

U S E R S   G U I D E   F O R   T H E  
M U L T I P L E   D U M P   F A T E   M O D E L

FINAL            REPORT

By

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## PREFACE

This report describes a numerical simulation for open water dredged material disposal sites, and is the result of research conducted during the period from 1 January 1994 through 31 June 1994. The principal investigator is Mr. Hans R. Moritz, an independent research hydraulic engineer.

The numerical simulation was developed under contract number DACW39-94-M-1304 between the U.S. Army Corps of Engineer Waterways Experiment Station (WES), Vicksburg, MS and Mr. Hans R. Moritz, Gresham, OR. The technical project officer at the Waterways Experiment Station is Dr. Billy H. Johnson of the Hydraulics Laboratory.

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U S E R S   G U I D E   F O R   T H E  
**M U L T I P L E   D U M P   F A T E   M O D E L**

1 - INTRODUCTION

**Open Water Disposal of Dredged Sediments - Background**

While often more cost effective than upland disposal, the option of placing clean dredged material within the open water may introduce additional concerns to the overall management of disposed dredged material. The management of ocean dredged material disposal Sites (ODMDS) includes environmental considerations such as obtaining and maintaining regulatory approval for site use and operational constraints concerning navigation issues and disposal efficiency. In order to satisfy these constraints, the project manager of the open water disposal site is required to:

- a) Ensure that dredged material placed offshore does not accumulate in a fashion which would pose a navigational hazard,
- b) Demonstrate that the placed dredged material stays within the site boundaries,
- c) Attain maximum utilization of site volumetric capacity.

The common link between the above concerns is the ability to accurately predict and track the placement of dredged material within a given disposal site. This issue is further emphasized when one considers that approximately 95 to 99% of dredged material placed within non-dispersive sites reaches the seafloor (Tavolaro 1984, Truitt 1989). The proper management of an ODMDS requires a sophisticated methodology to quantitatively predict/asses the bathymetric behavior of dredged material placed within the open water disposal site.

**Formulation of MDFATE**

A dredging project which includes open water disposal of dredged sediment typically consists of numerous dredged material placements ranging from a few to more than 1000. The operational duration of such projects can range from days to months. The life-cycle of an ODMDS may be greater than 10 years.

A new multiple dredged material placement model has been developed to predict post-disposal bathymetry for ocean dredged material disposal sites. This new PC-driven numerical simulation, named Multiple Dump FATE (MDFATE), 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. The MDFATE model has evolved from several earlier concepts (Moritz and Randall 1992).

MDFATE defines an ocean dredged material disposal site in terms of a numerical grid and incorporates two existing computer models, STFATE and LTFATE, to predict or verify ODMDS bathymetry resulting from a series of disposal cycles or "dumps". In this regard, STFATE and LTFATE are used independently within the MDFATE simulation. STFATE (Johnson 1990) and LTFATE (Scheffner et al 1994) are numerical models developed at the U.S. Army Engineer Waterways Experiment Station.

This manual provides an overview of MDFATE, focussing on application and implementation of the model within the user interface.

## **Overview of MDFATE Capabilities**

### Discretizing an Ocean Dredged Material Disposal Site

As a first step in simulating a disposal operation, MDFATE is used to produce a discretized representation (rectangular grid) of the ODMDS which is of interest. All that is required from the user is the ODMDS corner coordinates. Horizontal control (x,y) is manifested in terms of the coordinate system actually used at the site. State plane (feet) and lat-long (degrees) coordinates are currently supported. up to 9,500 nodal points can be used to represent a given ODMDS in terms of a MDFATE grid. This is sufficient to represent a 9,000 x 9,000 ft ODMDS in terms of a 100-foot grid interval.

Bathymetric (z) data are represented in terms of the elevation reference datum used at the site. Subsequent modification of an ODMDS grid's bathymetry is performed with respect to the datum established during the creation of the disposal area grid. MDFATE can either automatically generate the ODMDS grid bathymetry (flat or sloping), or overlay survey data (ASCII format) consistent with the actual sites's coordinate system. Survey data is adapted to the grid domain by a multi-point polynomial interpolant scheme.

## Simulating a Dredged Material Disposal Operation

Once a particular ODMDS grid has been created, MDFATE can be used to simulate a given disposal operation which may extend over a year and consist of hundreds of disposal cycles or "dumps". A "dump" consists of one load of dredged material being released into open water from either a barge/scow or a hopper dredge.

During MDFATE execution, the disposal operation is divided into separate week-long episodes over which long-term fate processes governing dredged material behavior on the seafloor are simulated using a modified version of the LTFATE model. Results are modeled in a cumulative manner. Long-term processes include self-weight consolidation, sediment transport by waves-currents, and mound avalanching.

Within each episode, a modified version of STFATE simulates short-term fate processes which govern each "dump" occurring inside the ODMDS grid of interest. Short-term processes are those which influence disposed dredged material up to the point at which all momentum imparted to the material from the "dump" activity is expended through convection, diffusion, and bottom friction (Figure 1).

MDFATE utilizes HPDSIM and TIDE (portions of the LTFATE model), to generate wave and tidal information for every 3-hour interval during the disposal operation. This information is utilized by the modified STFATE model, within MDFATE, to simulate wave-current affects acting upon each "dump" as dredged material passes through the water column and comes to rest on the seafloor. STFATE produces a characteristic foot-print for each type of dredged material type/disposal method involved the disposal operation. The resultant disposal foot-print is used to represent each dredged material placement.

MDFATE specification of the disposal operation is performed through a menu-driven format in which the user specifies basic data defining: (A) tidal and wave information, (B) volume of dredged material to be disposed, (C) duration of disposal, (D) disposal equipment characteristics (type/size/bearing), (E) dredged material properties (composition/etc), and (F) water column (residual) current. Positioning and control of disposal vessel during material placement is specified according to one of the following options:

- (1) within a specified radial distance of a pre-determined geographic location (i.e. coordinates defining a disposal buoy location). Dumps are placed in a random manner weighted in the direction of disposal vessel approach.
- (2) along a pre-determined transect line based on beginning and ending coordinates.

- (3) each dump location defined by user entered coordinates.
- (4) dump locations are based upon pre-recorded coordinates for each load. Coordinates (x,y) are contained in an ASCII data file queued by MDFATE.

The simulated disposal operation is concluded when all "dumps" for the disposal operation have been superimposed and the long-term fate simulation has been completed for the specified time interval.

#### Other MDFATE Support Options

Within MDFATE are a variety of viewing, sensitivity testing, and post-processing utilities. These options can be used to edit/update MDFATE grid bathymetry, develop 2- and 3-dimensional views of ODMDS bathymetry, quantify nominal sediment transport rates, calculate sediment volumes, and determine relative differences between grids.

#### **Organization of Report**

Chapter 1 describes operational considerations for open water disposal of clean dredged sediments and background of the MDFATE model. Chapter 2 provides information for getting started with the MDFATE model. Information includes target hardware requirements, loading MDFATE onto a hard disc, description of interface structure/assumptions/requirements, and guidance for model input. Chapter 3 is a user tutorial illustrated through a case study example. Chapter 4 presents conclusions regarding the MDFATE model.



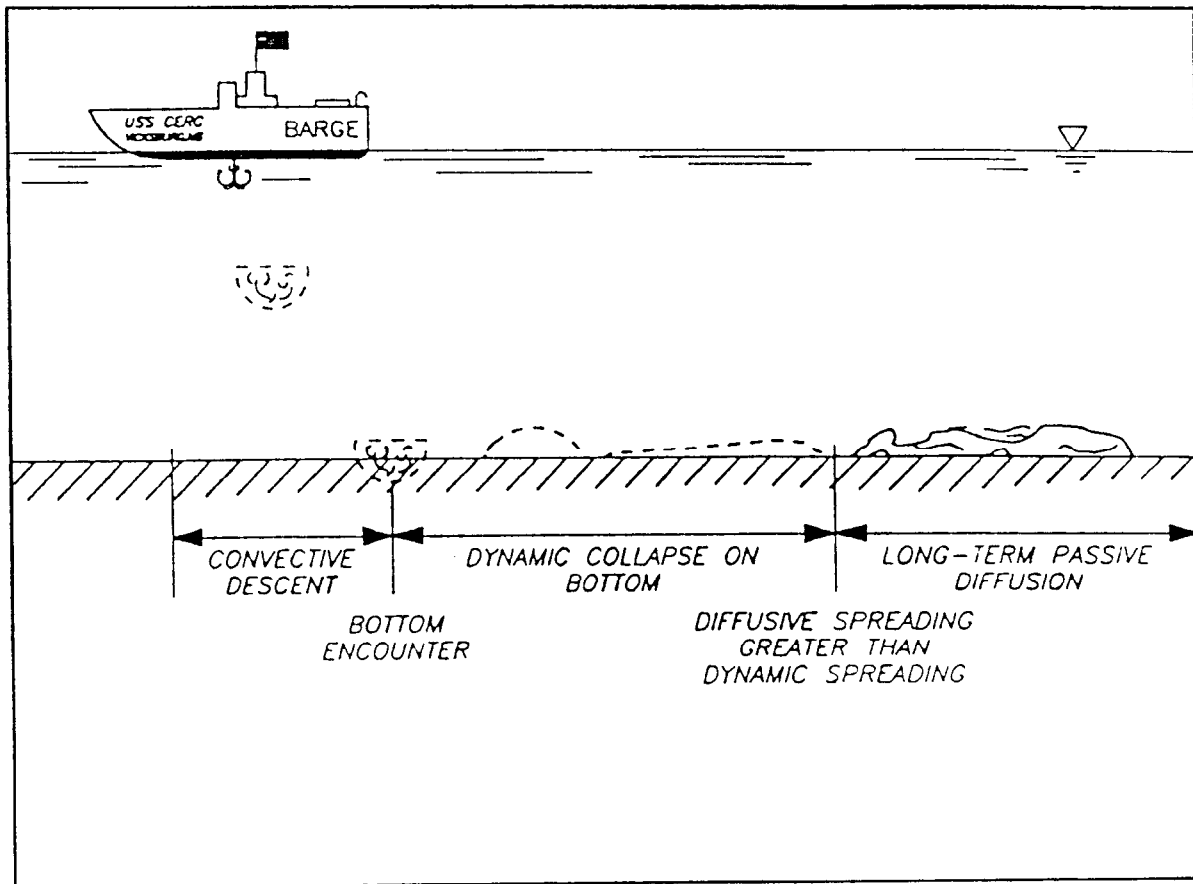
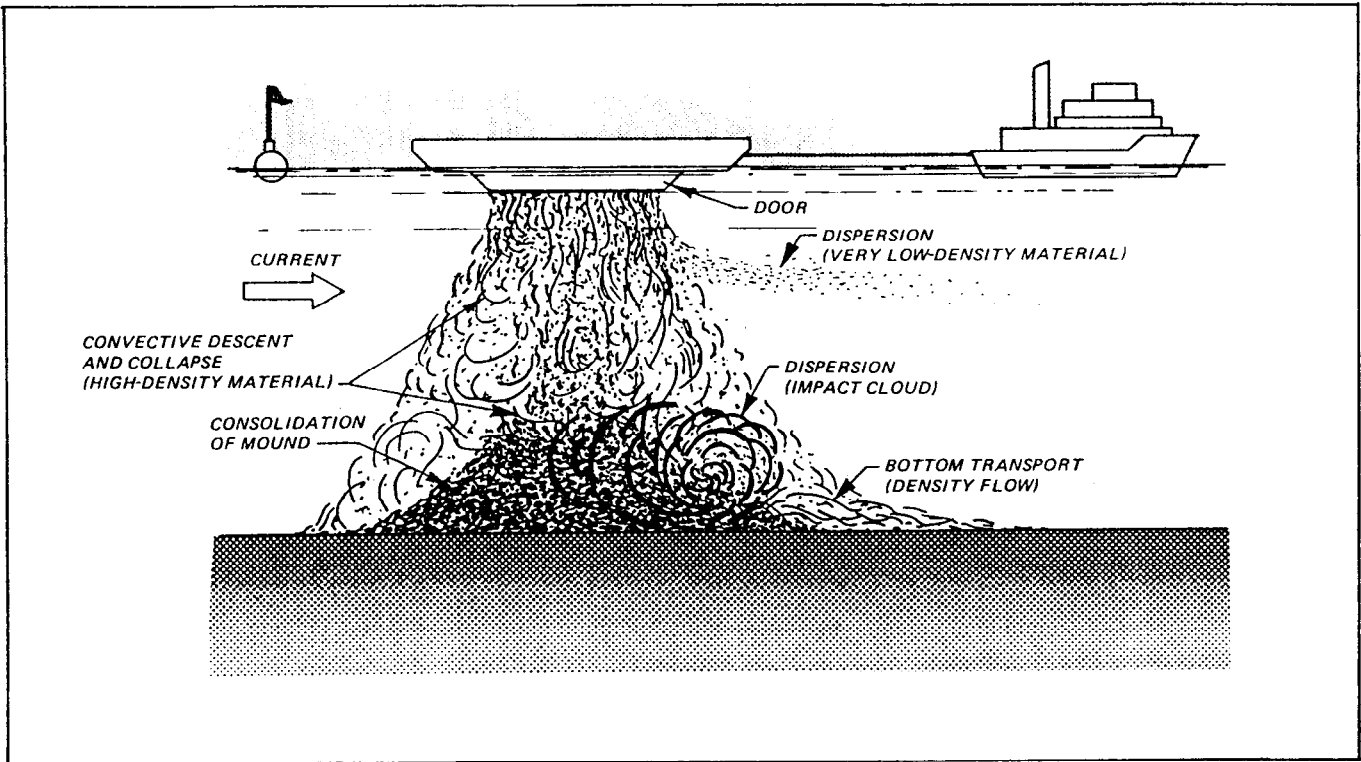


Figure 1. (top) Four phases of dredged material behavior when the material is discharged subaqueously (COE, 1990). (bottom) Computational phases of the short-term fate model, DREDGE (Sheffner, 1990).

## 2 GETTING STARTED

Text that is to be typed on a keyboard is printed in **bold** and enclosed in square brackets [COPY]. Non-character keyboard entries are in bold and enclosed in angular brackets <ENTER>.

### **MDFATE Hardware Requirements**

The source code for the MDFATE program was written in FORTRAN and intended for use on an Intel 80486 CPU based IBM (or equivalent) PC with a math co-processor, or PENTIUM based PC. The operating system of the PC should be (disk operating system) DOS 5.0 or higher.

A VGA monitor, and 526KB of uncommitted (free) DOS controlled RAM (random access memory) are required for MDFATE execution. Pre-existing resident software may compete with the MDFATE RAM requirements. Therefore, the CONFIG.SYS and/or AUTOEXEC.BAT files may require modification if resident software prevents MDFATE execution. Minimum hard-disc storage capacity required by MDFATE is 8 MB.

