The Automated Dredging and Disposal Alternatives Modeling System (ADDAMS)

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PURPOSE: This technical note describes the current capabilities and availability of the Automated Dredging and Disposal Alternatives Modeling System (ADDAMS). ***This technical note replaces an earlier version of Technical Note EEDP-06-12, which should be discarded.***

BACKGROUND: Planning, design, and management of dredging and dredged material disposal projects often require complex or tedious calculations or involve complex decision-making criteria. In addition, the evaluations often must be done for several disposal alternatives or disposal sites. ADDAMS is a personal computer (PC)-based system developed to assist in making such evaluations in a timely manner. ADDAMS is a collection of computer programs (applications) designed to assist in managing dredging projects. This technical note describes the system, currently available applications, mechanisms for acquiring and running the system, and provisions for revision and expansion.

DESCRIPTION OF ADDAMS:

Objective: The Automated Dredging and Disposal Alternatives Modeling System (ADDAMS) is an interactive personal computer (PC)-based design and analysis system for dredged material management. ADDAMS is composed of individual modules or applications, each of which has computer programs designed to assist in the evaluation of a specific aspect of a dredging project. The system was created in response to requests by Corps field offices for tools to rapidly evaluate dredged material management alternatives. The objective of ADDAMS is to provide state-of-the-art computer-based tools that will increase the accuracy, reliability, and cost-effectiveness of Corps dredged material management activities in a timely manner.

Available Applications: Reflecting the nature of dredged material management activities, the applications and methodologies contained in ADDAMS are richly diverse in sophistication and origin. The contents range from simple algebraic expressions, both theoretical and empirical in origin, to numerically intense algorithms spawned by the increasing power and availability of computers.

Figure 1 shows the currently available applications of ADDAMS. Initially the ADDAMS applications were written for DOS-based computers. The most frequently used applications have already been converted to a Windows format or are in the process of being converted. Figure 1 shows the current mix of DOS-based and Windows-based applications under the ADDAMS umbrella. Figure 1 also shows the two general types of ADDAMS applications: dredged material management and environmental effects evaluation. A summary description of each ADDAMS application, including a listing of capabilities and technical points of contact, is found in

Appendix A of this technical note. As applications are updated or new applications are added, Figure 1 and Appendix A will be updated by changes to this technical note.

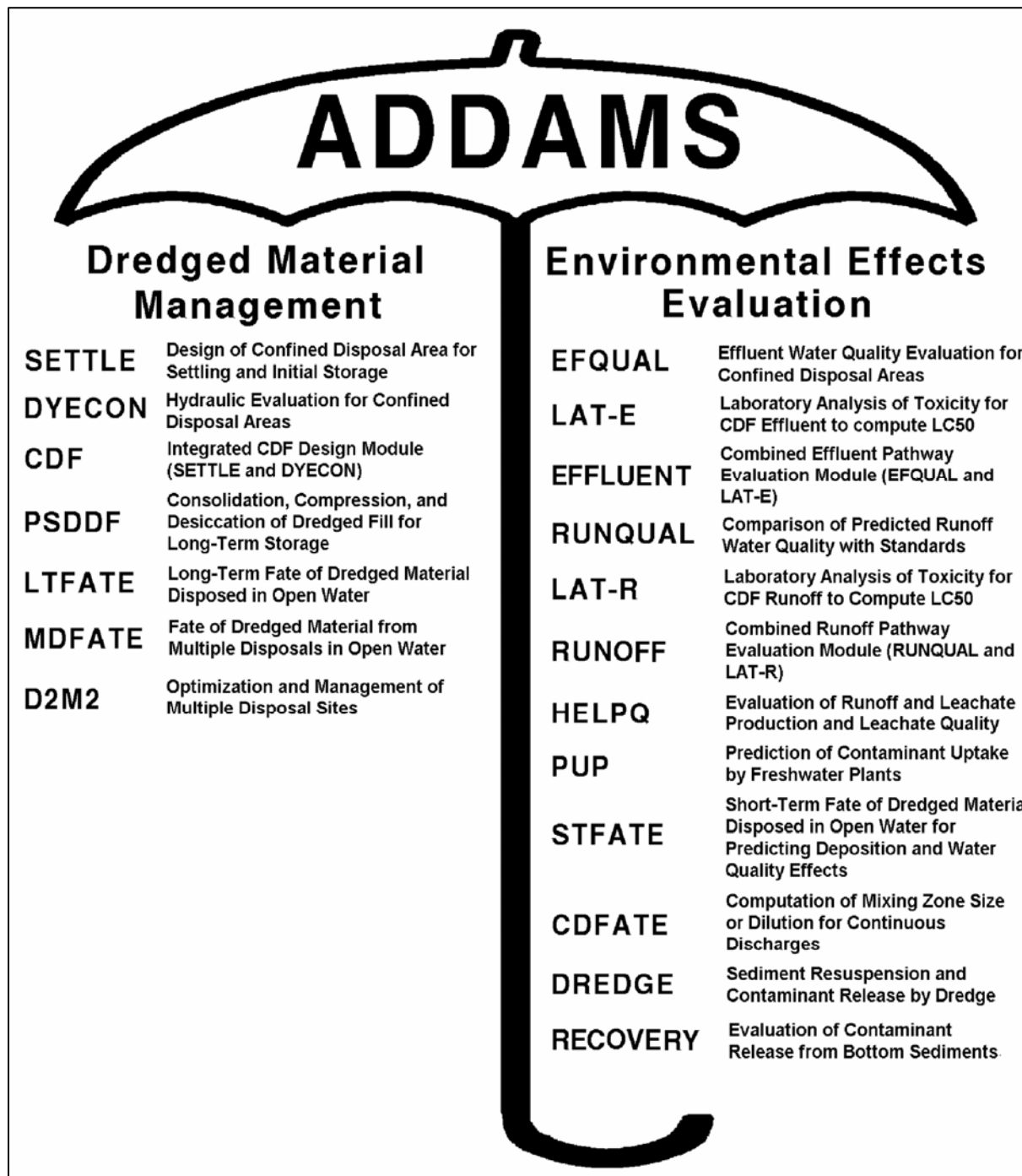A demo that includes SETTLE, DYECON, PSDDF, STFATE, D2M2, EFQUAL, RUNQUAL, and HELPQ is also available (*http://www.wes.army.mil/el/elmodels/*).

