SPN-D2M2
User's Guide

prepared for
US Army Engineer District, San Francisco

by
Gahagan & Bryant Associates
33 Commercial Blvd.
Novato, CA 94949

in association with
David Ford Consulting Engineer
Rochelle Huff, Computer Consultant

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Introduction

What's in this manual?

The SPN-D2M2 *User's Guide* contains detailed information about using computer program SPN-D2M2-the specialized dredged-material disposal management model developed for the US Army Engineer District, San Francisco. The manual is organized as follows:

- This chapter explains the manual's organization and the special conventions.

- The "Overview of SPN-D2M2" chapter describes, in simple terms, the material management problem that SPN-D2M2 solves and how it does so. The chapter also identifies the data and parameters you have to provide and describes how you do so. Finally, it describes the SPN-D2M2 output: what the program computes and reports.

- The "Installing SPN-D2M2" chapter tells you how to set up SPN-D2M2 on a hard disk on your computer.

- The "Starting, Executing, and Quitting SPN-D2M2" chapter describes the mechanical details of how to use the program.

- The "Preparing SPN-D2M2 Input" chapter describes the program input. You provide all the input on a series of dialog screens; the chapter shows examples of these and describes all the data and parameters.

- "Interpreting SPN-D2M2 Output" describes the general structure of the program output and identifies each element of the reports created by SPN-D2M2.

- Appendix A describes how to create a file that will permit SPN-D2M2 to use your printer properly.

- Appendix B provides tips for troubleshooting, in case SPN-D2M2 fails to find a minimum-cost management plan for the system that you have described.

- The examples in Appendix C chapter illustrate the program's options.

Conventions

This manual uses typographical conventions and some special notation to describe SPN-D2M2. The following formatting in the text identifies special information:

Formatting convention	Type of information
Bold type	Words or characters that you type. For example, if the manual instructs **you** to type **cd spnd2m2** you should type the lowercase letters "cd" followed by a space and lowercase letters "spnd2m2." What you type is always shown in lowercase letters, unless it must be typed in uppercase letters to work properly.
Italic type	Placeholders for items you must supply, such as filenames. For example, when this manual instructs you to type **cd** *directory_name* you should type the letters "cd" followed by a space and then the name of a directory that you chose. Italics are used also for some specialized terms.
Checkbox (☑)	Step-by-step procedures.

The names of the keys on your computer keyboard are shown in this manual in small capital letters. For example, the "Esc" key is shown as ESCAPE. (Note that the keys on your keyboard may not be labeled exactly as they are in this manual, but all keyboards have a key that is equivalent to those shown.) Special keys for SPN-D2M2 include

Keys	Function/comments
Arrow keys ($\uparrow,\downarrow,\leftarrow,\rightarrow$) HOME;END;PAGE UP;PAGE DOWN	These keys control the position of the cursor on the SPN-D2M2 dialog screens. In this manual, the UP ARROW, DOWNARROW,LEFTARROW, and RIGHTARROW keys are described collectively as the DIRECTION keys.
Function keys	These keys, labeled Fl, F2, ,... F12 in this manual, control special features. For example, the F l key provides help with what you are doing. The role of each function key is always shown on screen.
Numeric keypad keys	If you have an extended keyboard, you can enter numbers with the numeric keypad; press the NUM LOCK key first.

Acknowledgments

advice from Darryl Davis of HEC and Brian Heverin of the Philadelphia District, and was programmed by Rochelle Huff.

SPN-D2M2 corrects errors, improves the user interface, and implements modifications to the original program that are required by the San Francisco District for development of a long-term management strategy for San Francisco Bay. Tom Wakeman and other staff of the San Francisco District and Rick Olejniczak of Gahagan & Bryant Associates identified the errors and necessary modifications. Rochelle Huff modified the program, with guidance from David Ford. David Ford prepared this user's manual.

Overview of SPN–D2M2

What will SPN–D2M2 do?

SPN–D2M2 solves the problem of allocating material in a disposal system to minimize the cost (economic or other) of operating the system. It does so by implicitly evaluating all possible management alternatives for the management problem as you describe it.

The figure below illustrates a simple management problem. The disposal (placement) system shown includes a single dredging project and two placement sites. The volume of material that is to be dredged at project X is estimated from historical shoaling and dredging rates. That material can be placed in either disposal site, if that site has sufficient capacity. The arrows in the figure represent the links, via barge, pipeline, or other transportation equipment, between the dredging project and the disposal site.
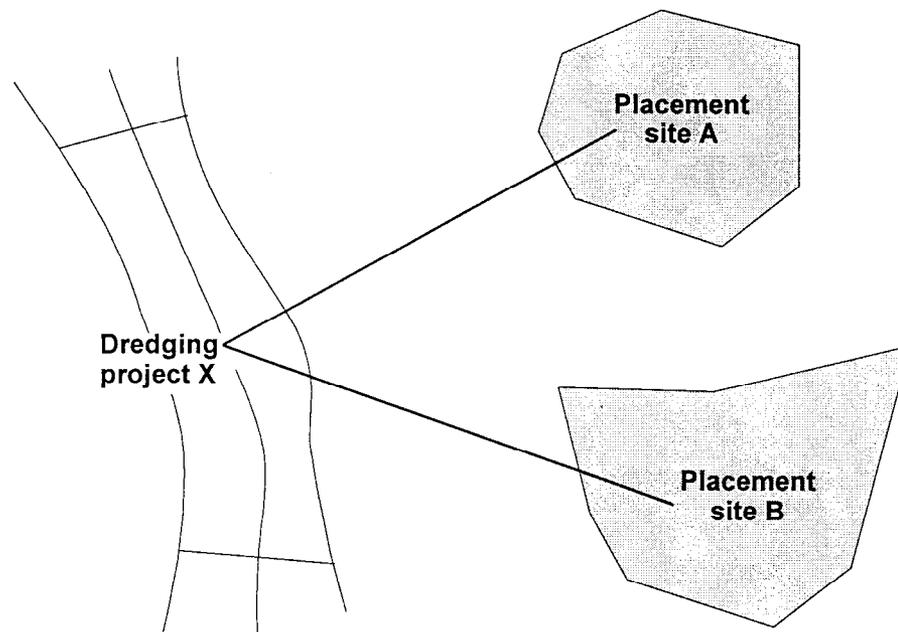
SPN–D2M2 uses a numerical model of the dredging, links, and placement. The core of this is simple volume accounting. In equation form, the volume accounting model for the example system is

$$V_{XA} + V_{XB} = D_X$$

in which V_{XA} = volume dredged at X and placed in site A; V_{XB} = volume dredged at X and placed in site B; and D_X = known volume that must be dredged at X. V_{XA} and V_{XB} must be determined; they are known in system analysis jargon as the *decision variables*.

To be realistic, the model also must include equations to limit these decision variables. In system analysis jargon, these *are constraints*. First, the values of the decision variables must be nonnegative.

$$V_{XA} \geq 0$$

$$V_{XB} \geq 0$$

Second, the total volume placed at each site cannot exceed the capacity of the site. In this example, the only volume placed at A is that transported from X, and the only volume placed at B is that transported from X, so

$$V_{XA} \leq K_A$$

$$V_{XB} \leq K_B$$

in which K_A = the capacity of site A, and K_B = capacity of site B.

For illustration, assume that 10 units of material are dredged at X, and that the capacity of sites A and B are 12 units and 7 units, respectively. What is the solution to the material management problem? In equation form, the management problem is

$$V_{XA} + V_{XB} = 10$$

$$0 \leq V_{XA} \leq 12$$

$$0 \leq V_{XB} \leq 7$$

Clearly many solutions exist to this allocation problem. All material could be placed in site A, or the material could be split between sites A and B. For example, 7 units could be allocated to B and 3 to A, or 6 units could be allocated to B and 4 to A. The chart that follows shows the feasible strategies; any management plan that falls on the line satisfies all the equations. Note that it isn't possible to allocate all 10 units to site B, for that would exceed its capacity. Other allocations are also infeasible, as shown.
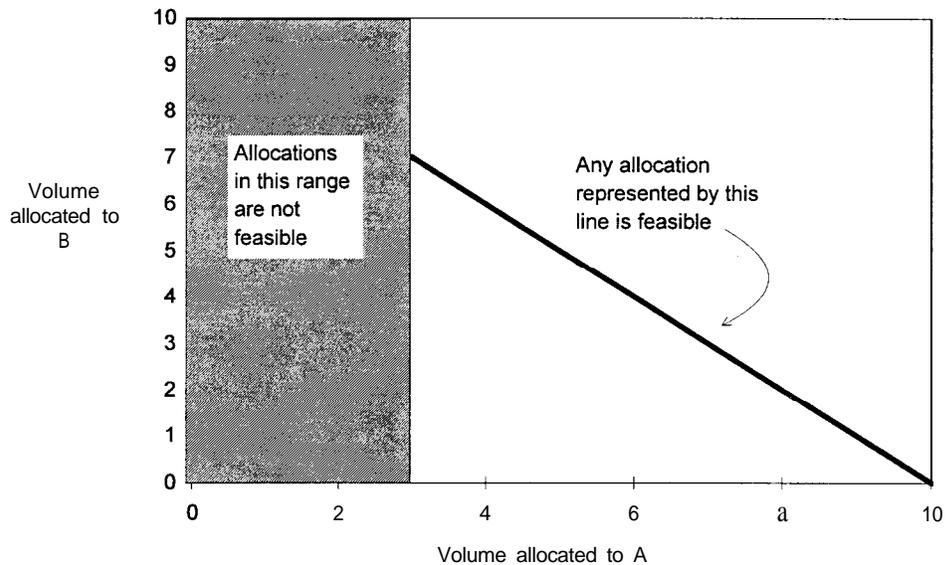
With so many choices then, what's the "best" management strategy for the example? To answer this, a management objective must be defined. If that objective is quantifiable, each feasible allocation can be evaluated in terms of the objective, the resulting values can be compared, and the best solution can be identified.

Suppose for the example that the adverse impact (referred to as cost herein) of placing material in site A is twice that of placing it in site B. The objective then is to find the allocation that minimizes the total cost. This could be represented as

minimize Z = 2 (total volume placed in A) + (total volume placed in B)

In the jargon of system analysis, Z is the *objective function. Now* the performance of each feasible solution can be evaluated with this statement of the objective. The table that follows shows the performance of some of the feasible alternatives.

V_{XA}	V_{XB}	Z
10	0	20
9	1	19
8	2	18
7	3	17
6	4	16
5	5	15
4	6	14
3	7	13

Of these, the best solution is to allocate 7 units to B and the remaining 3 units to A. At this solution, the B is at capacity.

The model described can be expanded to include more placement sites and more dredging projects. To do so, one additional volume-accounting equation is added for each dredging project and one capacity limitation is added for each placement site. As each placement site is added, a measure of the cost of moving material to and using the site also is added to the objective function.

Similarly, system management over time can be analyzed by discretizing time and including a set of volume-accounting equations for each discrete time step. In that case, the volume-accounting equations will be modified to acknowledge that material placed in a site accumulates, thus reducing the volume available in subsequent periods. For the example, the equations for time periods 1 and 2 are

$$V_{XA1} + V_{XB1} = D_{X1}$$
$$V_{XA2} + V_{XB2} = D_{X2}$$
$$V_{XA1} \leq K_A$$
$$V_{XA1} + V_{XA2} \leq K_A$$
$$V_{XB1} \leq K_B$$
$$V_{XB1} + V_{XB2} \leq K_B$$
$$V_{XA1}, V_{XA2}, V_{XB1}, V_{XB2} \geq 0$$

in which V_{XA1}, V_{XA2} = volumes dredged at X and placed at A during time periods 1 and 2, respectively; V_{XB1}, V_{XB2} = volumes dredged at X and placed at B during time periods 1 and 2, respectively; D_{X1}, D_{X2} = known volume to be dredged at X during time periods 1 and 2, respectively. The first and second constraints insure that the total volume dredged will be transported and placed in either site A or B. The third and fourth constraints insure that site A will not be overfilled in either period 1 or 2. Likewise, the fifth and sixth constraints insure that site B will not be overfilled. The sums in the fourth and sixth equations represent the cumulative volume of material placed in each site. If the material consolidates while in the site, these sums can be multiplied by a consolidation factor, which is referred to in SPN-D2M2 as the wet-to-dry ratio.

This example doesn't include either the cost of or limitations on moving material from dredging project X to disposal sites A and B, but SPN-D2M2 can do so. The capacity of and cost/unit volume/unit distance of each type of transportation equipment can be incorporated in the model by adding terms to the volume accounting equation and the objective function and by adding constraint equations.

With the addition of more equations, solution becomes complex. SPN-D2M2 overcomes this with a specialize search procedure: a linear programming (LP) algorithm. The concept of LP is that in the minimum-cost solution, a known number of the decision variables will be at their limits, as defined by the constraints. The LP algorithm systematically evaluates solutions thus defined and compares to find the best long-term management strategy.

Which data and parameters are needed?

In order for SPN-D2M2 to find the best long-term material management strategy, you must provide the following

Category	Data or parameters required
General	Description of the analysis you want, including number of periods, discount rate for economic analysis.
Dredging projects	Location of the project; links with disposal sites and transportation equipment available for links; volume of material dredged each period
Disposal sites	Location of the disposal site; cost and time of acquisition of site; initial material volume in site and material wet-to-dry ratio; site capacity-elevation-area relationship; limits on disposal; unit costs of disposal and OM&R; timing and cost of lease, if site is leased; description of reuse options, if any; and description of transfer-site availability and cost, if any.
Transportation equipment	Distance v. cost per unit volume relationship.
Operation instructions	If you want to force the system to allocate material in a certain manner, you can specify a volume to transport, a dredge site from which to transport it, a disposal site in which to place it, transportation equipment to use, and the period in which to do so.

How are the data and parameters specified?

Like many Corps analysis programs, SPN-D2M2 reads data and parameters from a computer file. However, unlike other programs, SPN-D2M2 prepares this file from information that you enter on a series of dialog screens; these are described in detail in the "Preparing SPN-D2M2 Input" chapter. Furthermore, with SPN-D2M2, you control the sequence in which these screens are displayed, and you decide when you want SPN-D2M2 to carry out the analysis with the information you have provided.

What are the additional special capabilities?

In addition to the capability to find the best management plan for a system of interconnected dredging projects and disposal sites, SPN-D2M2 can (1) model rehandling of material placed in a site, (2) account for site "resting," (3) determine efficient plans for expanding the capacity of a material management system, and (4) restart with a previously-computed initial state of the system.

Rehandling. If material that is placed in a disposal site is subsequently removed from that site and either sold for beneficial use or placed in another site, the material is said to be rehandled. SPN-D2M2 models both cases. Reused material is removed from the system, and a benefit in accrued. Transferred material is relocated with the same system, at a specified cost.

Site resting. This refers to alternating periods of use and non-use. During the periods of non-use, water drains, and material in a disposal site consolidates. This, in turn, may prolong the useful life of the site. SPN-D2M2 will model this resting cycle, when the duration of use and non-use periods is specified.

Capacity expansion. If a material-management system does not have sufficient capacity to accommodate the anticipated volume of material, the volume that is dredged must be reduced, or the capacity of the system must be expanded. SPN-D2M2 will search for the minimum-cost scheme for expanding a system if alternatives are identified and the cost of each is defined. SPN-D2M2 uses an optimization technique know as branch-and-bound enumeration. This technique is described in detail in the paper by Ford (1986).

Restart. SPN-D2M2 requires specification of the initial volume of material in each disposal site. In the case of long-term simulation of system operation, this initial volume may, in fact, be the final volume computed in a previous simulation. For example, suppose you wish to analyze operation for two successive 25-year terms. You might begin analysis of the first 25-year term with various placement sites at the current storage levels. SPN-D2M2 would propose the best management plan then, given the volumes dredged. By accounting for the material throughout the term, it would also compute the volume of material stored in each site at the end of the term. For the second 25-year term, you would begin with these as the initial storage values. In that case, the "restart" capability of SPN-D2M2 will be useful. When invoked, this feature yields a SPN-D2M2 input file identical to the file you prepare for the first analysis, but with initial volumes equal the final volumes computed.

What is computed and reported?

When SPN-D2M2 completes the search for the best long-term management strategy, it creates a file that includes a detailed report of system operation. You can either print that file with the SPN-D2M2 Print option or examine it on screen with the View option.

The SPN-D2M2 output shows, for the optimal strategy, the volume of material that should be moved from each dredging project to each disposal site for each period of analysis and how that material should be moved. It also shows the status of each disposal site for each period.

If the capacity expansion option is used, the output also shows the trial expansion schemes evaluated by SPN-D2M2 and the scheme that is the best of those evaluated.

References

If you are interested in more technical details, consult the following:

- USACE (1984). *Dredged-material Disposal Management Model (D2M2): User's Manual.* Hydrologic Engineering Center, Davis, CA.

- Ford, D.T. (1984) "Dredged-material Disposal Management Model," *Journal of the Water Resources Planning and Management Division,* ASCE, 1 10(1), 57-74.

- Ford, D.T. (1986). "Dredged-material Disposal System Capacity Expansion," *Journal of the Water Resources Planning and Management Division,* ASCE, 112(2), 277-291.

Installing SPN-D2M2

What kind of computer do you need?

SPN-D2M2 is designed to work with modem personal computer (PC) workstations. The software and hardware required includes

- 80386, 80486, or Pentium-base machine. You must also have an Intel or compatible numeric processor;

- Minimum of 4mb available memory;

- MS-DOS or PC-DOS version 3.3 or later. If you intend to run SPN-D2M2 under Microsoft Windows, you must have Windows version 3.00a or a later version.;

- A high-speed, high-capacity hard disk to maintain the SPN-D2M2 internal database; and

- A printer, if you wish to print the reports.

All SPN-D2M2 dialog screens are character-based, so no special display hardware is required.

Making a backup copy of the SPN-D2M2 disks

Before you install SPN-D2M2 on your computer, you may wish to protect your original copy of the SPN-D2M2 diskette by making a backup copy. You **can** use the DOS command **diskcopy** to make the copy. For help using **diskcopy,** consult your DOS user's guide.

Setting up SPN-D2M2

The SPN-D2M2 files are provided on a diskette in a compressed format, along with the SPN-D2M2 Setup program. Setup expands the files and copies them to your hard disk. You must run the Setup program before you can use SPN-D2M2.