### **Software Requirements**

Software required to fully utilize MDFATE are; A) DOS PC operating system, B) the MDFATE software package. Items included in the MDFATE package are:

- ▶ MDFATE Shell programs
- ▶ Short- and Longterm modeling programs and datafiles
- ▶ Grid generation/editing programs
- ▶ Wave field and tide generating programs
- ▶ Install program for video and printer access
- ▶ Utility programs for viewing, volumes, transport rates

Additional information concerning the MDFATE software package can be obtained from the Hydraulics Laboratory (Dr. Billy H. Johnson); U.S. Army Corps of Engineers Waterways Experiment Station, 3909 Halls Ferry Road, Vicksburg, MS 39181-6199.

### **MDFATE Software Installation**

Before the user can execute the MDFATE, several software installation measures must first be fulfilled. Installation is rather easy and performed as follows:

- 1) On the target computer's hard-drive, make a directory to store the MDFATE software. Use the DOS [MD] command to make a directory. The directory should be made on a "disc-drive" which has at least 8 MB of free space.

2) Use the DOS **[COPY]** command to copy the MDFATE files onto the new directory. Assuming the MDFATE diskettes are inserted into drive **A:**, and the target directory (say MODEL) is located on the C-drive. Issue the command: **[copy A:\*. \* C:\MODEL\\*. \*]**. Repeat this operation for all of the MDFATE diskettes.

3) If necessary, use the INSTALL utility to configure the LOOK and UT1 programs for the target computer system. Do this by typing **[INSTALL]** at the DOS prompt while in C:\MODEL\. The INSTALL program will ask the user the name of the file to install; the user responds with **[LOOK.EXE]**, and answers the prompts accordingly. The same process is repeated for UT1. As default, LOOK and UT1 are configured for VGA video graphics format and Hewlett-Packard printing.

The MDFATE model is executed by:

- Gaining access to the MDFATE target directory, i.e. C:\MODEL.
- Typing **[MDFATE]** at the DOS prompt and hitting <RETURN>.

#### **Input and Output Data Files for MDFATE**

During execution of MDFATE, the model may access or create a variety of data files. Some of the data files are "permanent" and must be accessed by the program in order to edit, view, or simulate disposal for a particular ODMDS grid of interest. Other data files are considered temporary and are relevant only to the present disposal site configuration and MDFATE simulation activity.

#### **MDFATE Generated Support Files**

Data files created during MDFATE program execution are given filenames which conform to a particular format. These filenames are composed of three segments; disc-drive and directory specification, root name, and extension. Examples of each filename segment are given below:

**Disc-drive & directory specification** = Drive:\Directory\  
(i.e. C:\MODEL\). If no directory is to be specified, then only C:\

**Root name** = six (6) characters, or less, naming the disposal area grid (i.e. MONITR)

**Extension** = three characters indicating data file type (i.e. .IN for ODMDS grid data file)

The above format must be followed whenever the program user is entering MDFATE data file names. Within the operational environment of the MDFATE, file name extensions are appended automatically to the root name when file name entries are made by the user.

File names with extensions .IN, .OUT, .DAT, .TNS, .TIM and .ACT are created by MDFATE when generating a new disposal area grid, or simulating disposal activities within an existing disposal area grid. A description of the above filename extensions is given in Table 1.

Table 1. MDFATE generated filename description according to file extension.

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.IN -> designates a file which contains grid-adapted bathymetric data in X (across grid), Y (up grid), and Z (elevation) format.

.TNS -> designates a \*.IN file which has been converted to the LTFATE and MDFATE viewing utility format.

.OUT -> designates a file which describes overall disposal area grid parameters and bathymetric distribution.

.DAT -> designates a file containing data as contained in the .IN file, but in ASCII format which enables post processing of the MDFATE ODMDS grid by other imaging software.

.TIM -> designates a file specifying the duration (days) of the preceding Short-/Long-term simulation.

.ACT -> designates a file which describes the most recent disposal activities within a simulated disposal area grid and documents locations where horizontal and vertical tolerances have been exceeded.

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All files shown in Table 1 are "permanent" and must not be deleted, unless the particular ODMDS grid (root-name) is no longer used by MDFATE.

#### Optional Data Files - User Supplied

During MDFATE execution, several opportunities arise where the user may specify options which require access to information contained on specific pre-existing data files. MDFATE options which require access to these user supplied files are; A) Use of survey (ASCII) bathymetry data during creation/editing of a MDFATE grid, B) Specification of dump coordinates for individual disposal locations during disposal simulation, C) Generation of

wave field using Wave Information Study (WIS) correlation coefficient matrix for use during disposal simulation, D) Generation tide elevation/current time series from pre-determined constituents for use during disposal simulation. A summary description of the above "optional" data files is shown in Table 2.

Table 2. Optional data files accessed by MDFATE according to file extension.

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6CHAR.3CHAR -> (any six character root name.any three characters extension) -> Survey information used to create/edit ODMDS grid bathymetry. Data is columnar (EASTING,NORTHING,ELEVATION or any combination), each of three columns set apart by spaces.

6CHAR.3CHAR -> (any six character root name.any three characters extension) -> Coordinates defining individual disposal locations. Data is used in one of four positioning/control options during simulation of dredged material disposal. Data is columnar (EASTING,NORTHING or any combination) each of two columns set apart by spaces.

HPDPRE.OUT->WIS datafile describing the 32 (or 20) -year hindcast for the geographic location of interest. Data file is approximately 1.4 MB is size and is accessed by MDFATE to generate a synthetic wave environment during disposal simulation. If this file is unavailable, the user can elect to specify mean wave parameters, or ignore wave effects. If this file is available, it should be located in the same directory as the MDFATE software.

TIDAL.DAT -> Datafile containing tidal constituents for the geographic location of interest. Accessed by MDFATE to generate tidal-induced water elevations/currents. If this file is unavailable, then the user can choose to ignore tidal effects. If this file is available, it should be located in the same directory as the MDFATE software.

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## **MDFATE User Interface**

Execution of MDFATE is controlled by a menu and prompt-input interface similar to that used by ADDAMS (Automated Dredging and Disposal Alternatives Management Simulation, WES). The MDFATE interface contains range checking, defaults, and suggested values for prompted data entry.

### Prompted Input

If an incorrect numeric entry is made, error checking consists of the menu being redisplayed until the correct entry is made. A key rule which must always be followed when operating MDFATE, is that all ALPHA character entries must be typed in UPPER CASE. When using MDFATE it is suggested that the <CAPS LOCK> key be initiated.

MDFATE is operated from a series of menu oriented screens, of which the first is Activity Selection Menu that appears when the command [MDFATE] <ENTER> is keyed at the DOS prompt within the MDFATE target directory.

## Menu Format

At the bottom of each menu is a legend which instructs the user how to move about within each menu and make data entries/selections.

Arrow keys <↑> <↓> are used to move from one data line to another.

- <RETURN> key is used to make data selection.
- <PAGE UP> and <PAGE DOWN> keys are used to move from menu to menu.
- <ESC> key will return the user to the previous activity menu.
- <HOME> key will return user to the first of the secondary menus under the current activity menu.
- <FUNCTION> keys can be used to make selections in some menus.

The Activity Selection Menu (shown in Figure 2) prompts the user to select the desired MDFATE action. There are 6 actions available from the Activity Selection Menu. The Activity Selection Menu (ASM) is the first of three hierarchical menu types. Selection of any one of the first five options in the ASM will result in presentation of a menu specific to the desired option, but resembling the ASM. Within each of the five ASM options, secondary menus are presented, specific to each ASM option. In a few instances, there are simple third order menus which ask for 1 numeric entry with a <RETURN>.

## MDFATE Options

Generally, the first MDFATE activity in which to engage is Option #1 (or <F1> key) - "Create an open water disposal site grid". Generation of an ODMDS grid must first be performed before dredged material disposal can be simulated. After an ODMDS grid is generated, various options are available to view <F4> or edit <F2> the bathymetry and obtain volumes above a given elevation <F5>. Simple geomorphic berm/mound shapes can be easily superimposed on the ODMDS grid <F5>. Of primary importance, is the option of simulating dredged material disposal within an existing ODMDS grid <F3>.

```
Open Water Dredged Material Disposal Site Management and Simulation

MDFATE - Multiple Dump Fate of Dredged Material Placed in Open Water

Activity Selection Menu

F1 - Create an open water disposal site grid.
F2 - Update or edit the bathymetry of an existing site grid.
F3 - Simulate dredged material disposal within an existing grid.
F4 - View MDFATE output; grid bathymetry, disposal summary data.
F5 - Access Utilities for mounds, volumes, or transport rates.
Esc - Quit MDFATE

Use ↑ and ↓ keys to highlight option and then ENTER to select,
or press the selection key of the desired option.
```

Figure 2. MDFATE - Activity Selection Menu

```
Open Water Dredged Material Disposal Site Management and Simulation

MDFATE - Open Water Disposal Area Grid Generation

F1 - Enter name of new disposal area grid to be created.
F2 - Enter DOS path for new disposal site grid file. (Optional)
F3 - Continue with specifying new disposal area grid parameters.
F4 - Create new disposal area grid with specified parameters.
Esc - Return to MDFATE Activity Selection Menu.

NEW GRID FILE:

Use ↑ and ↓ keys to highlight option and then ENTER to select,
or press the selection key of the desired option.
```

Figure 3. Open Water Disposal Area Grid Generation Menu

## Create an Open Water Disposal Site Grid - ASM Option 1 <F1>

Selection of the first ASM option <F1> results with the display of a new menu, "Open Water Disposal Area Generation" (Figure 3). This menu allows for generation of a numerical grid to represent the open water disposal area (ODMDS) of interest.

MDFATE generates a rectangular grid which is intended to coincide with the actual plan configuration of the offshore disposal site. Grid generation is accomplished by utilizing the disposal site's effective corner coordinates, principal axis dimensions, and intended monitoring survey interval to create a grid on which to represent the disposal area. If the disposal site's actual areal planform is not rectangular, then appropriate corner coordinates must be selected in order to encompass the actual site boundaries. Individual grid dimensions are uniform and square. If the disposal area is very large (greater than 10,000 ft on a side), the user should contemplate partitioning very large disposal areas into smaller sub-areas in order to obtain better simulation results through improved grid resolution.

The "Open Water Disposal Area Generation" menu requires designation of a filename <F1> (disc drive and directory <F2>, optional) on which to store the data defining the ODMDS grid. A successful entry in this menu will result in an asterisk '\*' being placed next to the completed action. After naming the ODMDS file, press <F3> to continue specifying grid generation parameters. This results in a secondary menu format in which to specify data.

The first entry in the secondary menu designates which geographic coordinate system (state plane or Latitude-Longitude) to define the disposal area's X and Y data. The second entry concerns specification of the site's dimensions. The geometry of the ODMDS (grid size and axis dimensions) is specified according to whether the ODMDS is coincident with the geographic coordinate system.

If the principal axis of the ODMDS (grid) are coincident with the coordinate system, then the site's northwest corner coordinates are entered along with principal dimensions of the ODMDS (north-south and east-west).

If the principal axis of the ODMDS (grid) are oblique to the coordinate system, then the coordinates for each one of the site's four corners (northwestern, northeast, southwest, and southeast) are entered according to menu prompt. Figure 4 shows different orientations of grid axis with respect to a coordinate system. The disposal site's easterly-westerly and northerly-southerly transect lengths (ft) are calculated. Transects are based upon averaged orthogonal dimensions of the disposal area.



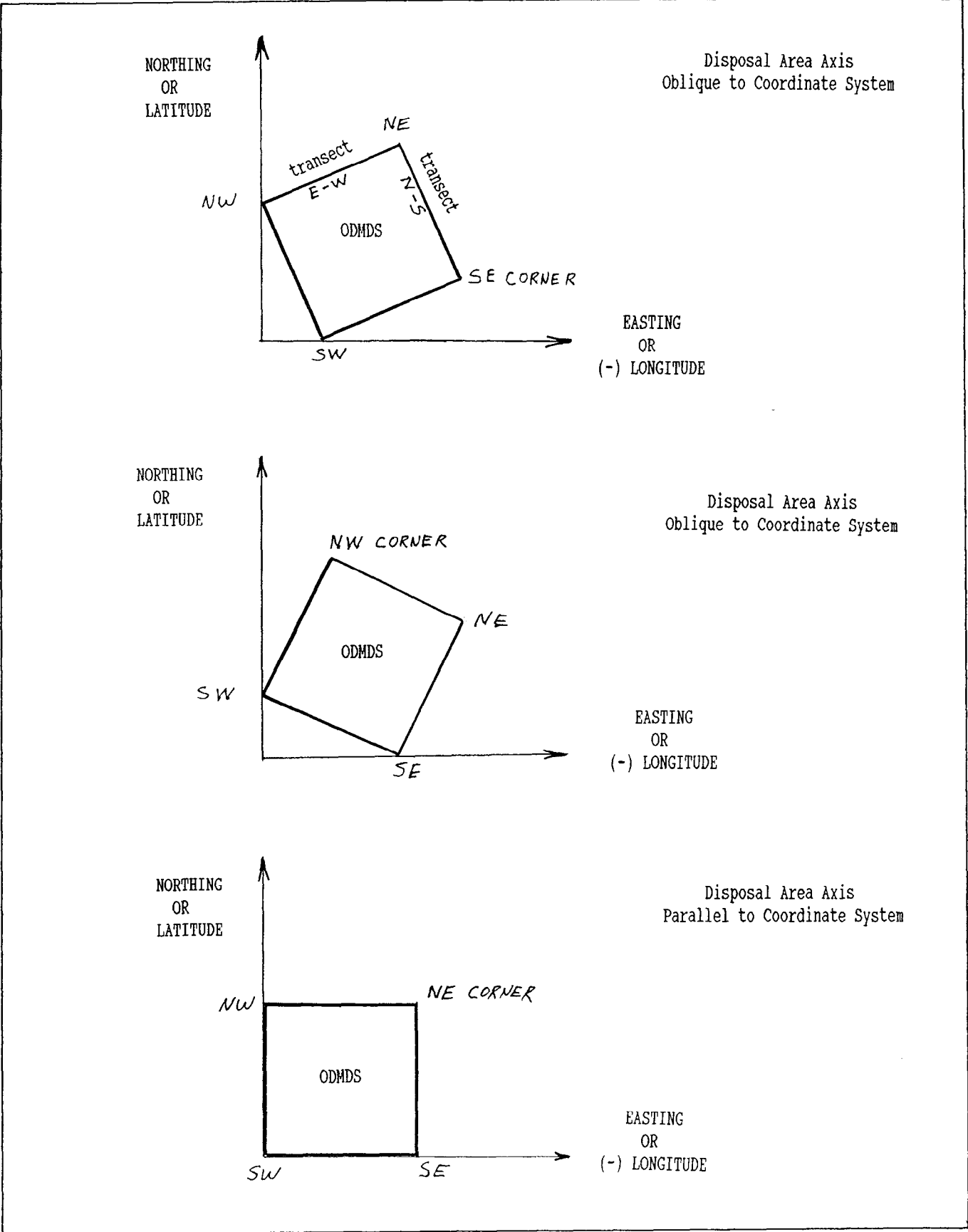


Figure 4. MDFATE grid and coordinate system orientation convention

After specification of the site's overall dimensions, another menu is presented for entry of the ODMDS grid dimension. This value corresponds to the intended survey interval at the actual ODMDS and should be within the range of 50-200 ft. A default value is calculated.