Figure 1. Current applications in ADDAMS

DOCUMENTATION AND USER'S GUIDE: Each ADDAMS application has documentation describing how to run that application. This technical note is intended to serve as the user's guide and documentation for the overall ADDAMS system. All files for ADDAMS are available on the Internet at *http://www.wes.army.mil/el/elmodels/*. A detailed list of references is provided both in this technical note and directly on-screen within the applications including those concerned with the technical background and theory involved and documentation for the programming as appropriate. Points of contact for each application are also listed directly on the screens for answering questions regarding the respective applications.

GENERAL INSTRUCTIONS:

Target Hardware Environment: The strong preference of Corps field offices is for the system to reside in a desktop hardware environment commonly available. The system is therefore designed for personal computers resident at Corps field offices, running Windows operating systems. Since components of ADDAMS have been developed over the last 17 years, different components were designed for different operating systems. Early components were designed to run in DOS; later components were designed for Windows 95 and 98. Recent upgrades have been designed for Windows 2000 and XP.

Installation and Start-Up: On the ADDAMS Web site each ADDAMS application has a program file that is a self-extracting compressed archive of the application's installation routine. Download the file into a temporary subdirectory on your computer; then run the program file to extract the installation files. To install a DOS-based application, run the INSTALL program from the temporary subdirectory and follow the on-screen directions to complete the installation. To install a Windows-based application, run the setup.exe file and follow the on-screen directions. If downloading more than one application program, you will need to both extract and install an application before extracting the next program file; otherwise, the program files should be downloaded to different subdirectories.

It is recommended that the ADDAMS files be saved in a directory on the hard drive dedicated for the ADDAMS system, for example, C:\ADDAMS. To begin a session using one of the DOS-based applications, go to the DOS or command prompt, make the ADDAMS directory the current default directory, and type ADDAMS or the name of the application. Alternatively, use the "Run" command in Windows or the "Open" option to execute the application batch file (Application.BAT). Menus will then be displayed. To begin a session using one of the Windows-based applications, double-click on the appropriate icon on the desktop.

Note that ADDAMS supporting documents are also available on the ADDAMS web site. The available documents are in Adobe Acrobat format (pdf). Download the document files into any subdirectory you choose. You can view or print the documents using Adobe Acrobat Reader 3.0 or higher, which can be downloaded by clicking on the Pdf Reader button and following the instructions.

User Interface: The initial ADDAMS programs were written for DOS-based personal computers. The DOS version applications are SETTLE, DYECON, PSDDF, LTFATE, MDFATE, D2M2, EFQUAL, LAT-E, RUNQUAL, LAT-R, HELPQ, PUP, STFATE, CDFATE, and RECOVERY.

These DOS applications employ a menu-driven environment and support full-screen data entry. Single keystrokes (usually the F1-F10 function keys, number keys, Esc key, cursor keys, and the Enter key) select menu options in the system. The vast majority of these applications do not use mouse controls.

Cursor keys highlight input fields (displayed in reverse video) much like a spreadsheet program. To enter alphanumeric data, the user moves the cursor to the cell of interest using the up or down arrows to move vertically, and the Tab and Shift-Tab keys to move horizontally. The Enter key moves forward through the cells. The left and right arrow keys can be used to move the cursor within a selected cell in order to edit the cell's contents. The Backspace key deletes characters in a cell. The space bar inserts spaces in a cell. The Delete and Insert keys, respectively, delete and insert a row of data on a screen of tabular data.

Page Down moves the cursor to the next screen of data entry and the Page Up key moves the cursor to the previous screen of data entry. The End key or Esc key permits the user to quit data entry and exit the application without saving the data. The Home key exits from the current data entry activity screen to the activity selection menu for the application and retains the entered data in memory.

More recent ADDAMS applications (DREDGE, CDF, EFFLUENT, and RUNOFF) have been written in Windows format with all the Windows programs except DREDGE supporting all Windows operating systems (95/98, NT, 2000 and XP). DREDGE operates only in Windows 95/98 and XP. Online help is available to guide the user through the applications. In addition, Windows versions of STFATE and CDFATE are available.

Results from computations are generally displayed in tabular or graphic format on the screen or written to print files or devices.

Applications and File Management: Each ADDAMS application consists of one or more stand-alone computer programs or numerical models to perform a specific analysis. ASCII files store input data from previous runs and are used to store output of results.

The DOS version of ADDAMS displays an initial menu of applications. Once an application is selected, an activity selection menu will be displayed at several levels for entering and editing data, executing the application, printing the results, performing file operations, and exiting the program.

The File Manager is accessible within each application. The File Manager acts only on data files for the selected application. The File Manager can select, name, or copy files, or display a directory listing the files.

The Windows applications of ADDAMS employ standard Windows file management methods including a File option dropdown menu and icons on the toolbar to open new or existing files, and print or save data.

Printing: Opportunities are provided to print a hard copy of input data, output of results, data files, and file directories in both DOS and Windows applications. The DOS commands Control-Print Screen and Shift-Print Screen can also be used to print, respectively, all

information written to the screen or currently on the monitor. Many of the print functions of the DOS applications do not work in a Windows environment; however, the print screen functions operate when the DOS applications are run from a window as opposed to full screen. The screen captures can be printed in word processing or presentation/graphics software. The output files from the DOS applications can be printed from any Windows application for ASCII files such as Notepad, Wordpad, or Word using fixed fonts (non-scalable fonts).