☑ *To set up SPN-D2M2*

1 Turn on your computer, if it is not already turned on.

2 Insert the SPN-D2M2 diskette in a diskette drive in your computer. This diskette drive is the *source_drive.*

3 At the DOS command prompt, type

   source_drive:setup   source_drive   destination_drive   printer_type

destination-drive is the hard-disk drive on your computer; Setup will expand the files and store them on that drive. Choices *for printer-type are* **epson** or **hp.** For example, if you put the diskette in the A drive of your computer and you want to store the SPN-D2M2 tiles on the D hard disk and print the output with an Epson printer, type

a:setup a: d: epson

(If you have a printer that is not Epson or HP compatible, you can create a printer-control file for your printer. See Appendix A for instructions.)

4 Press ENTER.

5   Follow any instructions on screen.

Changing your system configuration

For SPN-D2M2 to execute properly on your computer, you may need to modify the contents of your system configuration files. To see if this is necessary, review the contents of the **config.sys** file on your computer. Add the following lines if they are not already there:

files=20
buffers=30

If your config.sys file includes lines specifying more than 20 files or more than 30 buffers, you need not change it.

You can view and edit **config.sys** with any text editor or word processor that will save the results as a plain-text file. This includes the MS-DOS **edit** program that is available with MS-DOS 5.0 and later versions. Consult your DOS user's manual for information on **edit** and **config.sys.**

Please note that if you edit **config.sys,** you must reboot your computer for the changes to take effect.

Starting, Executing, and Quitting SPN-D2M2

Starting SPN-D2M2

Once you have installed SPN-D2M2, you can start work. You can start SPN-D2M2 from the DOS command prompt. When you start SPN-D2M2, it displays a title screen and then the main menu. From there you can create a file or open an existing file and begin the analysis.

❑ *To start SPN-D2M2 in DOS*

1 Turn on you computer if it is not already turned on.

2 At the DOS command prompt, change to the SPN-D2M2 directory by typing **cd spnd2m2**

3 Press ENTER.

4 At the DOS prompt, type **spnd2m2**

5 Press ENTER.

If you are running Microsoft Windows, you can run SPN-D2M2 without exiting Windows. Although SPN-D2M2 was not designed as a Microsoft Windows application, it will execute properly if you start it at the MS-DOS command prompt in a window.

☑ *To start SPN-D2M2 in Windows*

1 Turn on you computer if it is not already turned on.

2 Start Windows. If you have questions about how to do this, consult your Windows user's guide.

3 Run MS-DOS Prompt from Windows. On most systems, MS-DOS Prompt appears as a program item in the Main group in the Windows Program Manager.

4 At the DOS command prompt, change to the SPN-D2M2 directory by typing **cd spnd2m2**

5 Press ENTER.

6 At the DOS prompt, type **spnd2m2**

7 Press ENTER.

Controlling SPN-D2M2 execution with the menus

To control what SPN-D2M2 does, you select commands from menus that are shown on screen. The Main menu, which is shown below, includes commands that control the overall sequence of what SPN-D2M2 does. For example, if you want to open a SPN-D2M2 input file that you created earlier, choose the Open command from this menu.

Press F2 to print a copy of this or any- other screen.

Press F1 for help with any command or dialog screen input box.

Use the F6 and F7 keys to change the _foreground and background colors

Press FIO or select the Exit command to -quit SPN-D2M2.

```
                    ┌─────────────────────────────┐
                    │           SPN-D2M2          │
                    └─────────────────────────────┘

                              1. Open...
                              2. Save...
                              3. Edit...
                              4. Execute...
                              5. View...
                              6. Print...
                              7. Exit



         ███Use arrow keys to highlight selection.  Press <ENTER>███
    1Help  2Prtscr 3      4      5      6Foregr/7Backgr 8      9      10Exit
```

The Edit menu, which is similar, appears when you select the Edit command from the Main menu. It controls the sequence in which you enter the data and parameters required.

☑ *To choose* a command *from a menu*

Use the **UP ARROW** and **DOWN ARROW** keys to select the command. The selected command is indicated by a highlight.

2 Press **ENTER.**

-or-

1   Type the number adjacent to the command you wish to select.

Opening an input file

SPN-D2M2 requires that you provide a file with data and parameters that describe the system you want to analyze. You can either create that file "from scratch," or you can open a file that you earlier created and saved.

☑ To open a previously-saved file in the current directory

1   Choose the Open command from the Main menu.

2   In the Filename box on the Open dialog screen, type the complete name of the file you want to open. For example, to open the file **data.d2i** type **data.d2i.** The filename must be a valid DOS filename. That is, it may be up to eight characters long, and it may include any characters except spaces and the following, which have a special meaning to DOS: * ? / . , ; [ ] + = \ : | < >

-or-

Press **F3** to see a listing of all the tiles in the current directory. Then select one of the files from this list. To do so, use the DIRECTION keys to highlight the file you want and press ENTER

3 Press **F9(or ENTER).**

☑ To open a previously-saved file in another directory

1   Type the full pathname of the file, with drive and directory, in the Filename box on the Open dialog screen. For example, to open the file **data.d2i** in the **temp** directory on the **d drive,** type **d:\temp\data.d2i**

2 Press **F9(or ENTER).**

Editing data

For convenience, the data and parameters that you must provide are categorized as shown here.
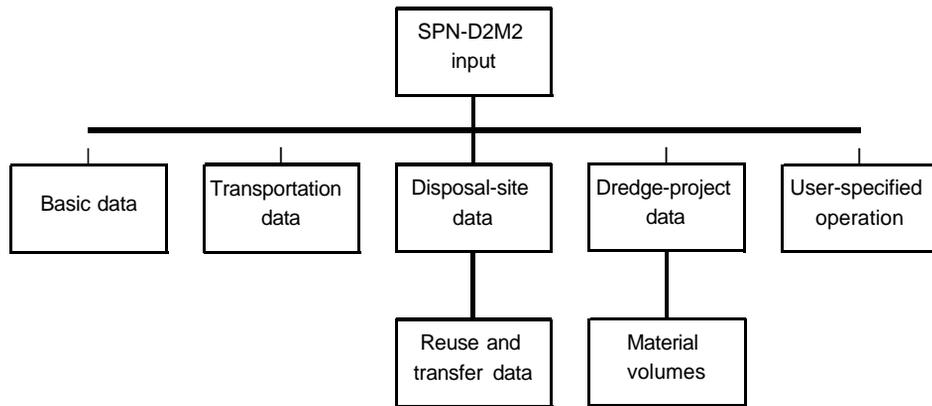
All these data and parameters are entered on dialog screens. Each dialog screen is like a form. You fill in the boxes on the screen to specify how you want SPN-D2M2 to model the system. You can move from box to box on a dialog screen by using the DIRECTION, TAB, HOME, END, and ENTER keys. If you make a mistake when you fill in a box, you can just move the cursor to the box and type the corrected information. You won't always have to fill in every box on every screen. When you've completed all the boxes on a screen, press F9 to accept the values. If you want to return all values on a screen to the way they were, you can cancel the dialog screen by pressing ESCAPE.

Each of the dialog screens is described in detail in the "Preparing SPN-D2M2 Input" chapter.

Saving an input file

When you first enter SPN-D2M2 data and parameters, all your work is held in the computer's memory. This is temporary, because a power interruption or turning off your computer will clear the memory. To save your work permanently, use the Save command to store it on your hard disk or on a diskette.

☑ To save a file for the first time

1 Select the Save command.

2 Type a name for the Filename box on the Save dialog screen. This filename must be a valid DOS filename. For example, type **c:\temp\data.d2i** to save the file **data.d2i** in the **temp** directory on drive C.

3 Press F9 (or ENTER). SPN-D2M2 saves the file and leaves it open so you can continue to work.

Likewise, when you open and edit a file that contains SPN-D2M2 data and parameters, all your work is held in the computer's memory. To save your work permanently, use the Save command to store it on your hard disk or on a diskette. Save frequently to protect yourself from loss of work and time.

☑ *To save a file that you have edited*

1   Select the Save command.

2   If the name shown in the Save box is correct, go to the next step. Otherwise, type a name for the file in the Save box.

3   Press **F9** (or **ENTER**). SPN-D2M2 saves all changes made since the last time you saved the file, and the file is left open so you can continue to work.

Getting help

While you are using SPN-D2M2, you may have questions about menu options or input boxes and dialog screens. To help you, SPN-D2M2 includes extensive on-line documentation. SPN-D2M2 selects an appropriate topic from this documentation for you, based on what you're currently doing. For example, if you are filling in the latitude and longitude input box on a Disposal-site Data dialog screen, SPN-D2M2 displays the Help topic for that input box. The figure below is an example.


```
                      Disposal-site Data - 1/2
  ┌────────────────────────────────────────────────────────────────┐
ID│ Latitude, Longitude (Disposal-site Data screen 1/2)            │
  │ ────────────────────────────────────────────────────────────── │
LO│                                                                  │
La│ These values define the location of the site for computation of │
Lo│ the distance between dredge site and disposal site.  For a      │
  │ large site, you should select and describe a point that will    │
  │ represent well the average distance that material must be moved. │
SI│                                                                  │
Ac│ Specify longitude and latitude as 7-digit integers. Use the     │
Ex│ form, dddmmss, in which ddd is the location in degrees, mm is    │
Ea│ the location in minutes, and ss is the location in seconds.  Use │
La│ + for north latitude, - for south latitude, + for west          │
# │ longitude, and - for east longitude.                            │
# │                                                                  │
  │ For example, a point near Alcatraz Island is at latitude 37      │
ST│ degrees, 49 minutes and 25 seconds north and longitude 122 degrees,│
In│                                                                  │
We│                              Press PAGE DOWN for next screen.    │
  └────────────────────────────────────────────────────────────────┘
                       Press any key to continue.
  1Help  2Prtscr 3        4DelRow 5InsRow 6       7        8Delete 9 OK    10Menu
                                                           INSERT
```

☑ *To get he/p related to what you are doing*

1 Press **Fl**.

2 Press **PAGE DOWN** or **PAGE UP** if the topic is longer that one screen.

3 Press **ESCAPE** to clear the Help topic and continue.

Executing SPN-D2M2 to find the best material-management strategy

Once you've entered the necessary data and parameters on the SPN-D2M2 dialog screens, you're ready to execute SPN-D2M2 so it can find the minimum-cost management strategy.

☑ *To execute SPN-D2M2*

1 Select Execute from the Main menu

2 Press **ENTER.**

3 When SPN-D2M2 finds the minimum-cost management strategy, it prepares a detailed report of that strategy. The report is stored in a computer file that you may view on screen. You must name the file in which the report will be stored. If the name shown in the Filename box on the Output File dialog screen is acceptable, go to the next step. Otherwise, type a name for the file.

4 Press **F9(or ENTER).**

   After this last step SPN-D2M2 will begin execution. The time that is required depends on the speed of your computer and the size of the disposal system you are modeling. You don't need to monitor the execution: SPN-D2M2 is preparing a report of the best management strategy. You can view or print that report at your convenience.

Viewing the report

As noted, when SPN-D2M2 finds the minimum-cost management strategy, it prepares a detailed report of that strategy. You may view that report on screen.

☑ *To view the SPN-D2M2 output report*

1 Select the View command from the Main menu, using the **UP ARROW** or **DOWN ARROW** keys.

2 Press **ENTER.**

3 If the name shown in the View box is correct, go to the next step. Otherwise, type a name for the output file that you want to view in the View box.

`4 PreSS F9(or ENTER).`

SPN-D2M2 displays the output on screen by using the LIST program. The program, which is licensed to the Corps from Vernon Buerg, provides you with capability to scroll quickly through the lengthy output and to search for items of interest. You use the `DIRECTION, PAGE UP,` and `PAGE DOWN` keys to view the output, just as you use these keys with other SPN-D2M2 menus and dialog screens.

Printing the report

After you have executed SPN-D2M2 to find the best management strategy, you can print the report that defines the details of this strategy. The output file created by SPN-D2M2 contains lines that have 132 characters. These long lines will "wrap around" on most PC printers unless special codes are sent to the printer to select smaller fonts and to reorient the printed page. If you installed SPN-D2M2 according to the instructions in the "Starting, Executing, and Quitting SPN-D2M2" chapter, a specialized program was installed on your PC to send these codes to your HP-compatible or Epson-compatible printer.

☑ *To print the SPN-D2M2 output report*

1   Select the Print command from the Main menu, using the **UP ARROW** or **DOWN ARROW** keys.

2   Press **ENTER.**

If you prefer, you can open the SPN-D2M2 output file with your word processor, and print it from within the word processor. That will allow you to select alternative fonts, alter the margins, etc. For instructions on how to do this, consult you word processor's user's manual.

Quitting SPN-D2M2

When you are finished using SPN-D2M2, you can exit by returning to the Main menu and selecting Exit. You can always return to the Main menu by pressing **ESCAPE.** You may have to press **ESCAPE** more than once to return to the Main menu if you are editing input.

Preparing SPN-D2M2 Input

Structure of the input

The SPN-D2M2 input consists of a description of each dredging project, each disposal site, each type of transportation equipment that may link dredging projects and disposal sites, any user specified operation instructions, and some basic information for economic analysis and model setup. You provide the description, data, and parameters by completing dialog screens.

☑ To choose what you want to edit

1   Use the **UP ARROW** and **DOWN ARROW** keys to select Edit from the Main menu.

2   Press **ENTER** to display the Edit menu, which is shown below.

3   Use the **UP ARROW** and **DOWN ARROW** keys to select the data category. The selected category is indicated by a highlight.

4   Press **ENTER.** SPN-D2M2 then displays the appropriate dialog screen.

```
                        ┌─────────────────────────┐
                        │       Edit Data         │
                        └─────────────────────────┘

               ███1. Transportation Data███
                  2. Disposal-site Data
                  3. Dredge-site Data
                  4. User-specified Operation




             ███Use arrow keys to highlight selection.  Press <ENTER>███
        1Help 2Prtscr 3     4      5        6Foregr 7Backgr 8      9      10Menu
```

Use the UP ARROW and DOWN ARROW -keys to select a command. PreSS ENTER.

Press F10 to return to the -Main menu.
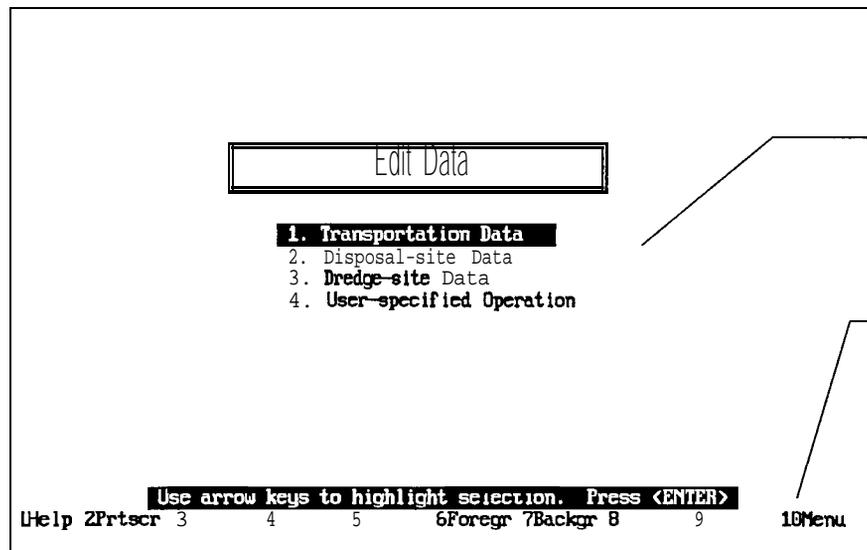
Alternatively, you can type the number adjacent to any menu command to immediately execute the command. For example, to edit dredge-site data, you can type 3 when the Edit menu is displayed.

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Basic Data dialog screen

With the Basic Data dialog screen, you fill in the boxes to specify how you want SPN-D2M2 to model the system. You can move from box to box on the screen by using the **DIRECTION, TAB, HOME, END,** and **ENTER** keys. You won't always have to fill in every box on every screen.

As noted at the bottom of this screen, the function keys provide special capabilities on this screen. Press **F1** for help, **F2** to print a copy of the screen, **F9** to accept the values on the screen, or **F10** to return to the Edit menu.

Press F9 to accept the values you've entered. Press ESCAPE to reset all values to the way they were.

Press F10 to return to the Main menu.

Input on this screen includes

- **Title.** Type any alphanumeric title information you want in these boxes. These titles are shown in the SPN-D2M2 output for your convenience. If you leave these boxes blank, no titles will appear in the SPN-D2M2 reports.

- **# of periods.** Type, in this box, the number of uniform time periods for which SPN-D2M2 is to analyze system operation. These time periods may be of any duration: weeks, months, years, etc. Valid values are integers 1 to 36.

    For example, if you want to analyze monthly management for 12 months, type **12** in this box. If you want to analyze annual management for 3 years, type **3**. If you want to analyze monthly operation for 3 years, type **36** (12 months/year X 3 years).

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The computation time required for D2M2 to find the minimum-cost management plan is related directly to the number of periods you specify. The time increases, more or less, as the square of the number of periods: if you double the number of periods, the time required increases by approximately a factor of 4.

- **1st period number.** Type the ordinate (position) number of the first period of analysis in this box. Valid values are integers 1 to 9999. For example, if you want to analyze annual operation, beginning in 2001, type **2001** here. If you want to analyze weekly operation, beginning with the 14th week of the year, type **14** here. All times/dates use the value specified here as the reference. All benefits and costs are discounted to the beginning of this time period.

- **Discount rate.** Type the effective discount rate per period, expressed as a percentage. SPN-D2M2 computes the present value of all benefits and costs with this rate. Default value is 0% (which means no discounting). Valid values are real numbers 0 to 100. Note that the value you select depends on the time interval you are using: If you are analyzing monthly operation, this will be the monthly discount rate (1/12 the annual rate), while for weekly operation, this is the *weekly* discount rate (1/52 the annual rate). For example, in 1993, the annual discount rate for Corps planning was 8.25%. If your analysis uses annual volumes, you would enter **8.25** in this box. If your analysis uses monthly volumes, you would enter **0.688** (=8.25/12) in the box.

- **Units code.** Type either **0** here to select IP (inch-pound) or **1** to select SI (modern metric) units of measurement. If you enter 0, any distances which material must be moved should be specified in miles, and volumes should be in cubic yards. If you enter 1, distances should be in kilometers and volumes in cubic meters.

