, until the computer program PASCLS, which will analyze historical weather data based on Pasquill's criteria, is completed, the user should analyze stability class B (63% probability of occurrence) as the most likely stability class. In urban environments the user may also wish to analyze class A, while in rural environments, he may wish to include class C.

As a final point concerning stability classes, the authors wish to clear up a popular misconception regarding the influence of atmospheric stability on pollutant levels. While it is true that increasing the atmospheric stability will often increase CO levels, it is not true in the general case. The effects of atmospheric stability, road/wind angle, source/receptor geometry, and sampling time on CO levels are inseparable and not necessarily monotonic. Thus, in some instances, increasing the atmospheric stability will decrease, not increase, CO levels. The user is, therefore, cautioned not to analyze higher atmospheric stability classes (or smaller road/wind angles and definitely not a combination of the two) with the intent of generating more conservative predictions. Such practices may very well lead to significant underpredictions.

Road/Wind Angles

As was the case with stability class, the user should be aware that CO levels do not necessarily increase as road/wind angles decrease. Thus, the user should not analyze smaller road/wind angles solely on the assumption that such a practice will yield a more conservative prediction than one for a larger road/wind angle.

Non-Prevailing Meteorological Conditions

In general, the user will not have sufficient information to justify making analyses for non-prevailing stability classes or road/wind angles in lieu of the prevailing conditions. If, however, the user feels compelled to analyze non-prevailing meteorological conditions, he should certainly analyze the prevailing conditions first, and he should have a reasonable understanding of the interactive effects of stability class, road/wind angle, sampling time, and source/receptor geometry on CO levels.

Emission Factors

Emission factors for AIRPOL-4A should be determined in accordance with Supplement 5 to AP-42, April 1975, U.S.EPA. The computer program EMISSION described in Appendix A generates emission factors in accordance with these guidelines.

EXAMPLES

Throughout these examples it is assumed that % gc = 100 - % hdgt, % hot starts = 27%, % cold operation = 20%, and ambient temperature = 75°F. Figures A1 and A2 in Appendix A contain the inputs and outputs to the program EMISSION for these examples.

Single Lane-Group Examples

This section deals exclusively with single lane-group examples designed to familiarize the reader with the basic mechanics of using AIRPOL-4A. In the next section, the reader will be introduced to multiple lane-group examples and the concept of superposition. In this section, each lane group is assumed to consist of two adjacent 12-foot roadway lanes having homogeneous traffic conditions across the two lanes.

Example 1

Consider Figures 6, 7, 8, and 9. These sites, all assumed to be parts of a single project, are to be analyzed for 0, 1, 5, 10, 25, and 50 percentile CO levels. The analyses are to be performed for one-hour sampling intervals. Emission, meteorological, and geometric data are given with each figure.

Figure 6 describes an at-grade facility for which predictions are desired on both the upwind and downwind sides of the roadway. CO levels are to be determined at 0- and 5-foot elevations for source/receptor distances of 20, 40, 60 ... 140, and 160 feet on the downwind side of the facility and 10, 20, 30, ... 70, and 80 feet on the upwind side. Analyses are desired for the years 1978 and 1985.

Figure 7 describes a cut section of roadway with receptors in the cut. CO levels are to be determined at 0- and 5-foot elevations above the cut floor for source/receptor distances of 10, 20, 30, ... 70, and 80 feet on the upwind and downwind sides of the roadway. Analysis is desired for 1978 only. Notice that since AIRPOL-4A forces $\alpha = 0^\circ$ when both source and receptors are in a cut, the upwind and downwind predictions in a cut are identical. Notice also that DLENGH need not be specified when $\alpha = 0^\circ$.

Figure 8 describes a cut section of roadway with receptors outside the cut. CO levels are to be determined for 5- and 10-foot elevations above the surrounding terrain (the top of the cut) for receptors 100, 150, 200, ... 400, and 450 feet from the downwind edge of the roadway. Analysis is desired for 1985.

Figure 9 describes a fill section of roadway. CO levels are to be determined for 5- and 40-foot elevations above the surrounding terrain (the bottom of the fill) for receptors 68, 78, 88, ... 128, and 138 feet from the downwind side of the facility. Analyses are desired for normal traffic for 1978 and 1985 and for stalled traffic (5 mph) for 1978.

Figure 10 shows a completed AIRPOL-4A input sheet for analyzing a division consisting of these four sites. Notice that the user has allowed the prediction interval, the metric command, and the wind speeds to assume their default values. Notice also that the user has allowed various items on the lane-group data cards to assume their default values. The reader should carefully study these inputs in relation to the problem descriptions and relate them to the outputs shown in Figures 11 through 20.

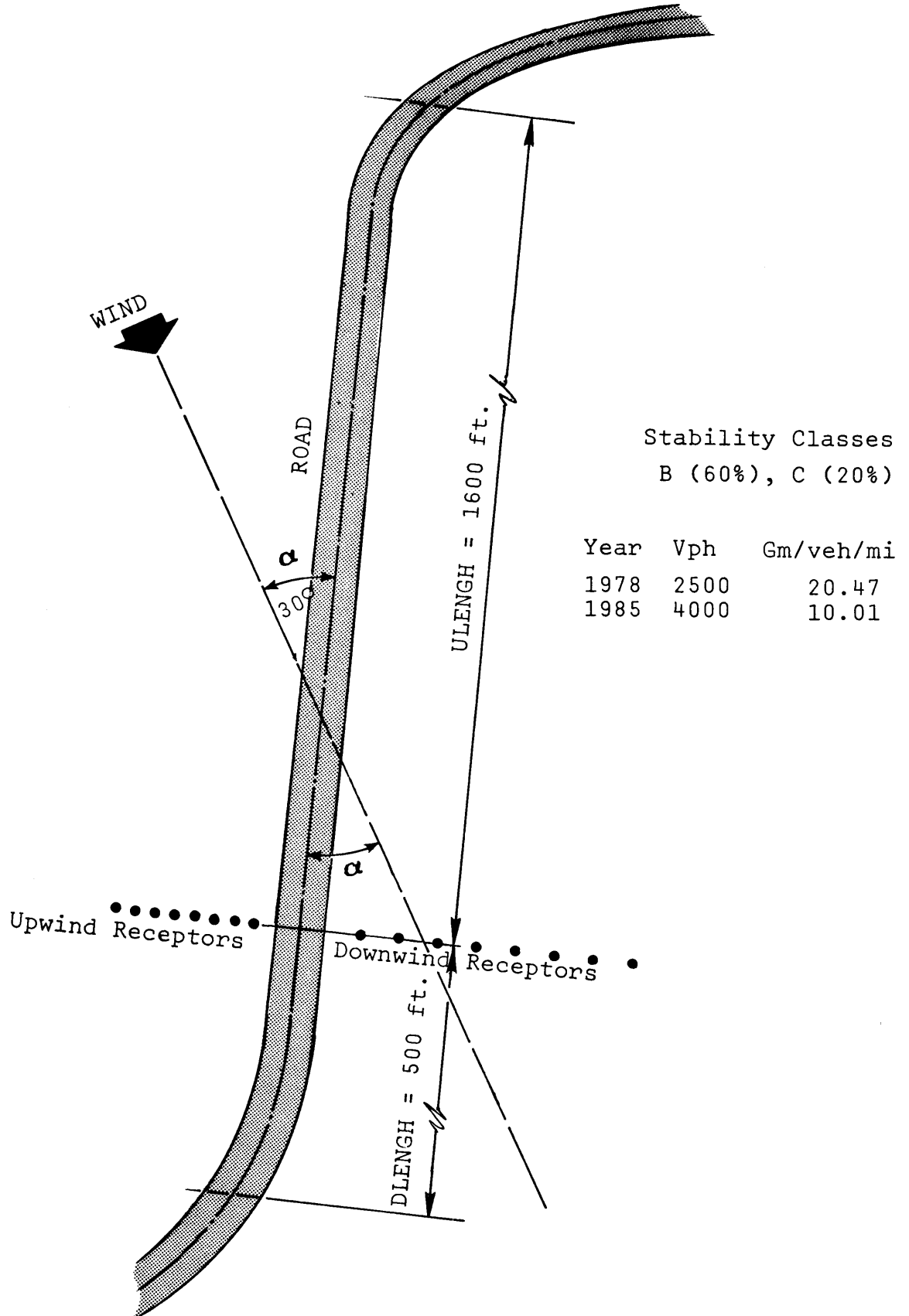


Figure 6. An at-grade facility.

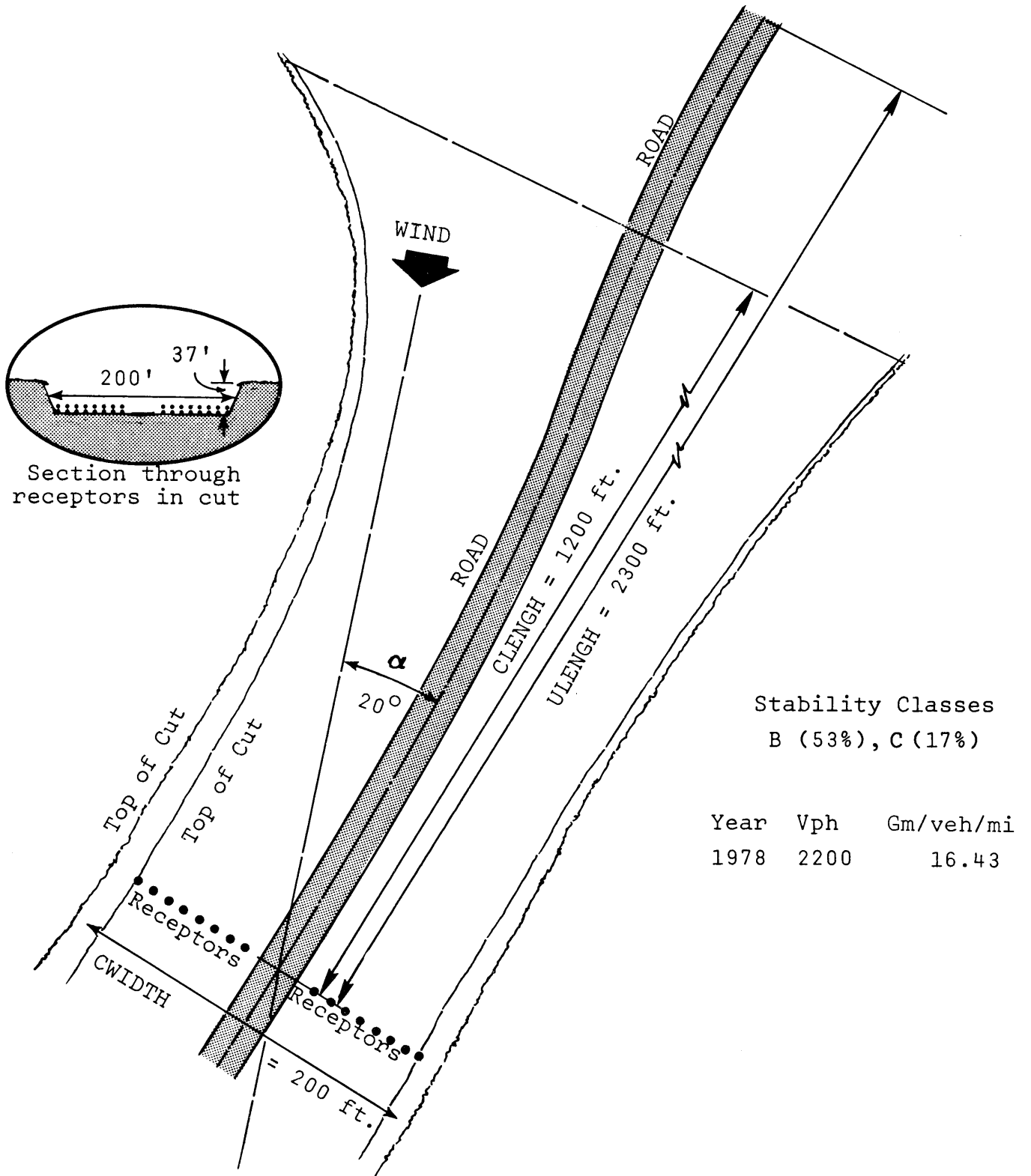


Figure 7. Roadway and receptors in a cut.