Ending: Normal termination is recommended at all times to avoid data loss. For DOS applications, data entry should be terminated by paging from the data entry screens or hitting the Home key to return to the activity selection menu. Hitting the Esc key or the function key for file operations will save the data, and then the Esc key is used to exit each menu to successively higher menu levels, and ultimately, back to DOS. During execution of a particular application's program, the user must wait until the sometimes lengthy computations are completed before exiting. The program can also be terminated by entering Control-Break, ending the task, closing the window, or turning off the computer, but these methods of ending are not recommended because loss of data may occur. For Windows applications the "save" or "save as" command should be used before closing or exiting the window.

AVAILABILITY OF ADDAMS: The ADDAMS system and applications are available on the Internet at *www.wes.army.mil/el/elmodels/*. For users who do not have Internet access, a request form for obtaining the ADDAMS applications on CD is provided as Appendix B.

REVISIONS, UPDATES, AND WORKSHOPS: The ADDAMS applications will be revised and updated as new technical approaches become available, and new applications will be developed to address additional management needs. Each application is designed as a module so that revisions or the addition of new applications can be easily accomplished. The ADDAMS Web site has the most current version of each respective application. Version numbers are displayed on-screen for the ADDAMS system and the various applications. Periodically, a new version of the entire system may be required.

Changes to this technical note will provide information on new applications. In addition, workshops are held on an as-needed basis to familiarize Corps personnel with use of the ADDAMS system. Also, upon request, workshops can be held within a District to provide training on specific applications needed for a particular project. Requests for additions to the mailing list for the technical note series and inquiries regarding the scheduling of ADDAMS workshops should be sent to the following address:

USAE Research and Development Center, Waterways Experiment Station
ATTN: CEERD-EM-D
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

POINTS OF CONTACT: For additional information regarding ADDAMS, contact Dr. Paul R. Schroeder, (601) 634-3709, Dr. Tommy E. Myers (601) 634-3939, Ms. Cheryl M. Lloyd (601) 634-3711, or the manager of the Environmental Effects of Dredging Program, Dr. Douglas G. Clarke, (601) 634-3770, *Douglas.G.Clarke@erdc.usace.army.mil*. Points of contact for technical

questions relating to various ADDAMS applications are provided in Appendix A of this technical note and on-screen in ADDAMS. This technical note should be cited as follows:

Schroeder, P. R., Palermo, M. R., Myers, T. E., and Lloyd, C. M. (2004). "The automated dredging and disposal alternatives modeling system (ADDAMS)," *Environmental Effects of Dredging Technical Notes Collection* (ERDC/TN EEDP-06-12), U.S. Army Engineer Research and Development Center, Vicksburg, MS. *http://www.wes.army.mil/el/dots/eedptn.html*

APPENDIX A: Description of ADDAMS Applications

SETTLE APPLICATION (DOS):

Title: Design of Confined Disposal Facilities for Suspended Solids Retention and Initial Storage Requirements (SETTLE)

Description: Confined disposal facilities (CDFs) must be designed to provide both the storage volume required for the dredged solids and the hydraulic retention time for removal of suspended solids from the effluent discharged from the area during hydraulic filling operations. Various settling processes occurring in the CDF control the initial storage during filling, clarification, and effluent suspended solids. Engineer Manual (EM) 1110-2-5027 (Headquarters, U.S. Army Corps of Engineers 1987) provides design guidance for CDFs. This application provides a computer program to assist users in the design of a CDF for solids retention and initial storage in accordance with the design procedures in the EM. Laboratory column settling tests are an integral part of these design procedures, and the data from these tests are required in order to use this application. The SETTLE application analyzes laboratory data from the settling tests and calculates design parameters for CDFs.

Major Capabilities:

- Analyzes laboratory settling test data for zone, flocculent, and compression settling.

- Determines the maximum allowable in situ volume that can be dredged and placed in a CDF with a given available storage volume.

- Determines the maximum allowable dredge size (or inflow rate) that can be used with a given CDF surface area and ponding volume to obtain clarification and maintain satisfactory retention of suspended solids.

- Determines the required CDF surface area and volume to accommodate a given dredge size and a given in situ volume to be dredged.

- Determines the required weir crest length for a given dredge size.

Current Version: 3.00 updated October 1995

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Hayes, D. F., and Schroeder, P. R. (1992). "Documentation of the SETTLE module for ADDAMS: Design of confined disposal facilities for solids retention and initial storage," *Environmental Effects of Dredging Technical Notes* EEDP-06-18, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
Headquarters, U.S. Army Corps of Engineers. (1987). "Confined disposal of dredged material," Engineer Manual 1110-2-5027, Washington, DC.
Palermo, M. R., Montgomery, R. L., and Poindexter, M. E. (1978). "Guidelines for designing, operating, and managing dredged material disposal areas," Technical Report DS-78-10, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
Thackston, E. L., and Palermo, M. R. (1988). "Refinement and simplification of column settling tests for design of dredged material containment areas," *Environmental Effects of Dredging Technical Notes* EEDP-02-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

DYECON APPLICATION (DOS):

Title: Determination of Hydraulic Retention Time and Efficiency of Confined Disposal Facilities (DYECON)

Description: This application provides a computer program to determine mean hydraulic retention time and hydraulic efficiency of a confined disposal facility (CDF) from a dye tracer slug test. Determination of retention time of ponded water is an important aspect of CDF design. Dye tracer studies may be undertaken to provide retention time data for large sites or those with unusual characteristics. Procedures for conducting such dye tracer tests are presented in Engineer Manual (EM) 1110-2-5027 (Headquarters, U.S. Army Corps of Engineers 1987). In the absence of dye tracer data, the hydraulic efficiency can be estimated empirically.