- **Max. # of cap. exp. iterations.** Enter the maximum number of iterations you will allow in the search for the best capacity-expansion plan. Default value is 25. Valid values range from 0 to 25. This is ignored if system capacity expansion is not to be considered.

- **# periods to restart.** Enter **0** here if you don't want to use the restart capability. If want to use the restart capability, enter here the number of periods to be included in the next analysis. Valid values are integers 1 to 36. When you enter a non-zero value, a restart file will be prepared for later analysis of operation for the number of periods you specify here. The restart file is a new D2M2 input file for the same disposal system. The initial disposal-site conditions specified in this new file are the final conditions determined from the current analysis. The file is identified as RESTART.D21. Any current file named RESTART.D21 is renamed

RESTART.BAK. You must open the new rile to edit it or to use it as input to D2M2.

Transportation Data dialog screen

You must complete one Transportation Data dialog screen for each type of equipment that links a dredging project with a disposal site. On the screen, which is shown below, you identify one type of equipment and enter, in a table, the distance v. cost per unit volume relationship for the equipment.

```
╔═══════════════════════════════════════════════════════╗
║                    Transportation  Data               ║
║                                                        ║
║  D          Description                                ║
║                                                        ║
║          COST FUNCTION                                 ║
║        Distance    Unit cost                           ║
║      1 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      2 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      3 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      4 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      5 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      6 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      7 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      8 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║      9 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║     10 ▓▓▓▓▓▓▓▓    ▓▓▓▓▓▓▓▓                             ║
║                                                        ║
║                                                        ║
║  Help  2Prtscr 3    4DelRow 5InsRou 6    7   8Delete 9 OK  10Menu ║
║                                                INSERT         ║
╚═══════════════════════════════════════════════════════╝
```

Press F4 to delete a row and F5 to insert a row in the COST FUNCTION table

Press F8 to delete this type of transportation equipment.

SPN-D2M2 computes the cost of moving material within the system with the transportation equipment as a function of both volume and distance moved. To do so, it first determines the distance between dredging project and disposal site. Then it uses the COST FUNCTION table you enter here to find the cost per unit volume for the distance. The total cost of moving material, then, is the product of volume and unit cost. The program interpolates as necessary within the table. SPN-D2M2 does not extrapolate beyond the maximum or minimum values you enter; if the computed or specified distance exceeds the maximum value in the table, SPN-D2M2 will show an error message in the report and will terminate without searching for the best management plan.

The COST FUNCTION table is like a spreadsheet, with distance in the first column and unit cost in the second. You can enter 10 or fewer pairs of distance-cost values. For fewer than 10, leave the remaining values blank. The distances must be specified in the units of measurement consistent with the

measurement units you specify: for the SI system, distances should be in km, and for the IP system, distances should be in mi. The first distance must be less than the minimum distance for which this transportation equipment is used. The last distance that you specify is the maximum distance for which this equipment can be used. The distances you specify should increase down the column. Valid distances range from 0.00 to 99999999. The unit cost values are shown in corresponding rows of the second column. D2M2 uses linear interpolation to find the unit cost for intermediate values. Valid values of unit cost range from 0.00 to 99999999.

If you make a mistake when you fill in a box, you can just move the cursor to the box and type the corrected information. When you've completed filling in the boxes and are satisfied with your input, press **F9** to display the next Transportation Data dialog screen. When you have completed a Transportation Data dialog screen for each alternative, press **F10** to return to the Edit menu. If you want to return all values on a screen to the way they were, you can cancel the dialog screen by pressing **ESCAPE.**

As noted at the bottom of the screen, other function keys provide special capabilities on this screen. They can be used to get help (**F1**), to print a copy of this screen (**F2**), to delete or insert a row in the table (**F4** and **F5**) to delete completely this transportation type from the model (**F8**), or to return to the Edit menu (**F10**).

☑ *To delete or to insert a row in the fable:*

1   Use the **UP** and **DOWN** keys to move the cursor into either column.

2   Press **F4** to delete the row at the cursor position, or press **F5** to insert a row. If you insert a row, the new row is a duplicate of the current row at this location. All rows below, in both columns, are shifted down. If necessary, the last row is deleted to make room for the added row.

Disposal-site Data dialog screen - 1/2

You must complete a pair of Disposal-site Data dialog screens for each disposal site in your system; for convenience, these are labeled 1/2 and 2/2.

```
                        Disposal-site Data - 1/2

  ID  ████     Description ████████████████████████████████

  LOCATION                               SITE TOPOGRAPHY
  Latitude (dddmmss)          ████     Capacity  Elevation    Area
  Longitude (dddmmss)                1
                                     2
                                     3
  SITE ACQUISITION DATA              4
  Acquisition cost                   5
  Expansion code             ████    6
  Earliest acquisition period        7
  Latest acquisition period          8
  # periods before resting           9
  # resting periods

  STORAGE DATA                         Max. addition/period  ████
  Initial storage            ████      Unit disposal cost
  Wet-to-dry ratio                     OM&R cost/period


  1Help  2Prtscr 3      4DelRow 5InsRow 6      7      8Delete 9 OK   10Menu
                                                        INSERT
```

When you complete this screen and press F9 SPN-D2M2 displays the second disposal-site screen.

Values on screen 1/2 include

- **ID.** Type a unique 6-character disposal site identifier here. This identifier is used later as "shorthand" to define system linkages. For example, the ID for disposal site B might be **SITE B. You** can use any combination of uppercase and lower-case letters, numbers, and characters.

- **Description.** Type a more detailed alphanumeric description of the disposal site here, if you wish. This description appears in the output reports for your convenience.

- **Latitude and longitude.** Enter the location of the disposal site in these boxes. The format is *dddmmss,* in which *ddd* is the number of degrees, *mm* is the number of minutes, and *ss* is the number of seconds. SPN-D2M2 uses these to find the total distance that material must be moved from a dredging project to reach this disposal site.

- **Acquisition cost.** Enter the cost of making this site available for use. This includes the cost of facilities, of real estate, and of mitigation of adverse environmental or cultural impacts. Valid values range from 0.00 to 99999999.

- **Expansion code.** Enter a code here to control the capacity-expansion feature of D2M2. This code indicates the availability of the disposal site during the analysis, as follows:

Code	*Meaning*
0	This disposal site available from the Earliest acquisition period. The site is available until the End of lease period. If the End of lease period is not specified, the site is available throughout the entire analysis.
1	This site is available from the Earliest acquisition period. The Lease renegotiation cost is added at the End of lease period. The site is available throughout the entire analysis.
2	This site is available from the Earliest acquisition period through the End of lease period. Renegotiation of the lease for this site is an option to provide additional capacity. D2M2 will determine if this is a cost effective option to provide additional capacity.
3	This site is an alternative to add to the system if additional capacity is needed. The site may be acquired between the Earliest and the Latest acquisition periods, inclusive. The cost is specified in the Acquisition cost box. If acquired, the site will then be available for the remainder of this analysis. This option should not be used with the "restart" capability.

- **Earliest acquisition period.** Enter the actual or earliest-possible period of site acquisition. For example, if analysis starts in 1993, and this site is available in 1995, enter 1995 in this box. This value should be greater than or equal the 1st period number on the Basic Data screen and less than (1st period number) + (# periods) - 1. If omitted or equal 0, this is set equal to 1 st period number.

- **Latest acquisition period.** Enter the ordinate of the last period in which acquisition of this site will be permitted. For example, if analysis begins in 1993, and you do not want this site to be added after 2010, enter 2010 in this box. This value must be selected to insure that the site acquisition cost can be fully amortized within the period of analysis. For example, if the cost is to be amortized over 30 years, the latest acquisition period should be no later than 30 years before the end of the analysis. You can omit this value if the site is not an expansion site.

- **# periods before resting & # resting periods.** Enter a 2-digit number to specify the number of periods this site is available prior to resting in a use-rest cycle, followed by a 2-digit number to specify the number ofperiods this site is rested. This site will be alternately included for the specified # of periods before resting and omitted for the specified # of resting periods. Valid values are integers 0 to 99. If either field is 0, the site is not rested.

- **Initial storage.** Enter the volume of material stored in this disposal site at the beginning of the first period. This volume must not exceed the capacity of the disposal site. Valid values are real numbers from 0.00 to 99999999.

- **Wet-to-dry ratio.** In this box, type the average ratio of volume of "wet" material deposited in this site to volume of material after drying. This drying is accomplished within one time step. Valid values range from 1 .OO to 99999999, but typical values range from 1 .OO (for material with no bulking) to 2.00 (for material that is half water and half solids).

- **Max. addition/period.** Enter here the maximum allowable addition of unconsolidated material to this disposal site per period. You can specify this as a volume or as an approximate elevation gain in the disposal site. Valid values range 0.00 from 9999999. To specify no limit, enter 0 in this box. In that case, SPN-D2M2 sets the maximum allowable volume addition per time step equal to the site capacity. You must use units consistent with other volumes specified in the input.

  To specify a maximum elevation increase, enter the elevation as a negative number in this box. You can use any units consistent with other elevations specified in the input. SPN-D2M2 uses the absolute value of this negative number as the maximum elevation increase due to addition of unconsolidated (wet) material in a single time step. SPN-D2M2 uses linear interpolation of the elevation-volume relationship to convert this elevation change to volume change when it searches for the minimum-cost management plan.

- **Unit disposal cost.** Enter the cost per unit volume of wet material added to disposal site. Valid values are real numbers 0.00 to 99999999. This should include all operation costs that are a function of the volume deposited in the site, including mitigation costs, etc. Note that this cost is not limited strictly to economic cost; it may be any measure of utility that you chose.

- **OM&R cost/period.** Type, in this box, any fixed annual operation, maintenance, and replacement (OM&R) cost for the disposal site. This cost is incurred at the end of each period the site is available, regardless of the volume of material stored in the site. Valid values range from 0.00 to 99999999.

- **Site topography table.** For display, SPN-D2M2 looks up and reports the elevation and surface area corresponding to the computed cumulative volume in the disposal site each period. To do so, it uses the disposal site capacity-elevation-surface area relationship you provide in this SITE TOPOGRAPHY table. If necessary, SPN-D2M2 uses linear interpolation. SPN-D2M2 assumes that the maximum capacity value in column 1

represents the capacity of the disposal site. Consequently, it does not extrapolate beyond the maximum or minimum values in the table.

The table is like a spreadsheet, with capacity in the first column, elevation in the second, and area in the third. You can enter 10 or fewer sets of capacity-elevation-area values. For fewer than 10, leave the remaining values blank. The capacity, elevation, and area values must be specified in units of measurement consistent with those you use on other dialog screens. For example, if you specify material volumes for dredging in cu yd, you must specify the volumes here in cu yd. The first volume in this table must be less than the minimum volume that will be placed in the site. Valid values range from 0.00 to 99999999. The volumes you specify should increase down the column. Enter the elevation and area values in corresponding rows of the second and third columns. Valid values of elevation range from -9999999 to 99999999. Valid values of area are real numbers from 0.00 to 99999999.

Press F4 to delete a row, or press F5 to insert a row in the site topography table.

Disposal-site Data dialog screen - 2/2


```
                         Disposal-site Data - 2/2

ID  ▮▮▮▮   Description  ▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮

LEASE DATA                           TRANSFER SITE DATA
End of lease period   ▮▮▮▮▮▮▮                              site 1
Renegotiation cast    ▮▮▮▮▮▮▮         Transfer site ID
                                     Earliest period possible
REUSE DATA                           Distance
1st period possible   ▮▮▮▮▮▮▮         Transportation ID
Maximum rate          ▮▮▮▮▮▮▮         Maximum rate
unit benefit          ▮▮▮▮▮▮▮
                                                          site 2
                                     Transfer site ID
                                     Earliest period possible
                                     Distance
                                     Transportation ID
                                     Maximum rate


Help 2Prtscr 3      4     5     6     7     B     9 OK   10Menu
                                                   INSERT
```

Leave these boxes blank if your system doesn't include rehandling.

Leave these boxes blank if material is not removed for reuse.

This is the second dialog screen for the disposal site; the site ID and description are shown for convenience. On this screen, you enter the following

- **End of lease period.** Type the period in which the lease terminates, if this is a leased site. Depending on the Expansion code, the site will either

be unavailable after this period, or the lease will be renegotiated in this period. Valid values range from 0 to 9999. If this field is 0, the lease does not terminate, so the site will be available throughout the analysis (including subsequent "restart" analysis, if that option is used).

- **Renegotiation cost.** Enter the lease renegotiation cost. Valid values range from 0.00 to 99999999.

- **1st period possible, Maximum rate, Unit benefit.** These values describe possible reuse of material that is placed in this disposal site. In the 1 st period possible box, type the 1 st period reuse is possible. Valid values range from 0 to 9999, but the value you specify must be later than the 1st period and earlier than the last period. Omit this value if reuse of material from this site is not possible. If reuse from an expansion site is possible, it begins when the site is acquired.

  In the Maximum rate box, type the maximum volume that may be removed per period for reuse. This must not exceed site capacity. Omit this value if no reuse is permitted from this disposal site. Valid values range from 0 to 99999999.

  In the Unit benefit box, enter the return for reuse of material from this site. SPN-D2M2 treats this is negative cost; that is, the benefit of reuse may offset the cost of disposal. If you want to model reuse in which a cost is incurred, enter a negative value here.

- **Transfer site data.** The values you enter in the boxes under the heading TRANSFER SITE DATA define how (or if) material placed in this site may be removed, transported, and placed in another site. This movement may be via waterborne vessel or over land (with a dump truck, for example). You can describe 2 or fewer options for transferring material.

  In the Transfer site ID box, type the 6-character ID of the disposal site to which material may be transferred. This site ID must match exactly the ID of a site that you have or will describe by completing disposal site dialog screens. It should not be the same as the ID of the site from which the material is removed.

  In the Earliest period available box, enter the first period that transferring is possible. This applies only to sites with known acquisition period. Otherwise transfer is assumed to begin when both sites have been acquired.

  In the Distance box, enter the distance from this site to the transfer site. Valid values are real numbers from 0.00 to 99999999. The distances must be specified in the units of measurement consistent with those you use on other dialog screens. For example, if you specify river distances in km on other screens, you must specify the distances here in km.

In the Transportation ID box, enter the 6-character ID of the transportation method for transferring material. This value must correspond to one of the transportation types specified on a Transportation Data entry screen.

In the Maximum rate box, type the maximum volume per period that may be transferred from this disposal site to the specified transfer site. If no value is specified, the site capacity is used as a limit. Valid values are real numbers from 0.00 to 99999999.

If you make a mistake when you fill in a box on either Disposal-site Data dialog screen, move the cursor to the box and type the corrected information. When you've completed filling in the boxes and are satisfied with your input, press F9. If you press F9 on the first of the two dialog screens, the second screen will be displayed. If you press F9 on the second screen, SPN-D2M2 will display the dialog screen for the next disposal site. If you want to reset all values on a screen to the way they were, you can cancel the dialog screen by pressing ESCAPE.

As noted at the bottom of the screen, other function keys provide special capabilities on this screen. They can be used to delete or insert a row in the site topography table (F4 and F5), to delete completely this disposal site from the model (F8), or to return to the Edit menu (F10).

Dredge-site Data dialog screens

You must complete one Dredge-site Data dialog screen and the companion Material Volume dialog screen for each dredging project in the system.

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On the Dredge-site screen, you specify

- **ID.** Type a unique 6-character dredge site identifier here. This identifier is used as shorthand to define system linkages. For example, the ID for dredging project A might be **PROJ A. You** can use any combination of letters, numbers, and characters that is convenient.

- **Description.** Type a more detailed alphanumeric description of the dredge site here, if you wish. This description appears in the output reports for your convenience.

- **Latitude and longitude.** Enter the location of the disposal site in these boxes. The format is *dddmmss,* in which *ddd* is the number of degrees, *mm* is the number of minutes, and *ss* is the number of seconds. SPN-D2M2 uses these to find the total distance that material must be moved from this dredging project to reach a disposal site.

- **Transportation links.** Values you enter in this table define how and to where material from this dredge site may be moved and placed. You must complete one row of the table for each "link" that you want SPN-D2M2 to consider. Values you provide are as follows:

Column heading	*Contents*
Disposal site ID	Enter the 6-character identifier of the site to which material may be transported for disposal. This identifier must match exactly one previously specified on the Disposal site data screen.
Transportation type	Enter a 6-character identifier of the method used for transportation of material from this dredging site to the disposal site identified in column 1 on this row. This ID must match exactly one specified on a Transportation Data screen.
Maximum rate	In this column, enter the maximum allowable volume per period that may be transported via this transportation link. If no value is specified, D2M2 assumes that the entire volume removed from this site each period is used as the limit. Valid values are real numbers 0.00 to 99999999.
Distance	Normally SPN-D2M2 will compute the distance between a dredging project and disposal site as the length of a great circle between sites, as defined by their latitude and longitude values. However, if you wish, you may specify a distance between this dredging project and the disposal site. If you specify a value here, the computed value is not used. The value you specify must be in units consistent with those used to define the transportation cost function.

You can define 10 or fewer links. For fewer than 10, leave the remaining rows blank. Press **F4** to delete a row, or press **F5** to insert a row in the table.

If you make a mistake when you fill in a box, you can just move the cursor to the box and type the corrected information. When you've completed filling in the boxes and are satisfied with your input, press **F9**. Pressing **F9** will cause SPN-D2M2 to display the Volume dialog screen. Otherwise, you can return to the Edit menu by pressing **F10.** If you want to return all values on a screen to the way they were, you can cancel the dialog screen by pressing **ESCAPE.**

As with other dialog screens, function keys provide special capabilities on this screen. They can be used to get help **(F1),** to print a copy of this screen **(F2),** to delete or insert a row in the table **(F4** and **F5),** to delete completely this dredging project from the model **(F8),** or to return to the Edit menu **(F10).**

Material Volume dialog screen.

SPN-D2M2 automatically will fill in the period numbers in these columns, starting with the 1st period ordinate you specified on the Basic Data screen.

