ERDC/CHL TR-99-19

Coastal and Hydraulics Laboratory

US Army Corps of Engineers®
Engineer Research and Development Center

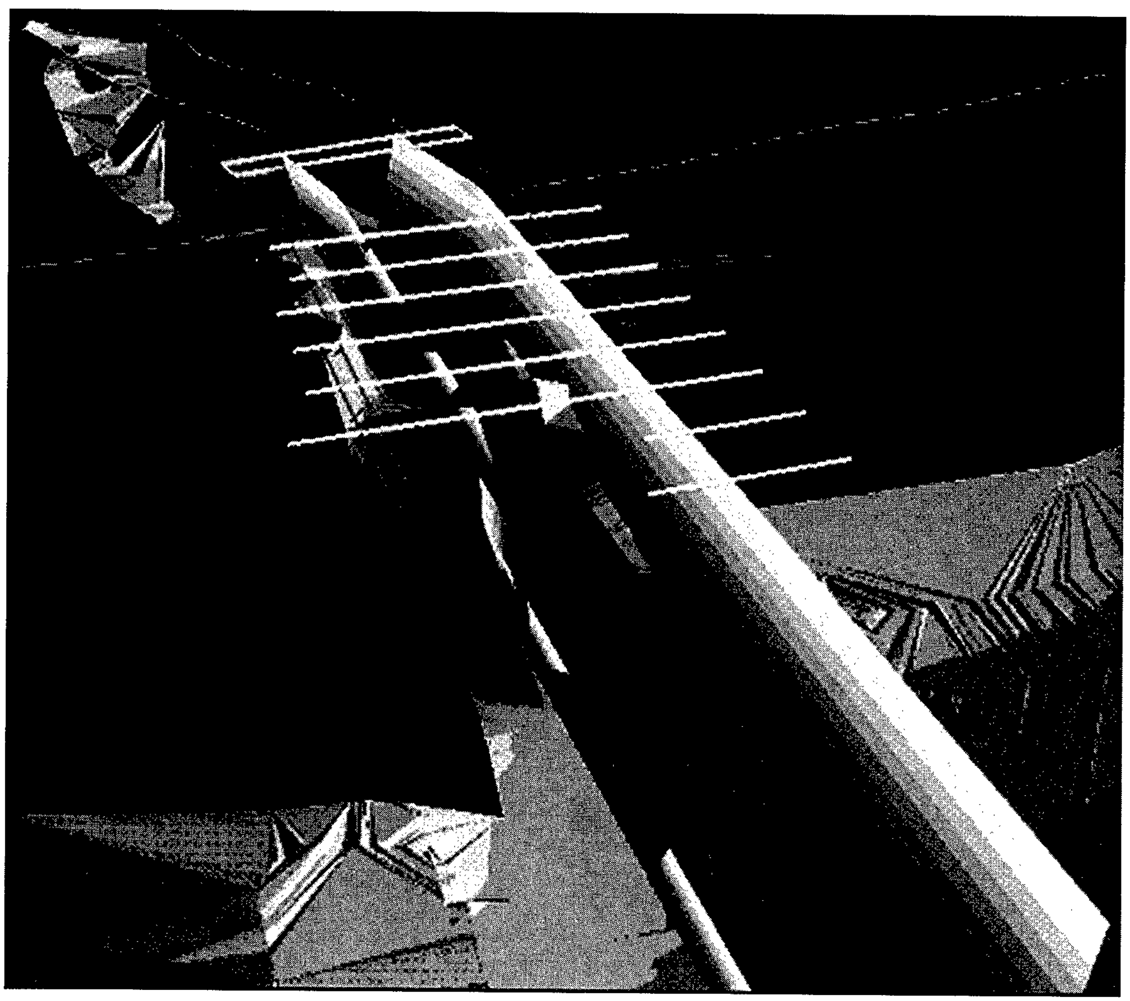
DMS: Diagnostic Modeling System

Report 7

The DMS Data Manager — Updated User's Guide

Shelley Johnston and Kenneth R. Craig

August 2002



Approved for public release; distribution is unlimited.

The contents of this report are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

The findings of this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

PRINTED ON RECYCLED PAPER

ERDC/CHL TR-99-19
August 2002

DMS: Diagnostic Modeling System

Report 7
The DMS Data Manager — Updated User's Guide

by Shelley Johnston

Coastal and Hydraulics Laboratory
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Kenneth R. Craig

Taylor Engineering, Inc.
9000 Cypress Green Drive
Jacksonville, FL 32256

20021119 014

Report 7 of a series

Approved for public release; distribution is unlimited

Prepared for U.S. Army Corps of Engineers
Washington, DC 20314-1000

Under Work Unit 33129

Contents

List of Figures

Preface

The study described in this report was performed under the Diagnostic Modeling System (DMS) Work Unit No. 33129 of the Coastal Sedimentation and Dredging Program administered by Headquarters, U.S. Army Corps of Engineers (HQUSACE). Research and Development activities of the DMS are being conducted at the U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), Vicksburg, MS. HQUSACE Business Area Leader (Navigation) is Mr. Barry W. Holliday; Coastal Program Technical Monitors are Messrs. Charles B. Chesnutt, Michael J. Klosterman, and David B. Wingerd; and Research and Development Coordinator is Mr. David B. Mathis. The ERDC Technical Director for Navigation is Dr. William H. McAnally.