Major Capabilities:

● Determines the theoretical and mean retention times of a CDF and the resulting hydraulic efficiency.

● Determines the mean and maximum dye concentrations, time of peak dye concentration, and related characteristics of the dye concentration curve.

Current Version: 3.00 updated June 1993

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Hayes, D. F., and Schroeder, P. R. (1992). "Documentation of the DYECON module for ADDAMS: Determining the hydraulic retention and efficiency of confined disposal facilities," *Environmental Effects of Dredging Technical Notes* EEDP-06-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.
Headquarters, U.S. Army Corps of Engineers. (1987). "Confined disposal of dredged material," Engineer Manual 1110-2-5027, Washington, DC.

CDF APPLICATION (Windows):

Title: CDF Design Module (CDF)

Description: The CDF application has all the basic components of both the SETTLE and DYECON modules described above, but CDF was written for Windows operating systems. CDF has an intuitive, easy-to-use graphical user interface for data entry, an on-line help system, and a design wizard for evaluating various design scenarios.

Major Capabilities:

● Determines the theoretical and mean retention times of a CDF and the resulting hydraulic efficiency.

● Analyzes laboratory settling test data for zone, flocculent, and compression settling.

● Determines the maximum allowable in situ volume that can be dredged and placed in a CDF with a given available storage volume.

● Determines the maximum allowable dredge size (or inflow rate) that can be used with a given CDF surface area and ponding volume to obtain clarification and maintain satisfactory retention of suspended solids.

● Determines the required CDF surface area and volume to accommodate a given dredge size and a given in situ volume to be dredged.

● Determines the required weir crest length for a given dredge size.

Current Version: 1.00

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected References:

Hayes, D. F., and Schroeder, P. R. (1992). "Documentation of the DYECON module for ADDAMS: Determining the hydraulic retention and efficiency of confined disposal facilities," *Environmental Effects of Dredging Technical Notes* EEDP-06-17, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Hayes, D. F., and Schroeder, P. R. (1992). "Documentation of the SETTLE module for ADDAMS: Design of confined disposal facilities for solids retention and initial storage," *Environmental Effects of Dredging Technical Notes* EEDP-06-18, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Headquarters, U.S. Army Corps of Engineers. (1987). "Confined disposal of dredged material," Engineer Manual 1110-2-5027, Washington, DC.

PSDDF APPLICATION (DOS):

Title: Evaluation of Primary Consolidation, Secondary Compression, and Desiccation of Dredged Fill for Determining Long-Term Storage Requirements (PSDDF)

Description: This application provides a mathematical model to estimate the storage volume occupied by a layer or layers of dredged material in a confined disposal facility (CDF) as a function of time. Management of CDFs to provide maximum storage capacity is becoming more necessary as both the storage capacity of existing sites and availability of land for new sites decrease. Maximum site capacity is achieved through densification of the dredged material by removal of interstitial water. The volume reduction and the resulting increase in storage capacity are obtained through both consolidation and desiccation (drying) of the dredged material. PSDDF can also simulate underwater placement of cohesive or noncohesive soil. PSDDF relies on the results of laboratory consolidation tests to estimate the magnitude and rate of consolidation and on climatic data for estimation of the rates of drying at a given site. The predictive procedures are described in Engineer Manual (EM) 1110-2-5027 (Headquarters, U.S. Army Corps of Engineers 1987).

Major Capabilities:

● Determines the final or ultimate thickness and elevation of multiple lifts of dredged material placed at given time intervals.

● Determines the time rate of settlement for multiple lifts and therefore the surface elevation of the dredged material fill as a function of time.

● Determines the water content, void ratio, total and effective stress, and pore pressure for multiple lifts as a function of time.

Current Version: 2.1 updated November 1996

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Headquarters, U.S. Army Corps of Engineers. (1987). "Confined disposal of dredged material," Engineer Manual 1110-2-5027, Washington, DC.

Poindexter-Rollings, M. E., and Stark, T. D. (1989). "PCDDF89 - Updated computer model to evaluate consolidation/desiccation of soft soils," *Environmental Effects of Dredging Technical Notes* EEDP-02-10, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Stark, T. D. (1991). "Program Documentation and User's Guide: PCDDF89, primary consolidation and desiccation of dredged fill," Instruction Report D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Stark, T. D. (1996). "Program Documentation and User's Guide: PSDDF - Primary consolidation, Secondary compression, and Desiccation of Dredged Fill," Draft Instruction Report D-96-xx, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

D2M2 APPLICATION (DOS):

Title: System Cost Optimization for Regional Dredging and Dredged Material Disposal (D2M2)

Description: This application provides the Dredged-Material Disposal Management Model (D2M2), developed by the U.S. Army Engineer Hydrologic Engineering Center (HEC), a simulation-optimization model for systematic analysis of long-term operation and expansion of multiple disposal sites. The model provides a means of determining the optimum usage of multiple disposal areas to meet the dredging requirements at multiple dredging sites; for example, along the length of a navigation channel. D2M2 uses a linear-optimization approach in determining the optimum usage based on input data for dredging volumes, location, frequencies, transportation facilities, and associated costs.

Major Capabilities:

● Determines the optimum usage of multiple disposal sites to meet dredging requirements at multiple dredging locations.

● Identifies the minimum-net-cost, short-term operation policy for a system of disposal sites and dredging areas.

● Analyzes disposal capacity expansion alternatives and determines the minimum cost disposal site acquisition schedule.