Bathymetry (Z, elevation) data is assumed to be represented in terms of a particular reference datum. Any subsequent modifications of the grid's bathymetry must be with respect to the datum which is utilized during the creation of the disposal area grid. There are two methods for producing bathymetry within a new MDFATE grid;

- A) automatically generating a flat or sloping site bathymetry, or
- B) to overlay survey data from ASCII format consistent with the selected coordinate system.

For a flat/sloping bathymetry, the user is prompted to enter the bathymetric elevation at the "northwest corner" of the disposal area. If there is no bathymetric gradient within the disposal area, then the "northwest corner" bathymetric elevation is assumed to represent the average bathymetric elevation of the entire disposal area. If the bathymetry of the disposal site exhibits a gradient, then this gradient is generated throughout the grid with respect to the "northwest corner". Negative west-to-east bathymetric gradients are entered as positive values, as is for negative north-to-south gradients.

To adapt survey data to a new MDFATE grid, the user enters the complete name of the ASCII file containing the survey data. If the survey file, is not successfully located by MDFATE, the specified name will be cleared from the input field, and the user should re-specify the proper survey file name. The survey data must be coincident with the geographic location of the disposal area and contained in a columnar format. The user specifies which column within the ASCII file corresponds to elevation, north coordinate, and south coordinate. The user also specifies the survey interval. The survey interval of the data should be no larger than 4 times that of the MDFATE grid.

When all of the prompted values from the ASM option (1) secondary menus have been entered, a save menu is presented. The user specifies the elevation format for the site's .DAT file (used for post-processing by other software). The user specifies a title for the new MDFATE grid file. The user then types [OK] at the appropriate prompt and hits <ESC>.

MDFAT-E returns to the main grid generation menu (Figure 5). To generate a new disposal area with the previously defined data, hit <F4>.

Successful generation of the new disposal area grid results in a short listing of the generated grid support files. Hit **<RETURN>** to return to the MDFATE ASM.

#### Update or Edit Site Grid Bathymetry - ASM Option 2 <F2>

Selecting the second ASM option <F2> permits the user to edit or update the bathymetry within a disposal area grid of interest. Upon selecting this ASM option, the user is presented with a secondary action menu, "Open Water Disposal Area Grid Editor" (Figure 5).

Before editing can begin, the user must select an existing grid filename **<F1>** (drive/directory location <F2>, optional). A successful entry will result in an asterisk "\*" being displayed next to the completed action. After successfully naming the ODMDS file, press <F3> to continue specifying editing parameters. This results in a secondary menu format in which to specify data.

The user can edit bathymetry on a point-by-point basis, or update the disposal site's bathymetry by superimposing survey data (ASCII file in columnar format).

Should the user select to edit bathymetric grid points on a point-by-point basis, the user is prompted to enter the number of total grid points to be edited. Grid point coordinates and the associated new bathymetric value are entered for each grid point to be edited. This is repeated until the number of specified grid points has been edited.

If the user elects to update bathymetry by superimposing a survey datafile, the user is prompted to enter the complete filename containing the imported survey data. If the survey file, is not successfully located by MDFATE, the specified name will be cleared from the input field, and the user should re-specify the proper survey file name. The user specifies which column within the ASCII file corresponds to elevation, north coordinate, and south coordinate. The user also specifies the survey interval. The survey interval of the data should be no larger than 4 times that of the MDFATE grid.

When all of the prompted values from the ASM option (2) secondary menus have been entered, a save menu is presented. The user specifies the elevation format for the site's .DAT file (used for post-processing of ODMDS bathymetry by other software). In order to prevent overwriting of the original grid file, the user can specify an alternate grid file name on which to store the edited result or the original grid file. The user specifies a title for the edited MDFATE grid file. The user then types [OK] at the appropriate prompt and hits <ESC>.

MDFATE returns to the main edit menu (Figure 5). To generate an edited version of the original disposal area with the previously defined editing data, hit <F4>.

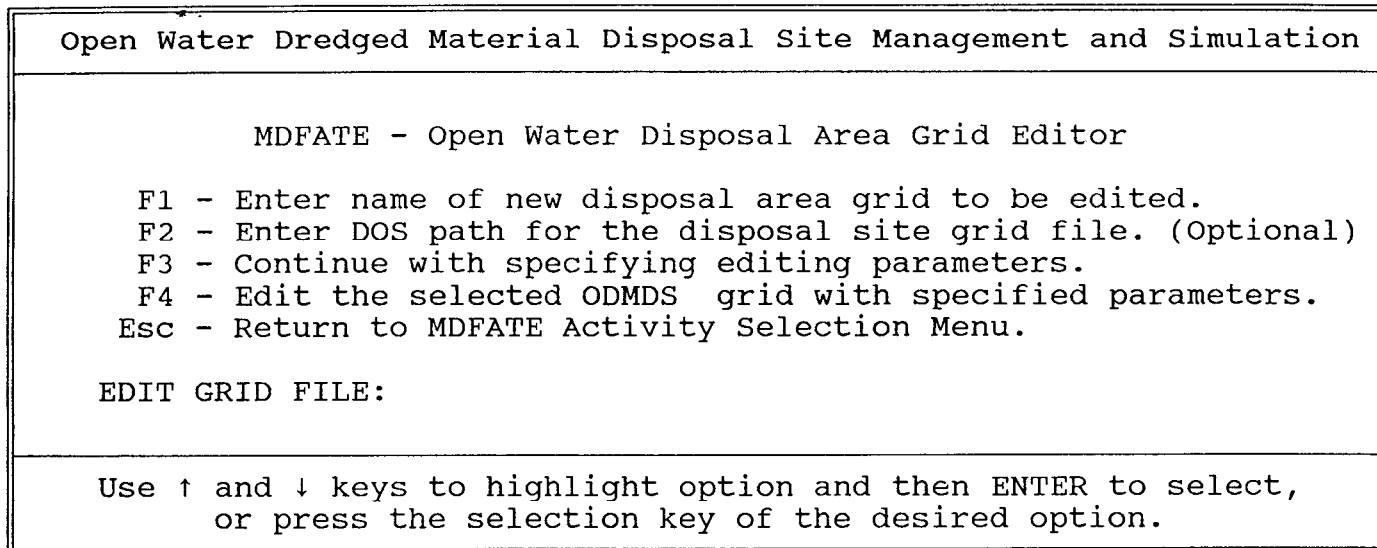


Figure 5. Open Water Disposal Area Grid Editor Menu

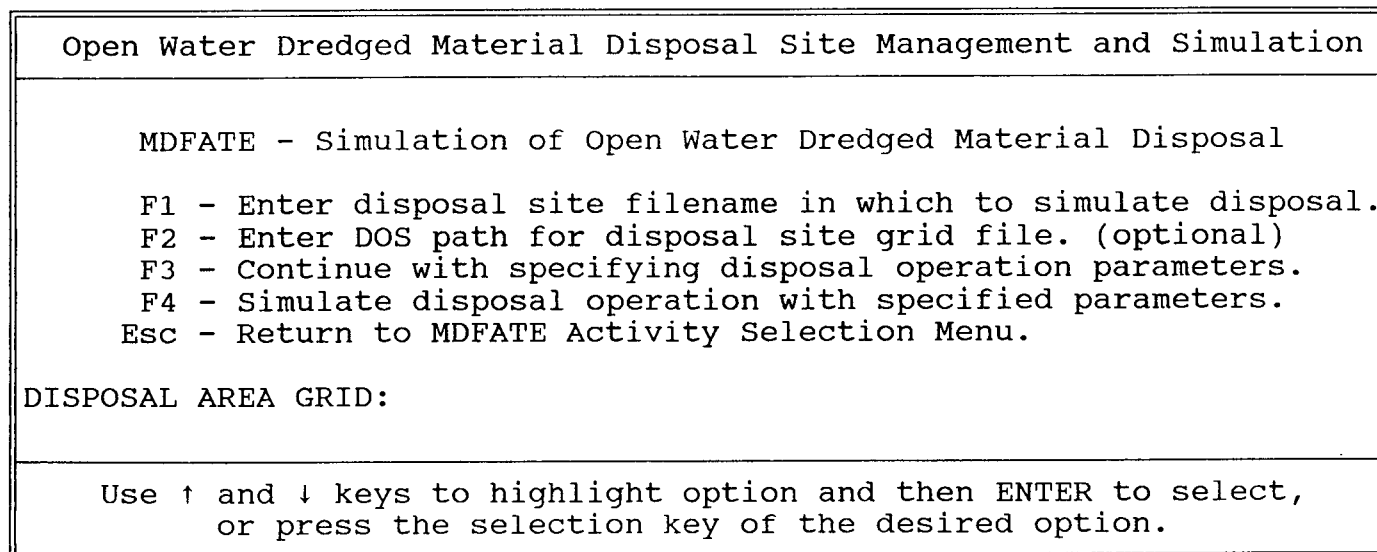


Figure 6. Simulation of Open Water Disposal Dredged Material Disposal Menu

Successful editing of the disposal area grid results in a short listing of the new grid support files. Hit <RETURN> to return to the MDFATE ASM.

#### Simulate Dredged Material Disposal - ASM Option 3 <F3>

All ASM options up to this point are intended to either support formation of a disposal area grid. Selection of the third ASM option <F3> allows the MDFATE to simulate an entire dredged material disposal activity within a pre-existing ODMDS grid.

Upon selecting this ASM option, the user is presented with a secondary action menu, "Simulation of Open Water Dredged Material Disposal" (Figure 6).

Before simulation can begin, the user must select an existing grid filename <F1> (drive/directory location <F2>, optional). A successful entry will result in an asterisk "\*" being displayed next to the completed action. After successfully naming an existing ODMDS file, press <F3> to continue specifying disposal simulation parameters. This results in a secondary menu format in which to specify data.

#### Disposal Simulation Timeframe

The first tier of secondary menu pertains to specifying whether:

.Only long-term fate processes are of interest - material already on seabed, concerned only with sediment transport and consolidation, or

.Short- and long-term fate processes are of interest - material is placed at open water disposal site and is then subject to long-term processes.

After selecting one of the above options, the user specifies whether the dredged material of interest originates from new work or is the result of maintenance. The above specification is used to modify the dredged material avalanching process. New work dredged material may have a steeper angle of repose than maintenance material depending upon dredging/disposal equipment and material type.

Specification of the wave and tidal environment follows the above menu. The wave environment can either be generated by: A) MDFATE through access to the HPDPRE.OUT datafile for the geographic location of interest, B) direct user specification of mean wave parameters, or C) the wave environment is not included in the MDFATE simulation. The tidal environment is generated by MDFATE through access to the TIDAL.DAT datafile for the geographic location of interest. If this data file is not available, then the user chooses to ignore the effect of tides in the MDFATE simulation.

Following specification of waves and tides at the ODMDS, the user responds to several menu queues and prompts. The prompted information is supplemented with concise explanations and suggested values, and is error checked for validity.

### Simulate Only Long-term Fate of Sediments

Should the user elect to simulate only long-term behavior of dredged material already on the seabed, a menu will be displayed which will require specification of the following data:

- . Commencement date to begin longterm simulation.
- . Number of days to simulate longterm effects.
- . Residual (non-tidal) water column and direction.
- . Sediment material type (up to three combined material types) for which to simulate longterm effects upon.

### Simulate Short- and Long-term Fate of Dredged Material

Should the user elect to simulate short- and long-term fate of dredged material placed at a designated open water disposal site, then several menus will be displayed to queue for information regarding:

#### Disposal Equipment

- . Disposal vessel type:
  - > split-hull barge/scow/hopper dredge
  - > multiple bin hopper dredge
- . Disposal vessel operating capacity (average)
- . Vessel Length and beam
- . Loaded and unloaded vessel draft (average)
- . Duration of time required to empty vessel, per load
- . Disposal vessel speed and heading during placement

If a multiple bin hopper dredge is to be modeled, then the following data is queued by MDFATE

- . Total number of hopper "bins" present on dredge
- . Number of bins which are emptied simultaneously
- . Dimensions of individual bin door openings
- . Distance separating bin door opens

#### Disposal Site and Dredged Material Characteristics

- . Navigable depth, above which placed dredged material can not exceed.
- . Distance within disposal site boundaries beyond which placement of dredged material is not permitted.
- . Date (month,year) on which to begin simulated disposal
- . Duration (days) of actual disposal operation
- . Total **time** frame in which to simulate behavior of dredged material (days).
- . Residual (non-tidal) current speed and direction
- . Density of water at dredging site and disposal site
- . Dredged material properties
- . Total dredged material to place

## Disposal Vessel Placement Positioning

• Placement technique used to control positioning of disposal vessel during dredged material release, four options are available.

(1) = Within specified distance (RADIUS) of a pre-determined point (coordinate). User specifies central dump coordinates and allowable disposal radius.

(2) = Along a pre-determined TRANSECT based on beginning and ending coordinates. User specifies beginning and ending dump coordinates.

(3) = Disposal of individual loads is specified on a POINT-BY-POINT basis by the user. User specifies number of dumps (or total disposal volume) and is queued for each dump coordinate location.

(4) = Disposal is controlled by coordinate locations obtained from a specified ASCII FILE. User specifies file name.

When all of the prompted values from the ASM option (3) secondary menus have been entered, a save menu is presented. The user specifies the elevation format for the site's .DAT file (used for post-processing of ODMDS bathymetry by other software). In order to prevent overwriting of the original grid file, the user can specify an alternate grid file name on which to store the simulated result or the original grid file. The user specifies a title for the simulated MDFATE grid file. The user then types [OK] at the appropriate prompt and hits <ESC>.

MDFATE returns to the main disposal simulation menu (Figure 6). To begin disposal simulation of the original disposal area with the previously defined operational data, hit <F4>.

Successful simulation results in a short listing of the new grid support files. Note that a file with the extension .ACT will produced, if short-term fate processes were simulated. This file summarizes the disposal simulation with regard to several key parameters. Hit <RETURN> to return to the MDFATE ASM.

View MDFATE Output and Bathymetry Data - ASM Option 4 <F4>

Selecting the fourth ASM option <F4> permits the user to view the (bathymetry or support files) within a disposal area grid of interest. Upon selecting this ASM option, the user is presented with a secondary action menu, "MDFATE Viewing Utility" (Figure 7).