Work was performed by Ms. Shelley Johnston, Coastal Evaluation and Design Branch (CEDB), CHL, and Mr. Kenneth R. Craig of Taylor Engineering, Inc., Jacksonville, FL. The contract monitor for work at Taylor Engineering and Principal Investigator of the DMS Work Unit was Dr. Nicholas C. Kraus, Senior Scientists Group, CHL. Dr. Kraus provided direction for and technical review of this report.

Work at CHL was performed under the general supervision of Dr. Yen-Hsi Chu, Chief, CEDB, and Mr. Thomas W. Richardson, Director, CHL.

This is Report 7 of a series. It provides an update and extension of material presented in Report 3, the DMS Data Manager User's Guide. Report 1 discusses a reduction of sediment shoaling by relocation of the Gulf Intracoastal Waterway, Matagorda Bay, Texas. Report 2 describes reduction of sediment shoaling of the entrance channel at East Pass, Florida. Report 4 describes the shoaling analysis of St. Marys Entrance, Florida. Report 5 will present results from Jacksonville Harbor Navigation Project, Jacksonville, Florida. Report 6 will describe the DMS Manual.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

The contents of this report are not to be used for advertising, publication or promotional purposes. Citation of trade names does not constitute an official endorsement or approval for the use of such commercial products.

1 Introduction

This report is an update and extension of the technical report "DMS: Diagnostic Modeling System; Report 3, The DMS Data Manager--A User's Guide" (Craig et al. 2001). This report documents the latest developments, functionality, and application of the Diagnostic Modeling System (DMS) Data Manager, a Geographic Information System (GIS)-based software package developed to organize and examine dredging-related data. The Data Manager is a product of an applied research and development project conducted by the U.S. Army Engineer Research and Development Center (ERDC), Coastal and Hydraulics Laboratory (CHL), and Taylor Engineering, Inc., Jacksonville, FL.

The DMS Data Manager is one of the three main components of the DMS, the others being the DMS Manual (Kraus et al., in preparation) and the DMS Analytical Toolbox, which is a flexible group of generic models and analytical tools operated with DMS concepts and methodology. This report updates the user's guide for the Data Manager. The newest version of the Data Manager includes several powerful improvements to the old versions. For example, there is now more control over where channel geometry and analysis results are stored, Computer-Aided Drafting (CAD) drawings can be a data source for the channel geometry, and cross sections can be extracted from multiple bathymetry themes at the same time.

Background

The DMS was developed under the Coastal Sedimentation and Dredging Program administered by Headquarters, U.S. Army Corps of Engineers (HQUSACE). The system is intended to provide the U.S. Army Corps of Engineers (USACE) with a rapid and inexpensive, yet reliable capability to develop and evaluate navigation channel operations and maintenance (O&M) alternatives based on limited information on the hydrodynamic and sediment transport conditions at a site.

The DMS is intended to allow rapid evaluation or diagnosis of a problem shoaling area and provide guidance for determining possible solutions. The economic lever underlying the DMS concept is that a low-level analysis, typically started within the Data Manual and possibly supplemented by a modest numerical modeling effort (DMS Analytical Toolbox), can yield substantial cost savings without interrupting ongoing O&M activities and schedule. That is, the DMS is intended to provide feasible alternatives for reducing USACE O&M costs within the dredging cycle of a project. The application time and effort in applying the DMS are expected to be roughly proportional to the maintenance time of the project.

The USACE maintains thousands of miles of navigation channels throughout the coastal and inland waters of the United States and its territories. These Federally maintained channels compose the maritime heart of the Nation's waterborne commerce and national defense. As such, their maintenance commands a major share of the USACE O&M budget every year. With the continual ebb and flood of the tide, together with littoral drift approaching channels, sediments enter and deposit in these channels, often in areas neither welcomed nor anticipated. Excessive deposition reduces channel depths, necessitating dredging. Chronic sediment shoaling areas require frequent dredging.

Such situations led to the creation of the DMS Work Unit. Early in the development process, the Work Unit identified a need for a software package to organize and provide access to relevant navigation project data in a central repository. The DMS Data Manager, now proven through application in several projects, is designed to address this need.