Current Version: SPN updated August 1995

Points of Contact: Hydrologic Engineering Center, CEWRC-HEC, (916) 756-1104
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Ford, D. T. (1984). "Dredged-material disposal management model," *Journal of the Water Resources Planning and Management Division*, American Society of Civil Engineers, 110(1), 57-74.

Ford, D. T. (1986). "Dredged-material disposal system capacity expansion," *Journal of the Water Resources Planning and Management Division*, American Society of Civil Engineers, 112(2), 277-291.

U.S. Army Corps of Engineers. (1984). "Dredged-material disposal management model (D2M2) user's manual," Hydrologic Engineering Center, Davis, CA.

PUP APPLICATION (DOS):

Title: Prediction of Metals Uptake by Freshwater Plants (PUP)

Description: This application predicts metals uptake from dredged material by freshwater plants using DTPA extract data. The application compares the predictions with reference sites to determine the acceptability of the uptake in upland and flooded environments.

Major Capabilities:

● Provides a quick screening tool for metals uptake by freshwater plants by comparing database values to sediment test results.

● Indicates contaminants of concern for further evaluation.

Current Version: 1.0 updated January 1990

Points of Contact: Dr. Bobby L. Folsom, Jr., CEERD-EP, (601) 634-4297
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Folsum, B. L., Jr., and Houck, H. H. (1990). "A computerized procedure for predicting plant uptake of heavy metals from contaminated freshwater dredged material," *Environmental Effects of Dredging Technical Notes* EEDP-04-12, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

HELPQ APPLICATION (DOS):

Title: Evaluation of Runoff and Leachate Production and Leachate Quality (HELPQ)

Description: This application couples the USEPA Hydrologic Evaluation of Landfill Performance model with an equilibrium partitioning model for contaminant transport. The model estimates leachate production, collection, and leakage from upland confined dredged material disposal facilities and also estimates contaminant concentrations and mass fluxes in the leachate.

Major Capabilities:

● Balances the water budget at the ground surface and then routes the infiltrated water and the available contaminants throughout the soil profile.

● Uses sand or gravel layers for lateral drainage or leachate collection and clay and synthetic materials as liners.

● Provides special treatment for estuarine sediments to simulate salt washout effects on contaminant partitioning.

● Accepts user-supplied sequential partitioning coefficients or calculates partitioning coefficients from user-supplied sequential batch leach data or column leach data.

● Calculates contaminant concentrations in the CDF profile, contaminant concentration and mass releases through the bottom of the CDF, and contaminant masses captured by leachate collection systems.

Current Version: 2.1 updated October 1999

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Aziz, N. M., and Schroeder, P. R. (1999). "Documentation of the hydrologic evaluation of leachate production and quality (HELPQ) module," Dredging Research Technical Note EEDP-06-20, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Aziz, N. M., and Schroeder, P. R. (1999). "ADDAMS application: Hydrologic evaluation of leachate production and quality (HELPQ) module in CDFs," Dredging Research Technical Note EEDP-06-21, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Schroeder, P. R., Aziz, N. M., Lloyd, C. M., and Zappi, P. A. (1994a). "The hydrologic evaluation of landfill performance (HELP) model: User's guide for version 3," EPA/600/R-94/168a, U.S. Environmental Protection Agency Risk Reduction Engineering Laboratory, Cincinnati, OH.

Schroeder, P. R., Dozier, T. S., Zappi, P. A., McEnroe, B. M., Sjostrom, J. W., and Peyton, R. L. (1994b). "The hydrologic evaluation of landfill performance (HELP) model: Engineering documentation for version 3," EPA/600/R-94/168b, U.S. Environmental Protection Agency Risk Reduction Engineering Laboratory, Cincinnati, OH.

EFQUAL APPLICATION (DOS):

Title: Analysis of Modified Elutriate Test Results for Prediction of Chemical Effluent Quality and Dilution Requirements for Confined Disposal Facilities (EFQUAL)

Description: This application provides a computer program to analyze the results of modified elutriate tests and predict the chemical quality of effluent discharged from confined disposal facilities (CDFs) during hydraulic filling operations. Such predictions are necessary to evaluate the acceptability of the effluent discharge under Section 404 of the Clean Water Act. The effluent may contain both dissolved and particle-associated contaminants. The modified elutriate test was developed for use in predicting both the dissolved and particle-associated concentrations of contaminants in the effluent. Results of the modified elutriate and column settling tests may be used to predict the total concentrations of contaminants for a given set of CDF operational conditions.

Major Capabilities:

● Computes predicted dissolved, particle-associated, and total concentrations of contaminants of the effluent.

● Compares predicted concentrations with given water quality criteria and standards and determines the required dilution, if any, in a mixing zone to meet the standards.

Current Version: 3.00 updated October 1995

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Francingues, N. R., Palermo, M. R., Peddicord, R. K., and Lee, C. R. (1985). "Management strategy for the disposal of dredged material: Contaminant testing and controls," Miscellaneous Paper EL-85-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Palermo, M. R. (1985). "Interim guidance for predicting quality of effluent discharged from confined dredged material disposal areas," *Environmental Effects of Dredging Technical Notes* EEDP-04-1 through 04-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Palermo, M. R., and Schroeder, P. R. (1991). "Documentation of the EFQUAL module for ADDAMS: Comparison of predicted effluent water quality with standards," *Environmental Effects of Dredging Technical Notes* EEDP-06-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

LAT-E APPLICATION (DOS):

Title: Laboratory Analysis of Toxicity for CDF Effluent to Compute LC50 (LAT-E)

Description: The Decision-Making Framework (DMF) for the management of dredged material has been developed and used at several sites (Lee et al. 1991). Among the many components of the DMF is effluent water quality, which is one pathway that is investigated when confined disposal is considered. The LAT-E Program compares survival data for various aquatic organisms at several elutriate dilutions and computes the LC50 for the effluent. Using the LC50 and a mixing zone model, the toxicity of the discharge can be evaluated for compliance with water quality regulations.