Volumes should be in cu yd or m^3, depending on the units code you enter on the Basic Data dialog screen.


```
1Help 2Prtscr 3      4DelRow 5InsRow 6      7      8      9 OK    10Menu
                                                           INSERT
```

On this screen, you must define the "wet" volumes that are to be dredged at this project each period. Valid values range from 0. to 99999999. You must specify a volume for each period of analysis. However, if you want all the

volumes to be the same, enter the correct volume for the first period, enter -1 for the second period, and leave all others blank. The values must be specified in units consistent with those you use on other dialog screens. For example, if you specify disposal site capacities in cu yd, you must specify the volumes here in cu yd. If you need to delete or to insert a row in this table, press F4 or F5, respectively.

When you've completed filling in the boxes and are satisfied with your input, press F9. If you want to return all values on a screen to the way they were, you can cancel the dialog screen by pressing ESCAPE. Press F1 for help, press F2 for a copy of this screen, press F8 to delete completely this dredging project from the model, or press F10 to return to the Edit menu.

User-specified Operation dialog screen

You need to complete the User-specified Operation dialog screen only if you wish to specify instructions that will "force" operation of the system, regardless of whether or not that operation is the minimum-cost operation. Each instruction consists of a volume to transport, a dredge site from which to transport it, a disposal site in which to place it, transportation equipment to use, and the period in which to do so.

If you fill all the boxes on this screen, SPN–D2M2 will display another when you press F9.

You enter the instructions in a table that is like a spreadsheet. In the table, you can specify 20 or fewer instructions. For fewer than 20, leave the remaining values blank. The contents of the table are as follows:

Column heading	Contents
From dredge site ID	ID of dredge project from which material is to be moved. This identifier must match exactly one previously specified on the Dredge-site data screen.
To disposal site ID	ID of disposal site to which material is to be moved. This ID must match exactly one previously specified on a Disposal-site data screen.
Period	This is the ordinate # of the period in which the specified material is to be dredged, transported, and placed. This value should be later than or equal the 1 st period ordinate and earlier than or equal the last period ordinate.
Volume	Enter the volume to be dredged, transported, and placed. Valid values are real numbers 0.00 to 99999999. The volumes must be specified in units consistent with those you use on other dialog screens. For example, if you specify disposal site capacities in cu yd, you must specify the volumes here in cu yd.
Trans type	Enter the ID of the equipment that is to be used to move the material. This ID must match exactly one previously specified on a Transportation data screen.

If you make a mistake when you fill in a box, you can just move the cursor to the box and type the corrected information. When you've completed filling in 15 rows and are satisfied with your input, press F9 to display the next User-specified Operation dialog screen. Otherwise, you can press F10 to return to the Edit menu. If you want to return all values on a screen to the way they were, you can cancel the dialog screen by pressing ESCAPE.

As noted at the bottom of the screen, other function keys provide special capabilities on this screen. They can be used to delete or insert a row in the table (F4 and F5), to delete completely this transportation type from the model (F8), or to return to the Edit menu (F10).

If you use this option, be *careful.* You may specify instructions that constrain the operation in such a fashion that SPN-D2M2 cannot find a feasible management plan. The operation instructions that you specify must at least satisfy the following:

- The dredge site must be linked to the disposal site with at least one type of transportation equipment.

- The volume you specify must not exceed the volume dredged in the period you define.

- The volume must not exceed the capacity of the transportation facilities.

- Transporting and disposing the material must not cause overfilling of the disposal site in a single period.

Interpreting SPN-D2M2 Output

Structure of the output

When SPN-D2M2 executes, it creates a computer file with reports of the input and the results. The output file includes

- An input error listing;

- A report of the basis data;

- A report showing your description of each disposal site;

- A report showing your description of each dredging project;

- A summary of the material volumes you specified;

- A capacity-expansion iteration log;

- For each disposal site, a report of material added and disposal site status for each period of the analysis;

- A material source/disposal site summary report; and

- A disposal site usage chart.

Input error listing

SPN-D2M2 is designed to check most of your input when you fill in the dialog screens. However, because of the complex interactions, some of the data cannot be checked until all the screens are completed. When SPN-D2M2 checks these, it lists the results in the output file. Consequently, when you view or print the output file, check this section first. The errors reported are classified as fatal errors, so SPN-D2M2 does not continue the search for the best management strategy. Instead, it stops and returns to the Main menu.

The table that follows lists the errors and suggests possible remedies.

Message	Possible remedy
TOO MANY ARCS ENCOUNTERED	Reduce the number of dredging projects, disposal sites, or transportation links that originate or terminate at the disposal sites.
DISPOSAL SITE ID = disposal_site_id HAS INVALID REHANDLING SITE ID = rehandling_site_id	Correct the rehandling data for disposal_site_id
DREDGING SITE ID = dredging_site_id HAS INVALID DISPOSAL SITE ID = disposal_site_id	Correct the disposal sites specified for dredging_site_id
DREDGING SITE ID = dredging_site_id HAS INVALID TRANSPORTATION TYPE ID = transportation_type_id	Correct the transportation data for rehandling data for dredging_site_id
DREDGING SITE ID = dredging_site_id DISTANCE TO DISPOSAL SITE EXCEEDS MAXIMUM FOR TRANS TYPE ID = transportation_type_id	Correct the distance for dredging_site_id or extend the cost function for transportation_type_id
THE DISTANCES OF THE DISTANCE-UNIT COST FUNCTION (transportation_type_id) ARE NOT INCREASING	Correct the distance-cost function for transportation_type_id
OPERATION INSTRUCTION HAS INVALID TRANSPORTATION TYPE ID = transportation_type_id	Correct the user-specified operation instruction that includes transportation_type_id
OPERATION INSTRUCTION HAS INVALID DREDGING SITE ID = dredging_site_id	Correct the user-specified operation instruction that includes dredging_site_id
OPERATION INSTRUCTION HAS INVALID DISPOSAL SITE ID = disposal_site_id	Correct the user-specified operation instruction that includes disposal_site_id

Basic data listing

SPN–D2M2 begins its report with a detailed listing of the input you've provided on the various dialog screens. Thus you can be sure how the system was modeled when you later view or print this report. First, all the items from the Basic Data dialog screen are shown; an example follows.

```
BASIC DATA
----------

    NUMBER OF PERIODS OF ANALYSIS..      30      NUMBER OF DISPOSAL SITES........      4
    FIRST PERIOD...................    1981      NUMBER OF DREDGE SITES..........      2
    DISCOUNT RATE PER PERIOD.......     7.63      NUMBER OF TRANSPORTATION TYPES..      2
    MAXIMUM NUMBER OF ITERATIONS...      25      UNITS CODE......................      0
    BRANCH AND BOUND TOLERANCE.....     0.00      NUMBER OF PERIODS TO RESTART....      0
```

Transportation data listing

Immediately following the basic data listing is a listing of the transportation data you provided; an example is shown here. The table shows the distance v. unit cost for each transportation type you described.

```
TRANSPORTATION DATA
-------------------

  ID = HOPGOV          GOVERNMENT HOPPER DREDGE

                1        2        3        4        5        6        7        8        9        10
   DISTANCE     1.00    10.00    15.00    20.00    30.00    40.00    50.00    60.00    80.00   100.00
   UNIT COST    1.40     3.00     3.90     4.75     6.60     8.40    10.20    11.95    15.60    19.30


  ID = 16PIPM          16-INCH PIPELINE DREDGE

                1        2        3        4        5        6        7        8        9        10
   DISTANCE     0.00     0.19     0.57     1.32     1.33     2.64     2.65     3.67     3.98     5.30
   UNIT COST    0.00     0.75     0.90     1.50     2.00     2.40     2.75     3.25     3.60     4.70
```

In this example, IP units are selected, so the distances shown are expressed in mi, and the unit costs are per cu yd.

Disposal site input listing

The data and parameters you entered for the disposal sites are shown next in the SPN–D2M2 report. An example of listing is shown below. Each value shown is specified on either Disposal-site Data dialog screen 1/2 or 2/2.

```
                              DISPOSAL SITE INPUT REPORT
                              --------------------------


              ID = SITE D          DISPOSAL SITE D

  LOCATION                                      STORAGE DATA
  --------                                      ------------

       LATITUDE......................  0.              INITIAL STORAGE.............      0.00
       LONGITUDE.....................  0.              WET-TO-DRY RATIO............      2.00
                                                       MAXIMUM ADDITION/PERIOD..... 11533000.
                                                       DISPOSAL COST...............      0.75

  SITE ACQUISITION DATA                         LEASE DATA
  ---------------------                         ----------

       ACQUISITION COST.............. 1725000.         END OF LEASE DATE...........      2011
       EXPANSION INDICATOR...........       0          RENEGOTIATION COST..........      0.
       EARLIEST ACQUISITION DATE.....    1987
       LATEST   ACQUISITION DATE.....    1987
       NO. OF PERIODS BEFORE RESTING..      0
       NO. OF RESTING PERIODS........       0

  REUSE DATA
  ----------                                    FIXED ANNUAL O,M+R COSTS.........      0.

       FIRST PERIOD AVAILABLE........       0
       MAXIMUM ALLOWABLE RATE........    0.00
       UNIT BENEFIT..................    0.00


  TRANSFER DATA                                 NUMBER OF TRANSFER SITES =       0
  -------------
```

In this example, the latitude and longitude were not specified; instead, the user has determined distances and specified those when dredging project and disposal site links were entered on the Dredge-site Data dialog box. No rchandling is available for material placed in this disposal site, so the reuse data are set to zero, and no transfer data are shown.

Dredge site input listing

A listing of all input that you provided on the Dredge-site Data screen is the next component of the SPN–D2M2 report; an example follows. The volumes you entered on the Material Volume screen are also listed.

```
                              DREDGE SITE INPUT REPORT
                              -----------------------


             ID = PROJ B        DREDGING PROJECT B

    LOCATION
    --------

        LATITUDE.....................     0.          NUMBER OF TRANSPORTATION LINKS..      3
        LONGITUDE....................     0.          MATERIAL VOLUME MULTIPLIER......    1.00

    TRANSPORTATION LINK DATA
    ------------------------

        DISPOSAL SITE ID        TRANS TYPE      MAXIMUM RATE        UNIT COST
            SITE D                16PIPM           0.00               1.20
            SITE R                16PIPM           0.00               0.82
            OCEAN1                HOPGOV           0.00              18.46


    MATERIAL VOLUMES (BEGINNING PERIOD =     1981)

            1         2         3         4         5         6         7         8         9        10
            0.00      0.00 550000.001100000.00 550000.00      0.00 550000.001100000.00      0.00      0.00
      1100000.001100000.00      0.00      0.001100000.001100000.00      0.00      0.001100000.001100000.00
            0.00      0.001100000.001100000.00 550000.00 550000.00 550000.00 550000.00 550000.00 550000.00
```

Again, the latitude and longitude of the site are omitted, as distances are specified on the Dredge-site Data screen. In the example, the dredging project is linked to three placement sites. Transportation types, maximum rates, and unit costs (per cu yd) are specified for each of these linkages.

Volume summary

Following the input summary, SPN–D2M2 tabulates the total volume of "wet" material that must be managed each period. This is computed by summing the volumes specified for all dredging projects each period.

```
                                VOLUME SUMMARY REPORT
                                ---------------------


PERIOD     1981       1982       1983       1984       1985       1986       1987       1988       1989       1990
------     ----       ----       ----       ----       ----       ----       ----       ----       ----       ----
VOLUME   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.


PERIOD     1991       1992       1993       1994       1995       1996       1997       1998       1999       2000
------     ----       ----       ----       ----       ----       ----       ----       ----       ----       ----
VOLUME   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.


PERIOD     2001       2002       2003       2004       2005       2006       2007       2008       2009       2010
------     ----       ----       ----       ----       ----       ----       ----       ----       ----       ----
VOLUME   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.   1100000.


   NETWORK CONTAINS    290 NODES,    460 ARCS, OUTFLO =        33000000.
```

Capacity expansion iteration log

The capacity expansion iteration log, which appears next in the output report, serves as a cost summary of the various expansion schemes considered. In most applications, the capacity-expansion option is not used; only the cost associated with the existing system is shown in that case. In the iteration log, the disposal sites are identified and pertinent acquisition and lease dates are shown. The sum of present value of site acquisition, lease renegotiation, and operation, maintenance, and replacement (OM&R) costs for all sites is computed and shown. The minimum-cost present value of system-operation cost is shown, as determined by solution of the material-management problem. This cost represents the cost of material transportation and disposal, less the revenue from reuse. The total net cost is the total of acquisition, lease renegotiation, OM&R, and operation costs for all sites for the period of analysis.

```
                                  CAPACITY EXPANSION ITERATION LOG

********************************************************************************************************************
* ITER *  SITE   *    SITE   * LEASE  * SITE  *  PRESENT VALUE      *  PRESENT VALUE     *       TOTAL       *
*      *   ID    *    ACQ.   * TERM.  * TERM. *  ACQ.+RENEG.+OMR    *   OPERATION        *     NET COST      *
*      *         *   PERIOD  * PER.   * PER.  *      COST           *      COST          *                  *
********************************************************************************************************************
*      *         *      *       *        *       *                     *                    *                  *
*   0  * OCEAN1 * 1981 * 1981 *  2011  * 2011 *                     *                    *                  *
*      * SITE D * 1987 * 1987 *  2011  * 2011 *                     *                    *                  *
*      * SITE R * 1981 * 1981 *  2011  * 2011 *                     *                    *                  *
*      * SITE E * 1981 * 1981 *  1999  * 2011 *      1112443.       *     19506596.      *    20619038.     *
*      *        *      *       *        *       *                     *                    *                  *
********************************************************************************************************************
```

Disposal site material added tabulations

The best management plan for the system is presented as a tabulation of the material added to disposal sites, either from dredging projects or from other

disposal sites if rehandling is possible. Material removed from the site for transfer or reuse is also tabulated. Such a tabulation is included for each site.

```
DISPOSAL SITE = SITE D          DISPOSAL SITE D

ACQUISITION PERIOD = 1987       WET-TO-DRY RATIO =    2.00

NOTE - MATERIAL FROM DREDGE SITES IS WET.
       TRANSFERRED MATERIAL IS DRY.

                                     MATERIAL ADDED
                              SOLUTION FOR ITERATION =    0
```

SITE ID	PROJ A 16PIPM		PROJ B 16PIPM				TOTAL	
PERIOD	VOLUME	COST	VOLUME	COST	VOLUME	COST	VOLUME	COST
1981	0.	0.	0.	0.	0.	0.	0.	0.
1982	0.	0.	0.	0.	0.	0.	0.	0.
1983	0.	0.	0.	0.	0.	0.	0.	0.
1984	0.	0.	0.	0.	0.	0.	0.	0.
1985	0.	0.	0.	0.	0.	0.	0.	0.
1986	0.	0.	0.	0.	0.	0.	0.	0.
1987	0.	0.	0.	0.	0.	0.	0.	0.
1988	0.	0.	0.	0.	0.	0.	0.	0.
1989	0.	0.	0.	0.	0.	0.	0.	0.
1990	90000.	51959.	0.	0.	0.	0.	90000.	51959.
1991	0.	0.	0.	0.	0.	0.	0.	0.
1992	0.	0.	0.	0.	0.	0.	0.	0.
1993	1100000.	509419.	0.	0.	0.	0.	1100000.	509419.
1994	1100000.	473328.	0.	0.	0.	0.	1100000.	473328.
1995	0.	0.	0.	0.	0.	0.	0.	0.
1996	0.	0.	0.	0.	0.	0.	0.	0.
1997	1100000.	379684.	0.	0.	0.	0.	1100000.	379684.
1998	1100000.	352784.	0.	0.	0.	0.	1100000.	352784.
1999	0.	0.	0.	0.	0.	0.	0.	0.
2000	0.	0.	0.	0.	0.	0.	0.	0.
2001	1100000.	282989.	0.	0.	0.	0.	1100000.	282989.
2002	1100000.	262940.	0.	0.	0.	0.	1100000.	262940.
2003	0.	0.	10000.	2221.	0.	0.	10000.	2221.
2004	0.	0.	1100000.	227002.	0.	0.	1100000.	227002.
2005	550000.	105460.	550000.	105460.	0.	0.	1100000.	210920.
2006	550000.	97988.	550000.	97988.	0.	0.	1100000.	195976.
2007	550000.	91046.	550000.	91046.	0.	0.	1100000.	182092.
2008	550000.	84596.	550000.	84596.	0.	0.	1100000.	169191.
2009	550000.	78602.	550000.	78602.	0.	0.	1100000.	157204.
2010	550000.	73033.	550000.	73033.	0.	0.	1100000.	146067.
TOTAL	9990000.	2843828.	4410000.	759948.	0.	0.	14400000.	3603776.

In the example shown here, disposal site D (SITE D) may be used for material from dredging project A (PROJ A) and from dredging project B (PROJ B). The volume of material transported from each is shown, and the discounted transportation cost is tabulated. The total for all dredging sites is shown, and the total for all periods is computed and tabulated. If the site fills, this is indicated also.