Overview

The DMS methodology provides a quick and concise capability to identify, categorize, and evaluate potential areas of navigation channel sediment deposition for correction. The DMS incorporates established public domain coastal hydrodynamic models to be applied in combination with a suite of analytical tools and procedures. The approach is to apply a common-sense-based methodology for treatment of shoaling problems. The tools included in the DMS help engineers identify problem areas of shoaling, characterize the causes of these problems, and develop practical, cost-effective solutions.

The DMS comprises three components. The DMS Data Manager, a GIS-based computer program and primary subject of this report, allows the user to organize and view all the relevant information within a project area. Examples of the data kept in the DMS Data Manager include digitized bathymetries, aerial photographs, GIS shapefiles, and shoaling history. This component gives "one-stop" access to all graphical and numerical information associated with a maintained channel.

The DMS Manual is a reference document containing diagrams and example photographs of different shoal categories. This field guide to shoaling problems helps identify the types of shoals by giving the user comparable examples. In addition to providing diagrams and examples, the DMS Manual also provides descriptions of the shoal and the mechanisms that create it.

The DMS Analytical Toolbox is a suite of generic analytical tools and recommendations for graphical formats for quick diagnosis of shoaling problems and investigation of possible solutions. This toolbox includes a collection of computer software (e.g., hydrodynamic models, wave refraction/diffraction models) and analytical models (e.g., sediment transport equations, wind-generated wave models) (Gosselin, Craig, and Taylor 2000; Gosselin and Craig, in preparation). In addition, the toolbox contains recommended output formats from the models. Standardizing output formats makes mechanisms that contribute to shoaling easier to identify. Use of standardized output formats facilitates the building of an experience base with which to compare future shoaling investigations. Applied in parallel, these three components provide for rapid assessment of shoaling problems.

In addition, several case studies have been performed to evaluate the DMS methodology and exercise the tools being developed. DMS technical reports detail applications at East Pass, FL (Gosselin, Craig, and Taylor 1999), Matagorda Bay, TX (Kraus, Mark, and Sarruff 2000), Jacksonville Harbor (Gosselin, Cranston, and Carvalho, in preparation), and St. Marys Entrance (Johnston et al. 2002).

Scope of the Report

This report describes data requirements and functionality of the Data Manager. Chapter 2 describes the Data Manager and system requirements. Chapter 3 discusses the functionality of the Data Manager tools available to develop baseline project information. Chapter 4 outlines the Data Manager tools with which to analyze relevant project data. Chapter 5 presents a summary of this report.

2 DMS Data Manager

Overview

Early in the DMS development process, the DMS Work Unit identified a need for an organized approach to data management. With more and more project data delivered and maintained in digital format, the work unit logically proceeded to design a software package to synthesize all data necessary to apply DMS concepts to a project. These data are inherently geographic in nature, leading to a GIS-based approach.

GIS software allows multiple layers of geographically referenced data to be viewed and analyzed. In its simplest implementation, a GIS provides a means to link the graphical representations of data (e.g., roads, channels, bathymetry) to an informational database specific to the location of interest. The graphical representations are known as features, while data in the database are attributes and records (Figure 1). Features can take the form of points, lines, or polygons.

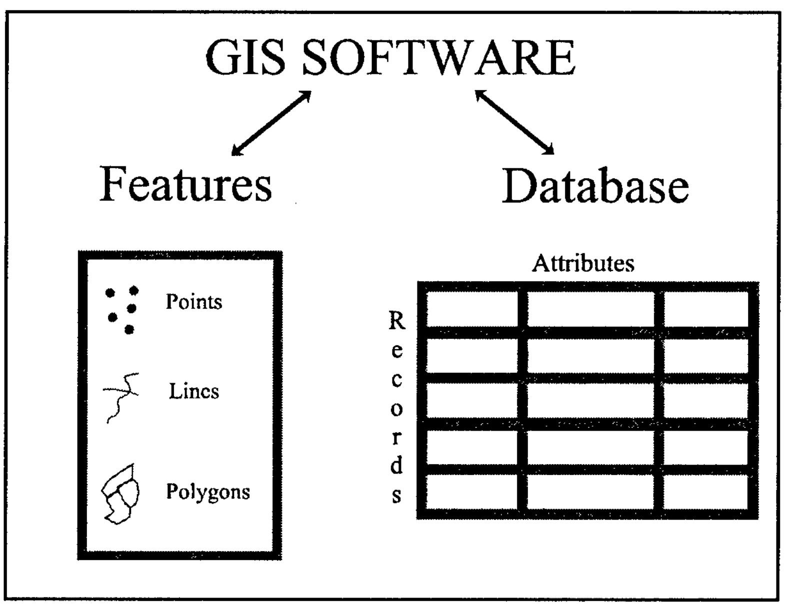


Figure 1. Relationship between GIS software, geographic features, and databases

Linking to the attribute information in the database allows a point to be recognized as a tide gauge or a channel marker, for example. Specifying how the point displays on screen can further enhance the relationship of the feature to what it represents. Carrying the channel marker example further, specific markers can be displayed as red squares or green triangles to indicate which side of the channel they define.