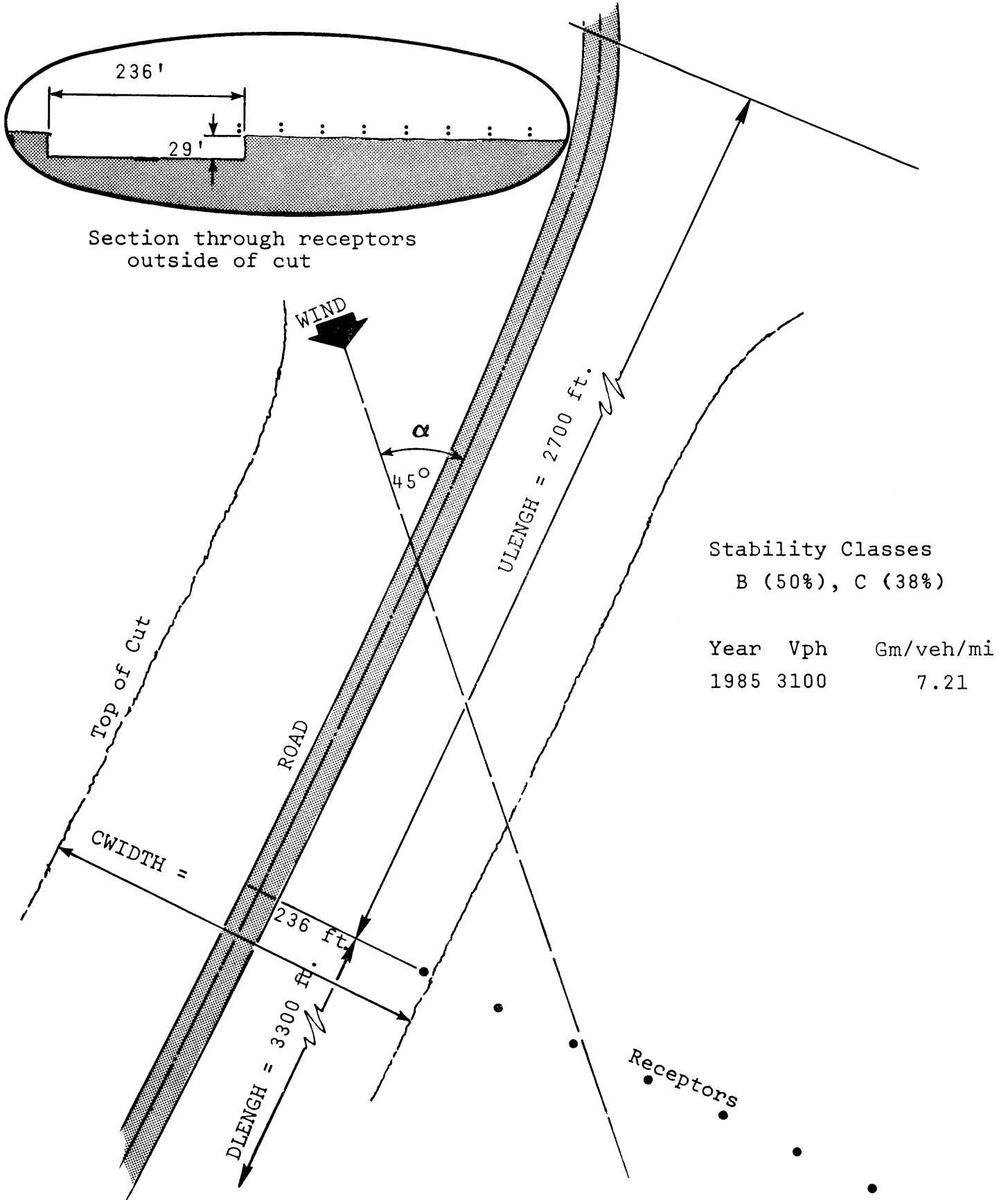


Figure 8. Roadway inside a cut and receptors outside the cut.

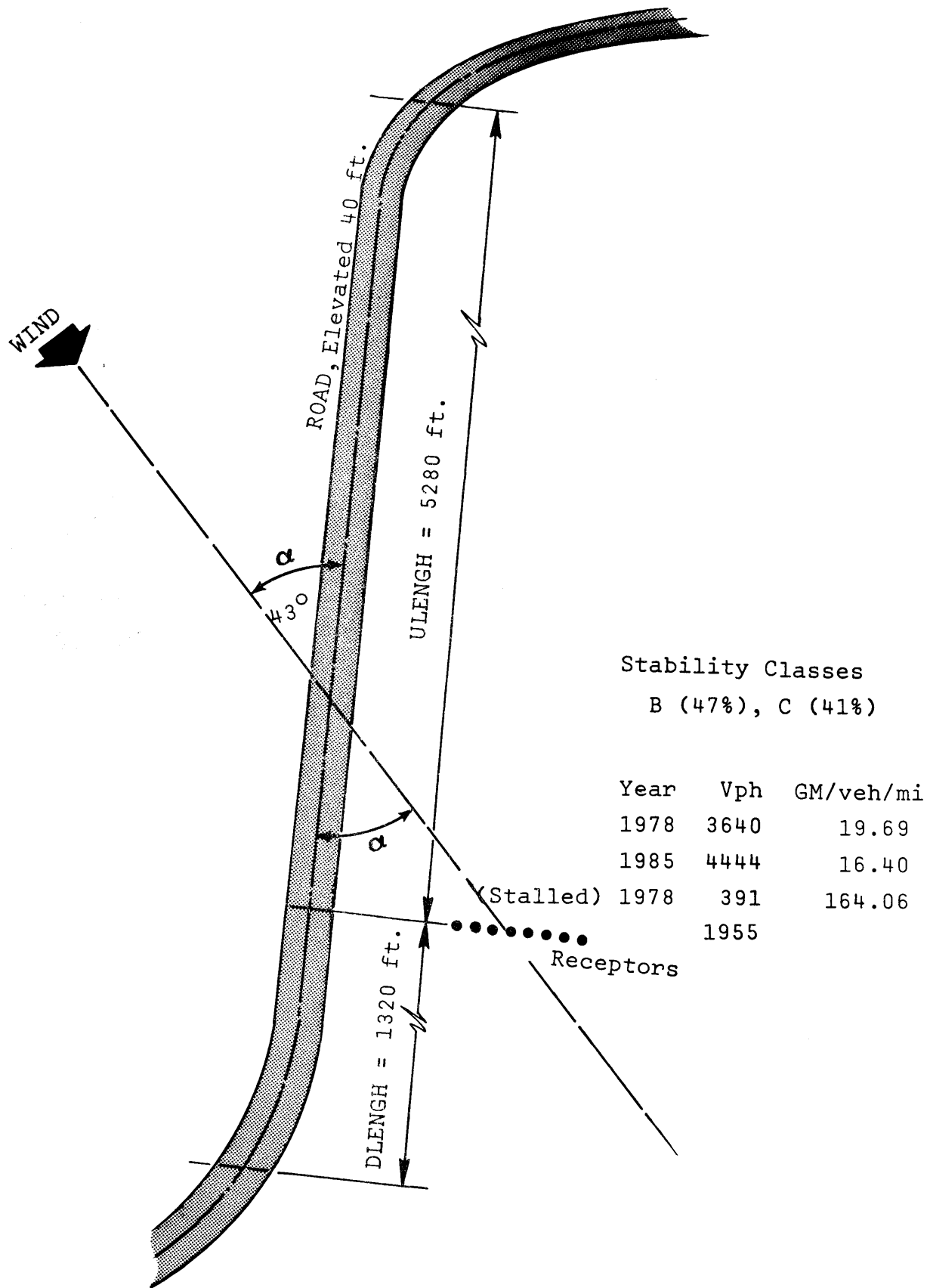


Figure 9. An elevated facility.

FIGURE 10. COMPLETED AIRPOL-4A INPUT FORM FOR EXAMPLE 1.

PAGE 1 OF 1

DP77-A VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
 AIRPOL -- VERSION 4A
 DATA PROCESSING INPUT
 NOVEMBER 1975

INPUT SUBMITTED BY: WYA Carpenter PHONE EXT: 313 ROOM NO. 313

DATE SUBMITTED: 1-27-76 PROJECT CHARGE NO: 91903

CO.	ROUTE	CITY	%	CO.	SECT.	TYPE	ACT.
91903							910

WS-1	WS-2	WS-3	WS-4	WS-5	WS-6
mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)
58-60 F3.1	62-64 F3.1	66-68 F3.1	70-72 F3.1	74-76 F3.1	78-80 F3.1

YR	YR	YR	YR	YR	YR
1	2	3	4	5	6
45-46 I2	48-49 I2	51-52 I2			

CLASS 1	CLASS 2
54 Z1	56 Z1

PREDICTION INTERVAL (minutes)	METRIC
39-41 I3	43 I1

HEADING
 (Information should be centered in these 33 columns)

5-37
844, A1

1ST MISERS MANUAL, EXAMPLE 1

SITE ID	TFVOL yr1	TFVOL yr2	TFVOL yr3	EF yr1	EF yr2	EF yr3	SOURCE HT	SOURCE LENGTH	CWIDTH	CLENGTH	ALPHA	OBS HT-2	OBS D-1	OBS INC
5-7 A3	11-14 F40	16-19 F40	21-24 F40	26-30 F5.2	32-36 F5.2	39-42 F5.2	44-48 F3.0	50-56 F3.2	58-64 F3.0	62-64 F3.2	68-69 F2.0	71-72 F2.0	74-76 F3.0	78-80 F3.0
1AH	2500	4000		2047	1001			15			30		110	110
ENS														
1AD	2600	4000		2047	1001			16			30		120	120
ENS														
1B	2200			11643					200	12			110	110
ENS														
1C	3640	3100			721				236		45		100	150
ENS														
1D		4444	1956	11969	1640	16406	40	53			43	40	68	110
ENS														
END														

NOTE: DUPLICATE COMPUTER JOB NO ON ALL CARDS

AND END CARDS. #() = # ON END AND JENS CARDS. #() = #

FIGURE II

USERS MANUAL, EXAMPLE 1

PAGE 1

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	FF	FF	FF	L	SOURC	UM/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC
---	---	---VPH	---VPH	---VPH	G/V/M1	G/V/M1	G/V/M1	S	---FI	---KFI	---FI	---KFI	S	---	---FI	---FI	---FI
IAU	H	2500.0	4000.0	0.0	20.47	10.01	0.0	0	0.0	1.60	0.50	0.0	U	30.0	0.0	10.0	10.0

FIGURE 12

SITE ID = IAU
USEPS MANUAL, EXAMPLE 1

ATPPOI -- VERSION 4A
NOVEMBER 1975

A SUPERPOSITION OF CO LEVELS
FROM THE ABOVE 1 LANE GROUPS.

PAGE 2

AVERAGE WIND SPEEDS IN MPH (M/S)

YEAR	DISTANCE, FT (M)	0.6		0.20		0.70		1.20		2.30		3.80	
		HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER
1974	10 (3.0)	1.02	1.09	0.99	1.06	0.92	0.99	0.86	0.93	0.75	0.81	0.63	0.68
	20 (6.1)	0.75	0.80	0.73	0.78	0.68	0.72	0.63	0.68	0.55	0.59	0.47	0.50
	30 (9.1)	0.51	0.54	0.50	0.53	0.46	0.49	0.43	0.46	0.38	0.40	0.32	0.34
	40 (12.2)	0.35	0.36	0.34	0.35	0.31	0.33	0.29	0.31	0.27	0.27	0.22	0.23
	50 (15.2)	0.24	0.25	0.23	0.24	0.22	0.23	0.20	0.21	0.18	0.19	0.15	0.16
	60 (18.3)	0.14	0.14	0.17	0.14	0.16	0.16	0.15	0.15	0.13	0.13	0.11	0.11
	70 (21.3)	0.13	0.14	0.13	0.13	0.12	0.12	0.11	0.12	0.10	0.10	0.08	0.08
	80 (24.4)	0.10	0.11	0.10	0.10	0.09	0.10	0.09	0.09	0.08	0.08	0.05	0.07
	10 (3.0)	0.80	0.86	0.77	0.83	0.72	0.77	0.67	0.72	0.59	0.63	0.50	0.53
	20 (6.1)	0.59	0.63	0.57	0.61	0.53	0.57	0.50	0.53	0.43	0.46	0.36	0.39
	30 (9.1)	0.40	0.42	0.39	0.41	0.36	0.38	0.34	0.36	0.29	0.31	0.25	0.26
	40 (12.2)	0.27	0.28	0.26	0.24	0.24	0.26	0.23	0.24	0.20	0.21	0.17	0.18
	50 (15.2)	0.14	0.20	0.18	0.19	0.17	0.18	0.16	0.17	0.14	0.14	0.12	0.12
	60 (18.3)	0.14	0.14	0.13	0.14	0.12	0.13	0.12	0.12	0.10	0.10	0.09	0.09
	70 (21.3)	0.10	0.11	0.10	0.10	0.09	0.10	0.09	0.09	0.08	0.08	0.06	0.07
	80 (24.4)	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.05	0.06	0.05	0.05

CO LEVELS IN PPM

YEAR	DISTANCE, FT (M)	0.6		0.20		0.70		1.20		2.30		3.80	
		HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER
1974	10 (3.0)	0.99	0.99	0.88	0.96	0.82	0.89	0.77	0.84	0.67	0.73	0.56	0.61
	20 (6.1)	0.50	0.55	0.49	0.53	0.46	0.50	0.43	0.46	0.37	0.40	0.31	0.34
	30 (9.1)	0.25	0.25	0.23	0.25	0.21	0.23	0.20	0.22	0.17	0.19	0.15	0.16
	40 (12.2)	0.10	0.11	0.10	0.11	0.09	0.10	0.09	0.09	0.08	0.08	0.06	0.07
	50 (15.2)	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.03
	60 (18.3)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02
	70 (21.3)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	80 (24.4)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1985	10 (3.0)	0.71	0.77	0.69	0.75	0.64	0.70	0.60	0.65	0.52	0.57	0.44	0.48
	20 (6.1)	0.39	0.43	0.38	0.42	0.36	0.39	0.33	0.36	0.29	0.32	0.25	0.27
	30 (9.1)	0.14	0.20	0.18	0.19	0.17	0.18	0.16	0.17	0.14	0.15	0.11	0.12
	40 (12.2)	0.05	0.09	0.08	0.08	0.07	0.08	0.07	0.07	0.06	0.06	0.05	0.05
	50 (15.2)	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02
	60 (18.3)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01
	70 (21.3)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	80 (24.4)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

FIGURE 13

AIRPOL -- VFRSION 4A
NOVEMBER 1975

USERS MANUAL, EXAMPLE 1

PAGE 3

JOB NO. 1ST

QUESTION MARKS (?) INDICATE A PROGRAMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUFS ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOURC	UM/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS	OBS			
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	HT-2	DIST1	HT-2		
I	I	VPH	VPH	VPH	G/V/MI	G/V/MI	G/V/MI	U	FI	KFI	FI	KFI	S	DEG	FI	FI	FI	FI	FI	FI	
IAD	T	2500.0	4000.0	0.0	20.47	10.01	0.0	U	0.0	1.60	0.50	0.0	0	30.0	0.0	20.0	0.0	20.0	0.0	20.0	20.0

FIGURE 14

A SUPERPOSITION OF CO LEVELS FROM THE ABOVE 1 LANE GROUPS.