Before viewing can begin, the user must select an existing grid filename <F1> (drive/directory location <F2>, optional). A successful entry will result in an astrisk "\*" being displayed next to the completed action. After successfully naming the

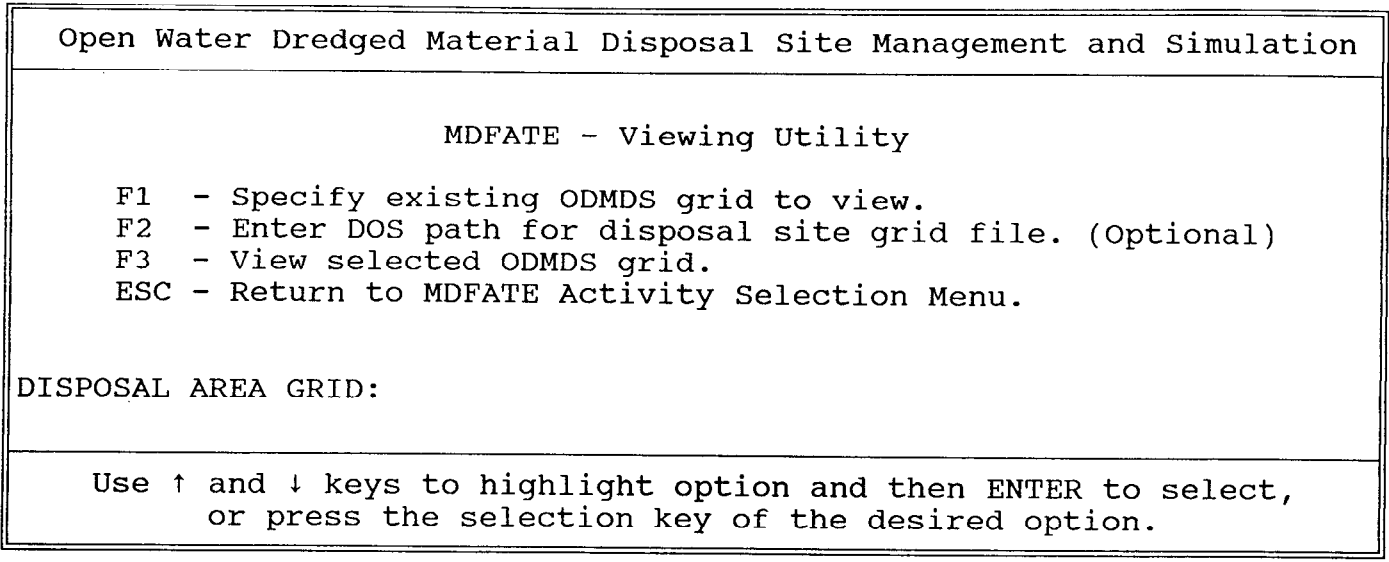


Figure 7. Viewing Utility Menu

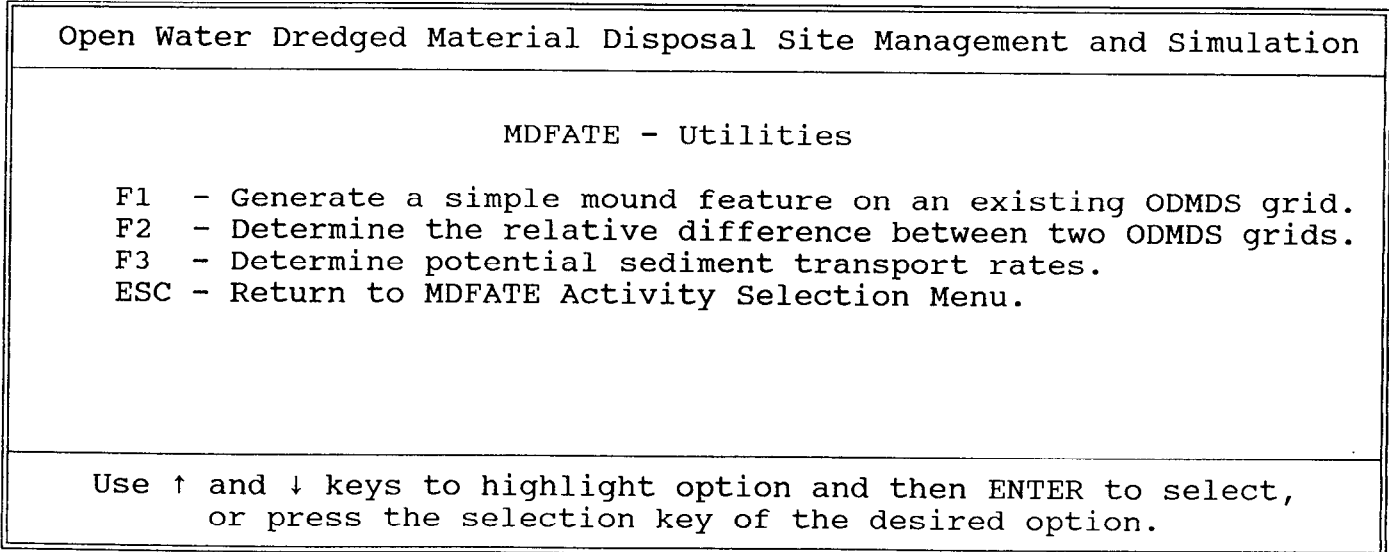


Figure 8. MDFATE - Utilities Menu



ODMDS file, press <F3> to specify viewing selection . This results in a third order menu format in which to specify one of the following viewing choices.

- "1" = 2-D CONTOUR plot of the disposal area seabed
- "2" = 3-D SURFACE plot of the disposal area seabed
- "3" = CROSS-SECTION of the disposal area seabed
- "4" = LISTING of the DISPOSAL operation sequence
- "5" = LISTING of the disposal AREA summary DATA

To make a viewing selection, enter the appropriate number [number] and hit <RETURN>. After viewing the appropriate file, the user is returned to the "MDFATE Viewing Utility" menu.

#### Utilities: Mounds, Volumes, Transport Rates - ASM Option 5 <F5>

Selecting the fifth ASM option <F5> permits the user to access utilities of interest. Upon selecting this ASM option, the user is presented with a secondary action menu, "MDFATE Utilities" (Figure 8).

There are three main **utilities** available. The first two require access to existing ODMDS grids. The third utility, "Determine potential sediment transport rates", does not require access to an existing grid.

Selecting <F1>, "Generate simple mound feature on ODMDS grid" , results in displaying a secondary menu queuing the user for pertinent information. This utility option permits the superposition of an berm or circular mound on the bathymetry of an existing grid. Information required from the user consists of:

Specification of bathymetry feature type to produce

- > circular mound
- > elongated berm

For elongated berm:

- . two coordinate locations to specify ends of berm
- . elevation of berm crest (top)
- . width of berm crest
- . average sideslope of berm (rise:run)

For circular mound:

- . coordinate location for center of mound
- . elevation at top of mound
- . average sideslope of mound (rise:run)

Selecting <F2>, "Determine difference between two grids", results in displaying a secondary menu queuing the user for pertinent information. This utility option permits the calculation of volumes of sediment above a given elevation within a given grid, between two grids, or generation of a difference "surface" between two grids. Information required from the user consists of:

Specification of desired volume/differencing option  
-> determine volume above a given elevation  
-> determine volume difference between two grids  
-> generate a surface describing the difference between two grids

For volume above a given elevation:  
.filename of grid to compute volume  
.elevation above which to compute volume of sediment  
For volume between two grids:  
.filename of "lower" bathymetry grid  
.filename of "upper" bathymetry grid  
(NOTE: both grids must be of the **same** format)  
For difference surface **between** two grids:  
.Same asd above

Selecting **<F3>**, "Determine potential sediment transport rates", results in displaying a third order menu queuing the user for pertinent information. This utility option permits the calculation of volumetric rates of sediment transport for a range of environmental variables. Information required from the user consists of:

- Wave height and period
- Water depth
- Sediment grain size

Sediment transport rates are calculated for a range of depth averaged water column currents. Cohesive and non-cohesive sediment transport relationships are used, depending upon the specified sediment grain size diameter.

Quit MDFATE - **<ESC>**

To quit MDFATE, hit **<ESC>**. The user will be returned to the **DOS** prompt.

### 3. - EXAMPLE APPLICATION OF MDFATE

To demonstrate the usefulness of MDFATE, a hypothetical disposal area will be used to illustrate the execution of the MDFATE options. Each of the options available through the MDFATE Activity Selection Menu (ASM) are independently discussed with regard to the example ODMDS application.

#### **Description of a Hypothetical Disposal Area**

The data used to describe the disposal area- of interest, originates from actual site conditions obtained from a larger offshore disposal area located within the Mid-Atlantic coastal

region of the US. The disposal area will simply be referred to as: ODMDS (Open Water Dredged Material Disposal Site). The data was obtained from the report "Quantitative Assessment of the Fate of Dredged Materials Placed at the Ocean Disposal Area, Cape Fear River, North Carolina", (Boone and Payonk 1991).

The ODMDS is rectangular in areal shape, has dimensions of approximately 2,100 ft (north-south direction) X 2,300 ft (east-west direction), and is located in approximately 43 ft. (average) water depth (MLW). Figure 9 shows the geographic setting of the ODMDS. Other relevant site data include:

- a) pre-disposal bathymetric survey of the disposal area with (X,Y) data in terms of state-plane coordinates and (Z) data in HLW ft (positive)
- b) state-plane coordinate locations documenting the corner locations of the ODMDS are;
  - Northwestern most corner: Easting = 2287700, Northing = 20000
  - Northeastern most corner: Easting = 2290000, Northing = 20000
  - Southwestern most corner: Easting = 2287700, Northing = 17900
  - Southeastern most corner: Easting = 2290000, Northing = 17900
- c) pertinent data defining a proposed dredged material disposal activity which is to take place at the site
- d) WIS information (correlation coefficient matrix) for the ODMDS geographic area.
- e) Tidal harmonic constituents for the ODMDS site.

The survey/monitoring interval for the ODMDS pre-disposal survey was 250 ft. Horizontal control was estimated not to exceed  $\pm 9.8$  ft, vertical control was estimated to be within  $\pm 0.5$  ft.

#### Operational Concerns for Open Water Placement of Dredged Material at the ODMDS Site

This ODMDS has been classified as dispersive. The Port Dredging Authority is concerned that the dredged material proposed to be placed within the relatively small confines of the ODMDS will migrate on to environmentally sensitive bathymetric areas surrounding the site. The ODMDS location was chosen due to its close proximity to the location of dredging. Another disposal area further away from the dredging site is available, but will cause the dredging project to incur substantial costs due to additional dredged material hauling constraints. Due to the close proximity of the ODMDS disposal area to the dredging project (channel limits), there is also some concern of dredged material placed at the ODMDS site migrating back into the channel limits.

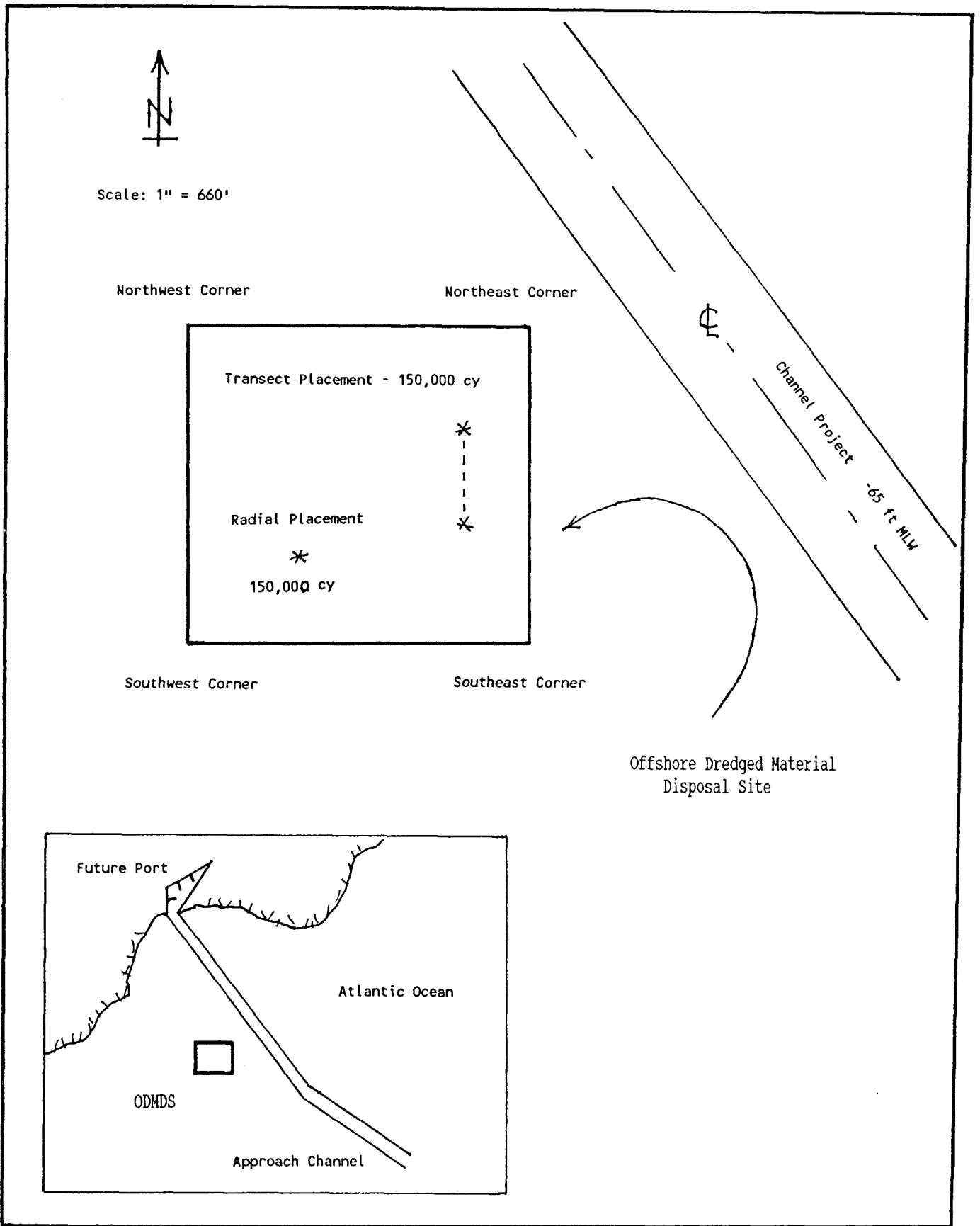


Figure 9. Project Site Map - Fictitious Offshore Disposal Area

A depth averaged water column current is present at the ODMDS offshore disposal area. The current has been estimated to be uniform throughout the water column with magnitude of 0.25 ft/sec and having direction which oscillates with respect to the winter/summer seasons. During the summer, the current flows from northeast -> southwest. During the winter, the current flows from southwest -> northeast. Dredging disposal activities are to transpire during summer. Since the ODMDS disposal area is situated to the southwest of the dredging project (channel entrance), dredging disposal equipment will be approaching the disposal area from the northeast.