Major Capability:

● Statistically analyzes the survival data from a suite of water column bioassay tests for acute toxicity in accordance with the guidance in the Inland Testing Manual (USEPA/ USACE 1994).

Current Version: 1.00 updated February 1997

Points of Contact: Dr. Dennis L. Brandon, CEERD-EP-R, (601) 634-2807
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Brandon, D. L., Schroeder, P. R., and Lee, C. R. (1997). "Computerization of the decision-making framework: Effluent toxicity bioassay test results (LAT-E program)," *Environmental Effects of Dredging Technical Notes* EEDP-04-27, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE). (1994). "Evaluation of dredged material proposed for discharge in waters of the U.S. - testing manual," EPA 842-B-92-008. U.S. Environmental Protection Agency, Washington, DC.

EFFLUENT APPLICATION (Windows):

Title: Combined Effluent Pathway Evaluation Module (EFQUAL and LAT-E)

Description: The EFFLUENT application has all the basic components of both the EFQUAL and LAT-E modules described above and was written for Windows operating systems.

Major Capabilities:

● Computes predicted dissolved, particle-associated, and total concentrations of contaminants of the effluent.

● Compares predicted concentrations with given water quality criteria and standards and determines the required dilution, if any, in a mixing zone to meet the standards.

● Statistically analyzes the survival data from a suite of water column bioassay tests for acute toxicity in accordance with the guidance in the Inland Testing Manual (USEPA/ USACE 1994).

Current Version: 1.00 updated January 2000

Points of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709
Dr. Dennis L. Brandon, CEERD-EP-R, (601) 634-2807

Selected Bibliography:

Brandon, D. L., Schroeder, P. R., and Lee, C. R. (1997). "Computerization of the decision-making framework: Effluent toxicity bioassay test results (LAT-E program)," *Environmental Effects of Dredging Technical Notes* EEDP-04-27, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Palermo, M. R. (1985). "Interim guidance for predicting quality of effluent discharged from confined dredged material disposal areas," *Environmental Effects of Dredging Technical Notes* EEDP-04-1 through 04-4, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Palermo, M. R., and Schroeder, P. R. (1991). "Documentation of the EFQUAL module for ADDAMS: Comparison of predicted effluent water quality with standards," *Environmental Effects of Dredging Technical Notes* EEDP-06-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE). (1994). "Evaluation of dredged material proposed for discharge in waters of the U.S. - testing manual," EPA 842-B-92-008. U.S. Environmental Protection Agency, Washington, DC.

RUNQUAL APPLICATION (DOS):

Title: Comparison of Predicted Runoff Water Quality with Standards (RUNQUAL)

Description: This application provides a computer program to analyze the results of surface runoff quality tests and to predict the chemical quality of the surface runoff discharged from confined disposal facilities (CDFs). Such predictions are necessary to evaluate the acceptability of the surface runoff under Section 404 of the Clean Water Act. The surface water runoff may contain both dissolved and particle-associated contaminants. Results of the surface runoff quality tests and the column settling tests may be used to predict the dissolved and total concentrations of contaminants for a given set of CDF operational conditions.

Major Capabilities:

● Computes predicted dissolved and total contaminant concentrations in the surface runoff discharged from a confined disposal site using surface runoff quality test data.

● Compares predicted surface runoff concentrations with specified water quality standards.

● Computes required dilutions of surface runoff discharge to meet specified water quality standards, considering background concentrations in the receiving water.

Current Version: 1.00 August 1993

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Schroeder, P. R., Gibson, A. C., and Dardeau, E. A., Jr. (1993). "Documentation of the RUNQUAL module for ADDAMS: Comparison of predicted runoff water quality with standards," *Environmental Effects of Dredging Technical Notes* EEDP-06-19, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

LAT-R APPLICATION (DOS):

Title: Laboratory Analysis of Toxicity for CDF Runoff to Compute LC50 (LAT-R)

Description: The Decision-Making Framework (DMF) for the management of dredged material has been developed and used at numerous Corps projects (Lee et al. 1991). Among the many components of the DMF is surface runoff water quality, which is one of the pathways investigated when confined disposal is considered. Evaluation of surface runoff quality, like the evaluation of effluent quality, is based on the chemical composition of the discharge as well as the biological effects (toxicity). To perform these evaluations, surface runoff tests are performed on wet, anaerobic sediment and oxidized, aerobic sediment to generate representative samples of the runoff immediately after disposal and later when the dredged material has dried out.

The LAT-R program compares survival data for various aquatic organisms at several runoff dilutions and computes the LC50 for the runoff under both wet and dried conditions. Using the LC50 and a mixing zone model, the toxicity of the discharge can be evaluated for compliance with water quality regulations.

Major Capability:

● Statistically analyzes the survival data from a suite of water column bioassay tests for acute toxicity in accordance with the guidance in the Inland Testing Manual (USEPA/ USACE 1994).

Current Version: 1.00 updated February 1997

Points of Contact: Dr. Dennis L. Brandon, CEERD-EP-R, (601) 634-2807
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Brandon, D. L., Schroeder, P. R., and Lee, C. R. (1997). "Computerization of the decision-making framework: Surface runoff toxicity bioassay test results (LAT-R program)," *Environmental Effects of Dredging Technical Notes* EEDP-04-28, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE). (1994). "Evaluation of dredged material proposed for discharge in waters of the U.S. - testing manual," EPA 842-B-92-008. U.S. Environmental Protection Agency, Washington, DC.

RUNOFF APPLICATION (Windows):

Title: Combined Runoff Pathway Evaluation Module (RUNQUAL and LAT-R)

Description: The RUNOFF application has all the basic components of both the RUNQUAL and LAT-R modules described above and was written for Windows operating systems.