Disposal site status tabulation

A disposal-site status tabulation is included for each disposal site. This shows, for each period, the total volume of consolidated material added to the site, the

resulting volume of material stored at the end of each period, and the disposal cost. The elevation and surface area corresponding to each storage are determined by reference to the capacity-elevation-area function that you provided. The total volume of consolidated material added and the cost of the addition are presented.

```
                       DISPOSAL SITE STATUS (DRY)
                       SOLUTION FOR ITERATION =    0

*****************************************************************************
*          *          *           *              *           *             *
* PERIOD  *  VOLUME   * END OF PER * DISPOSAL COST* ELEVATION  * SURFACE AREA *
*          * DISPOSED  *  STORAGE   *              *           *             *
*          *          *           *              *           *             *
*****************************************************************************
*          *          *           *              *           *             *
*   1981  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1982  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1983  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1984  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1985  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1986  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1987  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1988  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1989  *       0.  *        0.  *          0.  *   -3.00   *    230.00   *
*   1990  *   45000.  *    45000.  *      32372.  *   -2.88   *    230.00   *
*   1991  *       0.  *    45000.  *          0.  *   -2.88   *    230.00   *
*   1992  *       0.  *    45000.  *          0.  *   -2.88   *    230.00   *
*   1993  *  550000.  *   595000.  *     317382.  *   -1.40   *    230.00   *
*   1994  *  550000.  *  1145000.  *     294897.  *    0.09   *    230.00   *
*   1995  *       0.  *  1145000.  *          0.  *    0.09   *    230.00   *
*   1996  *       0.  *  1145000.  *          0.  *    0.09   *    230.00   *
*   1997  *  550000.  *  1695000.  *     236554.  *    1.57   *    230.00   *
*   1998  *  550000.  *  2245000.  *     219795.  *    3.05   *    230.00   *
*   1999  *       0.  *  2245000.  *          0.  *    3.05   *    230.00   *
*   2000  *       0.  *  2245000.  *          0.  *    3.05   *    230.00   *
*   2001  *  550000.  *  2795000.  *     176310.  *    4.53   *    230.00   *
*   2002  *  550000.  *  3345000.  *     163819.  *    6.02   *    230.00   *
*   2003  *    5000.  *  3350000.  *       1384.  *    6.03   *    230.00   *
*   2004  *  550000.  *  3900000.  *     141429.  *    7.51   *    230.00   *
*   2005  *  550000.  *  4450000.  *     131409.  *    8.99   *    230.00   *
*   2006  *  550000.  *  5000000.  *     122099.  *   10.48   *    230.00   *
*   2007  *  550000.  *  5550000.  *     113448.  *   11.96   *    230.00   *
*   2008  *  550000.  *  6100000.  *     105411.  *   13.58   *    226.84   *
*   2009  *  550000.  *  6650000.  *      97943.  *   15.20   *    223.59   *
*   2010  *  550000.  *  7200000.  *      91004.  *   16.83   *    220.35   *
*          *          *           *              *           *             *
*****************************************************************************
*          *          *           *              *           *             *
* TOTAL   * 7200000.  *           *     2245255.  *           *             *
*          *          *           *              *           *             *
*****************************************************************************
```

Dredged-material source / disposal site summary matrix

System operation for the entire period of analysis is summarized in the dredged-material source/disposal site matrix. Each dredged-material source and each disposal site is shown. The total volume moved from each source to each disposal site is shown. The first and last periods of disposal site use are shown.

```
                              DREDGED-MATERIAL SOURCE/DISPOSAL SITE
                                        SUMMARY REPORT
*******************************************************************************************************************
*          *          *          *          *          *          *          *          *          *           *
*          *                        DREDGING VOLUMES AND FIRST AND LAST PERIODS USED                           *
* DISPOSAL *                                                                                                     *
*   SITE   *************************************************************************************************************
*    ID    *          *          *          *          *          *          *          *          *           *
*          * PROJ A   * PROJ B   *          *          *          *          *          *          *  TOTAL    *
*          *          *          *          *          *          *          *          *          *           *
*******************************************************************************************************************
*          *          *          *          *          *          *          *          *          *           *
* OCEAN1   *       0. *       0. *       0. *       0. *       0. *       0. *       0. *       0. *        0. *
*          *    0/  0 *    0/  0 *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *           *
*          *          *          *          *          *          *          *          *          *           *
* SITE D   * 9990000. * 4410000. *       0. *       0. *       0. *       0. *       0. *       0. * 14400000. *
*          * 1990/2010* 2003/2010*  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *           *
*          *          *          *          *          *          *          *          *          *           *
* SITE R   *       0. *11540000. *       0. *       0. *       0. *       0. *       0. *       0. * 11540000. *
*          *    0/  0 * 1983/2003*  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *           *
*          *          *          *          *          *          *          *          *          *           *
* SITE E   * 7060000. *       0. *       0. *       0. *       0. *       0. *       0. *       0. *  7060000. *
*          * 1981/1990*    0/  0 *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *  0/   0  *           *
*          *          *          *          *          *          *          *          *          *           *
*******************************************************************************************************************
*          *          *          *          *          *          *          *          *          *           *
* TOTAL    *17050000. *15950000. *       0. *       0. *       0. *       0. *       0. *       0. * 33000000. *
*          *          *          *          *          *          *          *          *          *           *
*******************************************************************************************************************

NOTE:  TOTALS SUBJECT TO ROUNDING
```

Disposal site usage chart

The final item in the report is a graphic summary of disposal site use. Each period that any material is deposited in a site is indicated by an "X" in the appropriate column.

```
                              DISPOSAL SITE USAGE CHART

          DISPOSAL
            SITE
             ID

                    .
                    .
          OCEAN1    .
                    .
                    .
          SITE D    .        X   XX   XX   XXXXXXXXXX
                    .
          SITE R    .  XXX XX   XX   XX   XX   X
                    .
          SITE E    .XXX XXX XX
                    .
                    I----I----I----I----I----I----I
                   1980 1985 1990 1995 2000 2005 2010

                                  TIME
```

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Appendix A: Creating a Printer Control File

When you select the Print command, SPN-D2M2 sends special job, page, and font commands to your printer so that you can print the wide output report that it produces. The format of these command depends on the type of printer that you use. When you run Setup, you can specify that your printer is either HP-compatible or Epson-compatible. Setup then installs a file with the appropriate commands to set your printer to a smaller font. For the HP, the file also contains commands to shift the printer to landscape mode.

If your printer is not HP or Epson compatible, you can create a special file that contains command codes that should be sent before SPN-D2M2 prints the report. This file is named **prout.ini.** It is a plain text file, and it is stored in the **spnd2m2** directory. You can create the file with any text editor or word processor that will save a tile in plain text format. The **prout.ini** file contains any number of lines, each with a special code that is to be sent to the printer when a report is printed. Each line has the following format:

[escape_character_id,] command_characters

The first item is shown here in brackets to indicate that it is required only if you printer requires an "escape sequence" for commands. If it does, each command must begin with a so-called "escape character," followed by a comma and command characters. For example, for an HP-compatible printer, the command code to shift the printer to landscape mode is the escape character followed by **&110.** The escape character is **27**. Thus **prout.ini** would contain the line

27,&110

Consult your printer manual for additional information regarding various job, page, and font commands.

Appendix B: Troubleshooting

Occasionally, SPN-D2M2 will fail to find a minimum-cost management plan for the system you have described. Because of the complex nature of the system analysis problem solved, it is impossible to diagnose in advance the causes of every such failure. However, here are some possible remedies.

Carefully review the listing of input to be sure that you haven't mistyped data or parameters. The output report shows all the data and parameters you entered on the dialog screens. Check each value listed to insure that you didn't misplace a decimal, type an extra zero, etc. SPN-D2M2 can identify an obvious blunder, like typing the letter **O** instead of the number 0, but it can't determine that 104. should be 10.4, for example.

Confirm that you have, in fact, defined a system. Check the linkages you've specified. Is every dredging project linked to at least one disposal site? If a project is linked to only one disposal site, does that site have sufficient capacity for all the material that is to be dredged and placed there?

Confirm that the system you've defined is no larger than necessary. As noted earlier, the computational effort increases exponentially with the size of the system. Therefore, you should keep the system that you analyze as small as practical. Having data for 100 dredging projects and 40 disposal sites is not the same as having a system with 100 dredging projects and 40 disposal sites. This can be illustrated with the simple case below.
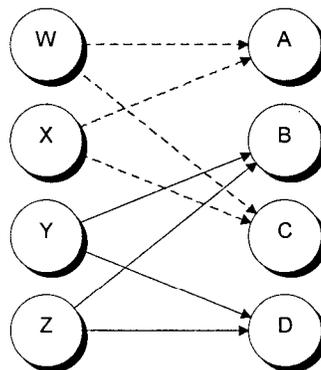
Four dredging projects are identified as W, X, Y, Z, and four disposal sites are identified as A, B, C, D. Although this appears to be a material-management system that could be analyzed with SPN-D2M2, it is, in fact, two independent

material-management systems that could be better analyzed with two different sets of input. Notice that W and X are connected to A and B, but not to C and D. Similarly, Y and Z are connected to C and D, but not to A and B. Thus any decision about where to place material dredged at W or X will have no impact on decisions about where to place material dredged at Y or Z.

A simple test that may be used to determine the components of a system involves sketching the system with interconnections show by arrows. Then, ignoring the direction of the arrows, try to trace a path from a selected dredging project to all other dredging projects and disposal sites. If you cannot do so without lifting your pencil from the paper on which you've made the sketch, the components form more than one independent system. For example, you could trace a path from W to A to X to C, but you can't include B or D without lifting your pencil. Therefore W, A, X, and C form a system.

Check any user-specified instructions. As noted earlier, you must be careful when you specify operation instructions. The operation instructions that you specify must at least satisfy the following:

- The dredge site must be linked to the disposal site with at least one type of transportation equipment.

- The volume you specify must not exceed the volume dredged in the period you define.

- The volume must not exceed the capacity of the transportation facilities.

- Transporting and disposing the material must not cause overfilling of the disposal site in a single period.

If you are using any of the special features (capacity expansion, resting, restarting, etc.), try analyzing the system without the features first. These features all make analysis more difficult, and they make interpretation of the output more difficult. To be sure that you've properly prepared input, eliminate the special feature and execute SPN-D2M2. For example, if you are analyzing capacity expansion, try setting the acquisition period equal the 1 st period number for all sites and re-running the model. Did you get a solution? If not, you may have defined a system that does not include sufficient capacity, even with the expansion sites added.

Do a quick volume check. Compare the volumes to be dredged with the capacity of the disposal sites. Does the capacity seem sufficient, assuming that the system will be management efficiently? If not, check the input for typographical errors.

Try analyzing operation for fewer periods. For example, if you can't get a solution for your system for 50 years of operation, try 25 years. Did you

get a solution? In that case, the system you've described probably doesn't have sufficient capacity for 50 years operation, but you haven't provided any capacity expansion options.

Try scaling the volumes. SPN-D2M2 is limited in accuracy by PC hardware. In this implementation, a real number is accurate to about one part in ten million. If you have specified volumes greater than one million cu yd, try scaling and specifying the volumes instead in terms of thousand cu yd or million cu yd.

Appendix C: Example Applications

Introduction

This appendix describes sample input data and illustrates a few of the many features that SPN-D2M2 has to offer as a planning tool. The input data presented herein are meant to be used as input for the examples and are for illustrative purposes only.

Overview of input data

For the purpose of this analysis, historical dredging volumes were used to model a 25-year dredging cycle in the San Francisco Estuary. The data include annual dredged material volumes of 14 dredging projects that approximate the Estuary's navigational needs. Input data are based primarily on a report *Task 1, Collect Data for Dredging Project Profiles and Placement Site ProJiles,* prepared by Gahagan & Bryant Associates, Inc. (GBA) under the Long Term Management Strategy (LTMS).

The disposal sites modeled consist of 40 existing and proposed dredged material placement options, encompassing levee rehabilitation, confined disposal, rehandling, unconfined aquatic disposal, and habitat restoration projects. These options are referenced as belonging to one of the in-Bay, upland and ocean environments.

The disposal and dredging sites chosen for the example runs are geographically and topographically diverse. This diversity is believed to model realistically and accurately the options available to a planner in attempting to economically optimize the allocation of material to various disposal sites within the San Francisco Bay Estuary.

Basic Data dialog screen. The number of periods used is 25.

Transportation Data dialog screen. Three types of water transport equipment are used: lightly-loaded scows, fully-loaded scows and hopper dredges. Lightly-loaded scows filled with a clamshell dredge are assumed to be used if water access depth is less than 15 ft; it is assumed that the cost to dredge in situ material is $1.50/cu yd, and the transport cost to a disposal site is $0.145/cu yd/nautical mile (nm). Fully-loaded scows filled with a clamshell dredge are assumed to be used if water access depth is greater that 15 ft; it is assumed that the cost to dredge in situ material is $1.5O/cu yd, and the transport cost to a disposal site is $O.O75/cu yd/nm. Hopper dredges are

assumed to be used if the maximum economical distance between dredging and disposal sites is 4 nm; it is assumed that the cost to dredge in situ material is $1.00/cu yd, and the transport cost to a disposal site is $0.20/cu yd/nm. Although hopper dredges are commonly used for transport distances greater than 4 nm, Figure C.l illustrates that for distances greater than 4 nm, the solution provided by the model should incorporate fully-loaded scow transport because it is less costly. (This figure and other figures and tables follow the text in this appendix). These assumptions are summarized in Table C. 1.

Disposal-site Data dialog screen. Table C.2 contains the pertinent input for the pool of 40 disposal sites. Approximate annual capacity of these sites can be based on either management constraints (such as 4.3 million cu yd for Alcatraz) or on physical constraints (such as 750,000 cu yd for Cargill East Rehandling Facility). In addition, a distinction is made between those sites that can be used on an annual basis (such as Alcatraz) and those that are only available for a one-time-placement episode (such as Sonoma Baylands).

Dredge-site data dialog screen. Fourteen dredging sites were included in the analysis. For each dredging site, the scow and hopper distances were computed assuming traverse through normal vessel traffic routes to each of the 40 disposal sites, based on GBA-generated regional maps that locates all dredging and disposal sites, navigation channels, and basic regional geography (Figures C.2, C.3, and C.4). Although SPN-D2M2 will calculate distance, given latitude and longitude, this feature was not used for these examples. A matrix of distances to each of the 40 disposal sites, access channel depths, suitable transportation modes, and transportation costs for each of the 14 dredging site projects can be found in Tables C.3 through C. 16.

Dredging volumes from the years 1967 through 1991 were used and are tabulated in Table C. 17.

Example 1: Comparison of two management options

This example examines two possible management options and compares output results. The first option optimizes a system without regard to how much dredged material is going to each of the three disposal environments (in-Bay, ocean and upland). The second option incorporates a requirement that a fixed percentage of dredged material be placed at each of the three disposal environments. A comparison of the material allocation and associated costs for each option is discussed below.

Option 1: Economic optimization without management requirements. For this option, the model is allowed to find the economically least-costly solution without constraints on material allocation. Selection of the 10 disposal sites for the Dredge-Site Data dialog screen is made by defining links with the ten geographically-closest disposal sites that

collectively provide adequate disposal capacity. This selection may include any combination of in-Bay, ocean or upland sites.

Option 2: Economic optimization with management requirements. For this option, it is assumed that management decisions may potentially require a target percentage of dredged material to be placed in each disposal environment, i.e. 20% at in-Bay sites, 50% at ocean sites, and 30% at upland sites. Selection of the disposal sites for the Dredge Site Data Dialog Screen is made by specifying linkages of dredge sites with appropriate disposal sites.

Discussion of results. For Option 1, the least cost solution included 86.5% of the dredged volume being placed at in-Bay sites at 85.4% of the total cost, 13.5% placed at upland sites at 15.7% of the total cost, and 0% placed at the ocean sites.

For Option 2, the least cost solution included 18.4% of the dredged volume being placed at in-Bay sites at 7.5% of the total cost, 26.3% of the total volume placed at upland sites at 15.3% of the total cost, and 55.3% of the total volume placed at ocean sites at 77.2% of the total cost.

These results are illustrated in Table C. 18.

Example 2: Rehandling facilities "tipping fees"

In this example, a model is developed which demonstrates SPN-D2M2's ability to analyze the effect of market forces on the material allocation optimization of dredged material to various rehandling facilities by varying "tipping fees". Tipping fees are defined as a charge levied by the rehandling site (on a per cu yd basis) to accept dredged material.

For this analysis, approximately 29% of all material removed from the dredge site array is considered unsuitable for direct upland or unconfined aquatic disposal, thus requiring treatment at a rehandling facility. For this example, only three rehandling facilities were considered, as shown in Table C. 19.

The assumed capacities are selected so as to allow the system to run through 25 periods of analysis without the maximum dredging event on a per period basis ever exceeding the total capacity of the three rehandling sites.

To simulate the effect of tipping fees on the placement of material within the system, each of the three disposal site's unit disposal cost (Disposal-site Data dialog screen) were varied between $1 and $4, while the other two sites' unit disposal cost was held constant at $1.

Discussions of results. The results of the first run are shown in Table C.20. This example illustrates the reallocation of material as tipping fees at

Leonard Ranch are increased incrementally from $1 to $4. When tipping fees are raised to $2, the 4% decrease in material placed at Leonard Ranch is reallocated to the Montezuma site, with no additional material placed at the Cargill site. When tipping fees are increased to $3, the additional 11% decrease in material placed at Leonard Ranch is placed at the Cargill site, with no additional material placed at the Montezuma site. On raising the tipping fee to $4, only 1% of the material placed at Leonard Ranch is re-allocated to Cargill, with material allocation to the Montezuma site remaining constant.

The results of the second run are shown in Table C.2 1. This example illustrates the reallocation of material as tipping fees at Cargill East Crystallizer Ponds are incrementally increased from $1 to $4. When tipping fees are raised to $2, of the 12% decrease in material placed at Cargill, 8% is reallocated to Leonard Ranch, and 4% to Montezuma. When tipping fees are increased to $3, the additional 4% decrease in material placed at Cargill is placed exclusively at the Montezuma site, with no additional material placed at the Leonard Ranch site.
On raising the tipping fee to $4, the additional 4% decrease in the volume placed at Cargill is equally split between the two alternate sites.

The results of the third run are shown in Table C.22. This example illustrates the re-allocation of material as tipping fees at the Montezuma Rehandling site are increased incrementally from $1 to $4. When tipping fees are raised to $2, the 8% decrease in material placed at the Montezuma site is reallocated entirely to the Leonard Ranch site, with no additional material placed at the Cargill site. When tipping fees are increased to $3, the additional 14% decrease in material placed at the Montezuma site is placed at the Cargill site, with no additional material placed at the Leonard Ranch site. On raising the tipping fee to $4, the additional 1% decrease in material placed at Montezuma is reallocated to Cargill, with material allocation to Leonard Ranch remaining constant.

Summary. As shown in the runs described above, when fees are fixed at the Cargill site, (varying either the Montezuma or Leonard Ranch site tipping fees) no material is reallocated to Cargill when tipping fees are $2/cu yd or less. However for tipping fees of $3/cu yd and above, Cargill is consistently the preferred alternative by a factor of approximately two.

When tipping fees at the Cargill site are varied, at $2/cu yd the Leonard Ranch site is favored by a factor of two. But for tipping fees beyond $3/cu yd, the two alternate sites are equally favored.