The Data Manager is a customized extension of the commercially available GIS software package ArcView from Environmental Systems Research Institute (ESRI) (1996). ArcView is widely distributed throughout the industry as a powerful data viewer, and many USACE Districts and cooperating partners (typically, State agencies) manage navigation and other projects with the aid of ArcView. Additionally, ArcView has substantial analysis capabilities as well as its own scripting language that allows customized functionality to be incorporated in projects.

The DMS approach requires the user to be familiar with GIS systems. Development can then be focused on simplifying the project setup and analysis phases. In general, efforts have been made to reduce the amount of data manipulation outside the Data Manager to create comprehensive projects. The Data Manager provides step-by-step procedures that prompt the user for necessary data to develop comprehensive project databases. Additionally, the Data Manager incorporates several custom analysis tools to perform simple volumetric comparisons and cross-section analyses.

Report generation and data maintenance were also identified needs in development of the Data Manager. The Dredging Record Center is a utility contained within the Data Manager that allows users to document past and on-going dredging operations in a Microsoft Access relational database. Users can produce consistently formatted reports from these data via the reporting option available in the Data Manager. This capability allows examination of past dredging records in a tabular and/or graphical format to aid in analysis and review of shoaling problems. Examples of such reports include channel station, area, and project summary reports with details and summary statistics (e.g., total volumes, annual volumes) for user-defined areas.

The Data Manager also communicates with the Hydraulic Processes Analysis System (HyPAS), as described by Pratt and Cook (2000), another ArcView extension developed to analyze a wide variety of data types generated by field measurements or in numerical modeling. The two packages communicate efficiently and provide data to each other for their respective applications. The combination of the two packages provides a set of powerful analysis tools to examine, in detail, data from Federal navigation projects.

Hardware Requirements

Basic hardware requirements to operate the DMS Data Manager parallel those required for the ArcView software package. However, based upon experience in operating the Data Manager and opening large files consisting of photographs and bathymetric surveys, recommended minimum hardware specifications are as follows:

a. Industry-standard personal computer with at least 1 GHz processor and hard disk with several gigabytes free space for DMS projects.

b. Memory: 128 MB.

c. OpenGL accelerated graphics card with geometry co-processor and 8 MB plus graphics/texture memory (also known as "local memory").

Hard copy of Data Manager output can be printed on any standard printer that has a Microsoft Windows driver. Access to color-enabled printers helps to clarify report data as well as accurately document map development.

Software Requirements

The DMS Data Manager was originally developed for the Windows NT 4.0 operating system together with the Version 3.2 release of ArcView[1] — extending the base functionality of the ArcView environment (Figure 2). Internal operating system calls contained in the software should be applicable to the other members of Microsoft's operating system family (Windows 95/98/2000; Windows XP). The Data Manager extension incorporates ESRI's Three-Dimensional (3-D) Analyst and Spatial Analyst extensions to develop and view bathymetric surfaces and to calculate sediment volumes. The 3-D and Spatial Analyst Extensions, although not necessary to view much of the base map data, provide significant functionality to the software. The CAD Viewer extension, provided with the base ArcView package, allows incorporation of CAD drawings in AutoCAD (.dwg), AutoCAD export (.dxf), and MicroStation (.dgn) formats within the database. Additionally, the latest version of the software supports many common image formats (.jpg, .tif, .sid, etc.), allowing easy viewing of existing and historic site conditions. Finally, the Data Manager takes advantage of Crystal Reports for ArcView application to generate reports. Crystal Reports is included with the base ArcView package.

Data Requirements

The Data Manager supports a wide variety of data formats, including Arc/Info coverages, shapefiles (ArcView's native format), AutoCAD drawings (through AutoCAD 2000), MicroStation files, Dbase databases, various text-based data files, and digital images. The initial steps required during development of the database concern selection of a common coordinate system (typically State Plane or Universal Transverse Mercator (UTM)), datum (North American Datum of 1927 (NAD 27) or 1983 (NAD 83) and specification of units (feet, meters, decimal degrees) to be applied to all the data. A common coordinate system provides a reference for the Data Manager and allows accurate data layering. The required data fall into four classifications: base map information, bathymetric surveys, dredging records, and miscellaneous. Each classification is discussed in the following sections.

[1] The Data Manager described in this report operates under ArcView 3.2. A new version of the Data Manager to run with ArcView 8 is expected at the end of 2002.

