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LANDFILL AIR EMISSIONS ESTIMATION MODEL

USER'S MANUAL

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PREFACE

The Control Technology Center (CTC) was established by the U.S. Environmental Protection Agency's (EPA's) Office of Research and Development (ORD) and Office of Air Quality Planning and Standards (OAQPS) to provide technical assistance to state and local air pollution control agencies. Three levels of assistance can be accessed through the CTC. First, a CTC HOTLINE has been established to provide telephone assistance on matters relating to air pollution control technology. Second, more in-depth engineering assistance can be provided when appropriate. Third, the CTC can provide technical guidance through publication of technical guidance documents, development of personal computer software, and presentation of workshops on control technology matters.

The personal computer software projects, such as this one, focus on topics of national or regional interest that are identified through contact with state and local agencies. In this case, the CTC became interested in assisting state and local agencies in estimating landfill air emission rates. This interest was prompted by numerous requests for technical assistance from state and local agencies on how to estimate landfill air emissions and guidance on how the gas can be collected and controlled. This interest was also prompted by the upcoming New Source Performance Standard (NSPS) and 111(d) Guidelines for Municipal Solid Waste Landfill Air Emissions, which are expected to be proposed later this year.

This document is a user's guide for the program, "Landfill Air Emissions Estimation Model." This estimation model is based on the Scholl Canyon Gas Generation Model, which was used in the development of the soon-to-be proposed Clean Air Act (CAA) regulations for landfills. The Scholl Canyon model is described in Reference 26. The recommended default values provided in the program as input variables for the Scholl Canyon Model were developed for the draft NSPS and guidelines. These values are based on test data collected for landfill regulation development. Development of these default values is outlined in Reference 20. The test data are summarized in Chapter 3 of Reference 1.

It should be noted that the default input values provided by the program and the user's guide may be revised depending on any future information collected by the Agency.

ABSTRACT

This document is a user's guide for a computer program entitled, "Landfill Air Emissions Estimation Model." This manual provides step-by-step guidance for using this program to estimate landfill air emissions. The purpose of this program is to aid local and state agencies in estimating landfill air emission rates for nonmethane organic compounds and individual air toxics. This program will also be helpful to landfill owners and operators affected by the upcoming New Source Performance Standard and Emission Guidelines for Municipal Solid Waste Landfill Air Emissions.

The model is based on the Scholl Canyon Gas Generation Model, which was used in the development of the soon-to-be proposed regulation for landfill air emissions. The Scholl Canyon Model is a first order decay equation that uses site specific characteristics for estimating the gas generation rate. In the absence of site-specific data, the program provides conservative default values taken from the soon-to-be proposed NSPS for new landfills and emission guidelines for existing landfills. These default values may be revised based upon any future information collected by the Agency.

EPA REVIEW NOTICE

This report has been reviewed by the U.S. Environmental Protection Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policy of the Agency, nor does mention of trade names or commercial products constitute endorsement or recommendations for use.

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

Contents

Figures

Tables

Terms

Term	Definition
Nonmethane Organic Compounds (NMOC)	NMOC is specified in this program as the fraction of landfill gas containing nonmethane organic compounds expressed as hexane. This includes air toxics and volatile organic compounds which are precursors of ozone. NMOC concentration can be measured using guidance provided by the soon-to-be proposed EPA Method 25C.
Potential Methane Generation Capacity (Lo)	Value for the potential amount of methane generated. Lo varies by refuse type.
Methane Generation Rate Content (k)	A constant that determines the rate of gas generation. The Scholl Canyon model assumes that k prior to the peak and k after the peak are the same. k is a function of moisture content, availability of nutrients for methanogens, pH, and temperature.
Landfill Capacity	The total amount of refuse to be disposed of in the landfill.
Year of Closure	The year in which the landfill ceases, or is expected to cease, accepting waste.
Air Toxics	Compounds found in landfill gas that are classified as toxic, such as vinyl chloride and benzene.

ACKNOWLEDGMENT

The author of the program was Robert Bass of Radian Corporation. Also serving on the EPA project team were W. Fred Dimmick and Mark Najarian of the Office of Air Quality Planning and Standards.

1.0 INTRODUCTION

In the past year, the Environmental Protection Agency (EPA) has responded to over 100 requests for technical assistance from state and local regulatory agencies on how to estimate landfill air emissions and guidance on how gaseous emissions can be collected and controlled.

The Landfill Air Emissions Estimation Model Program is a computer program for state and local regulatory agencies to use as a tool for estimating landfill air emissions. This program will also be of help to landfill owner/operators responding to the requirements resulting from the soon-to-be proposed New Source Performance Standards (NSPS) and Emission Guidelines for Municipal Solid Waste (MSW) Landfills. Additional information on the model and the model inputs is provided in Chapter 3 of the Background Information Document (BID) for Municipal Landfill Air Emissions.[1] This method for estimating landfill air emissions is based on a first order decay equation that employs site specific characteristics such as the year the landfill opens, the amount of refuse in place and the design capacity. The program also suggests default values for inputs when site specific information is unavailable.

This manual presents a reference for the features and commands for the program. The user's guide specifically addresses the operation of the software, and additional information concerning the development and theoretical basis of the calculations used in the program can be found in References 1, 24, 25, and 26. Section 2 explains the procedures for installing the program on a personal computer. Section 3 discusses the commands needed to use the program. An example user session is outlined in the Appendix. This manual should be thoroughly read before using the program.

2.0 INSTALLATION

The Landfill Air Emissions Estimation Model requires an IBM compatible model of a personal computer running DOS 2.0 or higher. The computer must also have at least one floppy disk drive and 512 kilobytes or more of main system memory.

Before installing or using the program, make a backup copy of the program and its data files (AIRTOXIC.TXT, MSHERC.COM, LANDFILL.HLP, and LANDFILL.CFG). Store this backup copy in a safe place for use only if something were to happen to the working copy of the program.

The program may be run either from a floppy disk or from a hard disk. However, hard disk installation is recommended as information can be accessed more quickly.

FLOPPY DRIVE INSTALLATION

For floppy drive use, no special installation steps are required. Simply insert a working copy of the program diskette into the disk drive whenever the program is to be run.

HARD DISK INSTALLATION

To install the Landfill Air Emissions Estimation Model program on a hard disk, first create a directory by using the following command:

```
MD \LANDFILL
```

Then, copy all of the files from the program diskette to the new directory by typing :

```
COPY A:*.* \LANDFILL
```

Finally, before trying to run the program, change to the LANDFILL directory by typing:

```
CD \LANDFILL
```

The program may be activated from any directory on the system by specifying the full path (i.e., c:\LANDFILL\LANDFILL) or by adding the landfill directory to the system search path (Path = <search path>).

3.0 OPERATION

This section is a detailed guide to the Landfill Air Emissions Estimation Model program. Suggestions and hints intended to help the user take full advantage of the program also are included.