Major Capabilities:

● Computes predicted dissolved and total contaminant concentrations in the surface runoff discharged from a confined disposal site using surface runoff quality test data.

● Compares predicted surface runoff concentrations with specified water quality standards.

● Computes required dilutions of surface runoff discharge to meet specified water quality standards, considering background concentrations in the receiving water.

● Statistically analyzes the survival data from a suite of water column bioassay tests for acute toxicity in accordance with the guidance in the Inland Testing Manual (USEPA/ USACE 1994).

Current Version: 1.00 updated January 2000

Points of Contact: Dr. Dennis L. Brandon, CEERD-EP-R, (601) 634-2807
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Brandon, D. L., Schroeder, P. R., and Lee, C. R. (1997). "Computerization of the decision-making framework: Surface runoff toxicity bioassay test results (LAT-R program)," *Environmental Effects of Dredging Technical Notes* EEDP-04-28, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Lee, C. R., Tatem, H. E., Brandon, D. l., Kay, S. H., Peddicord, R. K., Palermo, M.R. and Francingues, N. R., Jr. (1991). "General decisionmaking framework for management of dredged material: Application to Commencement Bay, Washington," Miscellaneous Paper D-91-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers (USEPA/USACE). (1994). "Evaluation of dredged material proposed for discharge in waters of the U.S. - testing manual," EPA 842-B-92-008. U.S. Environmental Protection Agency, Washington, DC.

CDFATE APPLICATION (DOS and Windows):

Title: Computation of Mixing Zone Size or Dilution for Continuous Discharges (CDFATE)

Description: This application predicts mixing zone requirements to meet water quality standards or predicts compliance with water quality standards given a mixing zone. The module is applicable for continuous discharges from dredged material disposal operations. The operations considered by the module include discharge of effluents or runoff from upland confined disposal from a weir, pipe, or stream; leakage through porous dikes; overflows from hopper dredges or barges; and discharges of dredged material from a pipeline.

Major Capabilities:

- Accommodates six types of surface or near-surface discharges.

- Predicts mixing zone requirements to meet water quality standards.

- Predicts compliance with water quality standards given a mixing zone.

Current Version: 1.0 updated November 1994 (Windows conversion September 2001)

Point of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Chase, D. (1994). "CDFATE user's manual," Draft, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Doneker, R. L., and Jirka, G. H. (1990). "Expert system for the hydrodynamic mixing zone analysis of conventional and toxic submerged single port discharges (CORMIX1)," EPA/600/3 - 90/012, Environmental Research Laboratory, Athens, GA.

Havis, R. N. (1994). "Mixing zone simulation model for dredge overflow and discharge into inland and coastal waters," Draft, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

STFATE APPLICATION (DOS and Windows):

Title: Short-Term Fate of Dredged Material Disposal in Open Water (STFATE)

Description: This application mathematically models the physical processes determining the short-term fate of dredged material disposed at open-water sites; that is, within the first few hours after disposal. STFATE was developed from the DIFID (DIsposal From an Instantaneous Dump) model. In STFATE, the behavior of the material is assumed to be separated into three phases: convective descent, dynamic collapse, and passive transport-dispersion. The model estimates receiving water concentrations of suspended sediment and dissolved constituent and the initial deposition of material on the bottom. Estimates of water column concentrations are often needed to determine mixing zones whereas the initial deposition pattern of material on the bottom is required in long-term sediment transport that assesses the potential for erosion, transport, and subsequent redeposition of the material. This model can also serve as a valuable aid in field monitoring programs. STFATE can be used in evaluating water column effects of open-water disposal of dredged material in accordance with Section 103 of the Marine Protection, Research, and Sanctuary Act and Section 404(b)(1) of the Clean Water Act.

Major Capabilities:

● Estimates receiving water concentrations of suspended solids, dredged material liquid and suspended phases, and dissolved contaminants as a function of time and location and compares contaminant concentrations with water quality standards.

● Estimates the percentage of suspended solids deposited on the bottom as a function of time and location and the thickness of deposition.

● Estimates mixing zone requirements to meet water quality standards.

Current Version: 5.01 May 2000 (Windows Version December 2004)

Points of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709
Jarrell Smith, CEERD-HC-CT, (601) 634-4310

Selected Bibliography:

Brandsma, M. G., and Divoky, D. J. (1976). "Development of models for prediction of short-term fate of dredged material discharged in the estuarine environment," Contract Report D-76-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Johnson, B. H. (1990). "User's guide for models of dredged material disposal in open water," Technical Report D-90-5, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers. (1991). "Evaluation of dredged material proposed for ocean disposal - testing manual," EPA-053/8-91/001, Office of Water, Washington, DC.

U.S. Environmental Protection Agency/U.S. Army Corps of Engineers. (1998). "Evaluation of dredged material proposed for discharge in waters of the U.S. - testing manual," EPA-823-B-98-004, Office of Water, Washington, DC.

LTFATE APPLICATION (DOS):

Title: Long-Term Fate of Dredged Material Disposed in Open Water (LTFATE)

Description: LTFATE is a numerical modeling system for systematically estimating the long-term response of an open-water dredged material disposal site to local environmental shear forces. The methodology is based on the development of databases of wave and current time series and the application of these boundary conditions to coupled hydrodynamic, sediment transport, and bathymetry change models. The approach was developed to provide an estimate of long-term material fate for determining whether an existing or proposed disposal site will be dispersive or nondispersive over periods on the order of months to years.

Major Capabilities:

● Estimates the dispersion characteristics of a dredged material placement site over long periods of time, ranging from days for storm events to a year or more for ambient conditions.

● Uses local wave and current condition information developed from either numerical model-generated databases or user-supplied data files.