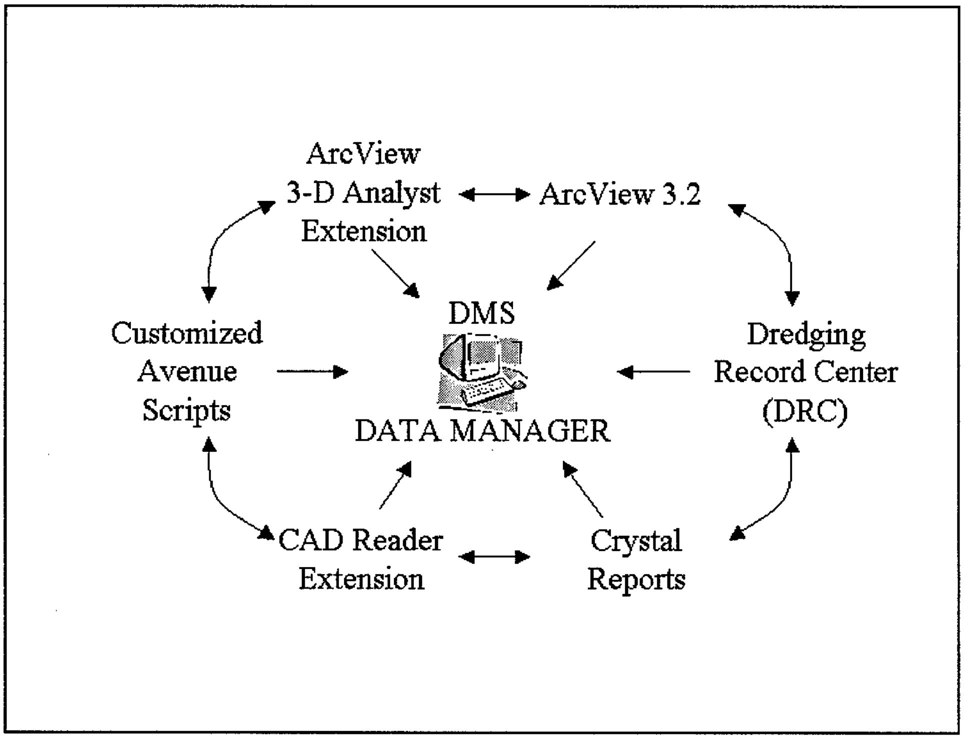


Figure 2. DMS Data Manager software components

Base map

Base map information can be any type of data the user associates readily with the project area. Examples include project (channel) boundaries, aids to navigation, shoreline positions, shore protection structures, marina and port facilities, sensitive environmental areas, deposition areas, hazardous areas, shipwrecks, fish havens, reefs, utilities, buildings, roads, and bridges. Typical formats for base map data will include Arc/Info coverages, shapefiles, or one of the CAD formats. The World Wide Web and in-house GIS personnel provide numerous sources for base map data from various Federal, State, and local government agencies.

ASCII text files

Several Data Manager tools require formatted ASCII files including coordinates defining channel center lines and stationing information. These data are often maintained on in-house spreadsheets or databases that can be exported to the appropriate format. Alternatively, the user can create the files in any standard word processing or text-editing program.

Bathymetric surveys

The Data Manager interpolates standard bathymetric and hydrographic survey data onto grids representing the bathymetry in and around the project area. These data will typically be available in ASCII text files (X, Y, Z) or CAD drawings. A survey conversion tool leads the user step by step through the surface-generation process and collects additional supporting information on each survey.

Dredging records

Historical dredging records can be maintained in the Dredging Record Center, a Microsoft Access database that communicates transparently with the Data Manager. Data are accessed with standard queries through a wizard interface in ArcView. Data input forms translate data to a standardized format. Typical records include date, contractor, location (e.g., station or river mile), horizontal dimensions, depth of cut, design and pay volumes, disposal location, and dredge specifications. Typically, preparation of this portion of the database will require manual input of printed data.

One of the primary advantages to a GIS-based approach is derived from the geographic relationships inherent in the data. Dredging records, for example, document project performance at a location and thus have a geographic component. Therefore, the data can be referenced to coordinates indicating that location (i.e., stationing). These data can then be selected for analysis based initially on the location. Specific problem areas can be isolated and examined to determine trends not readily discernible through standard tabulated data. Several reports can be generated based on these records.

Digital photographs

The HyPAS software provides a means to include digital photography to document general and specific changes to a system over time. These photographs can include aerials, oblique ground level shots of specific locations, and documentary evidence of projects – essentially any aspect of the project that will benefit from photographic representation. Typically, digital images should be converted to JPEG format at a standard resolution of 640 × 480 pixels through scanning software packages. HyPAS includes options to document the source, date, and description of the photograph. The user may easily view the images with a single mouse click, select and print those of special interest, and incorporate these images in various reports. Georeferenced aerial photography (e.g., stretched to match the adopted coordinate system) can be incorporated as an additional ArcView theme in the project base map.