RUNNING THE PROGRAM

For most users, running the program is as simple as typing the program name 'LANDFILL' at the DOS prompt. However, for users with HERCULES GRAPHICS CARDS (HGC), the driver MSHERC.COM must be loaded prior to running the program. Failure to do so will prohibit displaying graphical information with HGC cards.

To load the MSHERC driver, type 'MSHERC' at the DOS prompt and press [ENTER]. The message

HERCULES RESIDENT VIDEO SUPPORT ROUTINE. Section 1.11

should appear. The driver software is a terminate and stay resident (TRS) application and need not be loaded again if DOS has continued to execute since MSHERC was loaded. However, attempting to load MSHERC again is harmless and will result in the message

HERCULES VIDEO SUPPORT ROUTINES are already installed

being displayed. If at any time the system requires rebooting or power is interrupted, the MSHERC must be reloaded.

If a hardcopy of graphical information is needed, the user must activate the graphics utility GRAPHIC.COM prior to running the program. This will allow the user to print any graphical information from the screen to a printer by simply pressing the print screen key.

To load the GRAPHICS utility, type 'GRAPHICS' at the DOS prompt and press [ENTER].

To activate the Landfill Air Emissions Estimation Model program, type

LANDFILL

at the DOS prompt. If the disk directory in which the model resides is not being occupied and the system search path (set by the PATH = command) does not contain the directory in which the program resides, it is necessary to enter the entire path to the program (e.g., c:\LANDFILL\LANDFILL) to activate the program.

Once the program has been activated, the system will display an introductory message as shown in Figure 3-1 and will pause until the user presses any key. After pressing a key, the program will display the main menu of choices available. The Main Menu is shown in Figure 3-2.

THE MODEL HELP SYSTEM

Help information is available for most of the menus and data entry screens. To view the help available for a given menu, press the [F1] key. The help screen will display all the available information concerning that menu or data entry screen. Help information may contain several screens of

information and the current offset of this information is depicted by the small arrows in the left margin. In addition to the full help screens, a reminder of the function keys is provided at the bottom of each menu or data entry form.

MAIN MENU

The program uses bar menus, which appear in the center of the computer display to control the actions of the program. You may select an entry from the menu by using the cursor motion keys ([up arrow] and [down arrow]) to highlight the desired entry and pressing [ENTER]. After an entry has been selected, the program will either perform some action or present another menu of options (a sub-menu). To exit a sub-menu and return to the previous menu, press [ESC].

The selections available in the Main Menu are listed below:

Command	Description
Specify Study*	Designates a study name to revise or create.
Edit Study Data	Edits model parameters and operational data.
Calculate Air Emissions	Calculates the air emissions estimates.
Display Results	Prints the report of the emission estimates.
Configure Program	Allows designation of the working directory.
Exit	Exits the program and returns to DOS.

* A study name must be specified before any other function can by performed.

Specify Study

This selection causes the Specify Study sub-menu to be displayed, as shown in Figure 3-3, that lets the user choose between either naming a new study to create or recalling an old study to update. Upon making a selection from this sub-menu, one of the study name entry screens displayed in Figure 3-4 will appear. A listing of the old studies on file can be viewed by pressing [F2]. An example of this window is shown in Figure 3-5. A study can be selected from this window by using the cursor motion keys ([up arrow] and [down arrow]) and then pressing [ENTER] to enable the study. The user may create a new study by typing the desired name while within the specify New Study Name entry screen, and then simply pressing [ENTER] to return to the main menu. The study name can be up to 8 characters in length.

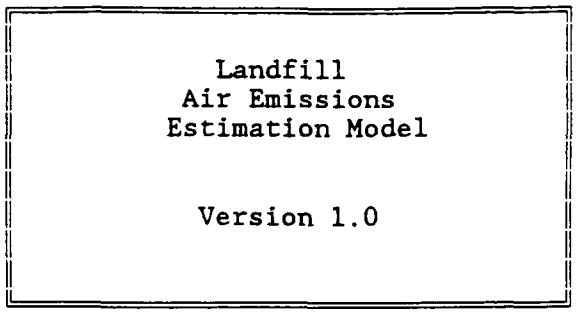

Figure 3-1. Introductory Screen

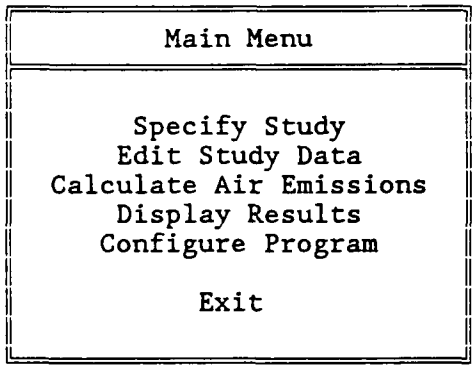

Figure 3-2. Main Menu

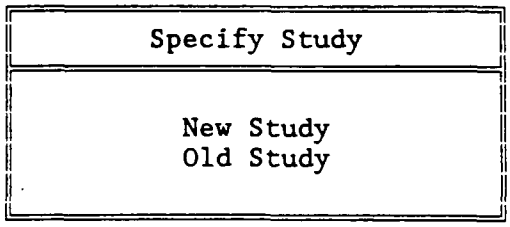

Figure 3-3. Specify Study Type Sub-Menu

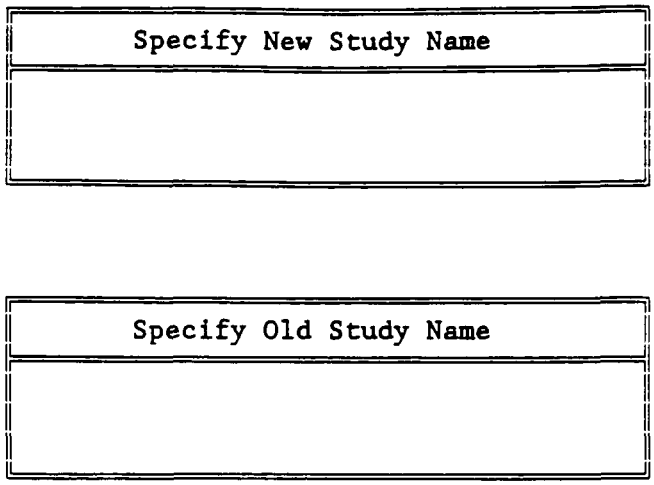

Figure 3-4. Specify Study Name Entry Screens

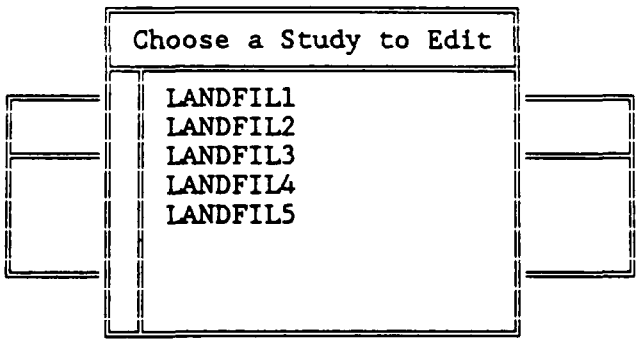

Figure 3-5. Choose a Study to Edit Window

Edit Study Data

The Edit Study Data option causes the sub-menu shown in Figure 3-6 to appear.