CONCENTRATION AVERAGING TIME		AVERAGE WIND SPEEDS IN MPH (M/S)											
1 HR. : 0 MIN.		0.0		0.20		0.70		1.20		2.30		3.80	
YEAR	DISTANCE, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)
		(1.5)	(0.0)	(1.5)	(0.0)	(1.5)	(0.0)	(1.5)	(0.0)	(1.5)	(0.0)	(1.5)	(0.0)
		(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)	(OBSERVER)
1978	20 (6.1)	1.33	1.43	1.29	1.39	1.20	1.29	1.12	1.21	0.98	1.05	0.83	0.89
	40 (12.2)	1.12	1.19	1.09	1.16	1.01	1.08	0.95	1.01	0.83	0.88	0.70	0.74
	60 (18.3)	0.92	0.96	0.89	0.94	0.83	0.87	0.78	0.82	0.68	0.71	0.57	0.60
	80 (24.4)	0.77	0.80	0.75	0.78	0.70	0.72	0.65	0.68	0.57	0.59	0.44	0.50
	100 (30.5)	0.66	0.68	0.64	0.66	0.60	0.62	0.56	0.58	0.49	0.50	0.41	0.42
	120 (36.6)	0.58	0.59	0.56	0.57	0.52	0.54	0.49	0.50	0.43	0.44	0.36	0.37
	140 (42.7)	0.51	0.52	0.50	0.51	0.46	0.47	0.43	0.44	0.38	0.38	0.32	0.32
	160 (48.8)	0.45	0.47	0.45	0.45	0.42	0.42	0.39	0.39	0.34	0.34	0.29	0.29
	20 (6.1)	1.04	1.12	1.01	1.09	0.94	0.94	0.88	0.95	0.76	0.82	0.65	0.70
	40 (12.2)	0.88	0.93	0.85	0.91	0.79	0.84	0.74	0.79	0.65	0.69	0.55	0.58
	60 (18.3)	0.72	0.75	0.70	0.73	0.65	0.68	0.61	0.64	0.53	0.56	0.45	0.47
	80 (24.4)	0.60	0.63	0.59	0.61	0.55	0.57	0.51	0.53	0.45	0.46	0.34	0.39
100 (30.5)	0.52	0.53	0.50	0.52	0.47	0.48	0.44	0.45	0.39	0.39	0.32	0.33	
120 (36.6)	0.45	0.46	0.44	0.45	0.41	0.42	0.38	0.39	0.33	0.34	0.28	0.29	
140 (42.7)	0.40	0.41	0.39	0.40	0.36	0.37	0.34	0.35	0.30	0.30	0.25	0.25	
160 (48.8)	0.35	0.36	0.35	0.35	0.33	0.33	0.30	0.31	0.27	0.27	0.22	0.23	
1978	20 (6.1)	1.72	1.88	1.67	1.83	1.55	1.70	1.45	1.59	1.26	1.39	1.07	1.17
	40 (12.2)	1.51	1.63	1.47	1.58	1.37	1.48	1.28	1.38	1.11	1.20	0.94	1.01
	60 (18.3)	1.29	1.36	1.25	1.32	1.16	1.23	1.09	1.15	0.95	1.00	0.80	0.85
	80 (24.4)	1.11	1.16	1.08	1.13	1.01	1.05	0.94	0.98	0.82	0.86	0.69	0.72
	100 (30.5)	0.99	1.01	0.95	0.98	0.88	0.92	0.83	0.86	0.72	0.75	0.61	0.63
	120 (36.6)	0.87	0.90	0.85	0.87	0.79	0.81	0.74	0.76	0.64	0.66	0.54	0.56
	140 (42.7)	0.79	0.80	0.76	0.78	0.71	0.73	0.66	0.68	0.58	0.59	0.49	0.50
	160 (48.8)	0.71	0.73	0.69	0.71	0.65	0.66	0.60	0.62	0.53	0.54	0.44	0.45
	20 (6.1)	1.34	1.47	1.30	1.43	1.22	1.33	1.14	1.25	0.99	1.08	0.84	0.92
	40 (12.2)	1.14	1.24	1.15	1.24	1.07	1.16	1.00	1.08	0.87	0.94	0.74	0.79
	60 (18.3)	1.01	1.07	0.98	1.04	0.91	0.96	0.85	0.90	0.79	0.87	0.63	0.66
	80 (24.4)	0.87	0.91	0.85	0.88	0.79	0.82	0.74	0.77	0.64	0.67	0.54	0.57
100 (30.5)	0.77	0.79	0.74	0.77	0.69	0.72	0.65	0.67	0.58	0.58	0.48	0.49	
120 (36.6)	0.68	0.70	0.66	0.68	0.62	0.63	0.58	0.59	0.50	0.52	0.42	0.44	
140 (42.7)	0.61	0.63	0.60	0.61	0.56	0.57	0.52	0.53	0.45	0.46	0.38	0.39	
160 (48.8)	0.55	0.57	0.54	0.55	0.51	0.52	0.47	0.48	0.41	0.42	0.35	0.35	

FIGURE 15

JOB NO. 1ST

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USERS MANUAL • EXAMPLE 1

AIRPOL -- VERSION 4A
NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

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S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOURC	UM//DM	CUT	CUT1	C	ALFA	OBS	OBS	OBS
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC
I	I	VPH	VPH	VPH	GZY/M1	GZY/M1	GZY/M1	C	FI	KFI	FI	KFI	S	DEG	FI	FI	FI
IR	E	2200.0	0.0	0.0	16.43	0.0	0.0	1	-37.0	2.30	0.0	1.20	?	0.0	0.0	10.0	10.0
													D				

FIGURE 1C

AIRPOL -- VERSION 4A NOVEMBER 1975 SITE ID = IH USERS MANUAL, EXAMPLE 1 PAGE 6 JOB NO. 1ST

A SUPERPOSITION OF CO LEVELS FROM THE ABOVE 1 LANE GROUPS.

CONCENTRATION AVERAGING TIME 1 HR. : 0 MIN.

YEAR	DISTANCE, FT (M)	0.0 (0.0)			0.20 (0.09)			0.70 (0.31)			1.20 (0.54)			2.30 (1.03)			3.80 (1.70)		
		OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	
	10	1.79	2.01	1.65	1.75	1.54	1.82	1.44	1.70	1.25	1.48	1.06	1.25	1.10	1.00	0.96	1.10	1.25	
	20	1.54	1.77	1.50	1.72	1.39	1.60	1.30	1.50	1.13	1.30	0.96	1.10	0.93	0.84	0.84	0.93	0.93	
1978	30	1.36	1.50	1.32	1.46	1.23	1.36	1.15	1.27	1.00	1.11	0.84	0.84	0.80	0.75	0.80	0.80	0.80	
	40	1.20	1.24	1.17	1.25	1.09	1.16	1.01	1.09	0.88	0.94	0.75	0.75	0.70	0.68	0.68	0.70	0.70	
	50	1.04	1.13	1.06	1.10	0.99	1.02	0.92	0.96	0.80	0.83	0.68	0.68	0.63	0.63	0.63	0.63	0.63	
	60	1.02	1.04	0.99	1.01	0.92	0.94	0.86	0.88	0.75	0.76	0.60	0.60	0.61	0.61	0.61	0.61	0.61	
	70	0.96	0.98	0.94	0.95	0.87	0.88	0.81	0.83	0.71	0.72	0.60	0.60	0.61	0.61	0.61	0.61	0.61	
	80	0.92	0.93	0.89	0.90	0.83	0.84	0.78	0.79	0.68	0.68	0.57	0.57	0.58	0.58	0.58	0.58	0.58	

CO LEVELS IN PPM

YEAR	DISTANCE, FT (M)	0.0 (0.0)			0.20 (0.09)			0.70 (0.31)			1.20 (0.54)			2.30 (1.03)			3.80 (1.70)		
		OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	
	10	2.33	2.73	2.26	2.05	2.11	2.47	1.97	2.31	1.72	2.01	1.45	1.70	1.70	1.45	1.28	1.45	1.70	
	20	2.05	2.33	1.99	1.89	1.86	2.11	1.74	1.97	1.51	1.71	1.28	1.45	1.45	1.28	1.10	1.20	1.45	
1978	30	1.77	1.92	1.72	1.67	1.60	1.74	1.50	1.63	1.30	1.42	1.10	1.20	1.20	1.10	0.97	1.01	1.20	
	40	1.55	1.63	1.51	1.58	1.41	1.47	1.31	1.38	1.14	1.20	0.97	1.01	1.01	0.97	0.87	0.90	1.01	
	50	1.40	1.44	1.36	1.40	1.27	1.31	1.19	1.22	1.03	1.06	0.87	0.87	0.87	0.80	0.80	0.82	0.87	
	60	1.29	1.32	1.26	1.28	1.17	1.19	1.09	1.11	0.95	0.97	0.80	0.80	0.82	0.76	0.76	0.76	0.82	
	70	1.20	1.22	1.16	1.18	1.09	1.10	1.01	1.03	0.88	0.90	0.75	0.76	0.76	0.75	0.75	0.76	0.82	
	80	1.12	1.13	1.06	1.10	1.01	1.02	0.94	0.95	0.82	0.83	0.69	0.70	0.70	0.69	0.69	0.70	0.82	

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FIGURE 17

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVULM	TFVULM	TFVULM	EF	EF	EF	L	SOURC	UW/DW	CUT	CUT1	C	ALFA	ORS	ORS	ORS	OBS	
I	G	YR-1	YR-3	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC		
-I	I	--VPH	--VPH	--VPH	GZY/MJ	GZY/MJ	GZY/MJ	↓	--FI	KFI	--FI	KFI	S	--DEG	--FI	--FI	--FI		
IC	F	0.0	3100.0	0.0	0.0	7.21	0.0	2	-29.0	2.70	3.30	0.0	?	45.0	0.0	100.0	50.0		
													D						

FIGURE 18

A SUPERPOSITION OF CO LEVELS FROM THE ABOVE 1 LANE GROUPS.

CONCENTRATION AVERAGING TIME 1 HR. : 0 MIN.

0.0		0.20		0.70		1.20		2.30		3.80	
(0.0)		(0.04)		(0.31)		(0.54)		(1.03)		(1.70)	
HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER
5.0 (1.5)	(0.0)	5.0 (1.5)	(0.0)	5.0 (1.5)	(0.0)	5.0 (1.5)	(0.0)	5.0 (1.5)	(0.0)	5.0 (1.5)	(0.0)

CO LEVELS IN PPM

S	100.	(30.5)	0.30	0.32	0.29	0.31	0.27	0.29	0.26	0.27	0.22	0.19	0.20
T	150.	(45.7)	0.23	0.23	0.22	0.23	0.20	0.21	0.19	0.20	0.17	0.14	0.14
A	200.	(61.0)	0.18	0.14	0.17	0.18	0.16	0.16	0.15	0.15	0.13	0.11	0.11
R	250.	(76.2)	0.15	0.15	0.14	0.15	0.13	0.14	0.13	0.13	0.11	0.09	0.09
I	300.	(91.4)	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.11	0.09	0.08	0.08
B	350.	(106.7)	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.09	0.08	0.07	0.07
I	400.	(121.9)	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.08	0.07	0.06	0.06
S	450.	(137.2)	0.09	0.09	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.05	0.06
S	100.	(30.5)	0.44	0.43	0.39	0.42	0.36	0.39	0.34	0.36	0.29	0.25	0.27
T	150.	(45.7)	0.31	0.32	0.30	0.31	0.28	0.29	0.26	0.27	0.23	0.19	0.20
A	200.	(61.0)	0.25	0.26	0.25	0.25	0.23	0.24	0.21	0.22	0.19	0.16	0.16
H	250.	(76.2)	0.21	0.22	0.21	0.21	0.19	0.20	0.18	0.18	0.16	0.13	0.14
I	300.	(91.4)	0.19	0.19	0.18	0.18	0.17	0.17	0.16	0.16	0.14	0.12	0.12
T	350.	(106.7)	0.15	0.17	0.16	0.16	0.15	0.15	0.14	0.14	0.12	0.10	0.10
C	400.	(121.9)	0.15	0.15	0.14	0.14	0.13	0.13	0.13	0.13	0.11	0.09	0.09
S	450.	(137.2)	0.13	0.14	0.13	0.13	0.12	0.12	0.11	0.11	0.10	0.08	0.08

FIGURE 19

AIRPOL -- VERSION 4A
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JOB NO. 1ST

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOURC	UW/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS	OBS	
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC	FI	
I	I	--VPH	--VPH	--VPH	GZY/MJ	GZY/MJ	GZY/MJ	S	FI	KFI	FI	KFI	S	DEG	FI	FI	FI	FI	
ID	A	3640.0	4444.0	1955.0	19.69	16.40	164.06	U	40.0	5.30	1.30	0.0	?	43.0	40.0	68.0	10.0		
													D						

FIGURE 20

SITE ID = ID
USERS MANUAL, EXAMPLE 1

AIPOPL -- VERSION 4A
NOVEMBER 1975

A SUPERPOSITION OF CO LEVELS
FROM THE ABOVE 1 LANE GROUPS.