Miscellaneous

Any additional relevant data fall under the miscellaneous classification. This category can include such data and documentation as sediment grain size curves, tabulated sediment data, a tidal record time series, datum corrections, and sea level rise rates based upon a survey epoch. In a manner similar to that used to maintain the dredge records, the end user incorporates these data into an ArcView database where they become readily viewable and searchable.

3 Project Setup

Introduction

The DMS Data Manager extension to ArcView comprises several custom tools designed to ease the analysis of bathymetric data. These tools can be categorized as either project setup tools or data analysis tools. The setup tools include the *Getting Started* screen, the *Setup Wizard*, *CAD Import*, and the *Import Bathymetry* Tool. Each of these addresses a different aspect of project creation. The end product is a well organized, comprehensive, and expandable data set that may be examined with the analysis tools. The data analysis tools are the *Cross Sections* Tool, the *Volume Calculator*, and the *Dredging Record Center*. The setup tools are discussed in this chapter, and the data analysis tools are discussed in the next chapter.

Within ArcView, the Data Manager tools can be accessed either through the DMS menu item in the current view or the DMS toolbar (Figure 3). The DMS toolbar (Figure 4) can be opened by clicking on the DMS button.

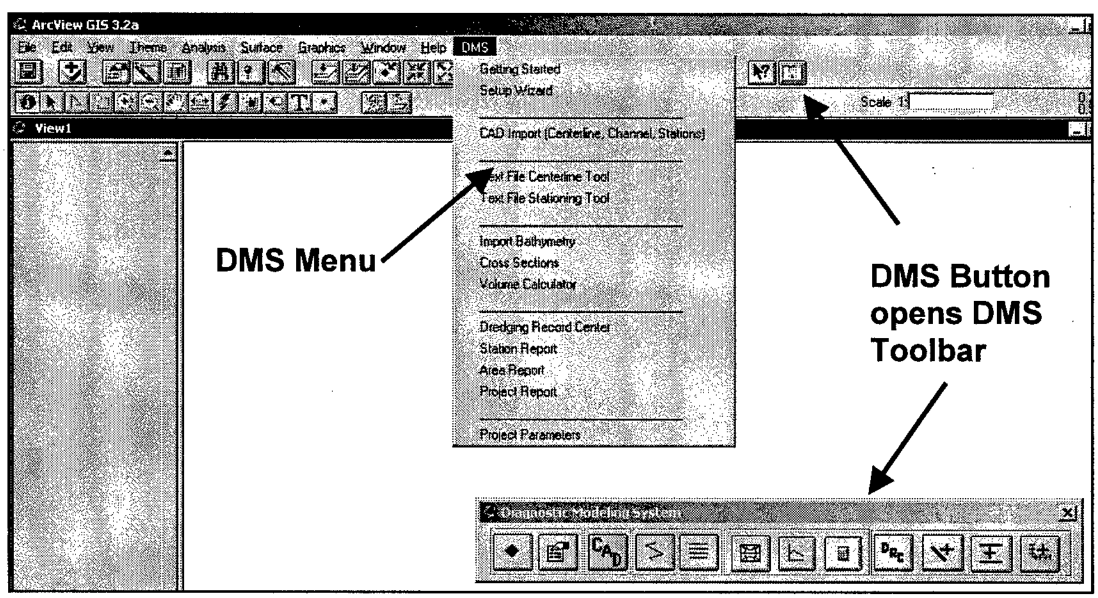


Figure 3. Data Manager tool access through the menu system or DMS toolbar

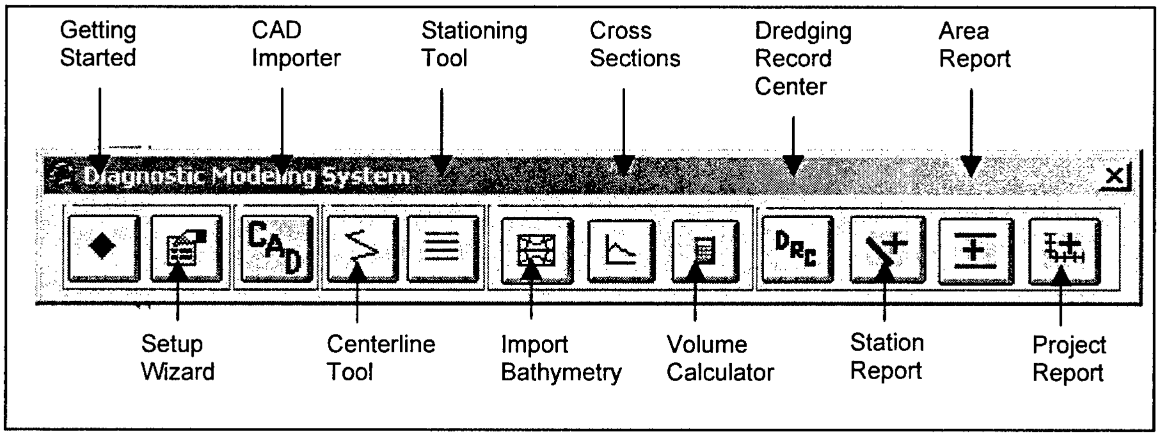


Figure 4. DMS toolbar

Project Setup

Getting Started screen

The DMS *Getting Started* screen contains generic information pertaining to the required data types necessary to operate the DMS Data Manager (Figure 5).