The selections available in this sub-menu are:

Command	Description
Chemical Composition	Edits the composition of the landfill gas.
Methane Rate Constant	Edits the methane generation rate constant.
Methane Potential	Edits the methane potential constant.
Operation Data	Edits the landfill operational data.

Chemical Composition--

Landfill gas is generated from the anaerobic decomposition of refuse in Municipal Solid Waste Landfills. The gas composition is typically about 50 percent methane (CH_4) and 50 percent carbon dioxide (CO_2) with trace amounts of nonmethane organic compounds (NMOCs) and air toxics species.

The Chemical Composition option from the Edit Study Data sub-menu displays the landfill gas Chemical Composition data entry form as shown in Figure 3-7. Data entry forms are used to obtain input values from the user. A data entry form consists of several data entry fields, each of which accepts a specific piece of information. A different field may be selected by using the cursor motion keys ([up arrow] and [down arrow]) to highlight the desired field. A default value may be displayed in the field, but this value may be overwritten. Once the desired value has been entered, simply press [ENTER] to proceed to the next field.

There are three data entry fields for the Chemical Composition data entry form: methane, NMOC, and air toxics. The default composition for CH_4 and CO_2 is 50 percent each. The default concentration of NMOCs is 8000 ppmv as hexane. Additional information concerning the rationale for selecting the default NMOC concentration, is provided in Reference 20. Concentrations at individual NMOCs were obtained from 46 landfills for the upcoming Clean Air Act regulations. The median non-zero values for the nine air toxics were selected as the suggested default values. For additional information concerning NMOC and air toxics concentration data, refer to the Background Information Document (BID).[1] The concentration of methane may be entered by the user. The corresponding concentration of CO_2 will automatically be calculated assuming that CO_2 is the remainder of the landfill gas. At any point during data entry into the Chemical Composition data entry form, the highlighted field may be returned to its default value by pressing [F2].

Landfill gas also contains trace levels of NMOC. The NMOC concentration determines the NMOC emission rate once the landfill gas flowrate has been estimated. The NMOC concentration is a function of the types of refuse in the landfill and the extent of the reactions which produce various compounds from the anaerobic decomposition of municipal refuse. Data were collected from emission test reports from industry, state and local regulatory agencies, including the South Coast Air Quality Management District (SCAQMD).[2,8-19] The data from 23 landfills range from 237 to 14294 ppmv. Based on an analysis conducted for the soon-to-be proposed regulation, the suggested default value for NMOC is 8000 ppmv. This analysis is documented in Reference 20. This memorandum can be found in the Public Docket, No. A-88-09. Because the NMOC concentration does vary, collection of site-specific data using soon-to-be-proposed EPA method 25C is encouraged.[21]

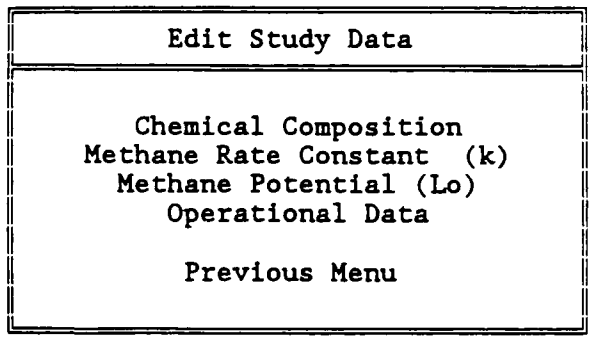

Figure 3-6. Edit Study Data Sub-Menu

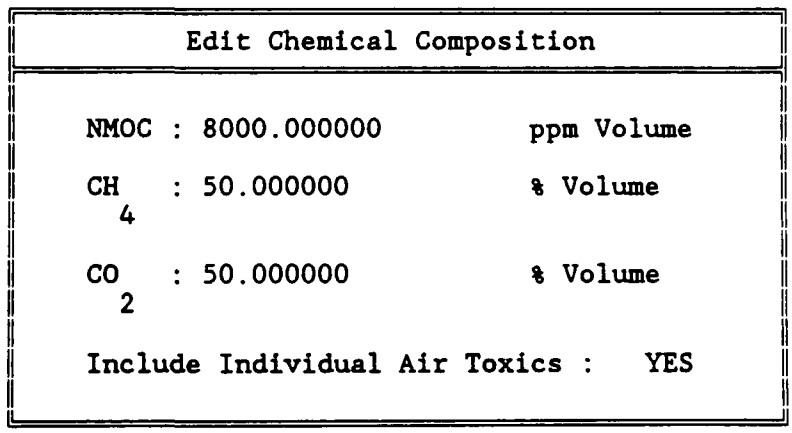

Figure 3-7. Edit Chemical Composition Data Entry Screen

Air Toxics--

Air toxics may be included in the analysis. The space bar toggles the Include Air Toxics option within the Chemical Composition data entry form. After the desired values have been selected from the Chemical Composition data entry form, [F10] must be pressed in order to accept the data. If air toxics were chosen to be included in the study, then upon accepting the data, the data entry form shown in Figure 3-8 will appear with the list of air toxics along with their default concentrations. As stated previously, the suggested default concentrations for the air toxics are the median non-zero values obtained from 46 landfills. This data was collected for the upcoming Clean Air Act (CAA) regulations. A more complete description of the air toxics data can be found in Chapter 3 of the Background Information Document.[1] Again, the default concentrations can be overwritten. Air toxics can be added or deleted from this list by pressing [F5] or [F6], respectively. The default air toxics and their concentrations can be retrieved by pressing [F2]. The warning screen shown in Figure 3-9 will appear prior to retrieving the default air toxics and the default concentrations. As in other data entry screens, [F10] must be pressed for the data to be accepted. Air Toxics may be added permanently to the default list by editing the file AIRTOXIC.TXT with a text editor or a word processor in non-document mode. The format for entering data into this file is shown in Table 3-1. The format consists of 30 characters for the chemical name, 10 digits for molecular weight, and 9 digits for the concentration. Codisposal or Superfund sites should use the upper end of the range of air toxics concentrations. However, it is recommended that all facilities obtain toxic composition data using EPA Method 18, which can be found in reference 22, as previously recommended by EPA's Emissions Measurement Branch of the Office of Air Quality Planning and Standards. Additional information concerning Codisposal or Superfund sites is provided in Reference 23.