I	HR.	CONCENTRATION	0.0			0.20			0.70			1.20			2.30			3.80		
			HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER	HEIGHTS, FT (M)	OHSEVER
S	1978	68.	(20.7)	0.26	0.43	0.25	0.42	0.23	0.39	0.22	0.37	0.19	0.32	0.16	0.27					
T		78.	(23.8)	0.27	0.41	0.26	0.40	0.24	0.37	0.23	0.35	0.20	0.30	0.17	0.26					
I		88.	(26.8)	0.28	0.40	0.27	0.38	0.25	0.36	0.23	0.34	0.20	0.29	0.17	0.25					
T	1985	98.	(29.9)	0.29	0.38	0.27	0.37	0.26	0.34	0.24	0.32	0.21	0.28	0.18	0.24					
Y		108.	(32.9)	0.29	0.37	0.28	0.36	0.26	0.33	0.24	0.31	0.21	0.27	0.18	0.23					
T		118.	(36.0)	0.29	0.36	0.28	0.34	0.26	0.32	0.25	0.30	0.21	0.26	0.18	0.22					
A		128.	(39.0)	0.29	0.34	0.29	0.33	0.27	0.31	0.25	0.29	0.22	0.25	0.18	0.21					
R		138.	(42.1)	0.30	0.33	0.29	0.32	0.27	0.30	0.25	0.28	0.22	0.25	0.18	0.21					
L		68.	(20.7)	0.26	0.44	0.25	0.43	0.24	0.40	0.22	0.37	0.19	0.32	0.16	0.27					
L		78.	(23.8)	0.27	0.42	0.26	0.41	0.25	0.38	0.23	0.36	0.20	0.31	0.17	0.26					
I		88.	(26.8)	0.28	0.40	0.27	0.39	0.25	0.36	0.24	0.34	0.21	0.30	0.17	0.25					
T	1985	98.	(29.9)	0.29	0.39	0.28	0.38	0.26	0.35	0.24	0.33	0.21	0.29	0.18	0.24					
Y		108.	(32.9)	0.29	0.37	0.28	0.36	0.26	0.34	0.24	0.32	0.21	0.29	0.18	0.24					
T		118.	(36.0)	0.30	0.36	0.29	0.35	0.27	0.33	0.25	0.31	0.22	0.27	0.18	0.22					
C		128.	(39.0)	0.30	0.35	0.29	0.34	0.27	0.32	0.25	0.30	0.22	0.26	0.19	0.22					
L		138.	(42.1)	0.30	0.34	0.29	0.33	0.27	0.31	0.25	0.29	0.22	0.25	0.19	0.21					
A		68.	(20.7)	0.15	1.94	1.12	1.88	1.04	1.75	0.97	1.64	0.88	1.43	0.72	1.20					
S		78.	(23.8)	1.20	1.85	1.16	1.80	1.08	1.67	1.01	1.56	0.85	1.36	0.74	1.15					
I		88.	(26.8)	1.24	1.77	1.20	1.72	1.12	1.60	1.04	1.50	0.91	1.30	0.77	1.10					
T	1978	98.	(29.9)	1.27	1.70	1.23	1.65	1.15	1.54	1.07	1.44	0.93	1.25	0.79	1.06					
Y		108.	(32.9)	1.29	1.64	1.25	1.60	1.17	1.49	1.09	1.39	0.95	1.21	0.80	1.02					
T		118.	(36.0)	1.31	1.59	1.27	1.54	1.18	1.44	1.10	1.34	0.96	1.17	0.81	0.99					
A		128.	(39.0)	1.32	1.54	1.28	1.50	1.19	1.39	1.11	1.30	0.97	1.13	0.82	0.96					
R		138.	(42.1)	1.33	1.50	1.29	1.45	1.20	1.35	1.12	1.27	0.98	1.10	0.82	0.93					
L		68.	(20.7)	0.15	0.49	0.16	0.47	0.15	0.44	0.14	0.41	0.12	0.36	0.10	0.30					
L		78.	(23.8)	0.14	0.47	0.17	0.45	0.16	0.42	0.15	0.40	0.13	0.34	0.11	0.29					
I		88.	(26.8)	0.19	0.45	0.19	0.44	0.18	0.41	0.16	0.38	0.14	0.33	0.12	0.28					
T	1978	98.	(29.9)	0.21	0.44	0.20	0.42	0.19	0.39	0.18	0.37	0.15	0.32	0.13	0.27					
Y		108.	(32.9)	0.22	0.42	0.21	0.41	0.20	0.38	0.19	0.36	0.16	0.31	0.14	0.26					
T		118.	(36.0)	0.23	0.41	0.23	0.40	0.21	0.37	0.20	0.35	0.17	0.30	0.14	0.25					
A		128.	(39.0)	0.24	0.40	0.24	0.39	0.22	0.36	0.21	0.34	0.18	0.29	0.15	0.25					
R		138.	(42.1)	0.25	0.39	0.24	0.38	0.23	0.35	0.21	0.33	0.19	0.28	0.16	0.24					
L		68.	(20.7)	0.17	0.49	0.16	0.48	0.15	0.45	0.14	0.42	0.12	0.36	0.10	0.31					
L		78.	(23.8)	0.18	0.48	0.18	0.46	0.17	0.43	0.15	0.40	0.13	0.35	0.11	0.30					
I		88.	(26.8)	0.20	0.46	0.19	0.44	0.18	0.41	0.17	0.39	0.15	0.34	0.12	0.28					
T	1985	98.	(29.9)	0.21	0.45	0.21	0.43	0.19	0.40	0.18	0.37	0.16	0.33	0.13	0.28					
Y		108.	(32.9)	0.22	0.43	0.22	0.42	0.20	0.39	0.19	0.36	0.17	0.32	0.14	0.27					
T		118.	(36.0)	0.24	0.42	0.23	0.40	0.21	0.38	0.20	0.35	0.17	0.31	0.15	0.26					
C		128.	(39.0)	0.25	0.40	0.24	0.39	0.22	0.37	0.21	0.34	0.18	0.29	0.15	0.25					
L		138.	(42.1)	0.25	0.39	0.24	0.38	0.23	0.36	0.21	0.33	0.19	0.28	0.16	0.24					
A		68.	(20.7)	0.73	2.14	0.71	2.11	0.66	1.97	0.62	1.84	0.54	1.60	0.45	1.35					
S		78.	(23.8)	0.80	2.09	0.78	2.03	0.73	1.89	0.68	1.77	0.59	1.54	0.50	1.30					
I		88.	(26.8)	0.87	2.02	0.84	1.96	0.79	1.82	0.74	1.70	0.64	1.48	0.54	1.30					
T	1978	98.	(29.9)	0.93	1.95	0.90	1.89	0.84	1.76	0.79	1.65	0.69	1.43	0.58	1.21					
Y		108.	(32.9)	0.99	1.89	0.96	1.83	0.89	1.71	0.84	1.59	0.73	1.39	0.61	1.17					
T		118.	(36.0)	1.04	1.83	1.01	1.78	0.94	1.65	0.88	1.55	0.77	1.35	0.65	1.14					
C		128.	(39.0)	1.09	1.78	1.05	1.73	0.98	1.61	0.92	1.50	0.80	1.31	0.67	1.10					
L		138.	(42.1)	1.13	1.73	1.09	1.68	1.02	1.57	0.95	1.46	0.83	1.27	0.70	1.08					

Example 2

Analyze the downwind side of the at-grade site in Figure 6 using metric inputs, Pasquill stability class A only, wind speeds of 0.1 and 1.3 m/s, and a sampling interval of 90 minutes. Figure 21 shows the completed AIRPOL-4A input form for this example, and Figures 22 and 23 show the output results.

2054

FIGURE 21. COMPLETED AIRPOL-4A INPUT FORM FOR EXAMPLE 2.

PAGE 1 OF 1

DP77-A VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
 AIRPOL -- VERSION 4A
 DATA PROCESSING INPUT
 NOVEMBER 1975

COMPUTER JOB NUMBER: 1-4 A4

INPUT SUBMITTED BY: W.A. Carpenter PHONE EXT.: 313 ROOM NO. 313

DATE SUBMITTED: 1-27-76 PROJECT CHARGE NO.: 9903 CITY: 9111 SECT.: 940

CO. ROUTE CITY% CO. TYPE ACT.

HEADING (Information should be centered in these 33 columns)

5-37 8A4, AI

MISSISSIPPI, EXAMPLE 2

YR	1	2	3	CLASS 1	CLASS 2	WS-1	WS-2	WS-3	WS-4	WS-5	WS-6
YR	45-46	48-49	51-52	54	56	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)
METRIC	43	44	45	46	47	F3.1	F3.1	F3.1	F3.1	F3.1	F3.1
PREDICTION INTERVAL (Minutes)	39-41					58-60	62-64	66-68	70-72	74-76	78-80
	I 3	I 2	I 2	Z 1	Z 1	F 3.1	F 3.1	F 3.1	F 3.1	F 3.1	F 3.1
	78	876				113					

NOTE: DUPLICATE COMPUTER JOB NO. ON ALL CARDS

SITE ID: 5-7 A3

TFVOL yr 1 veh/hr: 25100

TFVOL yr 2 veh/hr: 41010

TFVOL yr 3 veh/hr: 21

EF yr 1 gm/veh/mi (gm/veh/km): 26

EF yr 2 gm/veh/mi (gm/veh/km): 32

EF yr 3 gm/veh/mi (gm/veh/km): 38

SOURCE HT ft (m): 46-48

SOURCE LENGTH up wind kft (km): 50-52

SOURCE LENGTH down wind kft (km): 54-56

CWIDTH ft (m): 58-60

CLENGTH Kft (km): 62-64

ALPHA degrees: 68-69

OBS HT-2 ft (m): 71-72

OBS D-1 ft (m): 74-76

OBS INC ft (m): 78-80

TFVOL yr 1 veh/hr: 25100

TFVOL yr 2 veh/hr: 41010

TFVOL yr 3 veh/hr: 21

EF yr 1 gm/veh/mi (gm/veh/km): 26

EF yr 2 gm/veh/mi (gm/veh/km): 32

EF yr 3 gm/veh/mi (gm/veh/km): 38

SOURCE HT ft (m): 46-48

SOURCE LENGTH up wind kft (km): 50-52

SOURCE LENGTH down wind kft (km): 54-56

CWIDTH ft (m): 58-60

CLENGTH Kft (km): 62-64

ALPHA degrees: 68-69

OBS HT-2 ft (m): 71-72

OBS D-1 ft (m): 74-76

OBS INC ft (m): 78-80

THIS CARD IS REPENDANT. BENEATH IT IS FOLLOWED BY AN END CARD.

FIGURE 22

USERS MANUAL, EXAMPLE 2

AIRPOL -- VERSION 4A
NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVCLM	TFVCLM	TFVCLM	EF	FF	FF	L	SOURC	UW/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS	OBS
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC	INC
..I	I	--VPH	--VPH	--VPH	G/V/KM	G/V/KM	G/V/KM	S	M	KM	M	KM	S	DEG	M	M	M	M
2AD		2500.0	4000.0	0.0	12.72	6.22	0.0	0	0.0	0.49	0.15	0.0	D	30.0	0.0	3.0	3.0	3.0

FIGURE 23

AIRPOL -- VERSION 4A
 NOVEMBER 1975
 SITE ID = 2AD
 USERS MANUAL, EXAMPLE 2
 PAGE 2
 JOB NO. 2ND

A SUPERPOSITION OF CO LEVELS
 FROM THE ABOVE 1 LANE GROUPS.