The total quantity of dredged material to be placed within the offshore disposal area is estimated to be 300,000 cubic yards (cy). The material type to be dredged from the channel shoals will be composed primarily of fine silt ( $D_{50} = 0.009-0.06$  mm).

Two (2) types of placement configurations have been proposed for the ODMDS:

- 1) placement of dredged material within a specified distance (500ft) of a fixed/moored buoy (coordinate location specified as Easting = 2288563, Northing = 18675).
- 2) placement of dredged material in a berm-like formation, with beginning and ending coordinate locations specified. beginning coordinates as Easting = 2289712, Northing = 18725. Ending coordinates as Easting = 2289712, Northing = 19500.

Each placement geometry is to incorporate 150,000 cy. The dredged material placement equipment to be used for this project will be restricted to bottom-dump scows with capacity of 3,000 cy.

The Port Authority investigates whether the two (2) types of proposed dredged material placement geometries will remain within the ODMDS boundaries for one (1) year after project completion. It is assumed that the water column current is out of the southwest for the entire duration of the long-term simulation in order to determine if placed dredged material will migrate back into the channel limits: as a worst case scenario.

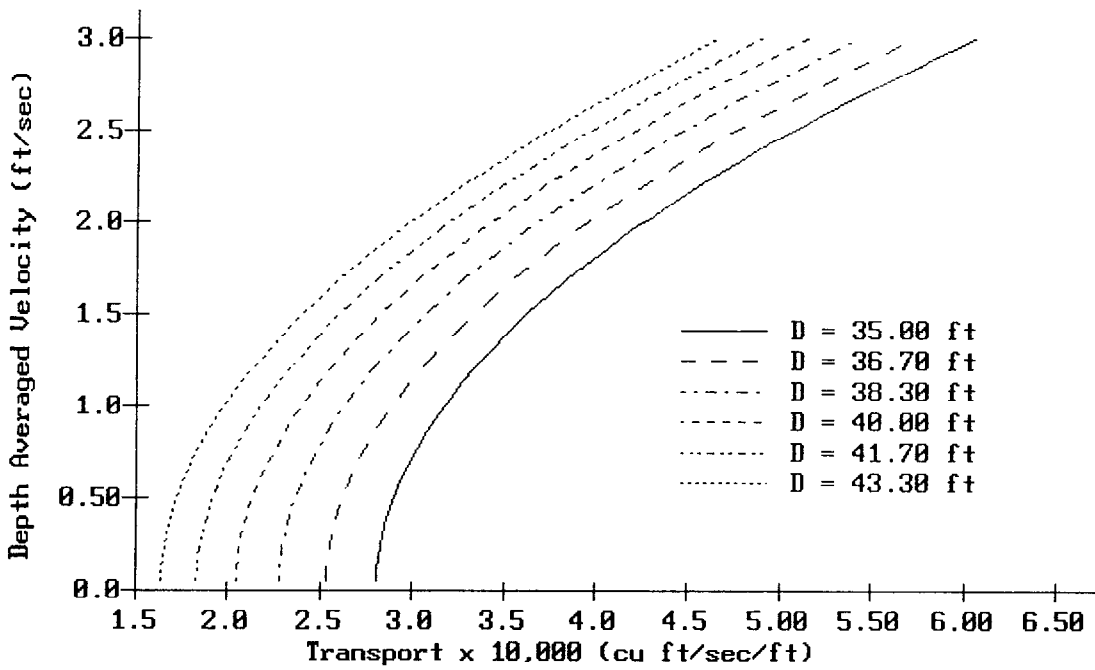
#### MDFATE Sediment Transport Sensitivity Testing

As a qualitative sensitivity test (first step), MDFATE ASM option 5 - "Access utilities for transport rates" is invoked <F5> to determine the potential range of sediment transport rates for the selected ODMDS. Data used in the transport rate prediction utility are:

water depth = 43 - 25 ft  
wave height = 8 ft  
wave period = 6 sec  
sediment diameter = 0.04 mm  
current speed = 0 - 3 ft/sec

SEDIMENT TRANSPORT RATE VS. VARIOUS PARAMETERS  
07-21-1994

D50 = .040 mm, H = 8.0 ft, T = 6.0 sec



SEDIMENT TRANSPORT RATE VS. VARIOUS PARAMETERS  
07-21-1994

D50 = .040 mm, H = 8.0 ft, T = 6.0 sec

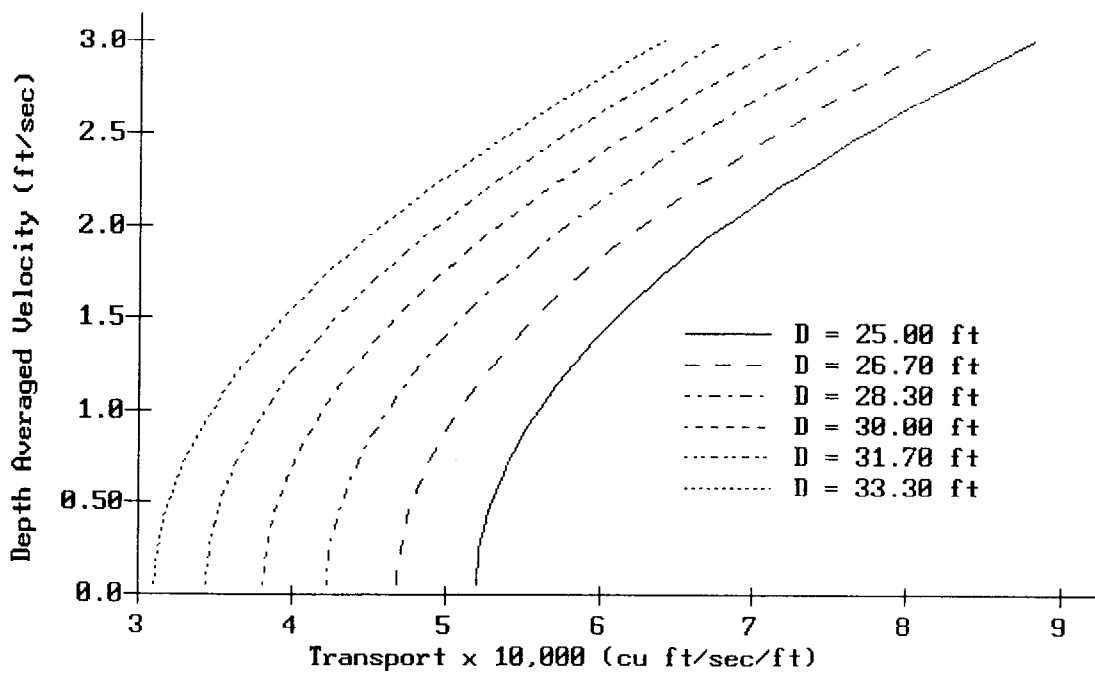


Figure 10. MDFATE predicted sediment transport rates

EASTING	NORTHING	ELEVATION	EASTING	NORTHING	ELEVATION	EASTING	NORTHING	ELEVATION
2288385.	19520.	34.5	2291528.	17967.	42.0	2287929.	18579.	35.5
2288267.	19630.	34.5	2290402.	19013.	40.0	2287771.	18726.	34.0
2288185.	19706.	36.0	2289838.	19536.	39.5	2287706.	18786.	34.0
2288091.	19793.	38.0	2289767.	19602.	39.0	2288364.	17903.	37.5
2287916.	19956.	38.5	2289650.	19711.	38.5	2288211.	18044.	37.5
228838.	17899.	39.5	2289536.	19816.	38.5	2288142.	18108.	36.5
2289756.	17975.	39.0	2289344.	19994.	39.0	2288034.	18209.	35.5
2289658.	18066.	39.5	2287773.	21452.	36.5	2287883.	18349.	37.0
2289501.	18211.	38.5	2287360.	21836.	38.0	2287822.	18406.	36.5
2289364.	18339.	38.5	2291247.	17956.	42.0	2287689.	18529.	34.5
2289270.	18426.	37.0	2290088.	19031.	39.0	2287645.	18570.	34.5
2289153.	18535.	38.0	2289768.	19328.	39.0	2288034.	17936.	37.5
2289066.	18616.	37.0	2289754.	19341.	38.5	2287978.	17988.	37.5
2288951.	18722.	36.0	2289564.	19518.	38.0	2287846.	18110.	38.5
2288854.	18812.	33.5	2289473.	19602.	38.0	2287746.	18203.	39.0
2288728.	18929.	34.0	2289361.	19706.	38.0	2287628.	18313.	38.5
2288639.	19012.	33.0	2289211.	19845.	38.0	2287617.	18323.	38.5
2288536.	19107.	31.0	2289144.	19907.	38.0	2287713.	17961.	39.5
2288428.	19207.	28.0	2290992.	17919.	42.0	2287618.	18049.	40.5
2288307.	19320.	30.0	2289794.	19031.	39.0			
2288194.	19424.	33.0	2289715.	19105.	38.5			
2288082.	19529.	35.0	2289578.	19232.	37.0			
2287975.	19628.	36.0	2289485.	19318.	36.5			
2287889.	19707.	38.0	2289415.	19383.	36.0			
2287779.	19810.	38.5	2289243.	19543.	37.0			
2287631.	19947.	39.0	2289140.	19638.	37.5			
2289488.	17951.	38.5	2289049.	19722.	38.0			
2289419.	18015.	38.0	2288939.	19824.	38.0			
2289287.	18138.	38.5	2288851.	19907.	37.5			
2289221.	18199.	38.5	2290697.	17921.	42.0			
2289080.	18330.	38.0	2290667.	17948.	41.5			
2288970.	18432.	37.5	2289889.	18670.	39.5			
2288859.	18534.	37.5	2289835.	18721.	38.5			
2288756.	18630.	35.0	2289717.	18829.	38.5			
2288656.	18723.	32.0	2289614.	18925.	38.0			
2288574.	18800.	29.5	2289503.	19029.	36.5			
2288394.	18966.	27.5	2289404.	19120.	35.5			
2288311.	19043.	24.5	2289287.	19229.	34.5			
2288256.	19094.	25.5	2289160.	19347.	36.0			
2288104.	19236.	30.0	2289046.	19453.	36.0			
2288017.	19316.	34.5	2288957.	19536.	36.5			
2287946.	19382.	36.5	2288856.	19629.	36.5			
2287828.	19491.	37.5	2288756.	19722.	37.0			
2289228.	17920.	39.0	2288612.	19855.	38.0			
2289126.	18014.	39.0	2288572.	19892.	37.5			
2289039.	18095.	38.5	2290396.	17926.	40.5			
2288910.	18215.	38.0	2290382.	17940.	41.0			
2288789.	18327.	37.0	2289814.	18467.	39.0			
2288671.	18436.	34.5	2289757.	18520.	38.0			
2288585.	18516.	34.5	2289643.	18626.	38.5			
2288480.	18614.	34.0	2289530.	18731.	38.0			
2288362.	18723.	32.5	2289448.	18807.	37.5			
2288289.	18791.	31.5	2289318.	18927.	35.5			
2288168.	18903.	31.0	2289196.	19041.	35.0			
2288056.	19007.	32.5	2289117.	19114.	34.0			
2287915.	19138.	34.0	2289005.	19218.	34.5			
2287861.	19188.	36.0	2288903.	19312.	35.0			
2287726.	19314.	36.0	2288809.	19400.	35.5			
2287596.	19434.	37.5	2288697.	19504.	34.5			
2287569.	19459.	37.5	2288540.	19650.	35.5			
2288937.	17917.	38.0	2288462.	19722.	32.5			
2288822.	18023.	37.5	2288327.	19847.	39.0			
2288731.	18108.	37.5	2288231.	19936.	38.5			
2288620.	18210.	37.0	2290092.	17936.	40.0			
2288510.	18313.	36.0	2290018.	18005.	39.5			
2288417.	18400.	36.0	2289868.	18144.	38.0			
2288289.	18518.	35.0	2289843.	18168.	39.5			
2288189.	18610.	35.0	2289788.	18218.	38.5			
2288064.	18727.	36.0	2289681.	18317.	38.5			
2287999.	18787.	35.0	2289556.	18434.	38.0			
2287915.	18865.	35.5	2289445.	18537.	38.5			
2287724.	19042.	33.5	2289367.	18609.	38.5			
2287676.	19087.	34.5	2289232.	18734.	37.0			
2288635.	17924.	37.5	2289156.	18805.	35.5			
2288547.	18006.	37.0	2289022.	18929.	35.0			
2288404.	18139.	37.0	2288912.	19031.	34.5			
2288325.	18211.	36.5	2288826.	19111.	34.0			
2288207.	18321.	36.0	2288698.	19230.	34.5			
2288138.	18386.	35.5	2288585.	19335.	34.0			
2287975.	18537.	35.5	2288473.	19438.	33.5			

Figure 11. Pre-disposal survey data (ASCII) for ODMDS.

MOUND CONTOUR: PRE-DISPOSAL CONDITIONS

01-21-1992

Time = 0 hr.