Edit Air Toxics Concentrations

Chemical	Molecular Wt.	Concentration (ppm V)
Benzene	78.120000	2.65
Carbon Tetrachloride	153.810000	15.00
Chloroform	119.380000	0.08242
Ethylene Dichloride	98.960000	1.85
Methylene Chloride	84.930000	20.00
Perchloroethene	165.830000	6.82
Trichloroethene	131.290000	2.02
Vinyl Chloride	62.500000	5.61
1,1-Dichloroethylene	96.940000	0.292

Figure 3-8. Edit Air Toxics Concentration Entry Screen

CAUTION

The action you are taking will reset the ENTIRE air toxics list to its default state.

Figure 3-9. Warning Screen Prior to Returning Air Toxics to their Default Values

Table 3-1. Format of AIRTOXIC.TXT

Air Toxic Chemical	Molecular Wt	Concentration (ppmv)
Benzene	78.12	2.65
Carbon Tetrachloride	153.81	15.00
Chloroform	119.38	0.08242
Ethylene Dichloride	98.96	1.85
Methylene Chloride	84.93	20.00
Perchloroethene	165.83	6.82
Trichloroethene	131.29	2.02
Vinyl Chloride	62.50	5.61
1,1-Dichloroethylene	96.94	0.292

Methane Rate Constant--

This selection causes the Edit Methane Generation Rate Constant sub-menu to appear as shown in Figure 3-10. This screen allows for the selection of the following three methods for setting the methane generation rate constant:

Use Default Value of k (0.02 1/yr)
Supply a Value of k
Calculate a Value of k

The first option allows the use of a default k value of 0.02. Further information is provided in the Background Information Document, Reference 1, as well as References 24 and 25. The next option allows entry of an alternative decay rate constant. The data entry form for this option appears in Figure 3-11.

The third selection branches to a data entry screen allowing the entry of parameters specific to the draft and soon-to-be proposed CFR method 2E testing procedures. Prior to this screen, another screen will appear informing the user that CFR method 2E testing or comparable testing must have been performed in order to perform the calculations. This screen is shown in Figure 3-12. If the Calculate a Value of k option is chosen, the Calculate Methane Gas Generation Constant data entry screen, presented in Figure 3-13, will be displayed. All of the parameters must be non-zero in order for a value of k to be calculated. A value of k will appear once all parameters are non-zero. The calculated value of k can be changed simply by changing one of the input parameters and pressing [ENTER]. Again, the default values may be overwritten and [F10] must be pressed in order to accept the value of k that has been calculated.

The methane generation rate constant, k, determines the methane generation rate (for each submass of refuse). The higher the value of k, the faster the methane generation rate increases and decreases over time. The value of k is a function of the following factors: (1) refuse moisture content, (2) availability of the nutrients for methanogens, (3) pH, and (4) temperature. The k values obtained from the data collected for the upcoming CAA regulation for municipal solid waste landfill air emissions from SCAQMD data (1982-1986), section 114 letter responses range in value from 0.003 to 0.21.[1] These values were obtained from both theoretical models using field test data as well as from actual measurements. The suggested default value for k is 0.02, and the method for deriving this value is outlined in Reference 20.

Methane Generation Potential--

This option allows the user to input a Methane Generation Potential Constant(Lo). The suggested default value of 8120 ft^3/Mg already in place may be overwritten. Press [ENTER] in order to accept the chosen value. The data entry screen for the Methane Generation Potential Constant is shown in Figure 3-14.

The value for the Methane Generation Potential Constant(Lo) of refuse depends only on the type of refuse present in the landfill. The higher the cellulose content of the refuse, the higher the value of Lo. The values of theoretical and obtainable Lo reported in Reference 22 range from 220 to 9540 ft^3 CH_4/Mg refuse. The default value of Lo is 8120 ft^3/Mg, and the method for deriving this value is outlined in Reference 20.

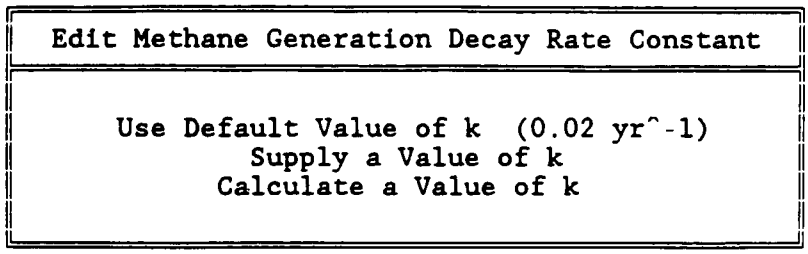

Figure 3-10. Edit Methane Generation Decay Rate Constant Sub-Menu

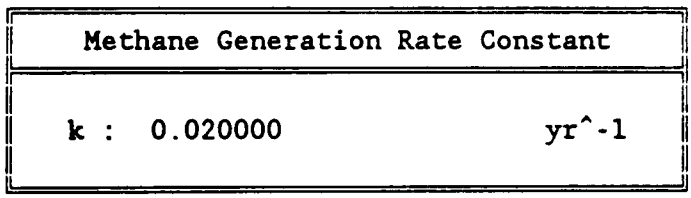

Figure 3-11. Methane Generation Rate Constant Entry Screen

To calculate a k value, you must have performed the field tests as outlined in Method 2E (to be proposed Fall 1990). Press ESCAPE to return to the previous menu.

Figure 3-12. CFR Method 2E Warning Screen.