CONCENTRATION: AVERAGING 11 1/4 1 HR. : 30 MIN.		0.72 (0.10)		2.91 (1.30)		AVERAGE WIND SPEEDS IN MPH (M/S)		***** (*****)		***** (*****)	
YEAR	OBSERVER DISTANCE, FT(M)	HEIGHTS, FT(M)	OBSERVER HEIGHTS, FT(M)	HEIGHTS, FT(M)	OBSERVER HEIGHTS, FT(M)	HEIGHTS, FT(M)	OBSERVER HEIGHTS, FT(M)	HEIGHTS, FT(M)	OBSERVER HEIGHTS, FT(M)	HEIGHTS, FT(M)	OBSERVER HEIGHTS, FT(M)
1978	10. (3.0)	0.77	0.83	0.55	0.59	4.9	4.9	0.0	4.9	0.0	4.9
	20. (6.0)	0.76	0.81	0.54	0.58	0.0	0.0	0.0	0.0	0.0	0.0
	30. (9.0)	0.72	0.77	0.51	0.55	0.0	0.0	0.0	0.0	0.0	0.0
	39. (12.0)	0.67	0.72	0.48	0.51	0.0	0.0	0.0	0.0	0.0	0.0
	49. (15.0)	0.62	0.66	0.44	0.46	0.0	0.0	0.0	0.0	0.0	0.0
	59. (18.0)	0.57	0.60	0.40	0.42	0.0	0.0	0.0	0.0	0.0	0.0
	69. (21.0)	0.52	0.55	0.37	0.39	0.0	0.0	0.0	0.0	0.0	0.0
	79. (24.0)	0.48	0.50	0.34	0.35	0.0	0.0	0.0	0.0	0.0	0.0
1985	10. (3.0)	0.60	0.65	0.43	0.46	0.0	0.0	0.0	0.0	0.0	0.0
	20. (6.0)	0.59	0.63	0.42	0.45	0.0	0.0	0.0	0.0	0.0	0.0
	30. (9.0)	0.55	0.60	0.40	0.43	0.0	0.0	0.0	0.0	0.0	0.0
	39. (12.0)	0.53	0.56	0.37	0.40	0.0	0.0	0.0	0.0	0.0	0.0
	49. (15.0)	0.44	0.51	0.34	0.36	0.0	0.0	0.0	0.0	0.0	0.0
	59. (18.0)	0.44	0.47	0.31	0.33	0.0	0.0	0.0	0.0	0.0	0.0
	69. (21.0)	0.41	0.43	0.29	0.30	0.0	0.0	0.0	0.0	0.0	0.0
	79. (24.0)	0.37	0.39	0.27	0.28	0.0	0.0	0.0	0.0	0.0	0.0

CO LEVELS IN PPM

Example 3

Generate a 1976 eight-hour analysis for the downwind side of the at-grade site in Figure 6. The analysis should cover the hours from 7:00 a.m. to 3:00 p.m. Traffic conditions (vph, mph, % hdgt) are

(4780, 54, 8) for morning rush-hour 7:00 to 9:00,

(2140, 62, 12) for morning off-peak 9:00 to 11:40, and

(2970, 59, 11) for afternoon shopping 11:40 to 3:00.

Assume that the average road/wind angle over this eight-hour period is 38° , the prevailing stability class is B, and the default percentile wind speeds are applicable to this time interval.

The first step in solving this problem is to determine the average traffic condition for the time period in question. This is done by finding

$$\frac{\text{vph}}{\text{vph}} = \frac{\sum \text{vph}_i \times \text{time}_i}{\sum \text{time}_i} = \frac{\text{Total vehicles}}{8 \text{ hours}} = \frac{25166.67}{8} = 3146 \text{ vph}$$

$$\frac{\text{mph}}{\text{mph}} = \frac{\sum \text{vph}_i \times \text{time}_i \times \text{mph}_i}{\sum \text{vph}_i \times \text{time}_i} = \frac{\text{Total vehicle mph}}{\text{Total vehicles}} = \frac{1454153.33}{25166.67} = 58$$

and

$$\begin{aligned} \frac{\% \text{hdgt}}{\% \text{hdgt}} &= \frac{\sum \text{vph}_i \times \text{time}_i \times \% \text{hdgt}_i}{\sum \text{vph}_i \times \text{time}_i} \\ &= \frac{\text{Total hdgt}}{\text{Total Vehicles}} \times 100\% = \frac{2538.60}{25166.67} \times 100\% = 10\%. \end{aligned}$$

The user should note that he would normally have to determine the average road/wind angle for the time period of interest from some data set. In this example, however, this angle has simply been given as 38° .

Figure 24 shows a completed AIRPOL-4A input sheet for this example. Figures 25 and 26 show the output results (eight-hour averages for each percentile wind speed). The reader should note the use of defaults in this example.

FIGURE 24. COMPLETED AIRPOL-4A INPUT FORM FOR EXAMPLE 3.

PAGE 1 OF 1

VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
 AIRPOL -- VERSION 4A
 DATA PROCESSING INPUT
 NOVEMBER 1975

DP 77-A

COMPUTER JOB NUMBER: 1-4 A4

INPUT SUBMITTED BY: NYA. Carpenter PHONE EXT.: 313 ROOM NO. 313

DATE SUBMITTED: 1-27-76 PROJECT CHARGE NO.: 9903 CITY: 911 CO. 940

HEADING	YR 1	YR 2	YR 3	YR 4	YR 5	YR 6	YR 7	YR 8	YR 9	YR 10	YR 11	YR 12	YR 13	YR 14	YR 15	YR 16	YR 17	YR 18	YR 19	YR 20	YR 21	YR 22	YR 23	YR 24	YR 25	YR 26	YR 27	YR 28	YR 29	YR 30	YR 31	YR 32	YR 33	
PREDICTION INTERVAL (minutes)	33	41	13																															
METRIC	43	L1																																
CLASS 1	54	Z1																																
CLASS 2	56	Z1																																
YR	45-46	I 2																																
YR	48-49	I 2																																
YR	51-52	I 2																																
WS-1 mph (m/s)	58	60	F3.1																															
WS-2 mph (m/s)	62	64	F3.1																															
WS-3 mph (m/s)	66	68	F3.1																															
WS-4 mph (m/s)	70	72	F3.1																															
WS-5 mph (m/s)	74	76	F3.1																															
WS-6 mph (m/s)	78	80	F3.1																															

(Information should be centered in these 33 columns)

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844, A1

313

USERS MANUAL, EXAMPLE 3

DATA CARDS

SITE ID	TFVOL yr 1 veh/hr	TFVOL yr 2 veh/hr	TFVOL yr 3 veh/hr	EF yr 1 gm/veh/mi	EF yr 2 gm/veh/mi	EF yr 3 gm/veh/mi	SOURCE HT ft (m)	SOURCE LENGTH down wind kft (km)	CWIDTH ft (m)	CLENGTH kft (km)	CASE	ALPHA degrees	OBS HT-2 ft (m)	OBS D-1 ft (m)	OBS INC ft (m)
5-7 A3	14	19	24	26	30	36	48	56	64	80	89	89	72	74	78
31A	3146			2.6	3.0	3.6	4.8	5.6	6.4	8.0	89	89	110	110	110
END															

NOTE: DUPLICATE COMPUTER JOB NO. ON ALL CARDS

FIGURE 25

USERS MANUAL, EXAMPLE 3

PAGE 1

JOB NO. 3RD

AIRPOL -- VERSION 4A
NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOUKC	UW/DW	CUT	CUT1	C	ALFA	ORS	ORS	OBS	OBS	
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DISTI	INC	INC	
---	I	---VPH	---VPH	---VPH	\$/V/M	\$/V/M	\$/V/M	↓	---FI	KFI	---FI	KFI	S	---	---FI	---FI	---	---	
3	A	3146.0	0.0	0.0	27.04	0.0	0.0	0	0.0	1.60	0.50	0.0	?	38.0	0.0	10.0	10.0	10.0	
													D						

FIGURE 26

A SUPERPOSITION OF CO LEVELS
FROM THE ABOVE 1 LANE GROUPS.

CONCENTRATION AVERAGING TIME		AVERAGE WIND SPEEDS IN MPH (M/S)											
YEAR	DISTANCE, FT (M)	0.0		0.20		0.70		1.20		2.30		3.80	
		OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)
1976	10 (3.0)	0.93	1.00	0.90	0.97	0.84	0.90	0.79	0.84	0.69	0.73	0.58	0.62
	20 (6.1)	0.93	1.00	0.91	0.97	0.84	0.90	0.79	0.85	0.69	0.74	0.58	0.62
	30 (9.1)	0.92	0.99	0.90	0.96	0.84	0.90	0.78	0.84	0.68	0.73	0.57	0.62
	40 (12.2)	0.91	0.97	0.88	0.95	0.82	0.88	0.77	0.82	0.67	0.72	0.57	0.60
	50 (15.2)	0.89	0.95	0.86	0.92	0.80	0.86	0.75	0.80	0.65	0.70	0.55	0.59
	60 (18.3)	0.86	0.92	0.84	0.89	0.78	0.83	0.73	0.78	0.63	0.68	0.53	0.57
	70 (21.3)	0.83	0.88	0.80	0.86	0.75	0.80	0.70	0.75	0.61	0.65	0.52	0.55
	80 (24.4)	0.80	0.84	0.77	0.82	0.72	0.76	0.67	0.71	0.59	0.62	0.49	0.52

S
T
A
R
T
I
L
I
T
Y
C
L
A
S
S

Example 4

Figure 27 illustrates the three possible upwind/downwind source length configurations. No input/output accompanies this example. The purpose is simply to illustrate the geometries involved with the determination of the algebraic signs of these lengths.

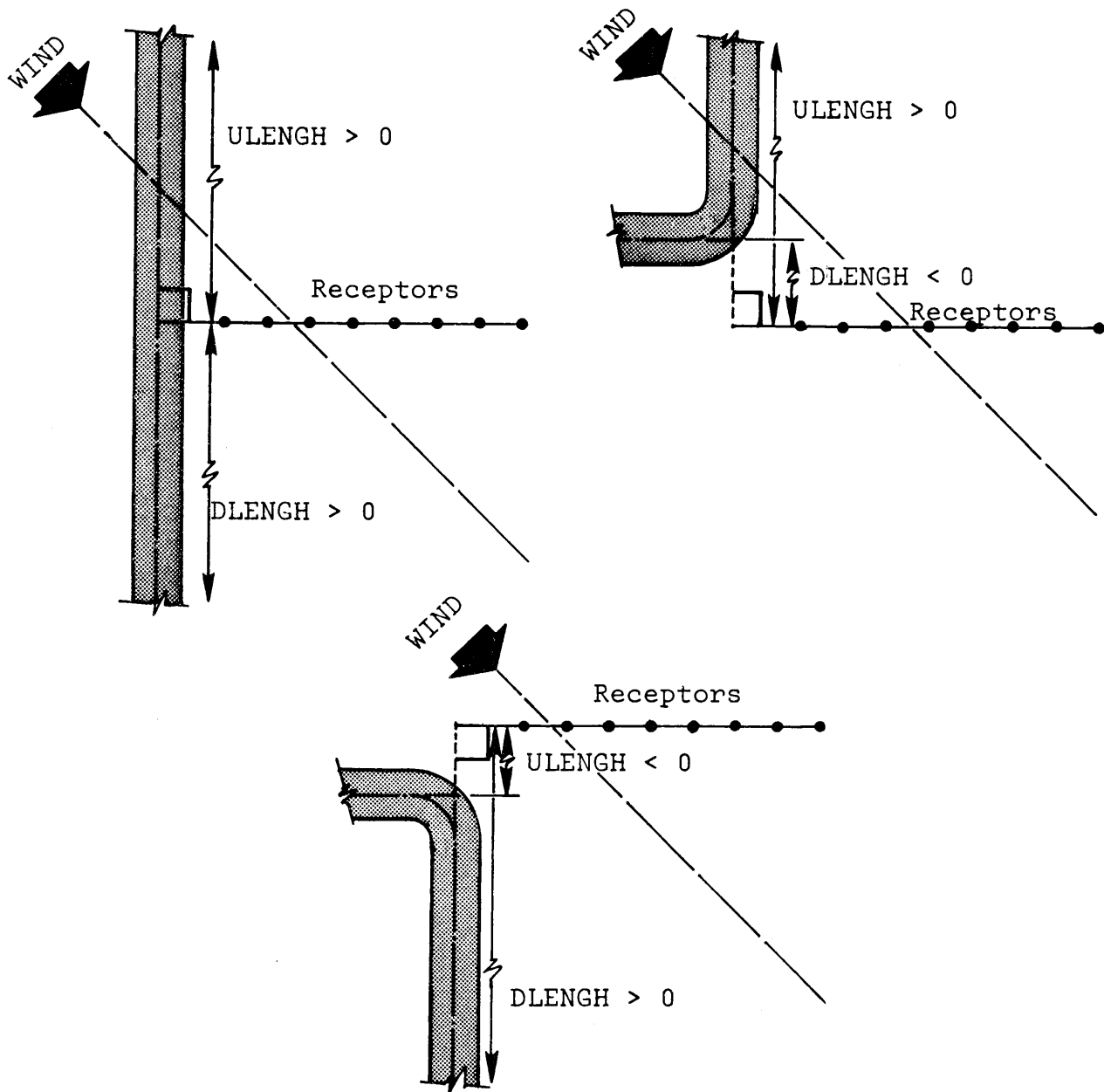


Figure 27. The three possible upwind/downwind source length configurations.

Multiple Lane-Group Examples

Superposition

AIRPOL-4A performs automatic superposition of CO levels from as many lane groups per site as the user supplies. With each lane group, the user specifies an OBS D-1, an OBS INC, and an OBS HT-2. These specifications generate 16 receptor locations, one at each of the two OBS HT's at each of the eight OBS D's. AIRPOL-4A guarantees proper alignment of the OBS HT's for each of the eight receptor locations by fixing OBS HT-1 to always be 5 ft. (1.5 m) and forcing OBS HT-2 for all lane groups in a site to be the same as OBS HT-2 for the first lane group in the site. AIRPOL-4A cannot, however, monitor the OBS D's for proper alignment. This is the responsibility of the user. Thus, the user must guarantee that OBS D-j ($j = 1,8$) for each lane group is physically aligned with OBS D-j for every other lane group in the site.