Table C.1: Transport Modes and Costs

Transport type	Disposal site access depth (ft MLLW)	Link distance (nm)	Cost function
Fully loaded 3000 cu yd scow	> 15	< 100	($0.075 * link distance) + $1.50
Lightly loaded 3000 cu yd scow	< 15	< 100	($0.145 * link distance) + $1.50
Hopper dredge	> 15	< 9	($0.20 * link distance) + $1.00

Figure C.1: Transportation Link Cost

Cost ($ NM/CY)

Legend:
- Hopper Dredge
- Lightly Loaded Scow
- Fully Loaded Scow

Link Distance (Miles)

10/21/94
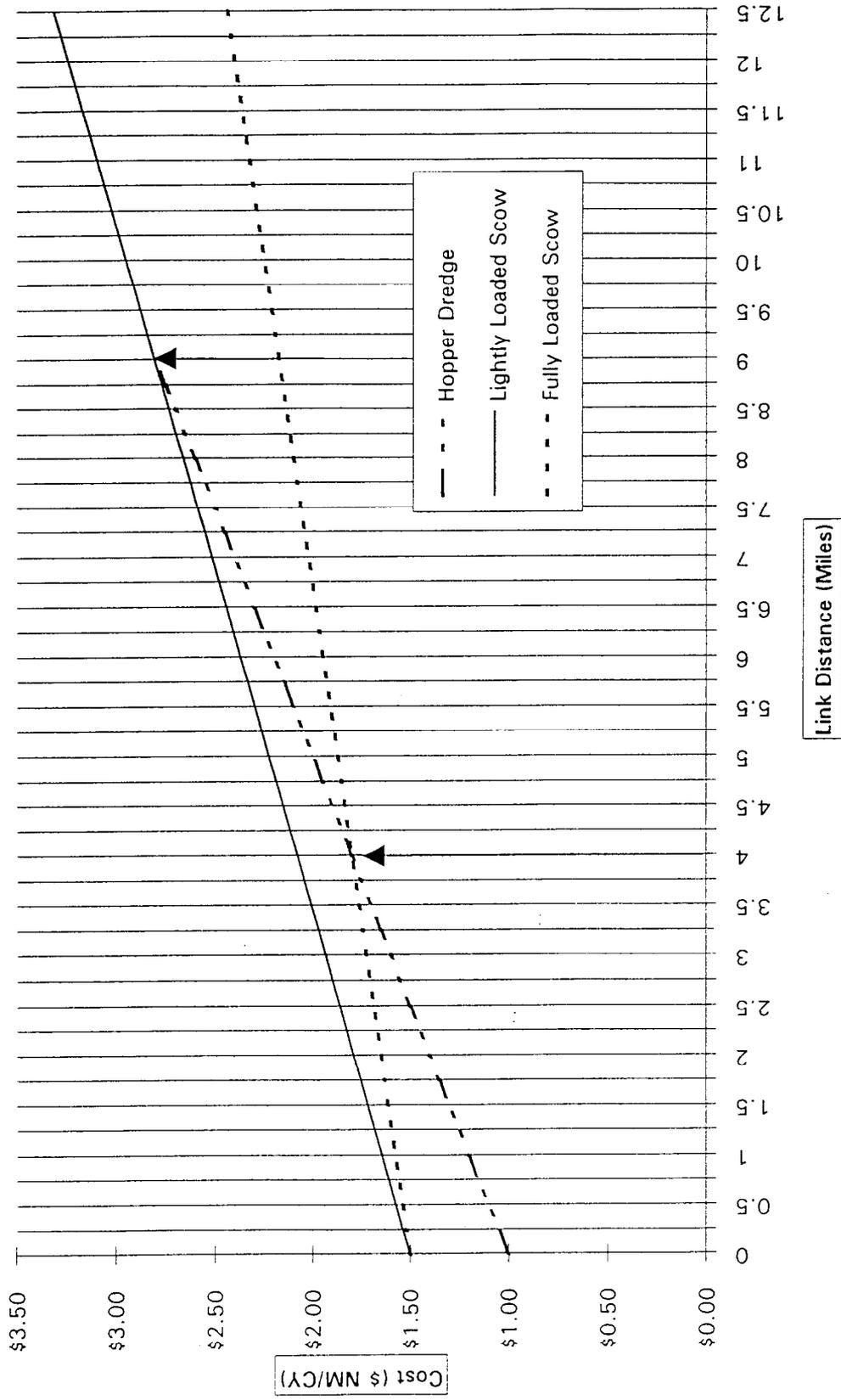
Figure C.2

San Francisco Bay Region LTMS Location Map – North Bay

Gahagan and Bryant Associates, Inc.
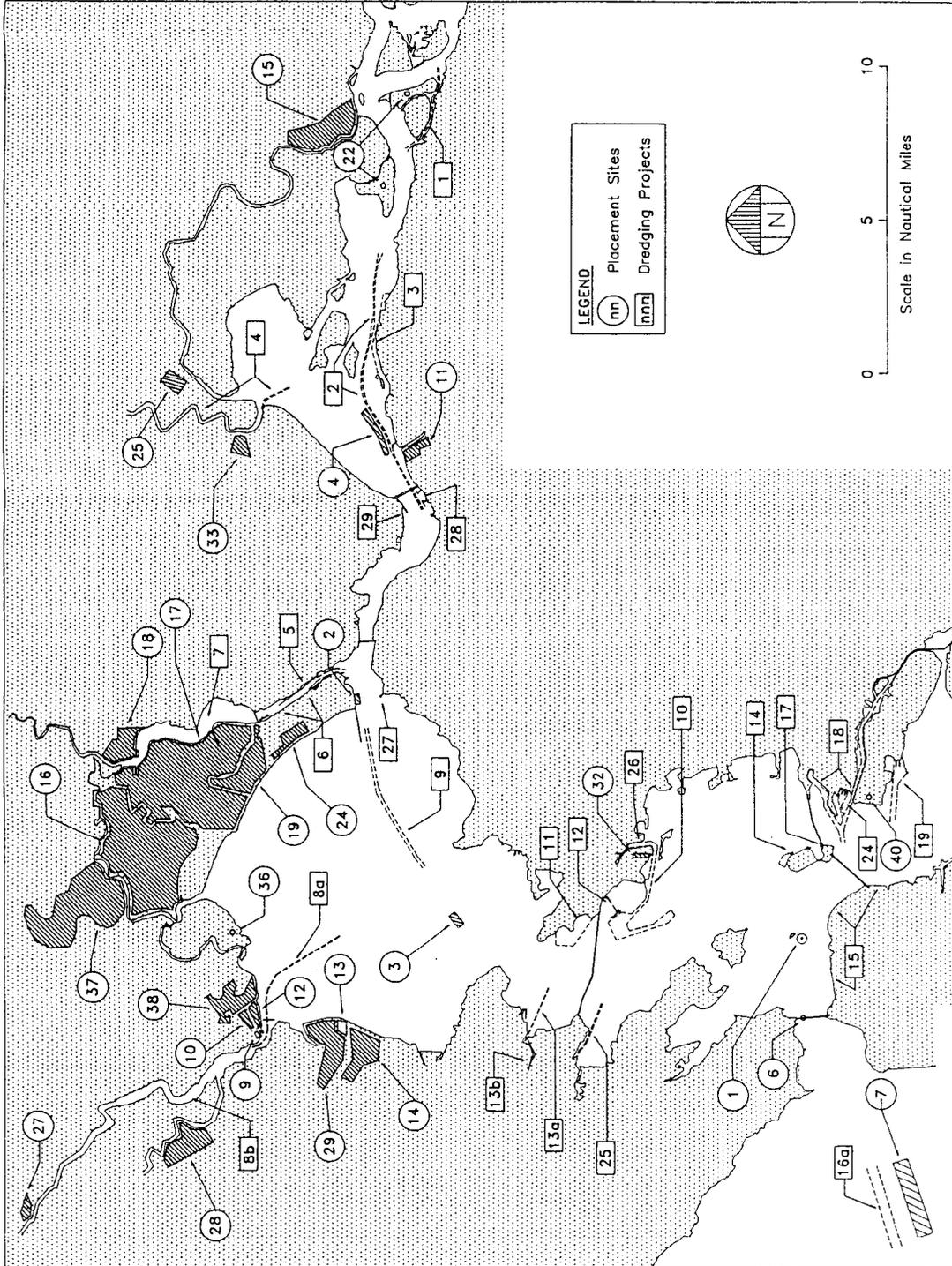
Placement Sites

No.	Description
1.	Alcatraz (SF-11)
2.	Carquinez Strait (SF-9)
3.	San Pablo Bay (SF-10)
4.	Suisun Bay
6.	Golden Gate Site, north tower
7.	San Francisco Bar Channel (SF-8)
9.	Port Sonoma-Marin Marina
10.	Leonard Ranch
11.	Praxis-Pacheco
12.	Sonoma Baylands
13.	Hamilton Field: Antennae Field
14.	Hamilton Field: Habitat Creation
15.	Montezuma Wetlands
16.	Skaggs Island
17.	Cargill Salt Division (west evaporator ponds)
18.	Cargill Salt Division (east crystalizer ponds)
19.	Cullinan Ranch
22.	Upper Suisun Bay Sites, Chipps Isl. & Winter Isl.
24.	Mare Island
25.	Pierce Island
27.	Petaluma River Drying Ponds
28.	Redwood Sanitary Landfill
29.	Bel Marin Keys
32.	Richmond Dry Docks
33.	Suisun Marsh Duck Clubs – Family Duck Club
36.	Tubbs Island
37.	Camp Islands
38.	North Point Properties
40.	Naval Air Station Alameda

Dredging Projects

No.	Description
1	New York Slough
2	Suisun Bay Channel
3	Concord NWS
4	Suisun (Slough) Channel
5	Mare Island Strait
6	Mare Island NSY
7	Napa River
8a	Petaluma River, Across the Flats
8b	Petaluma River, Mile 0.0 to Washington Street
9	Pinole Shoal
10	Richmond Harbor
11	Point Molate NFD
12	Chevron (Richmond Long Wharf)
13a	San Rafael Creek, Across the Flats
13b	San Rafael Creek, Mile 0.0 to Grand Ave.
14	Treasure Island NS
15	Port of San Francisco
16a	San Francisco Harbor (San Francisco Bar)
17	USCG Yerba Buena Island
18	Oakland Harbor / Port of Oakland
19	Alameda NAS
24	Oakland NSC
25	Larkspur Ferry Channel
26	ARCO
27	Unocal
28	Shell Oil
29	Exxon

LEGEND
(nn) Placement Sites
[nnn] Dredging Projects

N

Scale in Nautical Miles
0   5   10

Figure C.3

Gahagan and Bryant Associates, Inc.

San Francisco Bay Region LTMS Location Map — South Bay
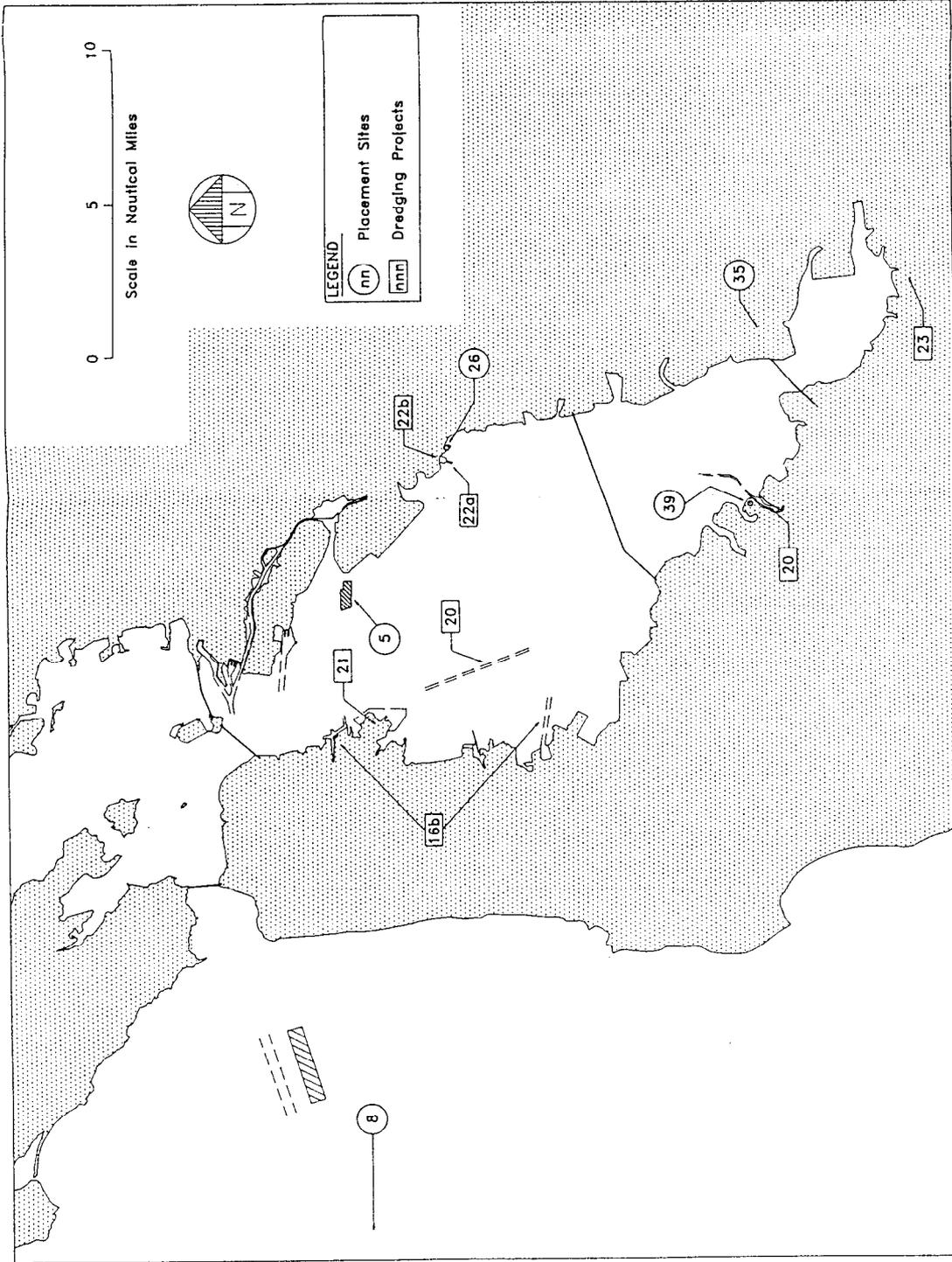
Dredging Projects

No.	Description
16b	San Francisco Harbor (Islais Creek and San Francisco Airport Channel)
20	Redwood City
21	Hunters Point NSY
22a	San Leandro Marina, Main Access Channel
22b	San Leandro Marina, Interior Access Channel
23	Moffett Field NAS

Placement Sites

No.	Description
5	Bay Farm Is. Borrow Pit
8	102 General Use Site (and U.S. Navy 103 Site)
26	San Leandro
35	Tri City S. F.
39	Bair Island

Scale in Nautical Miles

0   5   10

N

LEGEND

(nn) Placement Sites

[nnn] Dredging Projects

Figure C.4

Gahagan and Bryant Associates, Inc.

San Francisco Bay Region LTMS Location Map — Delta Area
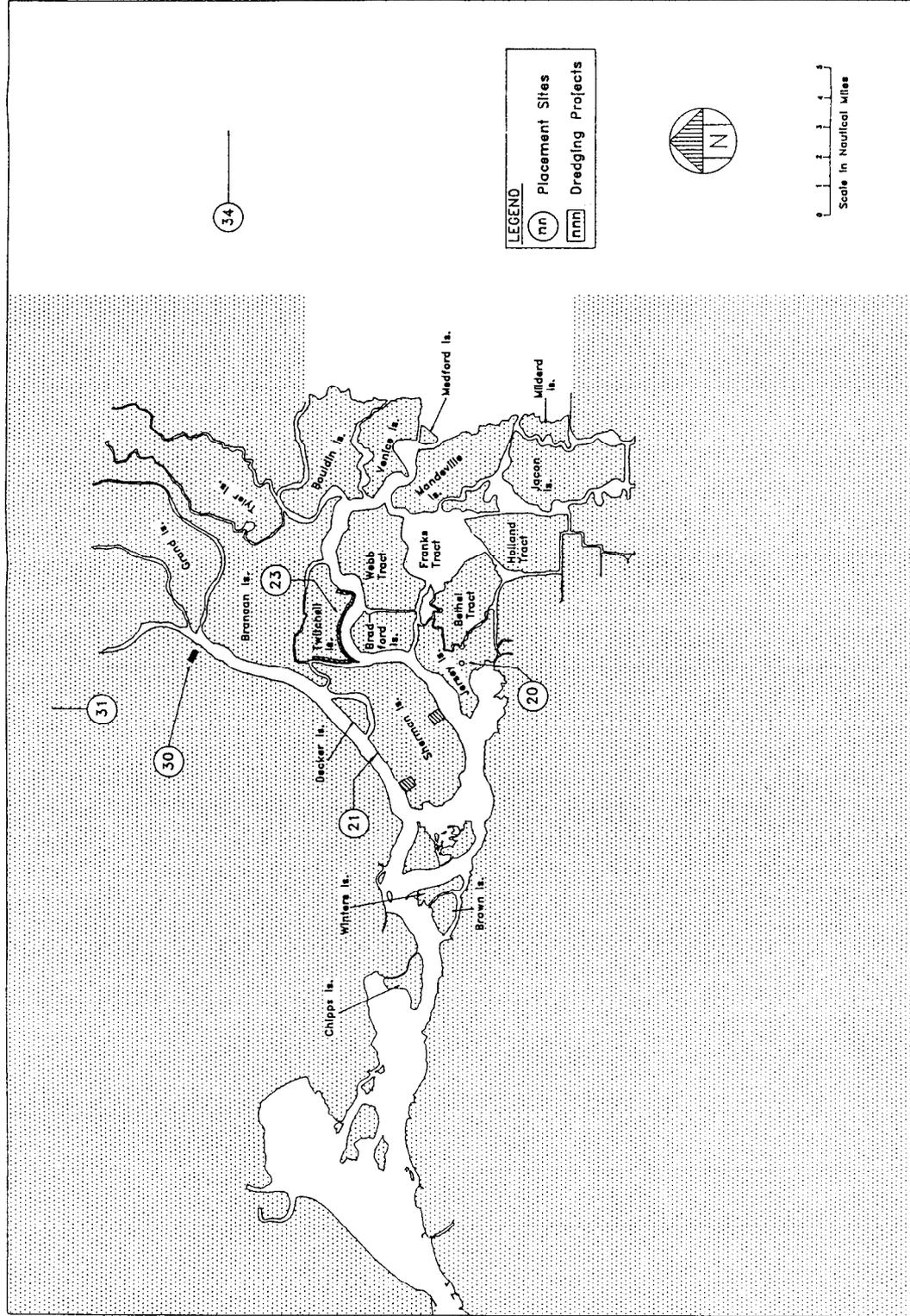
Placement Sites