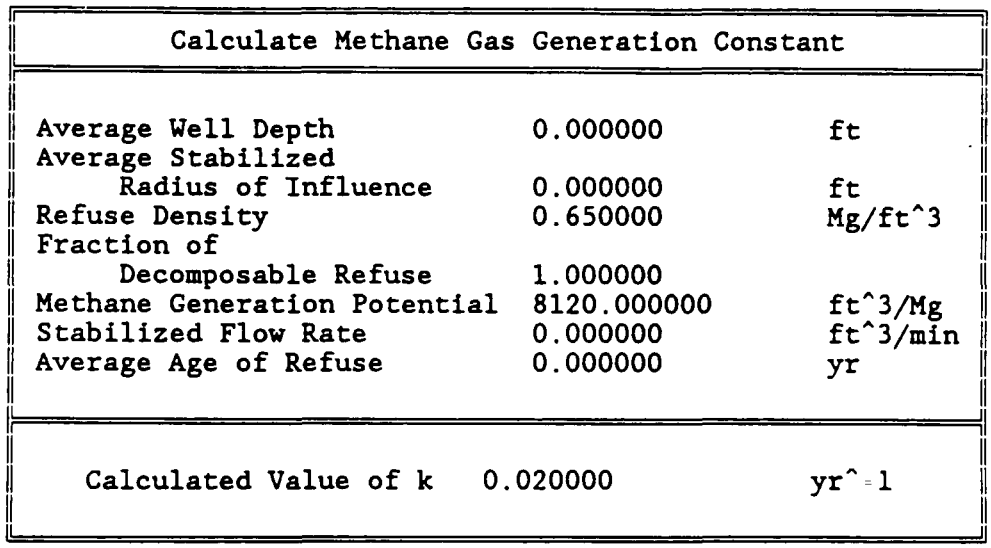

Figure 3-13. Calculate Methane Gas Generation Constant Data Entry Screen

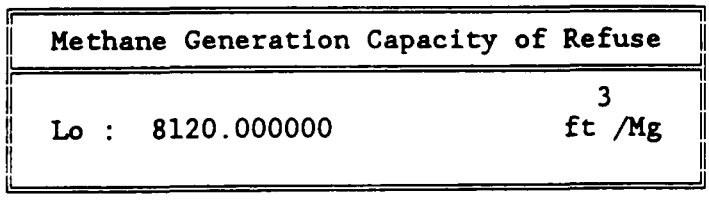

Figure 3-14. Methane Generation Capacity Data Entry Screen

Operational Data--

The Operational Data selection causes the Edit Refuse Data Periods data entry screen, presented in Figure 3-15, to appear. This data entry screen allows the user to enter the operational history of a landfill. Data entry occurs in two distinct parts: landfill operational parameters and specific landfill history.

Year Open / Current Year--

Upon activation of the entry screen, the user is permitted to change the landfill opening year and current year parameters. For a new study, the default current year is determined from the computer system clock and the opening year defaults to 10 years prior to that year. Both of these parameters can be changed by the user.

Design Capacity--

Upon keying the year open and current year into the entry screen, the design capacity of the landfill may then be entered. For a new study the maximum capacity of the landfill is initialized to zero, and a value must be entered before proceeding further. The value in place for an old study may be changed in order update the study. After accepting this information by pressing [F10] or [ENTER], the operational parameters are verified for appropriateness. The design capacity of the landfill cannot be zero and the operating life of the landfill must be less than the computer program memory limitation of 300 years.

Entering Refuse in Place--

After successful validation of the landfill operating parameters, the user will be permitted to enter the landfill history consisting of yearly total refuse-in-place information for the years of operation. The list of years may be scrolled up or down using the cursor motion keys ([up arrow], [down arrow], [page up], or [page down]). Initially, all data is zero. The user should enter the refuse-in-place for all years known. The [up arrow] key can be used to go back to and correct previously entered values. If any value (except the current year which cannot be zero) is zero, the program will interpolate using surrounding values after the list is accepted. The last value entered does not require [ENTER] to be pressed for it to be accepted. Instead, "F10) must be present to accept all values. The list may be returned to its all-zero state by pressing [F2].

After accepting the history data by pressing [F10], the data will be verified for validity. Each successive year cannot be less than the previous year (except in the zero case, which indicates unknown data) and must always be less than or equal to the design capacity.

Predicted Closure Year--

Successful entry of the operational data will cause the program to determine refuse in place for all years listed as zero. The program then determines the acceptance rate for the last one year period entered in the history list and uses this rate to project the closure year. Finally, the screen presented in Figure 3-16 will appear. If the landfill has not reached the design capacity, the user will be given the choice of either accepting or altering the calculated year of closure. If the landfill has already reached capacity, the user will not be permitted to change the closure year.

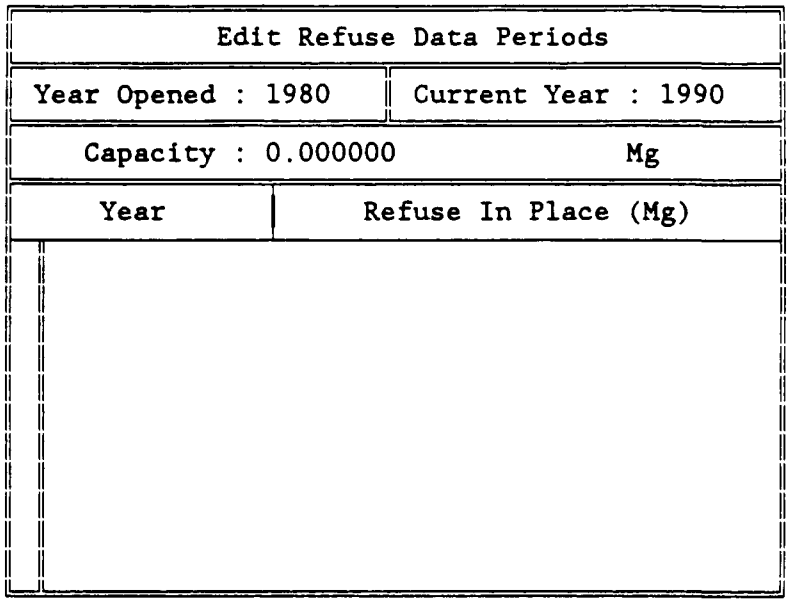

Figure 3-15. Edit Refuse Data Periods Data Entry Form

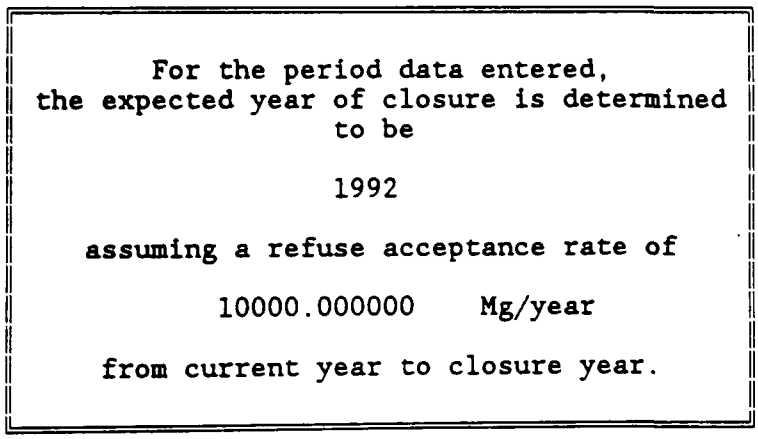

Figure 3-16. Closure Periods Screen

If the year of closure is changed and accepted by pressing either [F10] or [ENTER], the program will verify that the period of operation of the landfill is less than the program limitation of 300 years. If the closure year is valid, the program will recalculate the refuse acceptance rate necessary to reach design capacity by the entered year of closure. Operational data must be entered for each new study in order for calculations to take place. If no other data is entered into the model, default parameters will be used in the calculations. Once the operational data has been entered and accepted by the program, the Edit Study Data menu will reappear. If all of the study data has been entered, simply select the Previous Menu option to return to the Main Menu.

Calculate Air Emissions

This selection from the Main Menu causes the program to perform the air emissions calculations. While the calculations are taking place, the Calculation in Progress screen shown in Figure 3-17 will appear. After the calculations are complete a Calculation Summary will appear; an example Calculation Summary is shown in Figure 3-18. Pressing any key will cause the Main Menu to reappear.