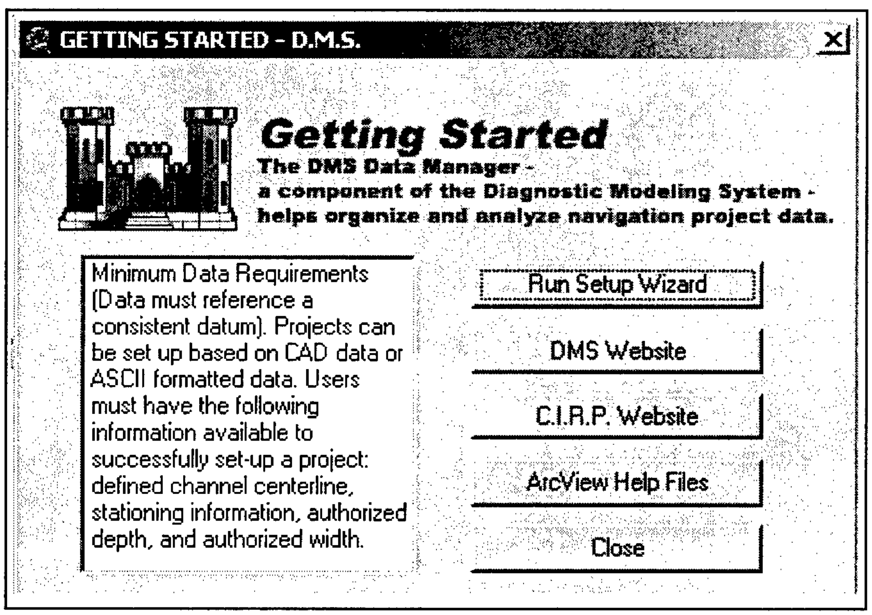


Figure 5. DMS Data Manager's *Getting Started tool*

Internet links to the DMS Web site (http://www.taylorengineering.com /dmshome/dmsdefault.htm) and the USACE Coastal Inlets Research Program (CIRP) Web site (http://cirp.wes.army.mil/cirp/cirp.html) are located on the right side of the screen. Clicking either button will open the default system Web browser and call the appropriate Web page. In addition, the ArcView help file system can be accessed quickly via the fourth button. Finally, clicking the top button leads directly to the next Step in the process, the *Setup Wizard.*

Setup Wizard

The *Setup Wizard* guides the user through the process of creating a Data Manager project by displaying a series of dialogues that prompt for general project information.

Step 1: Introductory screen. The first screen offers a simple welcome and introduces the user to the data requirements that follow (Figure 6). Navigation buttons at the bottom of the screen guide the user through the following steps. Users may abort the operation at any time by clicking on the cancel button.

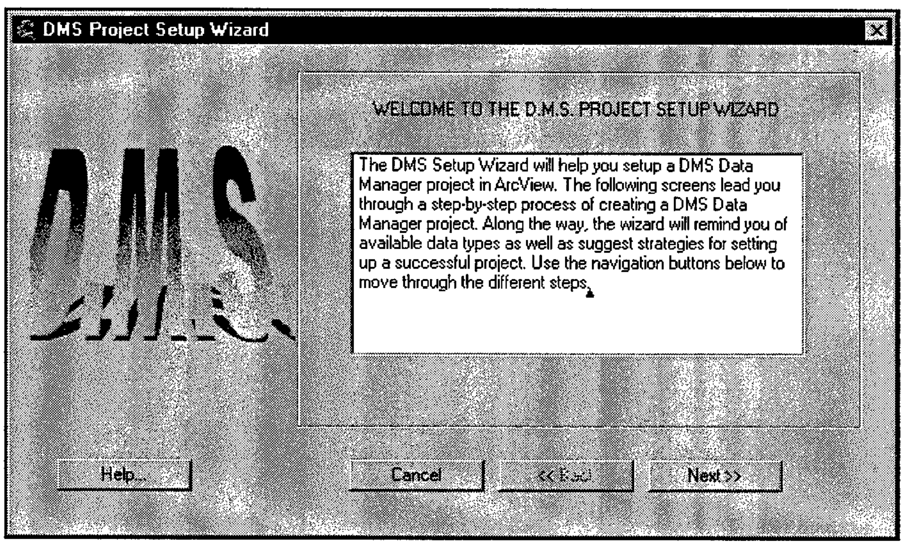


Figure 6. *Setup Wizard*, introductory screen

Step 2: Select a view. Step 2 presents users with a list of existing views in the current ArcView project (Figure 7). Users are prompted to select either one of these existing views or to create a new view to work within. If the user chooses to *Create a New View*, a new view will be created and named in the following step.