No.	Description
20	Jersey Island
21	Sherman Island (rehandling site)
23	Other Sacramento – San Joaquin Delta Levee Sites – (Twitchell Island Demo).
30	Delta Barrow Pits (Information from BCDC)
31	Yolo County Central Landfill
34	East Carbon Development Corp., Utah

LEGEND

(nn) Placement Sites

[nnn] Dredging Projects

N

Scale In Nautical Miles
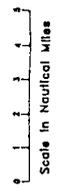
Table C.2: Disposal-Site Input Options

Disposal Site Number	Disposal Site Name	Approximate Annual Capacity (KCY)	Total Capacity (KCY)	"X" If One Time Placement	LATITUDE DD	MM	SS	Decimal Equivalent	LONGITUDE DD	MM	SS	Decimal Equivalent
1	Alcatraz	4,300	107,500		37	49	17	37.821	122	25	23	122.423
2	Carquinez St.	2,500	62,500		38	3	50	38.064	122	15	55	122.265
3	San Pablo Bay	500	12,500		38	0	28	38.008	122	24	55	122.415
4	Suisun Bay	200	5,000		38	3	15	38.054	122	5	6	122.085
5	Bay Farm Island Borrow Pit	230	5,750		37	44	30	37.742	122	17	0	122.283
6	North Tower Golden Gate Bridge	129	3,225		37	49	0	37.817	122	28	0	122.467
7	San Francisco Bar	500	12,500		37	45	6	37.752	122	35	45	122.596
8	Ocean (102) Site	6,000	150,000		37	39	0	37.650	123	29	0	123.483
9	Port Sonoma Marin	35	875					0.000				0.000
10	Leonard Ranch	350	8,750					0.000				0.000
11	Praxis-Pacheco	233	5,825		38	2	30	38.042	122	5	0	122.083
12	Sonoma Baylands	2,500		X				0.000				0.000
13	Hamilton Army Air Field; North Antenna Field	2,700		X				0.000				0.000
14	Hamilton Army Air Field (Habitat Development Site)	5,500		X	38	3	0	38.050	122	30	30	122.508
15	Montezuma Rehandling Site	20,000		X	38	5	0	38.083	122	52	30	122.875
16	Skaggs Island	1,440		X	38	11	0	38.183	122	23	30	122.392
17	Cargill West Evaporator Ponds	12,000		X	38	10	0	38.167	122	20	0	122.333
18	Cargill East Crystallizer Ponds	750	18,750	X	38	11	40	38.194	122	18	10	122.303
19	Cullinan Ranch	7,200		X				0.000				0.000
20	Jersey Island	1,600		X	38	2	0	38.033	121	41	0	121.683
21	Sherman Island	800		X	38	3	30	38.058	121	43	30	121.725
22	Upper Suisun Bay Sites	2,000		X	38	3	30	38.058	121	55	0	121.917
23	Twitchell Island Levees	300		X	38	6	30	38.108	121	39	0	121.650
24	Mare Island	450	11,250		38	6	0	38.100	122	17	0	122.283
25	Pierce Island	38	950		38	13	30	38.225	122	2	0	122.033
26	San Leandro Marina Site	63	1,575		38	41	30	38.692	122	10	0	122.167
27	Petaluma River Drying Ponds	130	3,450		38	13	30	38.225	122	36	0	122.600
28	Redwood Landfill	76			38	10	30	38.175	122	33	10	122.553
29	Bel Marin Keys	4,500		X				0.000				0.000
30	Delta Borrow Pits	30	750		38	10	0	38.167	121	41	0	121.683
32	Richmond Drydocks	14.2	500		37	54	20	37.906	122	20	47	122.346
33	Suisun Marsh Duck Club	?			38	8	0	38.133	122	5	30	122.092
36	East Carbon Development Corporation Idaho	1590			38	9	30	38.158	122	25	30	122.425
37	Camp Islands	760	19,000		38	12	0	38.200	122	25	0	122.417
38	North Point	208	5,200		38	8	30	38.142	122	28	0	122.467
39	Bair Island	?			37	34	30	37.575	122	12	30	122.208
40	Alameda Naval Air Station	200	5,000		37	46	30	37.775	122	18	30	122.308

Table C.3: Dredge Site Data Input Options

	Suisun Bay Channel Site - 2				
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	31	CLAM	$3.83	-
2	>15	11	CLAM	$2.33	-
3	>15	19	CLAM	$2.93	-
4	>15	1	CLAM or HOPPER	$1.58	$1.20
5	<15	39	CLMLT	$7.16	-
6	>15	32	CLAM	$3.90	-
7	>15	39	CLAM	$4.43	-
8	>15	87	CLAM	$8.03	-
9	<15	24	CLMLT	$4.98	-
10	<15	24	CLMLT	$4.98	-
11	>15	3	CLAM or HOPPER	$1.73	$1.60
12	<15	24	CLMLT	$4.98	-
13	>15	20	CLAM	$3.00	-
14	>15	20	CLAM	$3.00	-
15	>15	11	CLAM	$2.33	-
16	<15	17	CLMLT	$3.97	-
17	<15	16	CLAM	$2.70	-
18	<15	19	CLMLT	$4.26	-
19	<15	14	CLAM	$2.55	-
20	<15	19	CLMLT	$4.26	-
21	>15	15	CLAM	$2.63	-
22	<15	9	CLAM or HOPPER	$2.18	$2.80
23	>15	24	CLAM	$3.30	-
24	>15	13	CLAM	$2.48	-
25	<15	6	CLMLT	$2.37	-
26	<15	44	CLMLT	$7.88	-
27	<15	36	CLMLT	$6.72	-
28	N/A	N/A	TRUCK	-	-
29	>15	20	CLAM	$3.00	-
30	<15	16	CLAM	$2.70	-
32	>15	28	CLAM	$3.60	-
33	<15	5	CLMLT	$2.23	-
36	N/A	N/A	TRAIN	-	-
37	<15	17	CLMLT	$3.97	-
38	<15	24	CLMLT	$4.98	-
39	>15	52	CLAM	$5.40	-
40	>15	24	CLAM	$3.30	-

Table C.4: Dredge Site Data Input Options

			Concord NWS Site- 3		
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	32	CLAM	$3.90	-
2	>15	13	CLAM	$2.48	-
3	>15	21	CLAM	$3.08	-
4	>15	3	CLAM or HOPPER	$1.73	$1.60
5	<15	41	CLAM	$4.58	-
6	>15	34	CLAM	$4.05	-
7	>15	41	CLAM	$4.58	-
8	>15	89	CLAM	$8.18	-
9	<15	26	CLAM	$3.45	-
10	<15	26	CLAM	$3.45	-
11	>15	4	CLAM or HOPPER	$1.80	$1.80
12	<15	26	CLAM	$3.45	-
13	>15	22	CLAM	$3.15	-
14	>15	22	CLAM	$3.15	-
15	>15	9	CLAM or HOPPER	$2.18	$2.80
16	<15	17	CLAM	$2.78	-
17	<15	18	CLAM	$2.85	-
18	<15	21	CLAM	$3.08	-
19	<15	16	CLAM	$2.70	-
20	<15	18	CLAM	$2.85	-
21	>15	40	CLAM	$4.50	-
22	<15	7	CLAM or HOPPER	$2.03	$2.40
23	>15	18	CLAM	$2.85	-
24	>15	14	CLAM	$2.55	-
25	<15	9	CLAM or HOPPER	$2.18	$2.80
26	<15	47	CLAM	$5.03	-
27	<15	38	CLAM	$4.35	-
28	N/A	N/A	TRUCK	none	-
29	>15	22	CLAM	$3.15	-
30	<15	14	CLAM	$2.55	-
32	>15	30	CLAM	$3.75	-
33	<15	6	CLAM or HOPPER	$1.95	$2.20
36	N/A	N/A	TRAIN	-	-
37	<15	52	CLAM	$5.40	-
38	<15	17	CLAM	$2.78	-
39	>15	17	CLAM	$2.78	-
40	>15	26	CLAM	$3.45	-

Table C.5 Dredge Site Data Input Options

	Suisun Slough Channel Site - 4				
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	34	CLAM	$4.05	-
2	>15	14	CLAM	$2.55	-
3	>15	22	CLAM	$3.15	-
4	>15	4	CLAM or HOPPER	$1.80	$1.80
5	<15	43	CLMLT	$7.74	-
6	>15	35	CLAM	$4.13	-
7	>15	42	CLAM	$4.65	-
8	>15	90	CLAM	$8.25	-
9	<15	27	CLMLT	$5.42	-
10	<15	27	CLMLT	$5.42	-
11	>15	6	CLAM or HOPPER	$1.95	$2.20
12	<15	27	CLMLT	$5.42	-
13	>15	24	CLAM	$3.30	-
14	>15	24	CLAM	$3.30	-
15	>15	14	CLAM	$2.55	-
16	<15	20	CLMLT	$4.40	-
17	<15	19	CLAM	$2.93	-
18	<15	22	CLMLT	$4.69	-
19	<15	17	CLAM	$2.78	-
20	<15	23	CLMLT	$4.84	-
21	>15	18	CLAM	$2.85	-
22	<15	12	CLAM	$2.40	-
23	>15	27	CLAM	$3.53	-
24	>15	16	CLAM	$2.70	-
25	<15	3	CLMLT	$1.94	-
26	<15	47	CLMLT	$8.32	-
27	<15	39	CLMLT	$7.16	-
28	N/A	N/A	TRUCK	-	-
29	>15	24	CLAM	$3.30	-
30	<15	19	CLAM	$2.93	-
32	>15	31	CLAM	$3.83	-
33	<15	1	CLMLT	$1.65	-
36	N/A	N/A	TRAIN	-	-
37	<15	20	CLMLT	$4.40	-
38	<15	27	CLMLT	$5.42	-
39	>15	55	CLAM	$5.63	-
40	>15	27	CLAM	$3.53	-

Table C.6: Dredge Site Data Input Options

Mare Island Strait Site - 5					
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	21	CLAM	$3.08	-
2	>15	0	CLAM or HOPPER	$1.50	$1.00
3	>15	9	CLAM or HOPPER	$2.18	$2.80
4	>15	11	CLAM	$2.33	-
5	<15	29	CLMLT	$5.71	-
6	>15	22	CLAM	$3.15	-
7	>15	29	CLAM	$3.68	-
8	>15	77	CLAM	$7.28	-
9	<15	14	CLMLT	$3.53	-
10	<15	14	CLMLT	$3.53	-
11	>15	13	CLAM	$2.48	-
12	<15	14	CLMLT	$3.53	-
13	>15	10	CLAM	$2.25	-
14	>15	10	CLAM	$2.25	-
15	>15	21	CLAM	$3.08	-
16	<15	6	CLMLT	$2.37	-
17	<15	6	CLAM or HOPPER	$1.95	$2.20
18	<15	8	CLMLT	$2.66	-
19	<15	3	CLAM or HOPPER	$1.73	$1.60
20	<15	9	CLMLT	$2.81	-
21	>15	25	CLAM	$3.38	-
22	<15	19	CLAM	$2.93	-
23	>15	34	CLAM	$4.05	-
24	>15	3	CLAM or HOPPER	$1.73	$1.60
25	<15	17	CLMLT	$3.97	-
26	<15	34	CLMLT	$6.43	-
27	<15	26	CLMLT	$5.27	-
28	N/A	N/A	TRUCK	-	-
29	>15	10	CLAM	$2.25	-
30	<15	26	CLAM	$3.45	-
32	>15	18	CLAM	$2.85	-
33	<15	15	CLMLT	$3.68	-
36	N/A	N/A	TRAIN	-	-
37	<15	6	CLMLT	$2.37	-
38	<15	14	CLMLT	$3.53	-
39	>15	42	CLAM	$4.65	-
40	>15	14	CLAM	$2.55	-

Table C.7: Dredge Site Data Input Options

Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	19	CLAM	$2.93	-
2	>15	12	CLAM	$2.40	-
3	>15	7	CLAM or HOPPER	$2.03	$2.40
4	>15	21	CLAM	$3.08	-
5	<15	27	CLAM	$3.53	-
6	>15	21	CLAM	$3.08	-
7	>15	28	CLAM	$3.60	-
8	>15	76	CLAM	$7.20	-
9	<15	4	CLAM or HOPPER	$1.80	$1.80
10	<15	4	CLAM or HOPPER	$1.80	$1.80
11	>15	21	CLAM	$3.08	-
12	<15	4	CLAM or HOPPER	$1.80	$1.80
13	>15	8	CLAM or HOPPER	$2.10	$2.60
14	>15	8	CLAM or HOPPER	$2.10	$2.60
15	>15	33	CLAM	$3.98	-
16	<15	19	CLAM	$2.93	-
17	<15	20	CLAM	$3.00	-
18	<15	23	CLAM	$3.23	-
19	<15	16	CLAM	$2.70	-
20	<15	43	CLAM	$4.73	-
21	>15	38	CLAM	$4.35	-
22	<15	33	CLAM	$3.98	-
23	>15	46	CLAM	$4.95	-
24	>15	17	CLAM	$2.78	-
25	<15	28	CLAM	$3.60	-
26	<15	35	CLAM	$4.13	-
27	<15	13	CLAM	$2.48	-
28	N/A	N/A	TRUCK	-	$2.40
29	>15	8	CLAM or HOPPER	$2.10	$2.60
30	<15	42	CLAM	$4.65	-
32	>15	18	CLAM	$2.85	-
33	<15	28	CLAM	$3.60	-
36	N/A	N/A	TRAIN	-	-
37	<15	19	CLAM	$2.93	-
38	<15	4	CLAM or HOPPER	$1.80	$1.80
39	>15	40	CLAM	$4.50	-
40	>15	4	CLAM or HOPPER	$1.80	$1.80

Petaluma River (Across the Flats) Site - 8a

Table C.8: Dredge Site Data Input Options

	Pinole Shoal Site - 9				
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	14	CLAM	$2.55	-
2	>15	7	CLAM or HOPPER	$2.03	$2.40
3	>15	2	CLAM or HOPPER	$1.65	$1.40
4	>15	18	CLAM	$2.85	-
5	<15	22	CLMLT	$4.69	-
6	>15	15	CLAM	$2.63	-
7	>15	22	CLAM	$3.15	-
8	>15	70	CLAM	$6.75	-
9	<15	7	CLMLT	$2.52	-
10	<15	7	CLMLT	$2.52	-
11	>15	20	CLAM	$3.00	-
12	<15	7	CLMLT	$2.52	-
13	>15	4	CLAM or HOPPER	$1.80	$1.80
14	>15	4	CLAM or HOPPER	$1.80	$1.80
15	>15	28	CLAM	$3.60	-
16	<15	13	CLMLT	$3.39	-
17	<15	12	CLAM	$2.40	-
18	<15	15	CLMLT	$3.68	-
19	<15	10	CLAM	$2.25	-
20	<15	16	CLMLT	$3.82	-
21	>15	32	CLAM	$3.90	-
22	<15	26	CLAM	$3.45	-
23	>15	41	CLAM	$4.58	-
24	>15	10	CLAM	$2.25	-
25	<15	23	CLMLT	$4.84	-
26	<15	27	CLMLT	$5.42	-
27	<15	19	CLMLT	$4.26	-
28	N/A	N/A	TRUCK	-	-
29	>15	4	CLAM or HOPPER	$1.80	$1.80
30	<15	33	CLAM	$3.98	-
32	>15	11	CLAM	$2.33	-
33	<15	22	CLMLT	$4.69	-
36	N/A	N/A	TRAIN	-	-
37	<15	13	CLMLT	$3.39	-
38	<15	7	CLMLT	$2.52	-
39	>15	35	CLAM	$4.13	-
40	>15	7	CLAM or HOPPER	$2.03	$2.40

Table C.9: Dredge Site Data Input Options

	Richmond Harbor Site - 10				
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	8	CLAM or HOPPER	$2.10	$2.60
2	>15	29	CLAM	$3.68	-
3	>15	10	CLAM	$2.25	-
4	>15	26	CLAM	$3.45	-
5	<15	17	CLMLT	$3.97	-
6	>15	14	CLAM	$2.55	-
7	>15	22	CLAM	$3.15	-
8	>15	69.5	CLAM	$6.71	-
9	<15	18	CLMLT	$4.11	-
10	<15	18	CLMLT	$4.11	-
11	>15	26	CLAM	$3.45	-
12	<15	18	CLMLT	$4.11	-
13	>15	7	CLAM or HOPPER	$2.03	$2.40
14	>15	7	CLAM or HOPPER	$2.03	$2.40
15	>15	40	CLAM	$4.50	-
16	<15	25	CLMLT	$5.13	-
17	<15	24	CLAM	$3.30	-
18	<15	25	CLMLT	$5.13	-
19	<15	22	CLAM	$3.15	-
20	<15	48	CLAM	$5.10	-
21	>15	44	CLAM	$4.80	-
22	<15	37	CLAM	$4.28	-
23	>15	50	CLAM	$5.25	-
24	>15	21	CLAM	$3.08	-
25	<15	33	CLMLT	$6.29	-
26	<15	25	CLMLT	$5.13	-
27	<15	29	CLMLT	$5.71	
28	N/A	N/A	TRUCK	-	-
29	>15	18	CLAM	$2.85	-
30	<15	45	CLAM	$4.88	-
32	>15	1	CLAM or HOPPER	$1.58	$1.20
33	<15	33	CLMLT	$6.29	-
36	N/A	N/A	TRAIN	-	
37	<15	32	CLAM	$3.90	-
38	<15	24	CLAM	$3.30	-
39	>15	24	CLAM	$3.30	-
40	>15	22	CLAM	$3.15	-