Display Results

The Display Results selection from the Main Menu will cause the sub-menu shown to Figure 3-19 to appear, which gives the user the option of presenting the data in a Tabular Report or On-Screen Graphic format. If the On-Screen Graphic option is selected and a Hercules Graphics Card is being used then MSHERC must be activated prior to running the program. This is done by typing MSHERC while in the sub-directory containing the program and pressing [ENTER]. Once the On-Screen Graphic option is selected, the screen shown in Figure 3-20 will allow the user to select a chemical to view in graphic form. An example graphics display is presented in Figure 3-21. The on-screen graphics display may be dumped to a dot matrix printer for a hardcopy, if the GRAPHICS.COM utility was loaded prior to running the program. Also, the tabular report file can be imported into Lotus 1-2-3 by using the file import function (/FIN). Some of the data at the top of the spreadsheet will appear muddled; however, the tables of data used to generate the graphical analysis will remain applicable, and can be used to generate Lotus graphs.

If the Tabular Report option is chosen, then the Tabular Report sub-menu shown in Figure 3-22 will appear. This sub-menu gives the user the option of sending the report to the screen, printer, or to a file. If the Output to File option is chosen, the entry form shown in Figure 3-23 will appear. This entry form lets the user enter the filename under which the report is to be written. The file will be written to the current working directory; this can be viewed or changed by selecting the Configure Program option from the Main Menu. Once an option is chosen then as described before, Figure 3-20 will appear so that a chemical for reporting can be chosen. After a selection has been made, the report will be displayed on the screen, printed by the printer, or written to a file. If the report will not be printed by the printer then see the Configure Program section for details. An example report is shown in Figure 3-24.

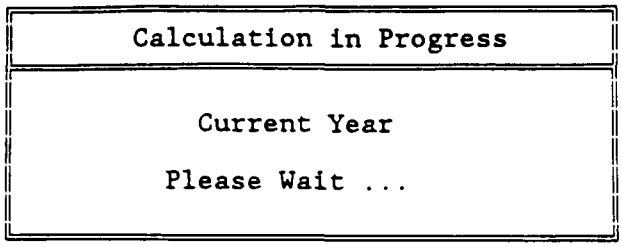

Figure 3-17. Calculation in Progress Screen

Calculation Summary

Current Year Results : 1990			Maximum Year Results : 1992		
Methane	: 3.651E+002	Mg/yr	Methane	: 4.115E+002	Mg/yr
	1.933E+007	Cft/yr		2.178E+007	Cft/yr
Carbon Dioxide	: 1.002E+003	Mg/yr	Carbon Dioxide	: 1.129E+003	Mg/yr
	1.933E+007	Cft/yr		2.178E+007	Cft/yr
NMOC	: 3.139E+001	Mg/yr	NMOC	: 3.538E+001	Mg/yr
	3.092E+005	Cft/yr		3.486E+005	Cft/yr