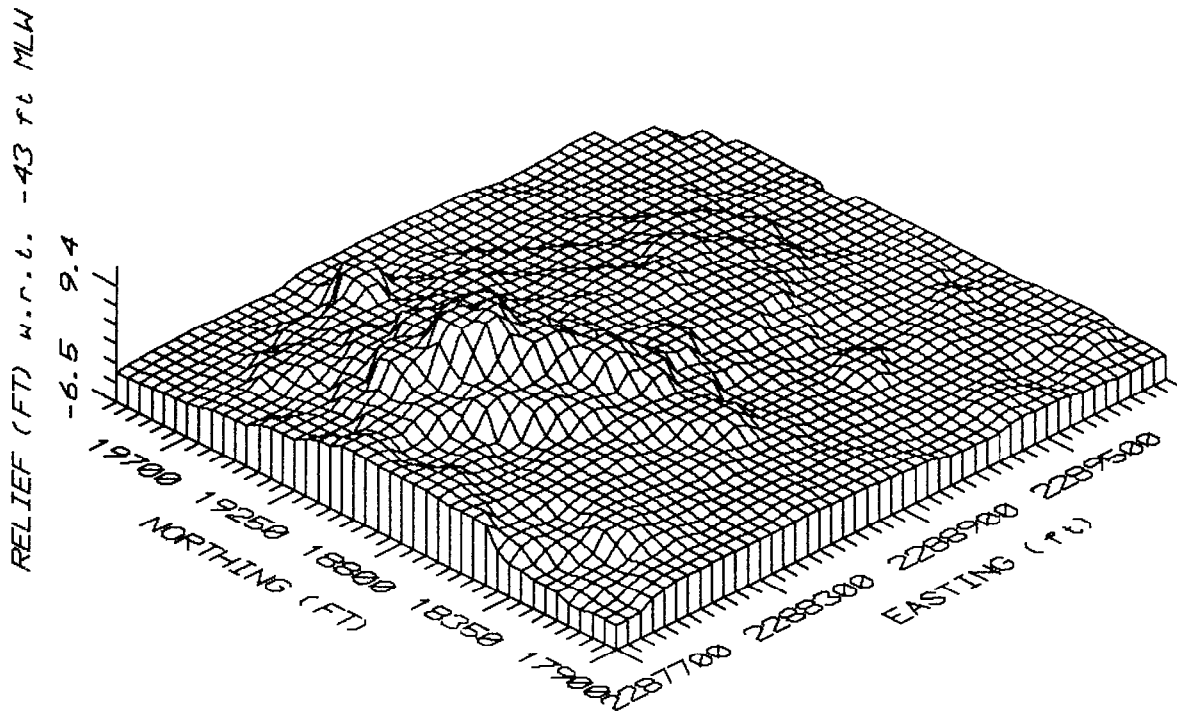
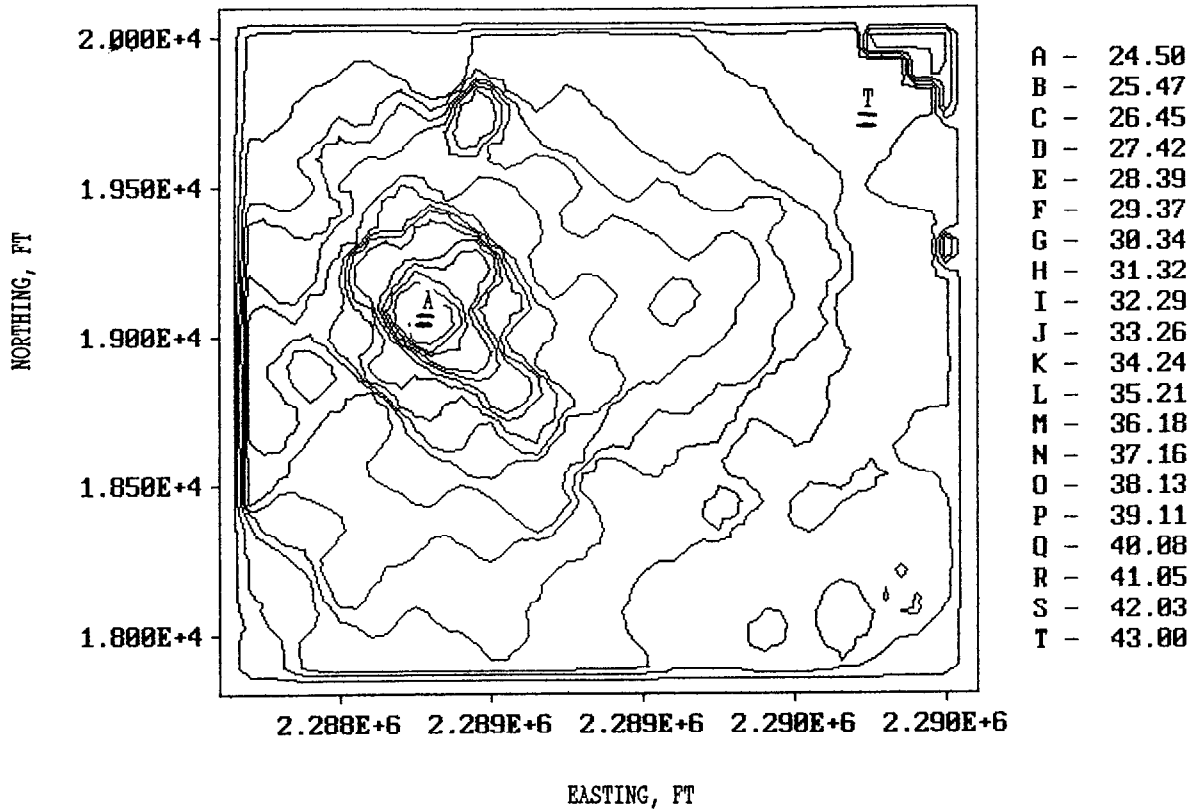


Figure 12. MDFATE generated pre-disposal bathymetry for ODMS



Results of the sediment transport sensitivity test are shown in Figure 10. It is noted that the higher the disposal material mound, the greater the predicted sediment transport rate. A disposal mound with crest elevation at -25 ft MLW will experience approximately 5 times the sediment movement than sediments which maintain a profile near the ambient seabed elevation of -43 ft. From these preliminary results, it seems advisable not to build dredged material mounds higher than say 10 ft above the ambient seabed elevation.

The MDFATE model is used to help better quantify whether dredged sediments placed at the ODMDS, as previously stated, will be operational stable.

### **Utilization of MDFATE to Analyze Dredged Material Placement**

#### Creation of the ODMDS Grid

The MDFATE ASM option 1, "Create a Open Water Disposal Site Grid" is invoked <F1>. The disposal area grid is named ODMDS and located on drive C:\SHOW\. State plan coordinate system is specified for the site. The Easting-Northing coordinates defining the ODMDS disposal area's corners are entered as well as the simulated monitoring/survey interval, which is specified at 100 ft. An irregular site bathymetry was generated, based upon the pre-disposal survey conducted at the actual site. The ASCII data from the pre-disposal survey is shown in Figure 11. Figure 12 shows the topographic (top) and orthographic (bottom) representation of the pre-disposal ODMDS grid, as produced by MDFATE ASM command <F4>.

#### Simulating Dredged Material Disposal at the ODMDS using MDFATE

The MDFATE ASM option 3, "Simulate Dredged Material Disposal", is invoked <F3>. The disposal area directory location and filename specified. This results in the display of disposal data entry menus. The following data is entered in order of encounter. Note that for the MDFATE model must be run separately for the berm and radial placement methods.

##### Simulation Timeframe of Interest

- . Simulate: short- and long-term processes

##### Wave and Tidal Data Specification

- . Use WIS HPDPRE.OUT correlation coefficient matrix to generate wave time series.
- . Use Tidal constituent data file to generate tides/currents

#### Disposal Equipment

- . Disposal vessel type ◦ split-hull barge/scow
- . Disposal vessel operating capacity = 3000 cy
- . Vessel Length = 200 ft
- . Vessel Beam = 50 ft
- . Loaded vessel draft = 15 ft
- . Unloaded vessel draft = 7 ft
- . Duration of time required to empty vessel, per load = 60 sec
- . Disposal vessel speed during placement ◦ 2 ft/sec
- . Disposal vessel heading during placement ◦ 225

#### Disposal Site and Dredged Material Characteristics

- . Navigable depth = (-) 20 ft (MLW)
- . Placement distance within disposal site boundaries ◦ 200 ft
- . Date on which to begin simulated disposal = 06.92
- . Duration of actual disposal operation = 60 days
- . Total time frame in which to simulate behavior of dredged material = 365 days
- . Residual (non-tidal) current speed = 0.25 ft/sec
- . Residual current direction = 45
- . Density of water at dredging site ◦ 1.010 gr/cc
- . Density of water at disposal site ◦ 1.024 gr/cc
- . Dredged material = SILT
  - specific gravity = 2.7
  - concentration (vol) = 0.35
  - fall speed = 0.05 ft/sec
  - critical shear = 0.02 lb/ft<sup>2</sup>
  - cohesive = yes
  - stripping = no
- . Total volume to place = 150,000 t 150,000 ◦ 300,000 cy

#### Disposal Vessel Placement Positioning

- . Radial placement 500 ft about: Easting = 2288563, Northing = 18675)
- . Transect placement from: Easting = 2289712, Northing ◦ 19725 to  
Easting ◦ 2289712, Northing = 19500  
(equivalent transect length of 775 ft)

When all of the prompted values from the ASM option (3) secondary menus have been entered, the save menu is displayed. In order to prevent overwriting of the original grid file (ODMDS), the user can specify an alternate grid file name on which to store the simulated result or the original grid file, say ODMDS1. The user specifies a title for the simulated MDFATE grid file. The user then types [OK] at the appropriate prompt and hits <ESC>. MDFATE then returns to the main disposal simulation menu. To begin disposal simulation of the original disposal area with the previously defined operational data, hit <F4>.

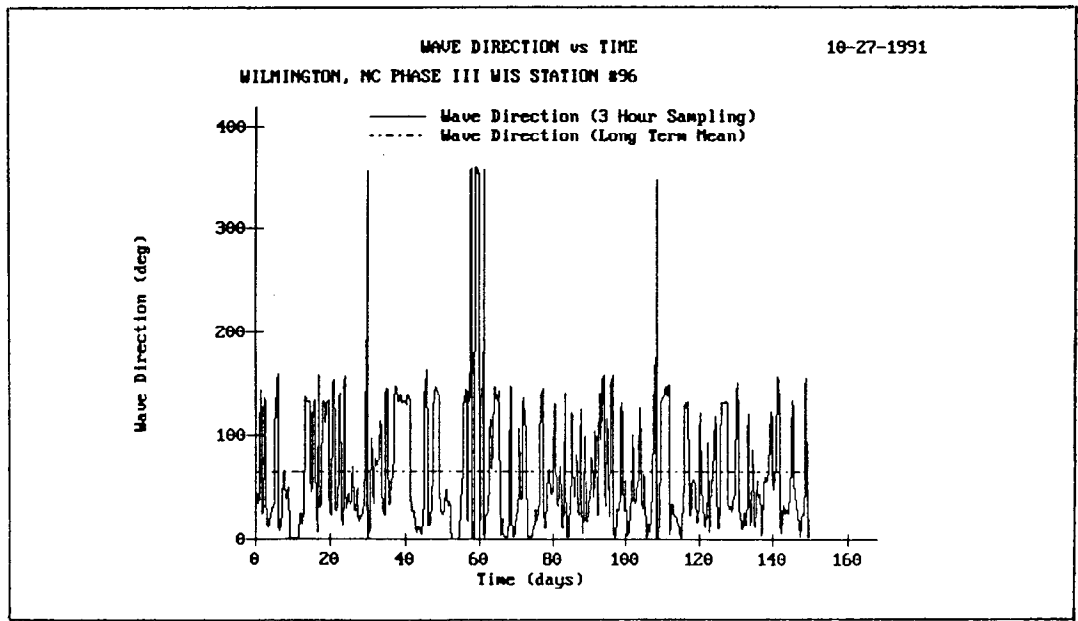
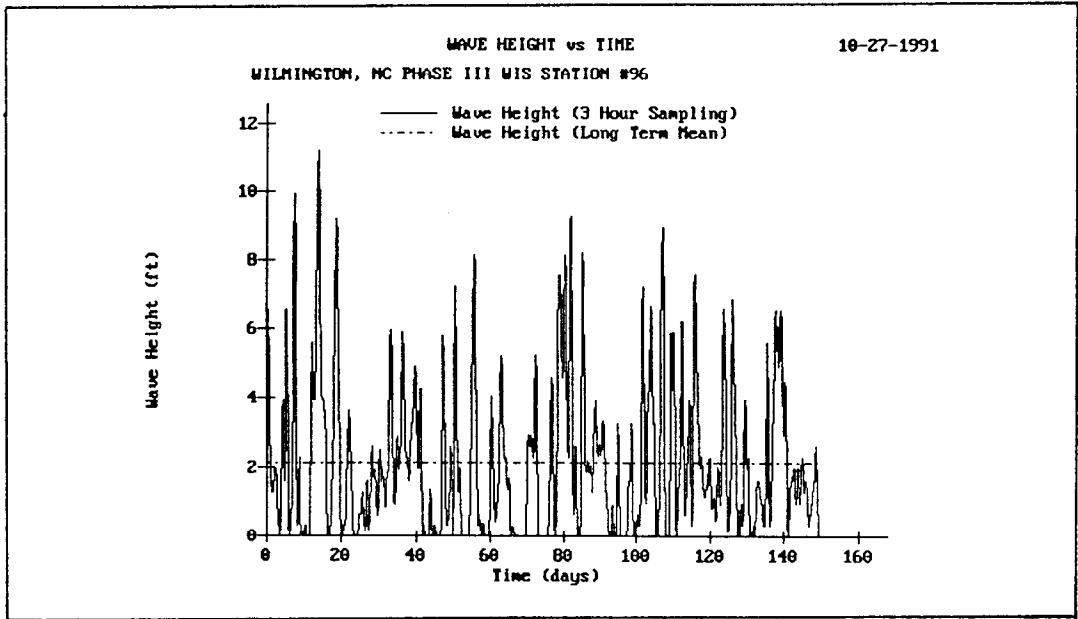
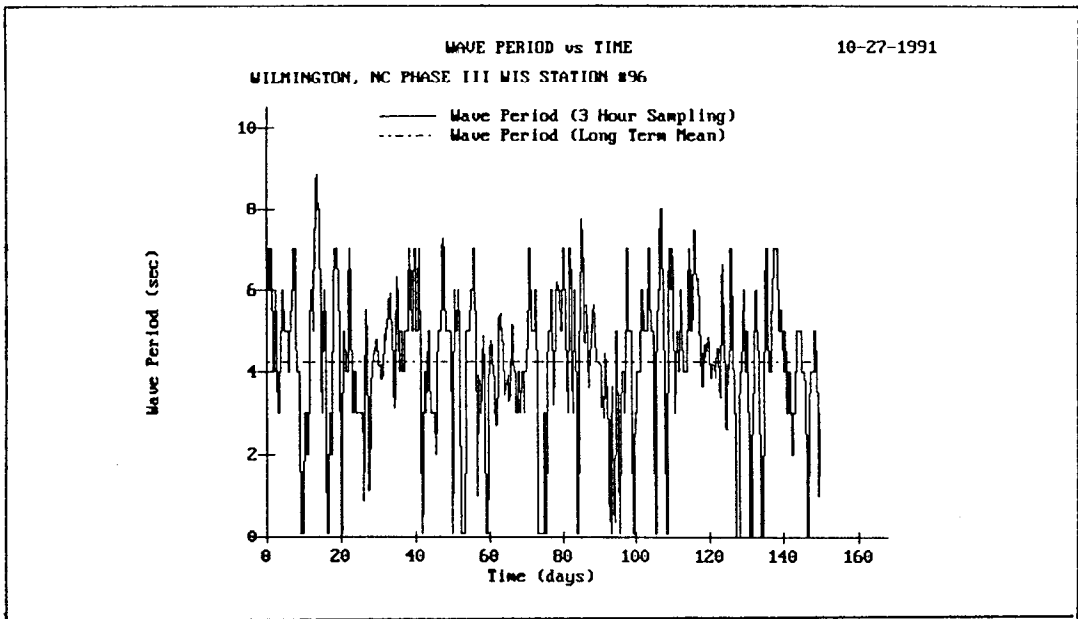


Figure 13. Simulated time series representation for coastal wave environment at Wilmington ODWDS for November 1992 - March 1993