Table C.10: Dredge Site Data Input Options

Point Molate NFD Site - 11					
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	10	CLAM	$2.25	-
2	>15	13	CLAM	$2.48	-
3	>15	5	CLAM or HOPPER	$1.88	$2.00
4	>15	22	CLAM	$3.15	-
5	<15	16	CLMLT	$3.82	-
6	>15	12	CLAM	$2.40	-
7	>15	19	CLAM	$2.93	-
8	>15	67	CLAM	$6.53	-
9	<15	13	CLMLT	$3.39	-
10	<15	13	CLMLT	$3.39	-
11	>15	20	CLAM	$3.00	-
12	<15	13	CLMLT	$3.39	-
13	>15	4	CLAM or HOPPER	$1.80	$1.80
14	>15	4	CLAM or HOPPER	$1.80	$1.80
15	>15	33	CLAM	$3.98	-
16	<15	19	CLMLT	$4.26	-
17	<15	20	CLAM	$3.00	-
18	<15	22	CLMLT	$4.69	-
19	<15	17	CLAM	$2.78	-
20	<15	41	CLMLT	$7.45	-
21	>15	36	CLAM	$4.20	-
22	<15	31	CLAM	$3.83	-
23	>15	45	CLAM	$4.88	-
24	>15	17	CLAM	$2.78	-
25	<15	29	CLMLT	$5.71	-
26	<15	26	CLMLT	$5.27	-
27	<15	25	CLMLT	$5.13	-
28	N/A	N/A	TRUCK	-	-
29	>15	4	CLAM or HOPPER	$1.80	$1.80
30	<15	40	CLAM	$4.50	-
32	>15	7	CLAM or HOPPER	$2.03	$2.40
33	<15	27	CLMLT	$5.42	-
36	N/A	N/A	TRAIN	-	-
37	<15	19	CLMLT	$4.26	-
38	<15	13	CLMLT	$3.39	-
39	>15	32	CLAM	$3.90	-
40	>15	13	CLAM	$2.48	-

Table C11: Dredge Site Data Input Options

San Rafael Creek (Across the Flats) Site - 13a					
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	10	CLAM	$2.25	-
2	>15	12	CLAM	$2.40	-
3	>15	5	CLAM or HOPPER	$1.88	$2.00
4	>15	22	CLAM	$3.15	-
5	<15	19	CLMLT	$4.26	-
6	>15	12	CLAM	$2.40	-
7	>15	19	CLAM	$2.93	-
8	>15	67	CLAM	$6.53	-
9	<15	14	CLMLT	$3.53	-
10	<15	14	CLMLT	$3.53	-
11	>15	21	CLAM	$3.08	-
12	<15	14	CLMLT	$3.53	-
13	>15	4	CLAM or HOPPER	$1.80	$1.80
14	>15	4	CLAM or HOPPER	$1.80	$1.80
15	>15	33	CLAM	$3.98	-
16	<15	18	CLMLT	$4.11	-
17	<15	20	CLAM	$3.00	-
18	<15	22	CLMLT	$4.69	-
19	<15	18	CLAM	$2.85	-
20	<15	41	CLMLT	$7.45	-
21	>15	37	CLAM	$4.28	-
22	<15	31	CLAM	$3.83	-
23	>15	45	CLAM	$4.88	-
24	>15	16	CLAM	$2.70	-
25	<15	29	CLMLT	$5.71	-
26	<15	28	CLMLT	$5.56	-
27	<15	25	CLMLT	$5.13	-
28	N/A	N/A	TRUCK	-	-
29	>15	4	CLAM or HOPPER	$1.80	$1.80
30	<15	40	CLAM	$4.50	-
32	>15	7	CLAM or HOPPER	$2.03	$2.40
33	<15	27	CLMLT	$5.42	-
36	N/A	N/A	TRAIN	-	-
37	<15	18	CLMLT	$4.11	-
38	<15	14	CLMLT	$3.53	-
39	>15	32	CLAM	$3.90	-
40	>15	14	CLAM	$2.55	-

Table C.12: Dredge Site Data Input Options

San Rafael Creek Site - 13b					
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Clam Cost $/CY/NM	Hopper Cost $/CY/NM
1	>15	12	CLAM	$2.40	-
2	>15	14	CLAM	$2.55	-
3	>15	6	CLAM or HOPPER	$1.95	$2.20
4	>15	24	CLAM	$3.30	-
5	<15	21	CLMLT	$4.55	-
6	>15	14	CLAM	$2.55	-
7	>15	21	CLAM	$3.08	-
8	>15	69	CLAM	$6.68	-
9	<15	16	CLMLT	$3.82	-
10	<15	16	CLMLT	$3.82	-
11	>15	22	CLAM	$3.15	-
12	<15	16	CLMLT	$3.82	-
13	>15	5	CLAM or HOPPER	$1.88	$2.00
14	>15	5	CLAM or HOPPER	$1.88	$2.00
15	>15	35	CLAM	$4.13	-
16	<15	20	CLMLT	$4.40	-
17	<15	22	CLAM	$3.15	-
18	<15	24	CLMLT	$4.98	-
19	<15	19	CLAM	$2.93	-
20	<15	43	CLMLT	$7.74	-
21	>15	39	CLAM	$4.43	-
22	<15	32	CLAM	$3.90	-
23	>15	47	CLAM	$5.03	-
24	>15	18	CLAM	$2.85	-
25	<15	31	CLMLT	$6.00	-
26	<15	30	CLMLT	$5.85	-
27	<15	27	CLMLT	$5.42	-
28	N/A	N/A	TRUCK	-	-
29	>15	5	CLAM or HOPPER	$1.88	$2.00
30	<15	41	CLAM	$4.58	-
32	>15	9	CLAM or HOPPER	$2.18	$2.80
33	<15	29	CLMLT	$5.71	-
36	N/A	N/A	TRAIN	-	-
37	<15	20	CLMLT	$4.40	-
38	<15	16	CLMLT	$3.82	-
39	>15	33	CLAM	$3.98	-
40	>15	16	CLAM	$2.70	-

Table C.13: Dredge Site Data Input Options

			San Francisco Harbor Site - 16a		
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	1	CLAM or HOPPER	$1.58	$1.20
2	>15	21	CLAM	$3.08	-
3	>15	13	CLAM	$2.48	-
4	>15	30	CLAM	$3.75	-
5	<15	24	CLMLT	$4.98	-
6	>15	3	CLAM or HOPPER	$1.73	$1.60
7	>15	10	CLAM	$2.25	-
8	>15	58	CLAM	$5.85	-
9	<15	22	CLMLT	$4.69	-
10	<15	22	CLMLT	$4.69	-
11	>15	29	CLAM	$3.68	-
12	<15	22	CLMLT	$4.69	-
13	>15	11	CLAM	$2.33	-
14	>15	11	CLAM	$2.33	-
15	>15	41	CLAM	$4.58	-
16	<15	26	CLMLT	$5.27	-
17	<15	27	CLAM	$3.53	-
18	<15	29	CLMLT	$5.71	-
19	<15	26	CLAM	$3.45	-
20	<15	50	CLMLT	$8.75	-
21	>15	46	CLAM	$4.95	-
22	<15	41	CLAM	$4.58	-
23	>15	54	CLAM	$5.55	-
24	>15	23	CLAM	$3.23	-
25	<15	37	CLMLT	$6.87	-
26	<15	16	CLMLT	$3.82	-
27	<15	32	CLMLT	$6.14	-
28	N/A	N/A	TRUCK	-	-
29	>15	11	CLAM	$2.33	-
30	<15	48	CLAM	$5.10	-
32	>15	7	CLAM or HOPPER	$2.03	$2.40
33	<15	34	CLMLT	$6.43	-
36	N/A	N/A	TRAIN	-	-
37	<15	26	CLMLT	$5.27	-
38	<15	22	CLMLT	$4.69	-
39	>15	22	CLAM	$3.15	-
40	>15	22	CLAM	$3.15	-

Table C.14: Dredge Site Data Input Options

	Port of Oakland Site - 18				
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	5	CLAM or HOPPER	$1.88	$2.00
2	>15	23	CLAM	$3.23	-
3	>15	16	CLAM	$2.70	-
4	>15	32	CLAM	$3.90	-
5	<15	9	CLMLT	$2.81	-
6	>15	7	CLAM or HOPPER	$2.03	$2.40
7	>15	14	CLAM	$2.55	-
8	>15	62.5	CLAM	$6.19	-
9	<15	25	CLMLT	$5.13	-
10	<15	25	CLMLT	$5.13	-
11	>15	32	CLAM	$3.90	-
12	<15	25	CLMLT	$5.13	-
13	>15	15	CLAM	$2.63	-
14	>15	15	CLAM	$2.63	-
15	>15	45	CLAM	$4.88	-
16	<15	28	CLMLT	$5.56	-
17	<15	33	CLAM	$3.98	-
18	<15	36	CLMLT	$6.72	-
19	<15	25	CLAM	$3.38	-
20	<15	52	CLAM	$5.40	-
21	>15	49	CLAM	$5.18	-
22	<15	14	CLAM	$2.55	-
23	>15	57	CLAM	$5.78	-
24	>15	25	CLAM	$3.38	-
25	<15	40	CLMLT	$7.30	-
26	<15	16	CLMLT	$3.82	-
27	<15	36	CLMLT	$6.72	-
28	N/A	N/A	TRUCK	-	-
29	>15	14	CLAM	$2.55	-
30	<15	52	CLAM	$5.40	-
32	>15	10	CLAM	$2.25	-
33	<15	39	CLMLT	$7.16	-
36	N/A	N/A	TRAIN	-	-
37	<15	23	CLMLT	$4.84	-
38	<15	26	CLMLT	$5.27	-
39	>15	32	CLAM	$3.90	-
40	>15	3	CLAM or HOPPER	$1.73	$1.60

Table C.15: Dredge Site Data Input Options

Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Transport Cost (Fully Loaded 3000 CY Scows) $/CY	Transport Cost (Hopper Dredge) $/CY
1	>15	7	CLAM or HOPPER	$2.03	$2.40
2	>15	25	CLAM	$3.38	-
3	>15	18	CLAM	$2.85	-
4	>15	35	CLAM	$4.13	-
5	<15	9	CLAM or HOPPER	$2.18	$2.80
6	>15	10	CLAM	$2.25	-
7	>15	17	CLAM	$2.78	-
8	>15	65	CLAM	$6.38	-
9	<15	25	CLAM	$3.38	-
10	<15	25	CLAM	$3.38	-
11	>15	33	CLAM	$3.98	-
12	<15	25	CLAM	$3.38	-
13	>15	17	CLAM	$2.78	-
14	>15	17	CLAM	$2.78	-
15	>15	48	CLAM	$5.10	-
16	<15	35	CLAM	$4.13	-
17	<15	35	CLAM	$4.13	-
18	<15	36	CLAM	$4.20	-
19	<15	30	CLAM	$3.75	-
20	<15	56	CLAM	$5.70	-
21	>15	51	CLAM	$5.33	-
22	<15	12	CLAM	$2.40	-
23	>15	60	CLAM	$6.00	-
24	>15	30	CLAM	$3.75	-
25	<15	41	CLAM	$4.58	-
26	<15	16	CLAM	$2.70	-
27	<15	37	CLAM	$4.28	-
28	N/A	N/A	TRUCK	-	-
29	>15	17	CLAM	$2.78	-
30	<15	52	CLAM	$5.40	-
32	>15	12	CLAM	$2.40	-
33	<15	39	CLAM	$4.43	-
36	N/A	N/A	TRAIN	-	-
37	<15	35	CLAM	$4.13	-
38	<15	25	CLAM	$3.38	-
39	>15	21	CLAM	$3.08	-
40	>15	6	CLAM or HOPPER	$1.95	$2.20

Alameda NAS Site - 19

Table C.16: Dredge Site Data Input Options

NSC Oakland Site - 24					
Disposal Site	Access Depth (Ft. MLLW)	Distance (Miles)	Transport Type	Clam Cost $/CY/NM	Hopper Cost $/CY/NM
1	>15	5	CLAM or HOPPER	$1.88	$2.00
2	>15	23	CLAM	$3.23	-
3	>15	16	CLAM	$2.70	-
4	>15	32	CLAM	$3.90	-
5	<15	9	CLMLT	$2.81	-
6	>15	7	CLAM or HOPPER	$2.03	$2.40
7	>15	14	CLAM	$2.55	-
8	>15	62	CLAM	$6.15	-
9	<15	25	CLMLT	$5.13	-
10	<15	25	CLMLT	$5.13	-
11	>15	32	CLAM	$3.90	-
12	<15	25	CLMLT	$5.13	-
13	>15	15	CLAM	$2.63	-
14	>15	15	CLAM	$2.63	-
15	>15	45	CLAM	$4.88	-
16	<15	28	CLMLT	$5.56	-
17	<15	33	CLAM	$3.98	-
18	<15	36	CLMLT	$6.72	-
19	<15	25	CLAM	$3.38	-
20	<15	52	CLMLT	$9.04	-
21	>15	49	CLAM	$5.18	-
22	<15	14	CLAM	$2.55	-
23	>15	57	CLAM	$5.78	-
24	>15	25	CLAM	$3.38	-
25	<15	40	CLMLT	$7.30	-
26	<15	16	CLMLT	$3.82	-
27	<15	36	CLMLT	$6.72	-
28	N/A	N/A	TRUCK	-	-
29	>15	14	CLAM	$2.55	-
30	<15	52	CLAM	$5.40	-
32	>15	10	CLAM	$2.25	-
33	<15	39	CLMLT	$7.16	-
36	N/A	N/A	TRAIN	-	-
37	<15	23	CLMLT	$4.84	-
38	<15	26	CLMLT	$5.27	-
39	>15	32	CLAM	$3.90	-
40	>15	6	CLAM or HOPPER	$1.95	$2.20

Table C.17: Dredged Material Volume Input

Year	1: Suisun Bay Channel	3: Concord NWS	4: Suisun Slough Channel	5: Mare Island Strait	8a: Petaluma River (Across the Flats)	9: Pinole Shoal	10: Port of Richmond	11: Point Molate NFD	13a: San Rafael Creek (Across the Flats)	13b: San Rafael Creek	16a: San Francisco Harbor	18: Port of Oakland	19: Alameda NAS	24: NSC Oakland	Total Volume/Year
1967	430600	36751	0	1933300	0	218200	491100	302756	0	0	295000	593380	1056200	2247336	7604623
1968	0	0	0	1180300	0	450000	28500	0	0	0	0	354562	195300	549862	2758524
1969	242886	30000	177719	2231000	0	266039	172000	176000	0	242866	0	219000	312500	950366	5020376
1970	154800	63200	172405	1253000	0	1106500	502000	88050	0	0	0	213000	972500	1273550	5799005
1971	0	0	0	2585000	0	0	319000	261000	0	0	0	0	876000	0	4041000
1972	50000	0	0	941500	0	665000	1226500	0	0	0	0	364000	155000	0	3402000
1973	101700	0	0	2018000	0	0	256500	0	0	0	17800	387500	0	0	2781500
1974	0	78721	0	2999500	0	481000	262500	82500	0	0	0	364000	1494000	0	5762221
1975	98500	78000	0	2271500	0	0	498000	94551	0	0	0	318668	881000	0	4240219
1976	85000	0	0	1071500	0	46900	275500	0	0	0	0	584500	813200	0	2876600
1977	0	0	0	417000	501672	0	238000	18113	0	0	487036	0	309000	0	1970821
1978	418804	0	0	2728900	0	0	471000	0	0	152945	0	360000	764000	0	4895649
1979	240806	0	0	390600	0	0	754000	0	0	0	0	432000	0	0	1817406
1980	285000	62400	0	1916500	0	149000	483000	0	0	0	0	536100	0	0	3432000
1981	166000	3373	0	354000	0	0	348000	35000	51599	0	0	1113000	495599	0	1566571
1982	326528	0	149528	2484239	0	386927	1022079	156485	0	0	208000	263200	1014267	0	6011253
1983	0	0	0	1817313	600998	0	118000	0	0	0	0	445500	1595298	2040798	6617907
1984	119545	0	0	1457362	0	432919	1032335	302887	0	0	23550	486950	0	0	3855548
1985	38600	0	0	363337	0	0	0	77700	0	0	144132	337300	0	0	961069
1986	0	0	0	808169	0	0	2482070	0	0	298816	16100	485475	1600000	0	5690630
1987	103446	0	0	448897	436869	309386	1201075	117956	0	0	0	868505	489000	1475461	5450595
1988	0	0	0	439662	0	0	335103	72715	54275	0	0	392841	664091	1183922	3142609
1989	0	0	0	255246	0	0	798842	0	0	0	0	344336	895663	0	2294087
1990	223987	0	197973	516410	0	0	200541	124964	0	0	0	211834	0	0	1475709
1991	0	0	0	154242	0	13370	475500	0	0	0	0	98904	969269	1068173	2779458
Site Totals:	3086202	352445	697625	33036477	1539539	4525241	13991145	1910677	105874	694627	1191618	8774555	15551887	10789468	96247380

Gahagan Bryant Associates Inc.

10/21/94

Table C.18: Example 1 Results

	Option 1			Option 2		
	In-Bay	Ocean	Upland	In-Bay	Ocean	Upland
Vol. placed (cu yd)	82,185,005	0	12,862,307	17,509,663	52,535,060	25,002,601
% total vol.	86.5	0	13.5	18.4	55.3	26.3
Cost ($)	128,130,554	0	23,940,046	31,561,403	327,054,012	64,953,682
% total cost	84.3	0	15.7	7.5	77.2	15.3

Table C.19: Example 2 Placement Sites

Site number: name	Maximum addition/period (cu yd)	Capacity (cu yd)
10: Leonard Ranch	500,000	8,750,000
15: Montezuma Rehandling	500,000	9,500,000
18: Cargill East Crystallizer Ponds	1,000,000	18,750,000

Table C.20: Run 1; Tipping Fee Sensitivity

Leonard Ranch		Cargill East Crystallizer Ponds		Montezuma Rehandling	
Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume
1	26%	1	41%	1	33%
2	22%	1	41%	1	37%
3	11%	1	52%	1	37%
4	10%	1	53%	1	37%

Table C.21: Run 2; Tipping Fee Sensitivity

Leonard Ranch		Cargill East Crystallizer Ponds		Montezuma Rehandling	
Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume
1	26%	1	41%	1	33%
1	34%	2	29%	1	37%
1	34%	3	25%	1	41%
1	36%	4	21%	1	43%

Table C.22: Run 3; Tipping Fee Sensitivity

Leonard Ranch		Cargill East Crystallizer Ponds		Montezuma Rehandling	
Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume	Tipping fee ($/cu yd)	% total volume
1	26%	1	41%	1	33%
1	34%	1	41%	2	25%
1	34%	1	55%	3	11%
1	36%	1	56%	4	10%