Figure 3-18. Calculation Summary

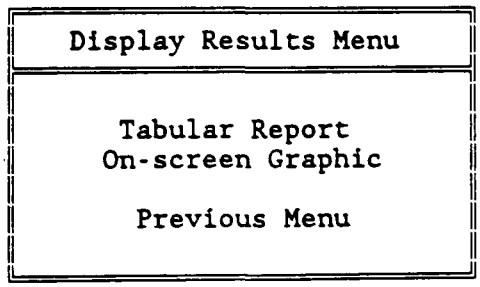

Figure 3-19. Display Results Sub-Menu

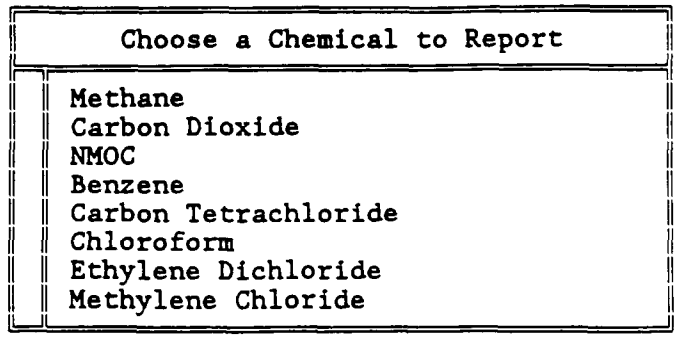

Figure 3-20. Choose a Chemical to Report Screen

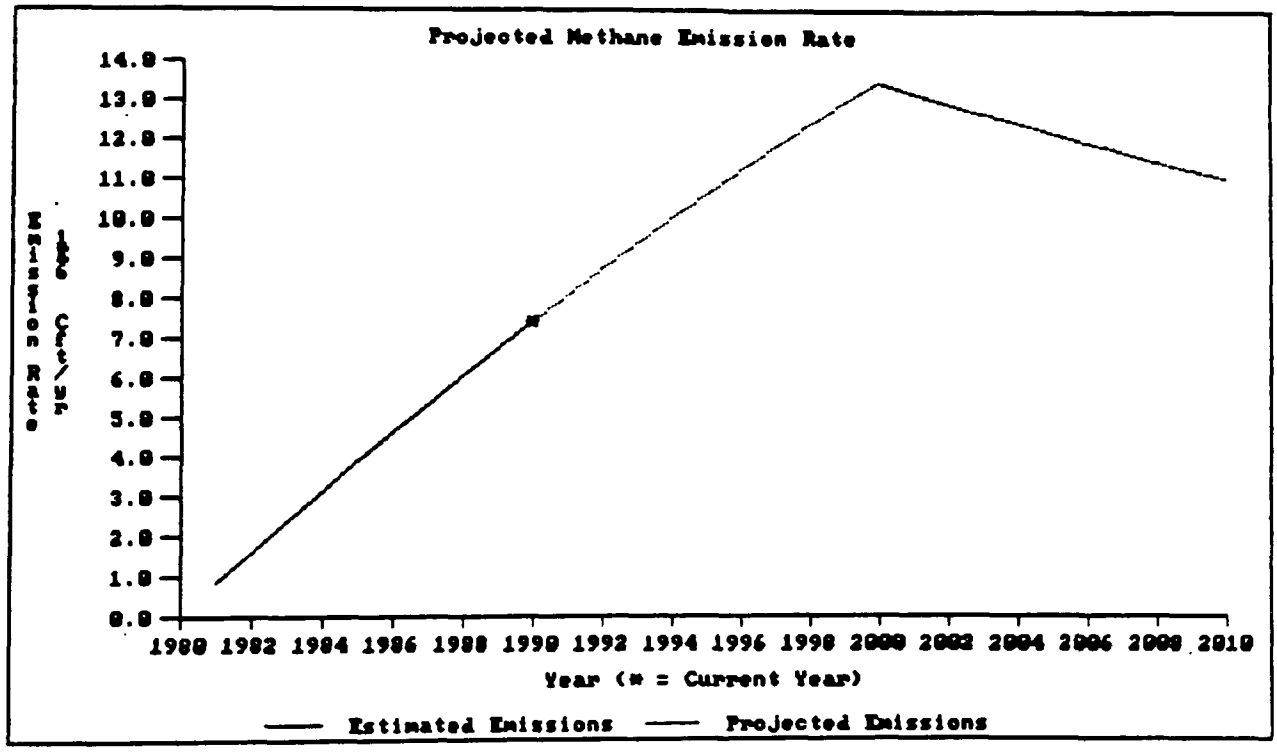

Figure 3-21. Example Graphics Display

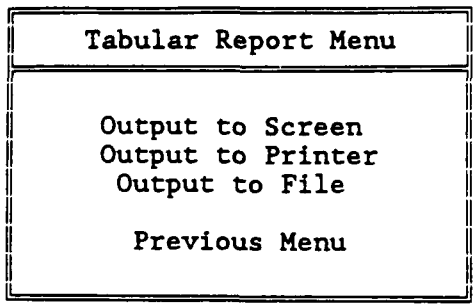

Figure 3-22. Tabular Report Menu

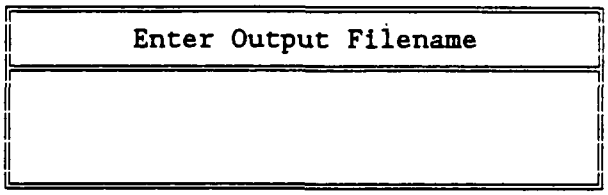

Figure 3-23. Output Filename Entry Screen

View Model Results

Model Parameters

Lo : 8120.000000 Cft / Mg
k : 0.020000 1/yr

NMOC : 8000.000000 ppmv
Methane : 50.000000 % volume
Carbon Dioxide : 50.000000 % volume

Landfill Parameters

Year Opened : 1980 Current Year : 1990 Year Closed : 1992
Capacity : 150000.000000 Mg
Average Acceptance Rate : 13000.000000 Mg/year
Average Acceptance Rate Required from
Current Year to Closure Year : 10000.000000 Mg/year

Figure 3-24. Example Model Results Output

Configure Program

The Configure Program option from the Main Menu allows the user to select the working directory for the program and the Default Print Device. The Edit System Configuration screen is shown in Figure 3-25. The working directory is the directory from which all study files are loaded and save study parameters are placed. There are four options for the Default Print Device: LPT1, LPT2, COM1, and COM2. A different option may be viewed by pressing the space bar; once the desired Default Print Device is shown, simply press [ENTER] to accept the device and return to the main menu.

Exit

The Exit program option allows the user to exit the program. Before exiting, the user will be asked if the current study is to be saved. This screen is shown in Figure 3-26. Next, the screen shown is Figure 3-27 will appear asking the user if the program is to be exited.

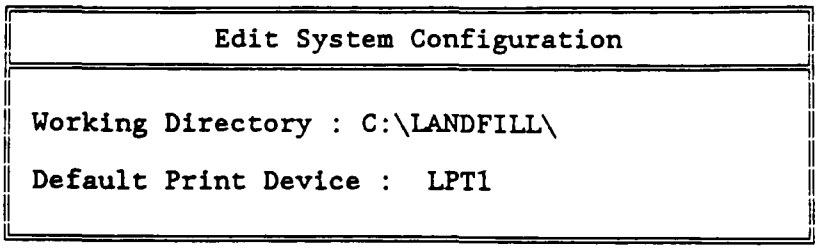

Figure 3-25. Edit System Configuration Screen

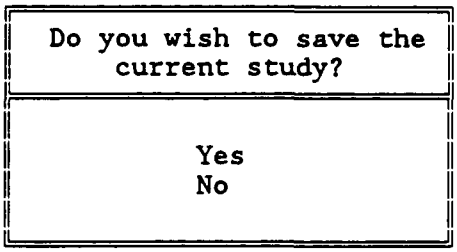

Figure 3-26. Save Study Menu

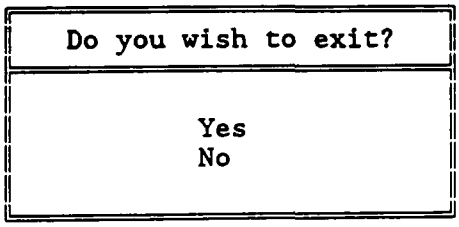

Figure 3-27. Exit Screen

4.0 REFERENCES

1. U.S. Environmental Protection Agency. Air Emissions From Municipal Solid Waste Landfills. Background Information for Proposed Standards and Guidelines. March 12, 1990. (Draft)

2. South Coast Air Quality Management District. Landfill Gas Emissions. Report of the Task Force. July 1982.

3. SCS Engineers. Gas Emission Rates from Solid Waste Landfills. Memo to Allen Geswein, EPA-OSW. November 17, 1986.

4. Pohland, F.G., and Harper, S.R. Critical Review and Summary of Leachate and Gas Production from Landfills. EPA/600/2-86/073 (NTIS PB86-240181). August 1986.

5. Blanchet, M.J. and Staff of the Pacific Gas and Electric Company. Treatment and Utilization of Landfill Gas. Mountain View Project Feasibility Study. EPA-530/SW-583, 1977.

6. Bogner, J.E. The U.S. Landfill Gas Resource: Low-cost Biogas from Municipal Solid Waste. Argonne National Laboratory, Argonne, IL. Prepared by U.S. Department of Energy. January 11, 1988.

7. DeWalle, F.B., Chian, E.S.K., and E. Hammerberg, 1978, Gas Production from Solid Waste in Landfills, J. Environmental Engineering Division ASCE, 104(EE3):415-432.

8. South Coast Air Quality Management District. Source Test Report. 85-592. El Monte, CA. December 1985.

9. South Coast Air Quality Management District. Source Test Report. 84-496. El Monte, CA. October 1984.

10. South Coast Air Quality Management District. Source Test Report. 85-511. El Monte, CA. November 1985.

11. South Coast Air Quality Management District. Source Test Report. 86-0342. El Monte, CA July 1986.

12. South Coast Air Quality Management District. Source Test Report. 85-102. El Monte, CA. February 1985.

13. South Coast Air Quality Management District. Source Test Report. 87-0391. El Monte, CA. December 1987.

14. South Coast Air Quality Management District. Source Test Report. 86-0220. El Monte, CA. May 1986.

15. South Coast Air Quality Management District. Source Test Report. 87-0110. El Monte, CA. April 1987.

16. South Coast Air Quality Management District. Source Test Report. 87-0318. El Monte, CA. October 1987.

17. South Coast Air Quality Management District. Source Test Report. 87-0329. El Monte, CA. October 1987.

18. South Coast Air Quality Management District. Source Test Report. 87-0376. El Monte, CA. November 1987.

19. South Coast Air Quality Management District. Source Test Report. 85-461. El Monte, CA. September 1985.

20. Memorandum. Kuo, I.R., Radian Corporation, to Alice Chow, EPA. "Rationale for Selecting Tier 1 Default Values". April 18, 1990. Docket A-88-09.