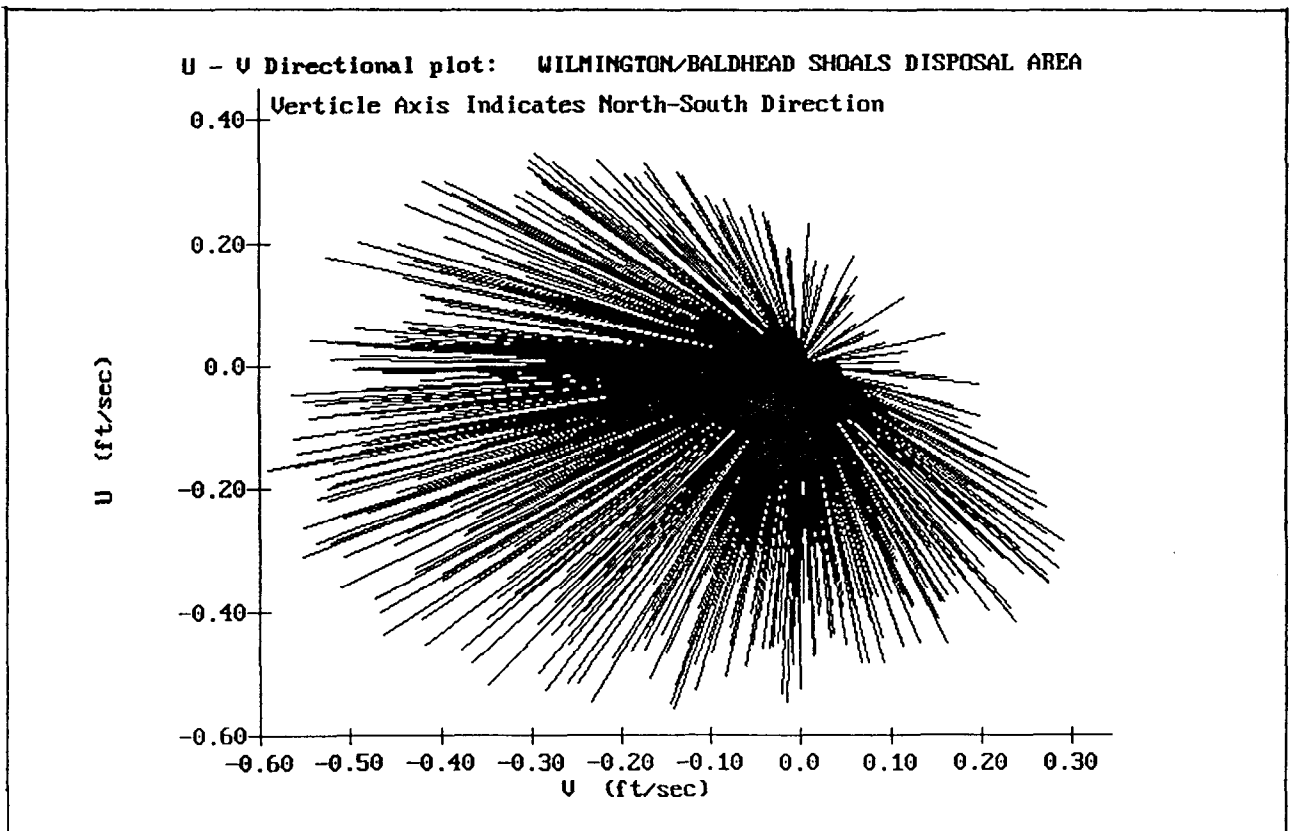
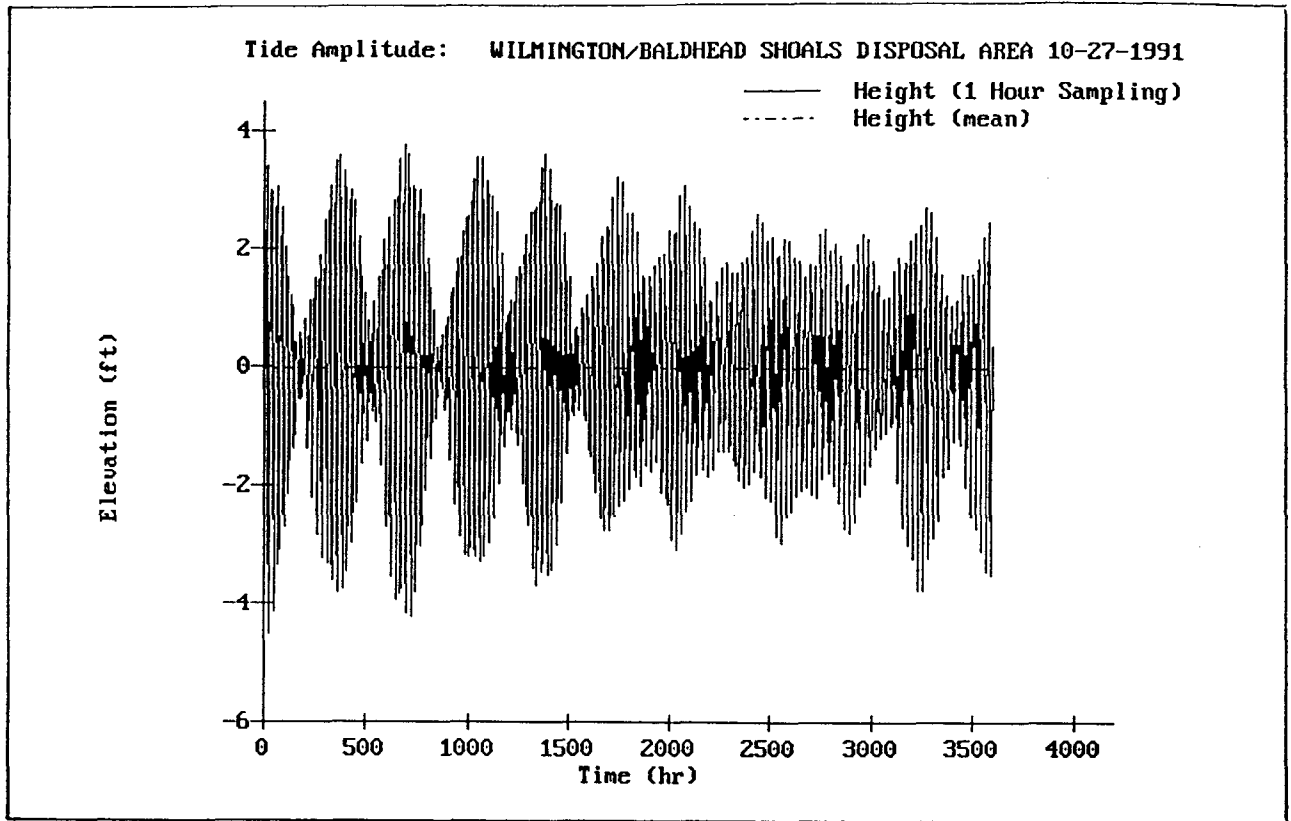


Figure 14. Characterization of tidal environment at Wilmington ODMDS for November 1992 - March 1993

MOUND CONTOUR: POST-DISPOSAL CONDITIONS

81-21-1992

Time = 8,760 hr

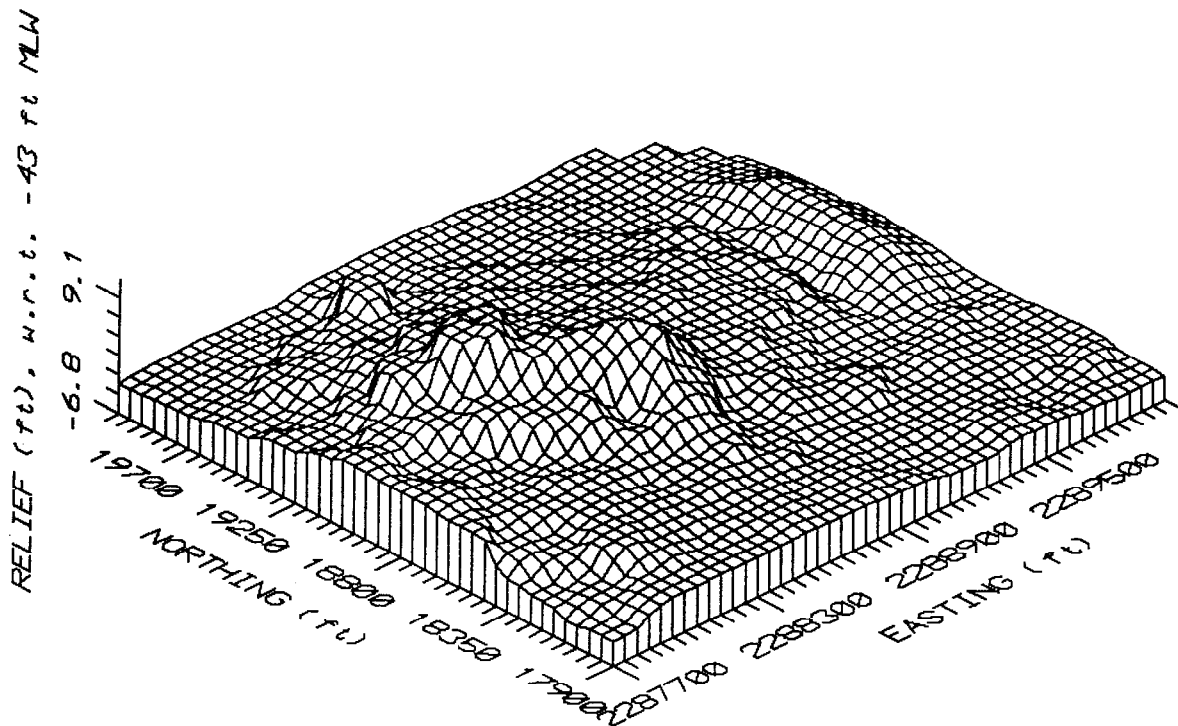
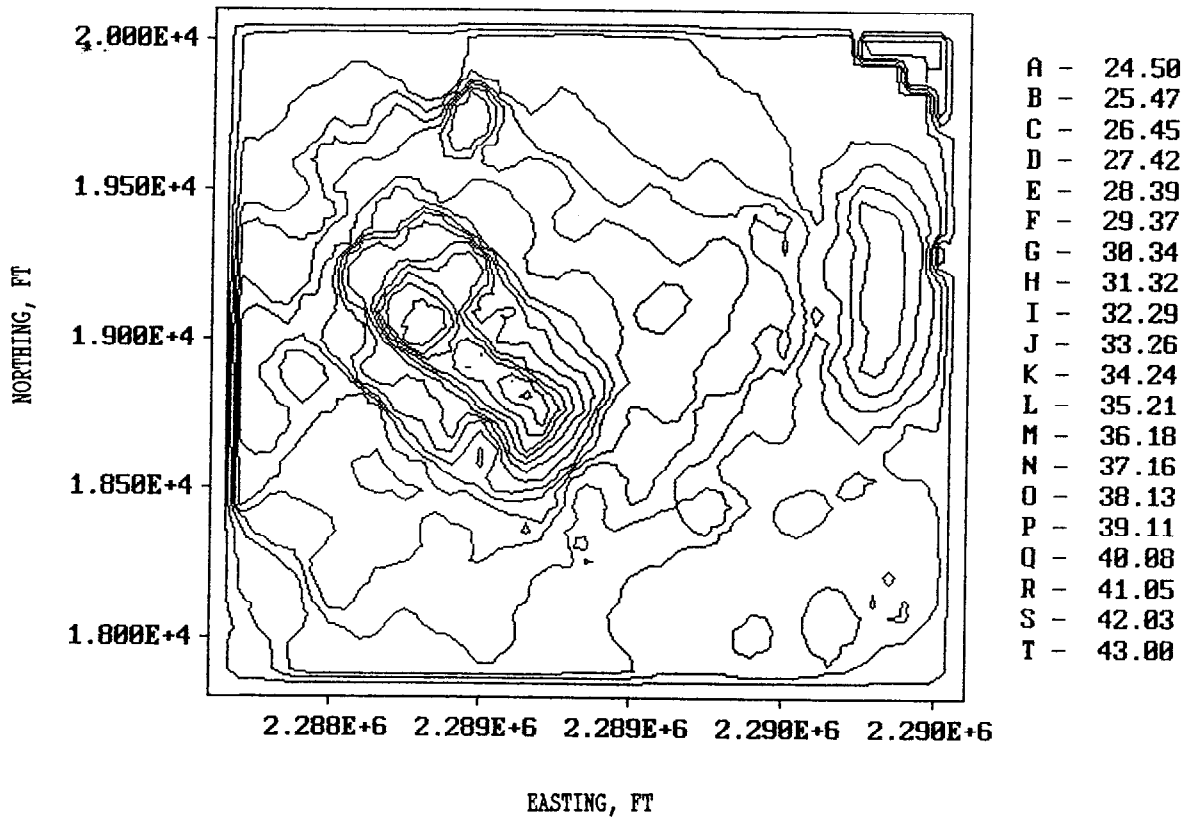


Figure 15. Topographic and orthographic views of the MDFATE generated post-disposal bathymetry

An example of the simulated wave and tidal data time series data is shown in Figures 13 and 14. Successful MDFATE simulation results in an on-screen notification where of: A) each placement (dump) of dredged material occurs, B) how many placements remain for the specified activity, and C) the status of long-term simulation.

#### Results of Example MDFATE Execution

Figure 15 shows a topographic and orthographic representation of the ODMDS1 one year after placement of 300,000 cy of silt dredged material. Note that the simulated mounds are about the same height as the pre-existing bathymetric features and that the berm appears to be migrating out of the ODMDS boundaries. Figures 16 and 17 show the ODMDS.ACT files documenting disposal operational criteria for the "radical" and "transect" placements. Note that no disposals occurred outside of the ODMDS tolerance of 200 ft. There is one grid point which exceeds the navigable depth criteria of (-) 20 ft (MLW).

To more clearly visualize the effect of the 300,000 cy disposal operation, a difference surface is generated showing the change between pre-disposal and post-disposal bathymetries. To do this, MDFATE ASM option 5, "Access utilities for mounds and volumes" is invoked <F5>. With the appearance of this menu, the option of "generating a difference surface between two grids" is entered by hitting <F2> in the Utilities menu. The "lower grid" is specified as the pre-disposal bathymetry, ODMDS. The "upper grid" is specified as the post-disposal bathymetry, ODMDS1. The result can be named anything, say DIFF. The difference surface is shown in figure 18.

Some interesting aspects are apparent from Figure 18. The "mounds" formed during the initial placement of dredged material have shifted to the Northeast, due to the water column current. Scour areas are clearly evident along the leading edge (currentward) of each mound configuration. These scour areas are due to the simulated hydrodynamic flow fields around the "mounds". The "transect placement" berm has begun to migrate out of the ODMDS disposal area grid. This particular disposal alternative may not be acceptable for navigational and environmental reasons. If a berm-style placement is to transpire at the ODMDS, then it should be conducted at the western end of the disposal area.