A subtle outgrowth of the need for proper alignment of superposed CO levels is that CO levels for receptors in cuts cannot be superimposed with CO levels resulting from other source/receptor geometries. This is a result of the fact that for all other geometries receptor elevations are specified relative to the surrounding terrain, while for the case placing both the source and receptors in a cut the receptor elevations are specified relative to the floor of the cut. Thus the only valid superposition for CO levels at receptors in a cut is for multiple lane groups all in the same cut.

Another point concerning superposition is that AIRPOL-4A expects the receptors for each lane group to lie along a line perpendicular to the lane group. If the receptors do not lie along such a line, then the upwind and downwind source lengths for each receptor point will be different from those for all the other receptor points. Since the input for AIRPOL-4A specifies that all 16 receptors per lane group have the same upwind/downwind source lengths, predictions for receptors not along a line perpendicular to the source lane group will be somewhat in error. The extent of this error will be a function of the fractional error in the upwind and downwind length specifications resulting from the displacement of the receptor line from the perpendicular.

Whenever it is necessary to generate predictions along a line not perpendicular to a source lane group and the deviation will cause significant errors in the upwind/downwind length specifications, the user should analyze only one receptor location at a time by setting OBS INC = 0. (A single point must, of course, lie on a line perpendicular to the source.)

Example 5

Consider Figure 28. Find average one-hour CO levels for the 0, 1, 5, 10, 25, and 50 percentile wind speeds at receptor elevations of 5 and 10 feet for this dual-divided, at-grade facility in 1982. The distributions of CO levels between the roadways and in the first 400 feet downwind of the southbound roadway are desired. Figure 29 shows a completed AIRPOL-4A input form for these problems.

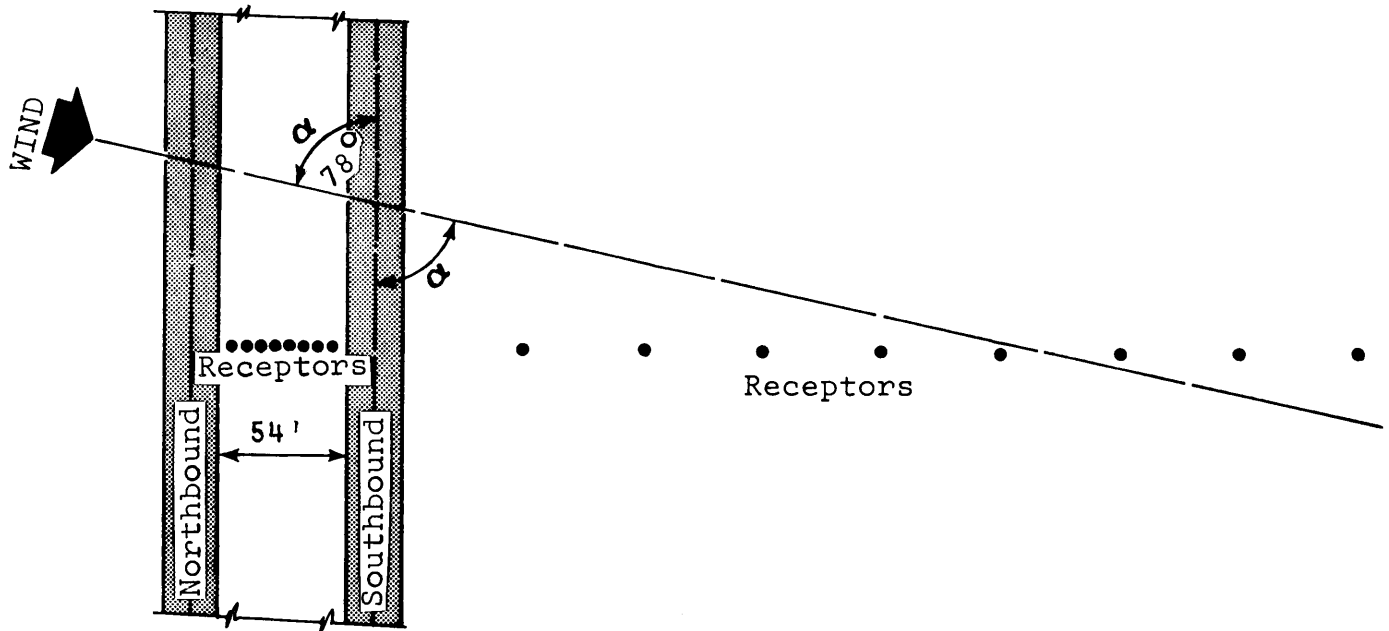
The site labeled 5A is for the analysis between the roadways. Notice that for this analysis, the user must examine the downwind side of the northbound lane and the upwind side of the southbound lane. Since the width of the median and emergency lanes is 54 feet, eight receptors at 6-foot intervals from either roadway will span the area between the roadways. Thus, starting with the northbound lane group as the reference, OBS D-1 = 6 and OBS INC = 6 for this lane group. Now, since OBS D-j (j = 1,8) for the southbound lane group must physically coincide with OBS D-j for the northbound lane group, the user must specify OBS D-1 = 48 and OBS INC = -6 for the southbound lane group. The output for this problem is shown in Figures 30 and 31. Notice that the receptor distances listed are relative to the northbound lane group, the first lane group specified for this site.

The site labeled 5B is for the analysis of the first 400 feet downwind from the southbound lane group. Taking this lane group as the reference, the user sets OBS D-1 = 50 and OBS INC = 50 to span the first 400 feet. To properly align the receptors from both lane groups, he must then set

$$\text{OBS D-1} = 54 \text{ (median)} + 24 \text{ (southbound roadway)} + 50 = 128$$

and OBS INC = 50 for the northbound lane group. The output for this problem is shown in Figures 32 and 33. Notice that the receptor distances specified on the output are relative to the southbound lane group, the first lane group input.

The reader should carefully observe the use of available defaults in analyzing the two problems in this example.



Prevailing Stability Class = B
 ULENGH (Both lane groups) = 4290 ft
 DLENGH (Both lane groups) = 2570 ft
 TFVOL (Northbound lane group) = 3875 vph
 TFVOL (Southbound lane group) = 4293 vph
 EF (Northbound lane group) = 14.70 gm/veh/mi
 EF (Southbound lane group) = 9.17 gm/veh/mi

Figure 28. An at-grade, dual-divided facility.

FIGURE 29. COMPLETED AIRPOL-4A INPUT FORM FOR EXAMPLE 5.

PAGE 1 OF 1

VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
AIRPOL -- VERSION 4A
DATA PROCESSING INPUT
NOVEMBER 1975

DP 77-A

COMPUTER JOB NUMBER: 1-4 A4

INPUT SUBMITTED BY: *W/A Carpenter* PHONE EXT.: **313** ROOM NO.: **313**

DATE SUBMITTED: **1-27-76** PROJECT CHARGE NO: **9903** CITY: **111** SECT. TYPE ACT. **940**

WS-1 mph (m/s) 58-60 F3.1	WS-2 mph (m/s) 62-64 F3.1	WS-3 mph (m/s) 66-68 F3.1	WS-4 mph (m/s) 70-72 F3.1	WS-5 mph (m/s) 74-76 F3.1	WS-6 mph (m/s) 78-80 F3.1
---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------	---------------------------------------

HEADING
(Information should be centered in these 33 columns)

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STIM MISERS MANUAL, EXAMPLE 5

DATA CARDS

SITE ID	TFVOL yr1 veh/hr	TFVOL yr2 veh/hr	TFVOL yr3 veh/hr	EF yr1 gm/veh/mi	EF yr2 gm/veh/mi	EF yr3 gm/veh/mi	SOURCE HT ft (m)	SOURCE LENGTH up wind kft (km)	SOURCE LENGTH down wind kft (km)	CWIDTH ft (m)	CLENGTH ft (m)	APHA degrees	OBS HT-2 ft (m)	OBS ID ft (m)	OBS INC ft (m)
5-7 A3	11 F 4.0	16 F 4.0	21 F 4.0	26 F 5.2	32 F 5.2	38 F 5.2	46 F 3.0	50-52 F 3.2	54-56 F 3.2	58-60 F 3.0	62-64 F 3.2	68-68 F 2.0	71-72 F 2.0	74-76 F 3.0	78-80 F 3.0
5A	3875			1470				43	26			78	10	16	16
5A	4293			1717				43	26			78	10	18	16
5B	4293			1717				43	26			78	10	150	150
5B	3876			1470				43	26			78	10	128	150
END															
END															

NOTE: DUPLICATE COMPUTER JOB NO. ON ALL CARDS

FIGURE 30

USERS MANUAL, EXAMPLE 5

QUESTION MARKS (?) INDICATE A PROGRAMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

SA	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	L	SOURC	UW/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS	OBS
	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC	INC
	VPH	VPH	VPH	GZV/MJ	GZV/MJ	GZV/MJ	S	FI	KFI	FI	KFI	S	DEG	FI	FI	FI	FI
5A	N	3875.0	0.0	0.0	14.70	0.0	0	0.0	4.30	2.60	0.0	D	78.0	10.0	6.0	6.0	6.0
5A	S	4293.0	0.0	0.0	9.17	0.0	0	0.0	4.30	2.60	0.0	U	78.0	10.0	48.0	-6.0	-6.0

FIGURE 31

AIRPOL -- VERSION 44
NOVEMBER 1975

SITE ID = 5A
USERS MANUAL, EXAMPLE 5

JOB NO. 5THM

PAGE 2

A SUPERPOSITION OF CO LEVELS
FROM THE ABOVE 2 LAPE GROUPS.

CONCENTRATION AVERAGING TIME
1 HR. : 0 MIN.

AVERAGE WIND SPEEDS IN MPH (M/S)

0.0		0.20		0.70		1.20		2.30		3.80	
HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER	HEIGHTS, FT (M)	OBSERVER
5.0 (1.5)	(3.0)	5.0 (1.5)	(3.0)	5.0 (1.5)	(3.0)	5.0 (1.5)	(3.0)	5.0 (1.5)	(3.0)	5.0 (1.5)	(3.0)
10.0 (3.0)	(3.0)	10.0 (3.0)	(3.0)	10.0 (3.0)	(3.0)	10.0 (3.0)	(3.0)	10.0 (3.0)	(3.0)	10.0 (3.0)	(3.0)

CO LEVELS IN PPM

6. (1.8)	1.22	0.73	1.18	0.70	1.10	0.66	1.03	0.61	0.90	0.53	0.76	0.45
12. (3.7)	1.20	0.75	1.17	0.73	1.09	0.68	1.02	0.63	0.88	0.55	0.75	0.47
18. (5.5)	1.15	0.75	1.11	0.73	1.04	0.68	0.97	0.63	0.84	0.55	0.71	0.47
24. (7.3)	1.10	0.75	1.07	0.72	0.99	0.67	0.93	0.63	0.81	0.55	0.68	0.46
30. (9.1)	1.05	0.74	1.02	0.72	0.95	0.67	0.89	0.63	0.77	0.54	0.65	0.46
36. (11.0)	1.01	0.73	0.98	0.71	0.91	0.66	0.85	0.62	0.74	0.54	0.63	0.45
42. (12.8)	0.97	0.72	0.94	0.70	0.87	0.66	0.82	0.61	0.71	0.53	0.60	0.45
48. (14.6)	1.01	0.80	0.98	0.77	0.91	0.72	0.85	0.67	0.74	0.59	0.63	0.50

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AIRPOL -- VERSION 4A
 NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLUME	TFVOLUME	EF	EF	EF	L	SOURCE	UM/DW	CUT	CUT1	C	ALFA	ORS	ORS	OBS	OBS	
I	G	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	HT-2	DIST1	INC	
I	I	VPH	VPH	G/V/MJ	G/V/MJ	G/V/MJ	S	FT	KFI	FT	KFI	S		FT	FT	FT	FT	
5K	S	4293.0	0.0	9.17	0.0	0.0	0	0.0	4.30	2.60	0.0	?	78.0	10.0	50.0	50.0	50.0	
												D						
5K	N	3875.0	0.0	14.70	0.0	0.0	0	0.0	4.30	2.60	0.0	?	78.0	10.0	128.0	50.0	50.0	
												D						

FIGURE 33

AIRPOL -- VERSION: 4A
 NOVEMBER 1975
 SITE ID = 58
 USEKS MANUAL, EXAMPLE 5
 PAGE 4
 JOR NO. 5THM

A SUPERPOSITION OF CO LEVELS
 FROM THE ABOVE 2 LANE GROUPS.

CONCENTRATION AVERAGING TIME
 1 HR. : 0 MIN.