21. Regulatory Package for New Source Performance Standards and 111(d) Guidelines for Municipal Solid Waste Air Emissions. Public Docket No. A-88-09.

22. Title 40 Code of Federal Regulations (CFR) Part 60, Appendix A.

23. Memorandum, Kuo, I.R., Radian Corporation, to Anne Pope, EPA. Subject: Air Emission from Codisposal Superfund Site - Phase I. February 8, 1990.

24. Memorandum. McGuinn, Y.C., Radian Corporation, to Susan Thorneloe, EPA. Subject: Use of Landfill Gas Generation Model to Estimate VOC Emissions from Landfills. June 21, 1988. Docket A-88-09.

25. Memorandum. McGuinn, Y.C., Radian Corporation, to Susan Thorneloe, EPA. Subject: Sensitivity Analysis of Landfill Gas Generation Model. June 21, 1988. Docket A-88-09.

26. Emcon Associates. Methane Generation and Recovery from Landfills. 1982.

APPENDIX

EXAMPLE USER SESSION

SCENARIO:

Landfill Design Capacity:	1,000,000 Mg
Annual Acceptance Rate:	35,000 Mg/yr from 1980 to 1990
Year Open:	1975
Refuse in place in 1980:	150,000 Mg

STEPS:

1. At the Main Menu select the Specify Study option.
2. Select New Study.
3. Enter "test" for the study name for this example.
4. Select the Edit Study Data option from the Main Menu.
5. Select Chemical Composition from the Edit Study Data sub-menu.
6. Since site-specific data on methane NMOC concentration, and toxics concentrations are not specified for this example landfill, use the suggested default chemical compositions provided.
7. Accept the chemical composition data by pressing F10.
8. Use the suggested default toxics concentrations provided. (For this example it is assumed that Method 18 testing has not been done.)
9. Accept the air toxics concentrations by pressing F10.
10. Select the Methane Rate Constant (k) option from the Edit Study Data sub-menu.
11. Since site-specific testing was not performed for this example landfill, select the Use Default Value of k (0.02 1/yr).
12. Select the Methane Potential (Lo) option.
13. Accept the suggested default for Methane Generation Capacity (8120 ft^3/Mg).
14. Select the Operational Data option from the Edit Study Data sub-menu.
15. Enter 1975 as the year open.

16. Enter 1990 current year.

17. Enter the design capacity of 1,000,000 Mg.

18. Enter 150,000 Mg of refuse in place for 1980, and add 35,000 Mg each year until 1990. For this example: 150,000 Mg in 1980 then an additional 35,000 Mg each year. The refuse-in-place for 1990 will be 500,000 Mg.

19. Accept these data by pressing F10.

20. The expected year of closure should be 2005 assuming an acceptance rate of 33333.3 Mg/year from the current year to closing year.

21. Accept the generated year of closure and refuse acceptance rate by pressing F10. For this example it is assumed that the year of closure calculated was acceptable.

22. Select the Previous Menu option from the Edit Study Data sub-menu to return to the Main Menu.

23. Select the Calculate Air Emissions option.

24. A calculation summary with the following results should appear:

Current Year Results: 1990		Maximum Year Results 2005	
Methane	1.234E+003 Mg/yr 7.120E+007 Cft/yr	Methane	2.335E+003 Mg/yr 1.236E+008 Cft/yr
Carbon Dioxide	3.691E+003 Mg/yr 7.120E+007 Cft/yr	Carbon Dioxide	6.407E+003 Mg/yr 1.236E+008 Cft/yr
NMOC	1.156E+002 Mg/yr 1.139E+006 Cft/yr	NMOC	2.007E+002 Mg/yr 1.978E+006 Cft/yr

25. Press any key to return to the Main Menu.

26. Select the Display Results option.

27. Select the Tabular Report option.

28. Select the Output to Screen option.

29. Select Benzene as a chemical to report.

30. A detailed report of benzene emissions for the study results may then be reviewed on the computer screen. For benzene, the emissions in the year 2015 should be 4.935×10^{-2} Mg or 5.364×10^{2} cubic feet.

31. Return to the Tabular Report Menu by pressing ESC.

32. Return to the Display Results Menu by pressing ESC.

33. Return to the Main Menu by pressing ESC.

34. Select the Configure Program option.

35. Make sure the Working Directory is the desired directory to which the study should be saved.

36. Select the Exit option.

37. Save the current study.

38. The study has been saved and the program has been exited.

39. If the study needs to be used again, then simply go into the program and select the Old Study option under the Specify Study Type sub-menu.

40. Now enter "test."

41. Study name "test" is now enabled and can be revised or accessed to make new reports.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
EPA-600/8-90-085a		

4. TITLE AND SUBTITLE	5. REPORT DATE
Landfill Air Emissions Estimation Model User's Manual	December 1990
	6. PERFORMING ORGANIZATION CODE

7. AUTHOR(S)	8. PERFORMING ORGANIZATION REPORT NO.
W. R. Pelt II, R. L. Bass, I. R. Kuo, and A. L. Blackard	

9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT NO.
Radian Corporation P. O. Box 13000 Research Triangle Park, North Carolina 27709	11. CONTRACT/GRANT NO. 68-02-4286, Task 48

12. SPONSORING AGENCY NAME AND ADDRESS	13. TYPE OF REPORT AND PERIOD COVERED
EPA, Office of Research and Development Air and Energy Engineering Research Laboratory Research Triangle Park, North Carolina 27711	Task Final; 2-9/90 14. SPONSORING AGENCY CODE EPA/600/13

15. SUPPLEMENTARY NOTES AEERL project officer is Susan A. Thorneloe, Mail Drop 63, 919/541-2709. EPA-600/8-90-085b is related disk.

16. ABSTRACT The document is a user's guide for the computer program, Landfill Air Emissions Estimation Model." It provides step-by-step guidance for using the program to estimate landfill air emissions. The purpose of this program is to aid local and state agencies in estimating landfill air emission rates for nonmethane organic compounds and individual air toxics. This program will also be helpful to landfill owners and operators affected by the upcoming New Source Performance Standard (NSPS) and Emission Guidelines for Municipal Solid Waste Landfill Air Emissions. The model is based on the Scholl Canyon Gas Generation Model, used in the development of the soon-to-be-proposed regulation for landfill air emissions. The Scholl Canyon Model is a first order decay equation that uses site-specific characteristics for estimating the gas generation rate. In the absence of site-specific data, the program provides conservative default values from the soon-to-be-proposed NSPS for new landfills and emission guidelines for existing landfills. These default values may be revised based on future information collected by the Agency.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Organic Compounds Mathematical Models Emission Toxicity Earth Fills Estimates Waste Disposal	Air Pollution Control Stationary Sources	13B 07C 12A 14G 06T 13C 15E

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