The entire simulation required approximately 6 hours to run and process (on a standard "386" PC). Therefore, a more powerful computer is recommended for MDFATE applications, say a "486" or higher CPU based PC.

DREDGING PLACEMENT SUMMARY FOR SITE: BSODA1

TYPE OF MATERIAL PLACED AT SITE: SILT  
 AMOUNT MATERIAL PLACED AT SITE: 150000  
 EQUIPMENT USED FOR MATERIAL PLACEMENT: BDSCOW  
 PLACEMENT TECHNIQUE: TOLERANCE/RADIUS  
 DATE OF PLACEMENT COMMENCEMENT: 06/01/92  
 DATE OF PLACEMENT CONCLUSION: 08/01/92  
 NUMBER OF LOADS TO PLACE ALL MATERIAL: 50

LOAD #	PER LOAD VOLUME	LOCATION					
		EASTING	NORTHING				
1	3000	2288450.0	18600.0				
2	3000	2288550.0	18800.0	45	3000	2288450.0	18550.0
3	3000	2289000.0	18550.0	46	3000	2288450.0	18700.0
4	3000	2288950.0	18450.0	47	3000	2288450.0	18700.0
5	3000	2289000.0	18450.0	48	3000	2288500.0	18800.0
6	3000	2288600.0	18750.0	49	3000	2288600.0	18700.0
7	3000	2288650.0	18500.0	50	3000	2288450.0	18650.0
8	3000	2288700.0	18500.0				
9	3000	2288450.0	18650.0				
10	3000	2289050.0	18650.0				
11	3000	2288600.0	18700.0				
12	3000	2288450.0	18800.0				
13	3000	2288650.0	18500.0				
14	3000	2288550.0	18500.0				
15	3000	2288600.0	18700.0				
16	3000	2288500.0	18550.0				
17	3000	2288600.0	18700.0				
18	3000	2288450.0	18800.0				
19	3000	2288950.0	18400.0				
20	3000	2288500.0	18750.0				
21	3000	2288450.0	18700.0				
22	3000	2288450.0	18600.0				
23	3000	2288550.0	18800.0				
24	3000	2288450.0	18800.0				
25	3000	2288450.0	18650.0	2288450.0	18550.0		19.3
26	3000	2288500.0	18500.0				
27	3000	2288550.0	18800.0				
28	3000	2288500.0	18800.0				
29	3000	2289050.0	18650.0				
30	3000	2288500.0	18800.0				
31	3000	2288600.0	18700.0				
32	3000	2288450.0	18550.0				
33	3000	2288500.0	18500.0				
34	3000	2288600.0	18750.0				
35	3000	2288600.0	18500.0				
36	3000	2288600.0	18750.0				
37	3000	2288600.0	18750.0				
38	3000	2288450.0	18650.0				
39	3000	2288600.0	18700.0				
40	3000	2288900.0	18350.0				
41	3000	2288450.0	18700.0				
42	3000	2288450.0	18650.0				
43	3000	2288900.0	18350.0				
44	3000	2288550.0	18500.0				

DREDGING PLACEMENT SUMMARY, CONT.

LOCATIONS WHERE CRITICAL DEPTH HAS BEEN EXCEEDED

CRITICAL DEPTH = 20.0

EASTING      NORTHING      ACTUAL DEPTH(ft)

2288450.0      18550.0      19.3

DREDGING PLACEMENT SUMMARY, CONT.

LOCATIONS WHERE DREDGING PLACEMENTS HAVE BEEN DEPOSITED OUTSIDE THE BOUNDARIES LATERAL TOLERANCE

LATERAL BOUNDARY TOLERANCE = 200

NO DISPOSALS HAVE BEEN PLACED OUTSIDE LATERAL BOUNDARY TOLERANCES

Figure 16. Summary of simulation for "radial" placement of silt at ODMS - ODMS.ACT file

DREDGING PLACEMENT SUMMARY FOR SITE: BSODA1

TYPE OF MATERIAL PLACED AT SITE: SILT  
 AMOUNT MATERIAL PLACED AT SITE: 150000  
 EQUIPMENT USED FOR MATERIAL PLACEMENT: BDSCOW  
 PLACEMENT TECHNIQUE: ALONG TRANSECT  
 DATE OF PLACEMENT COMMENCEMENT: 06/01/92  
 DATE OF PLACEMENT CONCLUSION: 08/01/92  
 NUMBER OF LOADS TO PLACE ALL MATERIAL: 50

LOAD #	PER LOAD VOLUME	LOCATION					
		EASTING	NORTHING				
1	3000	2289700.0	18750.0				
2	3000	2289700.0	18750.0	45	3000	2289700.0	19400.0
3	3000	2289700.0	18750.0	46	3000	2289700.0	19400.0
4	3000	2289700.0	18750.0	47	3000	2289700.0	19400.0
5	3000	2289700.0	18800.0	48	3000	2289700.0	19450.0
6	3000	2289700.0	18800.0	49	3000	2289700.0	19450.0
7	3000	2289700.0	18800.0	50	3000	2289700.0	19450.0
8	3000	2289700.0	18850.0				
9	3000	2289700.0	18850.0				
10	3000	2289700.0	18850.0				
11	3000	2289700.0	18900.0				
12	3000	2289700.0	18900.0				
13	3000	2289700.0	18900.0				
14	3000	2289700.0	18900.0				
15	3000	2289700.0	18950.0				
16	3000	2289700.0	18950.0				
17	3000	2289700.0	18950.0				
18	3000	2289700.0	19000.0				
19	3000	2289700.0	19000.0				
20	3000	2289700.0	19000.0				
21	3000	2289700.0	19050.0				
22	3000	2289700.0	19050.0				
23	3000	2289700.0	19050.0				
24	3000	2289700.0	19050.0	2288450.0	18550.0		19.3
25	3000	2289700.0	19100.0				
26	3000	2289700.0	19100.0				
27	3000	2289700.0	19100.0				
28	3000	2289700.0	19150.0				
29	3000	2289700.0	19150.0				
30	3000	2289700.0	19150.0				
31	3000	2289700.0	19200.0				
32	3000	2289700.0	19200.0				
33	3000	2289700.0	19200.0				
34	3000	2289700.0	19200.0				
35	3000	2289700.0	19250.0				
36	3000	2289700.0	19250.0				
37	3000	2289700.0	19250.0				
38	3000	2289700.0	19300.0				
39	3000	2289700.0	19300.0				
40	3000	2289700.0	19300.0				
41	3000	2289700.0	19350.0				
42	3000	2289700.0	19350.0				
43	3000	2289700.0	19350.0				
44	3000	2289700.0	19350.0				

DREDGING PLACEMENT SUMMARY, CONT.

LOCATIONS WHERE CRITICAL DEPTH HAS BEEN EXCEEDED

CRITICAL DEPTH = 20.0

EASTING      NORTHING      ACTUAL DEPTH(ft)

DREDGING PLACEMENT SUMMARY, CONT.

LOCATIONS WHERE DREDGING PLACEMENTS HAVE BEEN DEPOSITED OUTSIDE THE BOUNDARIES LATERAL TOLERANCE

LATERAL BOUNDARY TOLERANCE = 100

NO DISPOSALS HAVE BEEN PLACED OUTSIDE LATERAL BOUNDARY TOLERANCES

Figure 17. Summary of simulation for "transect" placement of silt at ODMS - ODMS.ACT file,



**MOUND CONTOUR: BATHOMETRIC DISTRIBUTION OF DREDGED MATERIAL**  
 Time = 8,760 hr

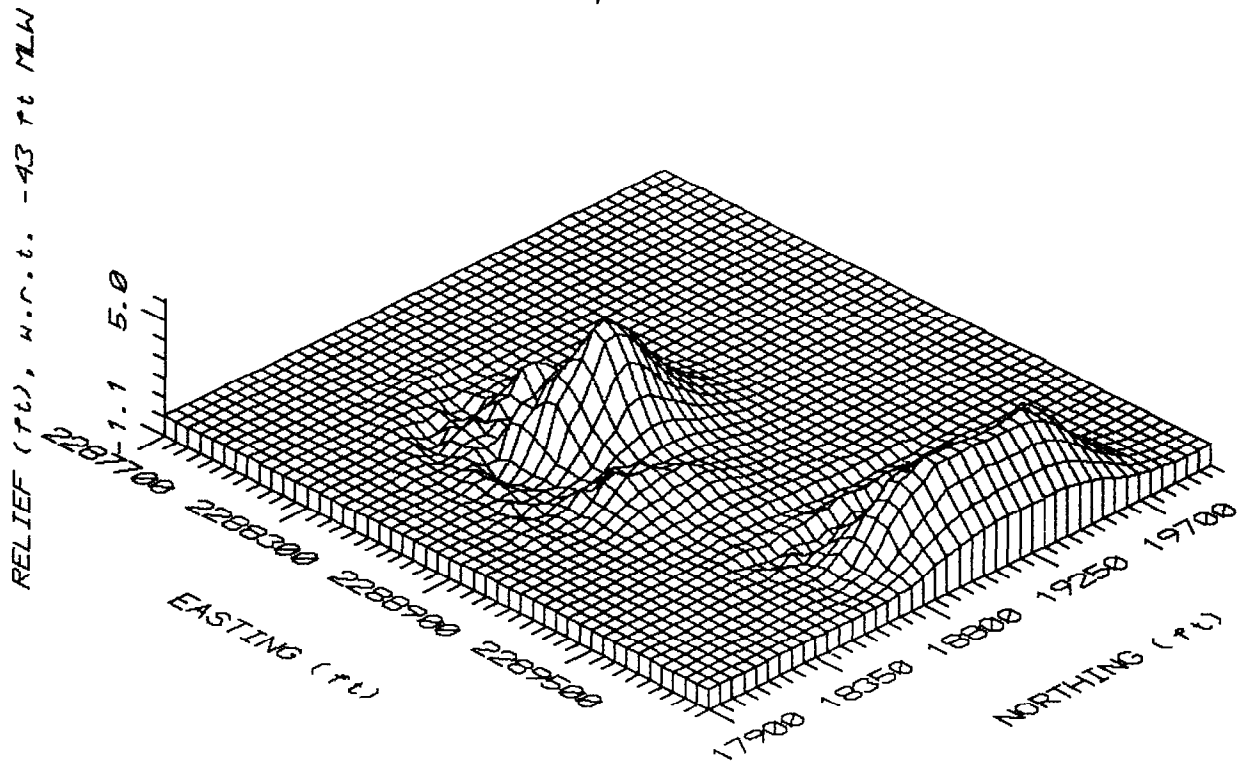
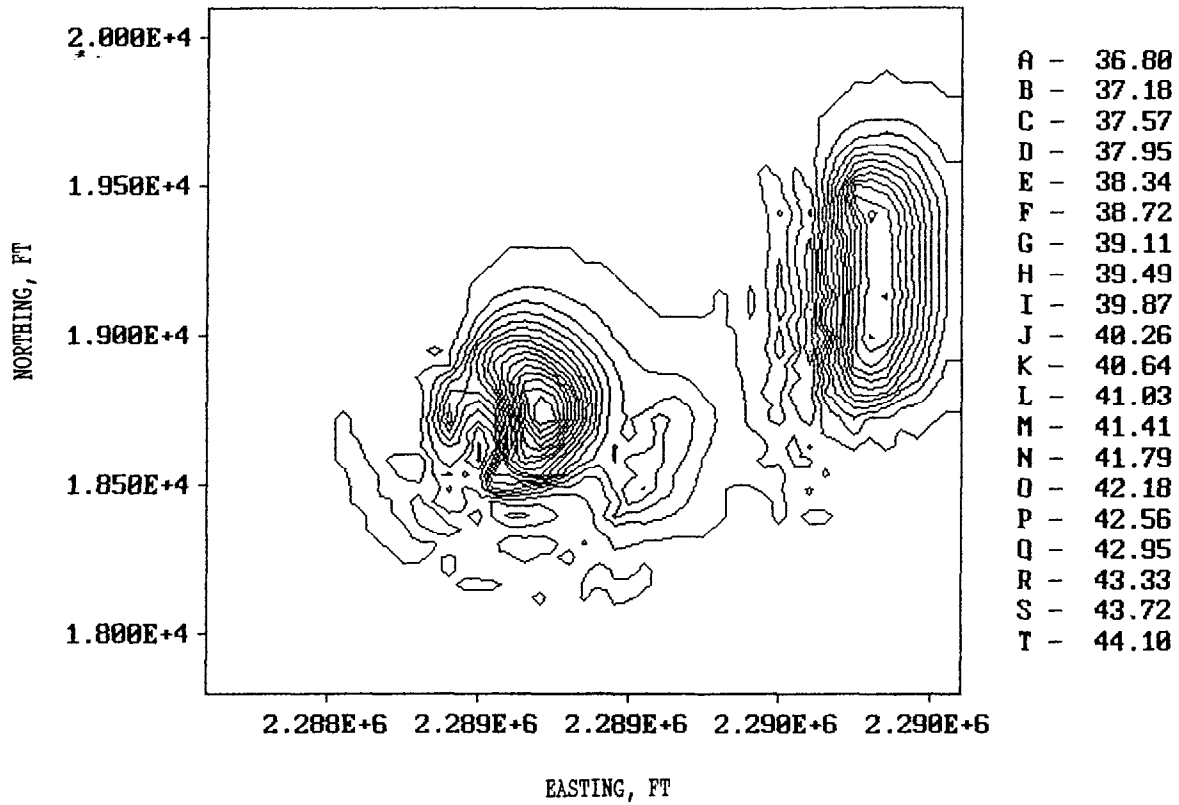


Figure 18. Topographic and orthographic views difference surface between pre- and post-disposal bathymetry.

#### 4. CONCLUSIONS REGARDING BENEFITS OF THE MDFATE MODEL

The manager of an ODMDS must simultaneously address the needs of obtaining regulatory approval for open water disposal of dredged sediments, ensure environmental compliance, and maximize disposal site efficiency. In order to satisfy these constraints, the ODMDS manager must ensure that dredged material placed offshore does not accumulate in a fashion that would pose a navigational hazard, demonstrate that unacceptable adverse impacts to significant resources do not occur, and attain maximum utilization of site volumetric capacity.

Given these operational constraints, the proper management of many disposal sites requires a sophisticated methodology to quantitatively predict and assess the behavior of dredged material placed in ODMDS's.

MDFATE was developed to bridge the gap between the modeling of individual disposal events or "dumps" (for which the STFATE and LTFATE models perform well) and tracking a myriad of disposals that occur within a disposal area over the duration of a disposal site's operative cycle. With the flexible options of MDFATE, many aspects of open water dredging and disposal operations can be examined and predicted at various levels of quantification. Thus, MDFATE should prove to be a valuable asset in the managing of ODMDS's.

Other potential uses for MDFATE include subaqueous capping of contaminated sediments, assessment of feeder berms/nearshore beach nourishment, and assessment of offshore pipeline/cable burying techniques.

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