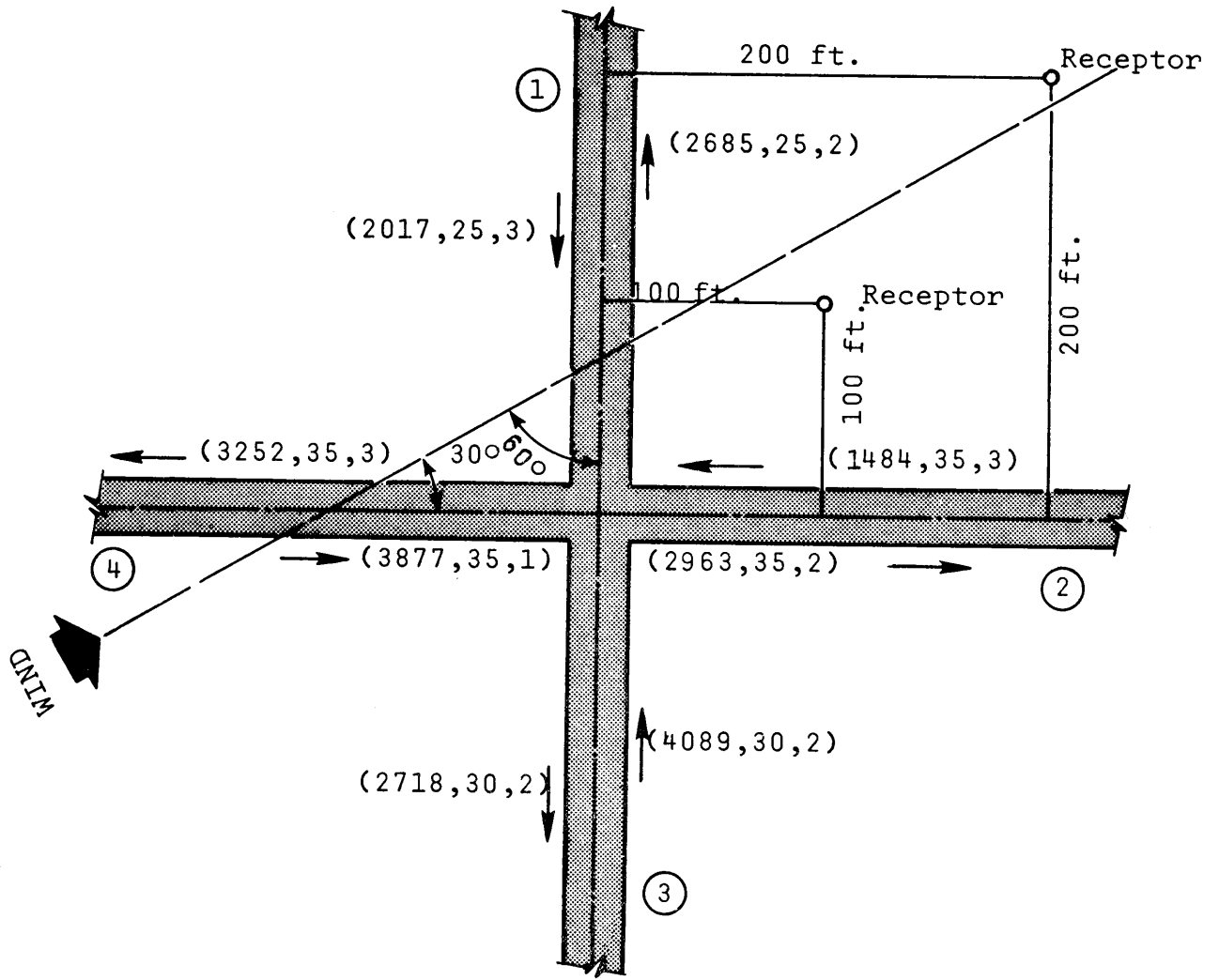
YEAR	DISTANCE, FT (M)	AVERAGE WIND SPEEDS IN MPH (M/S)					
		0.0 (0.0)	0.20 (0.09)	0.70 (0.31)	1.20 (0.54)	2.30 (1.03)	3.80 (1.70)
		OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)	OBSERVER HEIGHTS, FT (M)
	50	1.21 (15.2)	1.17 (1.04)	1.09 (1.05)	1.02 (1.02)	0.91 (0.91)	0.75 (0.75)
	100	0.93 (30.5)	0.88 (0.88)	0.85 (0.85)	0.78 (0.78)	0.74 (0.74)	0.58 (0.58)
	150	0.75 (45.7)	0.73 (0.73)	0.71 (0.71)	0.64 (0.64)	0.62 (0.62)	0.47 (0.47)
1982	200	0.63 (61.0)	0.62 (0.62)	0.60 (0.60)	0.54 (0.54)	0.52 (0.52)	0.39 (0.39)
	250	0.55 (75.2)	0.54 (0.54)	0.52 (0.52)	0.46 (0.46)	0.46 (0.46)	0.34 (0.34)
	300	0.48 (91.4)	0.48 (0.48)	0.46 (0.46)	0.41 (0.41)	0.40 (0.40)	0.30 (0.30)
	350	0.43 (106.7)	0.43 (0.43)	0.42 (0.42)	0.36 (0.36)	0.36 (0.36)	0.27 (0.27)
	400	0.37 (121.9)	0.39 (0.39)	0.38 (0.38)	0.33 (0.33)	0.33 (0.33)	0.24 (0.24)

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Example 6

Analyze the at-grade, four-way intersection shown in Figure 34 for the year 1985 and a one-hour sampling time. The traffic conditions, source lengths, road/wind angles, and receptor locations are as shown. Receptor elevations of 0 and 5 feet are required. Assume that the prevailing stability class = B and that the default percentile wind speeds are applicable.

Since there appear to be no drastic differences between the two directions for each leg, it would prove economical to analyze each leg as a lane group carrying its representative traffic. This, of course, requires the determination of the average traffic characteristics for each leg. Having made this transformation, the example becomes a four lane-group example where the upwind/downwind source lengths for each receptor for each lane group are different. Figure 35 shows a completed AIRPOL-4A input sheet for this example, and Figures 36 through 39 show the output. Notice that the distances shown on Figure 37 are relative to the first lane group input.



Traffic conditions are shown as (vph, mph, %hdgt).

Each leg extends \approx 2000 ft. in a nearly straight line.

Each leg is two lanes wide = 24 ft.

Figure 34. An at-grade, four-way intersection.

FIGURE 35. COMPLETED AIRPOL-4A INPUT FORM FOR EXAMPLE 6.

PAGE 1 OF 1

DP 77-A VIRGINIA DEPARTMENT OF HIGHWAYS & TRANSPORTATION
 AIRPOL -- VERSION 4A
 DATA PROCESSING INPUT
 NOVEMBER 1975

COMPUTER JOB NUMBER: 1-4 A4

INPUT SUBMITTED BY: W.A. Casper PHONE EXT.: 313 ROOM NO. 313

DATE SUBMITTED: 1-27-76 PROJECT CHARGE NO.: 9903

CO.	ROUTE	CITY	CO.	SECT.	TYPE	ACT.
9903			911			940

WS-1	WS-2	WS-3	WS-4	WS-5	WS-6
mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)	mph (m/s)
58-60 F3.1	62-64 F3.1	66-68 F3.1	70-72 F3.1	74-76 F3.1	78-80 F3.1

YR	YR	YR	YR	YR	YR
45-46 I 2	48-49 I 2	51-52 I 2	CLASS I	CLASS II	CLASS III
1	2	3			

METRIC: 43 LI

PREDICTION INTERVAL (minutes): 39-41 I 3

HEADING: 5-37 8A4,A1

(Information should be centered in these 33 columns)

EXAMPLE

DATA CARDS

SITE ID	TFVOL yr 1 veh/hr	TFVOL yr 2 veh/hr	TFVOL yr 3 veh/hr	EF yr 1 gm/veh/mi	EF yr 2 gm/veh/mi	EF yr 3 gm/veh/mi	SOURCE HT ft (m)	SOURCE up wind kft (km)	SOURCE down wind kft (km)	CWIDTH ft (m)	CLENGTH kft (km)	ALPHA degrees	OBS HT-2 ft (m)	OBS D-1 ft (m)	OBS INC ft (m)
5-7 A3	11 F4.0	16 F4.0	21 F4.0	25 F5.2	32 F5.2	38 F5.2	46-48 F3.0	50-52 F3.2	54-56 F3.2	58-60 F3.0	62-64 F3.2	68-69 F2.0	71-72 F2.0	74-76 F3.0	78-80 F3.0
6A	4702			811				11	19			60		100	
6A	4447			566				11	19			30		100	
6A	6807			667				21	-1			60		100	
6A	7129			666				21	-1			30		100	
6B	4702			811				12	18			60		200	
6B	4447			566				22	18			30		200	
6B	6807			667				22	-2			60		200	
6B	7129			666				22	-2			30		200	

NOTE: DUPLICATE COMPUTER JOB NO. ON ALL CARDS

BTMM

FIGURE 36

USERS MANUAL, EXAMPLE 6

JOR NO. 6THM

PAGE 1

AIRPOL -- VERSION 4A
NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOURC	UW/DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS
I	G	YR-1	YR-1	YR-3	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC
I	I	VPH	VPH	VPH	G/Y/M/I	G/Y/M/I	G/Y/M/I	U	FI	KFI	FI	KFI	S	FI	FI	FI	FI
6A	1	4702.0	0.0	0.0	8.11	0.0	0.0	0	0.0	0.10	1.90	0.0	?	60.0	0.0	100.0	0.0
													D				
6A	2	4447.0	0.0	0.0	5.66	0.0	0.0	0	0.0	0.10	1.90	0.0	?	30.0	0.0	100.0	0.0
													D				
6A	3	6807.0	0.0	0.0	6.67	0.0	0.0	0	0.0	2.10	-0.10	0.0	?	60.0	0.0	100.0	0.0
													D				
6A	4	7129.0	0.0	0.0	5.66	0.0	0.0	0	0.0	2.10	-0.10	0.0	?	30.0	0.0	100.0	0.0
													D				

FIGURE 37

AIRPOL -- VERSION 4A
 NOVEMBER 1975
 SITE ID = 6A
 USERS MANUAL, EXAMPLE 6
 PAGE 2
 JUR NO. 6THM

A SUPERPOSITION OF CO LEVELS
 FROM THE ABOVE 4 LANE GROUPS.

CONCENTRATION AVERAGING TIME
 1 HR. : 0 MIN.

AVERAGE WIND SPEEDS IN MPH (M/S)

YEAR	DISTANCE, FT(M)	0.20				0.70				1.20				2.30				3.80				
		HEIGHTS, FT(M)	OBSERVER	()	()	HEIGHTS, FT(M)	OBSERVER	()	()	HEIGHTS, FT(M)	OBSERVER	()	()	HEIGHTS, FT(M)	OBSERVER	()	()	HEIGHTS, FT(M)	OBSERVER	()	()	
1985	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84
	(30.5)	0.96	0.99	0.93	0.96	0.87	0.89	0.81	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84	0.84

CO LEVELS IN PPM

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FIGURE 38

USERS MANUAL, EXAMPLE 6

AIRPOL -- VERSION 4A
NOVEMBER 1975

QUESTION MARKS (?) INDICATE A PROGRAMMATIC CHANGE OF INPUTS UNDER THE INPUT CHECK/CORRECT PROCESS. ITEMS BELOW QUESTION MARKS ARE VALUES ACTUALLY USED BY THE PROGRAM IN PERFORMING THE ANALYSES.

S	L	TFVOLM	TFVOLM	TFVOLM	EF	EF	EF	L	SOURC	UW//DW	CUT	CUT1	C	ALFA	OBS	OBS	OBS	OBS	
I	G	YR-1	YR-3	YR-1	YR-1	YR-1	YR-3	U	HIGHT	LENGTH	WIDTH	LNTH	A	DEG	HT-2	DIST1	INC	FI	
I	I	VPH	VPH	VPH	G/V/M1	G/V/M1	G/V/M1	S	FI	KFI	FI	KFI	S	FI	FI	FI	FI	FI	
6R	1	4702.0	0.0	0.0	8.11	0.0	0.0	0	0.0	0.20	1.80	0.0	?	60.0	0.0	200.0	0.0	?	
													D						
6R	2	4447.0	0.0	0.0	5.66	0.0	0.0	0	0.0	0.20	1.80	0.0	?	30.0	0.0	200.0	0.0	?	
													D						
6R	3	6807.0	0.0	0.0	6.67	0.0	0.0	0	0.0	2.20	-0.20	0.0	?	60.0	0.0	200.0	0.0	?	
													D						
6R	4	7129.0	0.0	0.0	5.66	0.0	0.0	0	0.0	2.20	-0.20	0.0	?	30.0	0.0	200.0	0.0	?	
													D						

FIGURE 39

A SUPERPOSITION OF CO LEVELS FROM THE ABOVE 4 LANE GROUPS.

CONCENTRATION AVERAGING TIME		AVERAGE WIND SPEEDS IN MPH (M/S)				CO LEVELS IN PPM			
1 HR. :	0 MIN.	0.20	0.70	1.20	2.30	3.80	5.0	5.0	5.0
YEAR	DISTANCE, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)	HEIGHTS, FT(M)
1985	200. (61.0)	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43
	200. (61.0)	0.58	0.56	0.57	0.52	0.52	0.53	0.49	0.43

RECOMMENDATIONS

Based on the findings of the AIRPOL study, the authors recommend —

1. that AIRPOL-4A be implemented as the Department's air quality prediction tool,
2. that highway fill sections be analyzed as both fill and at-grade sites to balance the inability of Gaussian models to analyze such sections,
3. that Pasquill's method⁽⁶⁾ for determining atmospheric stability be employed in conjunction with AIRPOL-4A,
4. that the (A, B, C, D, E) distribution of Pasquill stability classes cited in this report be employed on an interim basis until the program PASCLS has been completed,
5. that the Department sponsor further research to determine the relationship between airport and roadside wind speeds,
6. that, as an interim measure, the Department use the relationship given in this report as
 $\text{ROADSIDE WIND SPEED} = 0.42 \times \text{AIRPORT WIND SPEED}$,
7. that the Department abandon the undefined concept of "worst case" analysis in favor of the percentile analysis detailed in this report,
8. that the Department use the cumulative wind speed distribution given in this report as the basis for percentile analyses until such time as this distribution can be reduced from historical data, and
9. that the prospective user be made thoroughly cognizant of the fact that altering wind directions and/or stability classes for the purpose of generating conservative, or upper limit, CO predictions can, in fact, generate underpredictions due to the non-monotonicity of CO levels as a function of wind direction and stability class.