● Accounts for the avalanching of noncohesive sediments and consolidation of cohesive sediments to accurately predict physical processes that occur at the site.

Current Version: 1.00 updated December 1997

Point of Contact: Dr. Joseph Z. Gailani, CEERD-HC-C, (601) 634-4851

Selected Bibliography:

Scheffner, N. W., Thevenot, M. M., Tallent, J. R., and Mason, J.M. (1995). "LTFATE: A model to investigate the long-term fate and stability of dredged material disposal sites; user's guide," Instruction Report DRP-95-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

MDFATE APPLICATION (DOS):

Title: Fate of Dredged Material from Multiple Disposals in Open Water (MDFATE)

Description: MDFATE, a multiple dredged material placement model, has been developed to predict post-disposal bathymetry for ocean dredged material disposal sites. This PC-driven numerical simulation incorporates existing numerical models to simulate the overall (short- and long-term) behavior of dredged material placed within an open-water disposal site. The MDFATE model spatially accounts for bathymetric changes within an offshore disposal area and can be used to assist with selection of the most efficient layout for a proposed disposal site, or provide guidance for optimizing dredged material placement operations.

Major Capabilities:

● Simulates multiple disposal events at one site to predict mound buildup.

● Simulates the effects of local currents and waves on the sediment as it falls through the water column and settles on the mound.

● Accounts for effects of grain size and bulk density on settling, changes in volume during deposition, and various dredging and placement methods.

Current Version: 1.1 updated August 1996

Point of Contact: Jarrell Smith, CEERD-HC-CT, (601) 634-4310

Selected Bibliography:

Moritz, H. R. (1994). "Users guide for the *M*ultiple *D*ump *FATE* model," Draft, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

DREDGE APPLICATION (Windows):

Title: Sediment Resuspension and Contaminant Release by Dredge (DREDGE)

Description: This application assists users in making a priori assessments of environmental impacts from proposed dredging operations. DREDGE estimates the mass rate at which bottom sediments become suspended into the water column as the result of hydraulic and mechanical dredging operations and the resulting suspended sediment concentrations. These are combined with information about site conditions to simulate the size and extent of the resulting suspended sediment plume. DREDGE also estimates particulate and dissolved contaminant concentrations in the water column based upon sediment contaminant concentrations and equilibrium partitioning theory.

Major Capabilities:

● Provides rapid calculation of dredge plume concentrations resulting from mechanical and hydraulic dredging operations.

● Contains an extensive toxic organic chemical and heavy metal database system plus default K_{ow} values for over 200 chemicals.

● Has source strength models for mechanical and hydraulic dredging operations.

● Provides a 2-D analytical transport model to predict the fate of resuspended sediments without particle flocculation in a water column.

Current Version: 1.1 updated October 1997

Points of Contact: Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709
Thomas D. Borrowman, CEERD-EP-E, (601) 634-4048

Selected Bibliography:

Hayes, D. F., and Chung-Hwan, J. (2000). "DREDGE module user's guide," Draft, U.S. Army Engineer Research and Development Center, Vicksburg, MS.
Ruiz, C. E., and Gerald, T. (2001). "RECOVERY version 2, a mathematical model to predict the temporal response of surface water to contaminated sediments," ERDC/EL TR-01-3, U. S. Army Engineer Research and Development Center, Vicksburg, MS.

RECOVERY APPLICATION (DOS):

Title: Evaluation of Contaminant Release from Bottom Sediments (RECOVERY)

Description: This application is a screening-level model to assess the long-term impact of contaminated bottom sediments on surface waters. The model couples contaminant interaction between the water column and the bottom sediment, as well as between the contaminated and clean bottom sediments. The analysis is intended primarily for organic contaminants with the assumption that the water column is well mixed. Processes incorporated in the model are sorption, decay, volatilization, burial, resuspension, settling, bioturbation, and pore-water diffusion. The solution couples contaminant mass balance in the water column and in the mixed sediment layer along with diffusion and bioturbation in the deep sediment layers.

Major Capabilities:

● Allows for a rapid analysis of recovery scenarios for contaminated sediments and cap evaluations.

● Simulates behavior of organics in a real system with a limited amount of data.

● Predicts desorption of contaminants from sediments.

Current Version: 3.00 updated December 1999

Points of Contact: Dr. Carlos E. Ruiz, CEERD-EP-W, (601) 634-3784
Dr. Paul R. Schroeder, CEERD-EP-E, (601) 634-3709

Selected Bibliography:

Ruiz, C. E., and Gerald, T. (2001). "RECOVERY version 2, a mathematical model to predict the temporal response of surface water to contaminated sediments," ERDC/EL TR-01-3, U. S. Army Engineer Research and Development Center, Vicksburg, MS.
Ruiz, C. E., Aziz, N. M., and Schroeder, P. R. (2000). "RECOVERY: a contaminated sediment-water interaction model," ERDC/EL SR-D-001, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

APPENDIX B: Request Form for ADDAMS

Please send the ADDAMS CD to:

Name and Title:_____

Mailing Address:_____

_____

Telephone Number: _____

Anticipated uses of ADDAMS: _____

Date: _____

Please <u>circle</u> the applications desired.

ADDAMS (all modules)	ADDAMS DEMO	
SETTLE	DYECON	CDF
PSDDF	D2M2	HELPQ
EFQUAL	LAT-E	EFFLUENT
RUNQUAL	LAT-R	RUNOFF
CDFATE DOS	CDFATE Windows	PUP
STFATE DOS	STFATE Windows	DREDGE
LTFATE	MDFATE	
RECOVERY		

MAIL THE COMPLETED REQUEST FORM TO:

USAE Research and Development Center Waterways Experiment Station
ATTN: CEERD-EP-E (Paul R. Schroeder)
3909 Halls Ferry Road
Vicksburg, MS 39180-6199