REFERENCES

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2. Carpenter, W. A., and G. G. Clemeña, "Analysis and Comparative Evaluation of AIRPOL-4", Virginia Highway & Transportation Research Council, Report No. VHTRC 75-R55, May 1975.
3. Carpenter, W. A., G. G. Clemeña, and W. R. Lunglhofer, "AIRPOL-4 Algorithms", Virginia Highway & Transportation Research Council, Report No. VHTRC 75-R70, May 1975.
4. Carpenter, W. A., G. G. Clemeña, and W. R. Lunglhofer, "Supportive Data and Methods Used for Evaluation of AIRPOL-4", Virginia Highway & Transportation Research Council, Report No. VHTRC 75-R57, May 1975.
5. Ludwig, F. L., W. G. Johnson, A. E. Moon, and R. L. Mancuso, "A Practical Multipurpose Urban Diffusion Model for Carbon Monoxide", Stanford Research Institute, Menlo Park, California, September 1970.
6. Environmental Protection Agency, "Compilation of Air Pollutant Emission Factors", Publication No. AP-42, 1973.
7. Carpenter, W. A., G. G. Clemeña, and W. R. Lunglhofer, "Introduction to AIRPOL-4, A User's Guide," Virginia Highway & Transportation Research Council, Report No. VHTRC 75-R56, May 1975.

APPENDIX A

A USER'S GUIDE FOR EMISSION

Introduction

The development of EMISSION is in response to the institution by the United States Environmental Protection Agency (EPA) of a new method for computing highway vehicle emission factors. The calculation of vehicle emission factors was formerly accomplished by the Virginia Department of Highways and Transportation's program AIRPOL-4 as a necessary step in its role of predicting air pollution levels. As a result of the EPA's new computation method and the possibility of frequent future changes in emission estimation methodology, it was deemed necessary to develop a program separate from AIRPOL-4 to eliminate many future revisions to AIRPOL-4.

EMISSION calculates carbon monoxide emission factors for a calendar year given the ambient temperature, percent of hot starts, percent of cold operation, and the average speeds and percent traffic mix for each of the six possible vehicle types. Among the features in the new method are:

- 1) Emission factors are summarized by calendar year and model year instead of by model year only. Deterioration factors are no longer presented separately (they are incorporated into the emission factor tables).
- 2) Recent automobile and truck emission factor surveillance data are incorporated, resulting in changes in emission factor values.
- 3) Additional correction factors which enable one to account for ambient temperature and hot/cold operation have been incorporated.
- 4) Average speed correction factors have been revised using the results of a recent research effort.

The projected emission factors used in EMISSION reflect the statutory schedule as of this date.

Usage

One line of input produces one line of output. All input values, including program revised values, are printed with the

composite emission factor resulting from the six vehicle types constituting the traffic volume. Any number of input cards can be used on a job run. Decimal points may be used, but are not recommended.

Figure A1 shows an EMISSION input form which has been coded with the data from the examples contained in the body of this report. (Figure A2 shows the outputs generated by these inputs.)

COMPUTER JOB NUMBER

Columns 1-3, format (A3), contain the computer job number, an identifier that is supplied by the Data Processing Division to delimit job runs. The job number is printed at the top of each output page with the program title.

DATA ID

Columns 4-9, format (2A3), contain identifying information which is used to document the output. It is suggested that this field be coded with a unique value.

YR

Columns 10-11, format (I2), are used to specify the last two digits of the calendar year for which a prediction is desired. EMISSION is capable of computing emission factors only for the years 1973 and later. Numbers less than 73 will be corrected to 73 by the program.

TEMP

Columns 12-13, format (F2.0), contain the ambient temperature which is used to calculate the temperature correction and the hot/cold operation correction factors.

% HOT START

Columns 14-15, format (F2.0), contain the percent of hot starts which is used to calculate the hot/cold operation correction factor.

% COLD OPERATION

Columns 16-17, format (F2.0), contain the percent of cold operation which is used to calculate the hot/cold operation correction factor.

SPEED

Columns 18-19, 23-24, 28-29, 33-34, 38-39, 43-44, format for each field (F2.0), are used to specify the average speeds for each of the six vehicle types. Each field is checked for correctness of its value; values exceeding 60 are corrected to 60, values of 13 and 14 are corrected to 15, values from 8 to 12 are corrected to 10 and values from 0 to 7 are corrected to 5. Values from 15 to 60 are left unaltered.

MIX

Columns 20-22, 25-27, 30-32, 35-37, 40-42, 45-47, format for each field (F3.0), are used to specify the percentages of the traffic volume due to each of the six vehicle types.

FIGURE A1

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION
EMISSION FACTORS PROGRAM
DATA PROCESSING INPUT FORM

FORM DP-101
11/75

PAGE 1 OF 1

COMPUTER JOB NO.	DATA ID	YEAR	TEMPERATURE	% HOT STARTS	% COLD OPERATION	LIGHT DUTY VEHICLES		LIGHT DUTY TRUCKS		LIGHT DUTY DIESEL VEHICLES		HEAVY DUTY GASOLINE VEHICLES		HEAVY DUTY DIESEL VEHICLES		MOTOR-CYCLES	
						Speed	Mix	Speed	Mix	Speed	Mix	Speed	Mix	Speed	Mix	Speed	Mix
1-3	4-9	10-11	12-13	14-15	16-17	18-22	23-27	28-32	33-37	38-42	43-47						
001	1A-78	78	75	27	20	56 97	0	0	56 97	0	0	0	0	0	0	0	0
001	1A-85	85	75	27	20	50 89	0	0	50 89	0	0	0	0	0	0	0	0
001	1B	78	75	27	20	60 96	0	0	60 96	0	0	0	0	0	0	0	0
001	1C	85	75	27	20	58 93	0	0	58 93	0	0	0	0	0	0	0	0
001	1D-78	78	75	27	20	59 92	0	0	59 92	0	0	0	0	0	0	0	0
001	1D-85	85	75	27	20	43 81	0	0	43 81	0	0	0	0	0	0	0	0
001	1D-78.5	78	75	27	20	5 92	0	0	5 92	0	0	0	0	0	0	0	0
001	2A=1A	78	75	27	20	56 97	0	0	56 97	0	0	0	0	0	0	0	0
001	3A	76	75	27	20	58 90	0	0	58 90	0	0	0	0	0	0	0	0
001	5A-NB	82	75	27	20	66 86	0	0	66 86	0	0	0	0	0	0	0	0
001	5A-SB	82	75	27	20	64 94	0	0	64 94	0	0	0	0	0	0	0	0
001	6A-1	85	75	27	20	25 98	0	0	25 98	0	0	0	0	0	0	0	0
001	6A-2	85	75	27	20	35 98	0	0	35 98	0	0	0	0	0	0	0	0
001	6A-3	85	75	27	20	30 98	0	0	30 98	0	0	0	0	0	0	0	0
001	6A-4	85	75	27	20	35 98	0	0	35 98	0	0	0	0	0	0	0	0

Input Submitted by R.L. Heisler Phone 5939
Date Submitted 1-26-76

Project Charge No. _____
Co. 7703 City/Co. _____ Sect. 711 Type _____ Act. 240

FIGURE A2

VIRGINIA DEPARTMENT OF HIGHWAYS AND TRANSPORTATION

EMISSION FACTORS PROGRAM

JOH 001

DATA ID	YR	TEMP CORR	% HOT START	% COLD OPER	LIGHT DUTY GAS VEH SPEED MIX	LIGHT DUTY TRUCK SPEED MIX	LIGHT DUTY DIESEL VEH SPEED MIX	HEAVY DUTY GAS VEH SPEED MIX	HEAVY DUTY DIESEL VEH SPEED MIX	MOTORCYCLE SPEED MIX	CO EMISSION GM-VEH/MI
1A-78	78	75.	27.	20.	56.0 91.0	5.0 0.0	5.0 0.0	56.0 9.0	5.0 0.0	5.0 0.0	20.47
1A-85	85	75.	27.	20.	50.0 89.0	5.0 0.0	5.0 0.0	50.0 11.0	5.0 0.0	5.0 0.0	10.01
1B	78	75.	27.	20.	60.0 96.0	5.0 0.0	5.0 0.0	60.0 4.0	5.0 0.0	5.0 0.0	16.43
1C	85	75.	27.	20.	58.0 93.0	5.0 0.0	5.0 0.0	58.0 7.0	5.0 0.0	5.0 0.0	7.21
1D-78	78	75.	27.	20.	59.0 92.0	5.0 0.0	5.0 0.0	59.0 8.0	5.0 0.0	5.0 0.0	19.69
1D-85	85	75.	27.	20.	43.0 81.0	5.0 0.0	5.0 0.0	43.0 19.0	5.0 0.0	5.0 0.0	16.40
1D-78S	78	75.	27.	20.	5.0 92.0	5.0 0.0	5.0 0.0	5.0 8.0	5.0 0.0	5.0 0.0	16.06
2A-1A	78	75.	27.	20.	56.0 91.0	5.0 0.0	5.0 0.0	56.0 9.0	5.0 0.0	5.0 0.0	20.47
3A	76	75.	27.	20.	58.0 90.0	5.0 0.0	5.0 0.0	58.0 10.0	5.0 0.0	5.0 0.0	27.04
5A-NR	82	75.	27.	20.	60.0 96.0	5.0 0.0	5.0 0.0	60.0 14.0	5.0 0.0	5.0 0.0	14.70
5A-SH	82	75.	27.	20.	60.0 94.0	5.0 0.0	5.0 0.0	60.0 6.0	5.0 0.0	5.0 0.0	9.17
6A-1	85	75.	27.	20.	25.0 98.0	5.0 0.0	5.0 0.0	25.0 2.0	5.0 0.0	5.0 0.0	8.11
6A-2	85	75.	27.	20.	35.0 98.0	5.0 0.0	5.0 0.0	35.0 2.0	5.0 0.0	5.0 0.0	5.66
6A-3	85	75.	27.	20.	30.0 98.0	5.0 0.0	5.0 0.0	30.0 2.0	5.0 0.0	5.0 0.0	6.67
6A-4	85	75.	27.	20.	35.0 98.0	5.0 0.0	5.0 0.0	35.0 2.0	5.0 0.0	5.0 0.0	5.66

END OF JOB

APPENDIX B

FORTRAN FORMAT SPECIFICATIONS FOR AIRPOL-4A

A Format

The A format specification is used when alphanumeric information is being input to a program. The A format specifies that all keypunch characters are valid inputs. The general form for the A specification is Aw, where w indicates the width of the field, i.e., the number of card columns to be read. Preceding an A specification with an integer r, a repeat factor, prescribes that r Aw fields are to be read.

I Format

The I format specification is used when integer numbers are being input to a FORTRAN program. Any combination of the characters 0 through 9 and blank, optionally preceded by a single "+" or "-", constitutes a valid input under an I specification. Blanks are interpreted as though they were zeros. The general specification for the I format is Iw, where the w indicates the width of the field, i.e., the number of card columns to be read. Numeric values are located in the integer field such that the right-most character in the field represents the units digit in the integer number.

F Format

The F format is used to input real numbers to a program. Any combination of the characters 0 through 9 and blank with a single optional decimal point and preceded by a single optional "+" or "-" constitutes a valid entry under an F format. The general form of the F specification is Fw.d where w specifies the total field width, i.e., the number of card columns to be read, and d specifies the assumed number of decimal places contained in the number. The user need not enter a decimal point in an F field, the computer will automatically place one between the dth and d + 1st column from the right of the field. The AIRPOL-4 input form has the assumed decimal points (for all cases where d > 0) printed on the form. (When d = 0, the decimal point is assumed to follow the right-most character in the field.) A decimal point placed by the user within an F input field overrides the d portion of the format specification and the computer will interpret the number exactly as it appears in the field. Thus, for example, if the user wanted to input

the number 28.7 in an F4.0 field, placing "28.7" in the 4-column F field would cause the value read to be interpreted as the number 28.7, since the location of the actual decimal point would override the location of the implied decimal point.

L Format

The L format specification is used to input logical (TRUE/FALSE) values to a program. A "T" placed in an L field is interpreted as a TRUE, while an "F" or a blank is interpreted as a FALSE. AIRPOL-4 uses the L format to input the TRUE/FALSE response to the question, "Do you want to use metric units for the data inputs?"

Z Format

The Z format is used to input hexadecimal numbers (base 16 numbers). The Z format is similar to the I specification with the exception that the characters A, B, C, D, E, and F are also valid inputs. The AIRPOL-4 program uses the Z format to allow the user to input stability class information as either 1 through 6 or A through F.