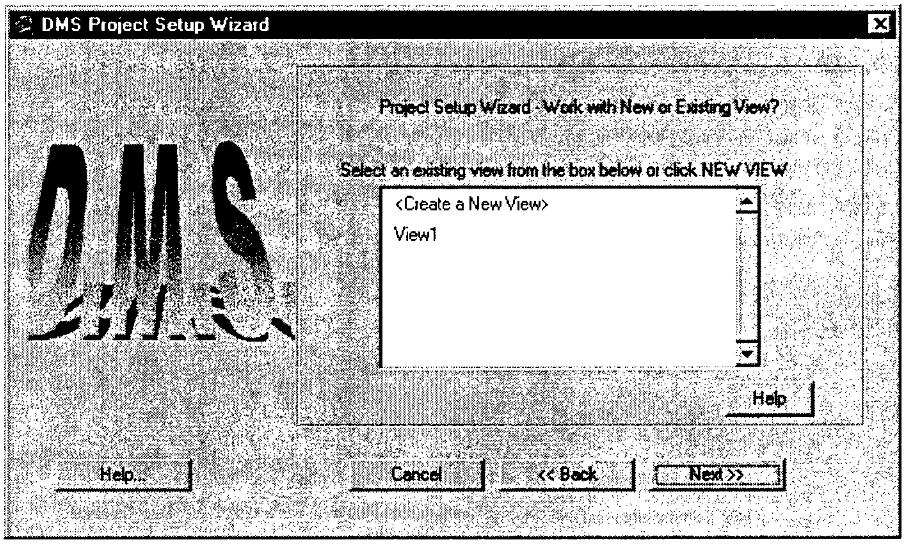


Figure 7. *Setup Wizard*, Select view screen

Step 3: Define project parameters. Step 3 prompts the user for general project parameters (Figure 8). The user may set the name of the current view through the *Project Name* field. Typically this title will reference the Federal project or channel name. Users may select the data projection from a standard list maintained within ArcView. The projection list is displayed by clicking the *Browse* button (Figure 9). Examples of typical data projections include state plane coordinates, UTM, or geographic coordinates (latitude/longitude). Next, the coordinate system units are selected from the drop-down box. Options include feet, meters, or decimal degrees.

The vertical datum for all elevation data can be selected from the next drop-down box. Users may select from the National Geodetic Vertical Datum of 1927 (NGVD 1927), North American Vertical Datum of 1988 (NAVD 1988), or several tidal datums.

In the next box, users can select the project working directory by either typing manually or browsing the existing directory structure through the *Browse* button. The working directory becomes the default directory where all new data are stored. This helps users maintain project data in an organized fashion.

Finally, users may define both the USACE District working on the project as well as the state where the project is located.

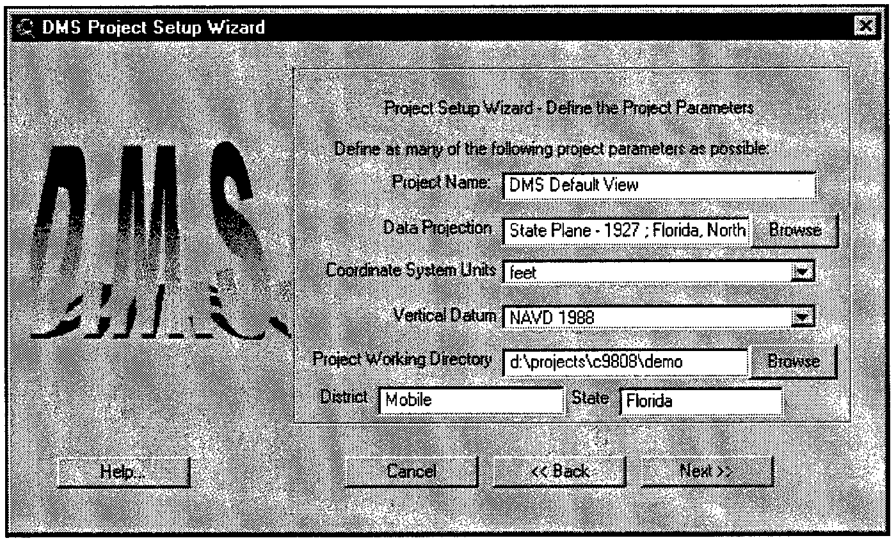


Figure 8. *Setup Wizard,* Project Parameter screen

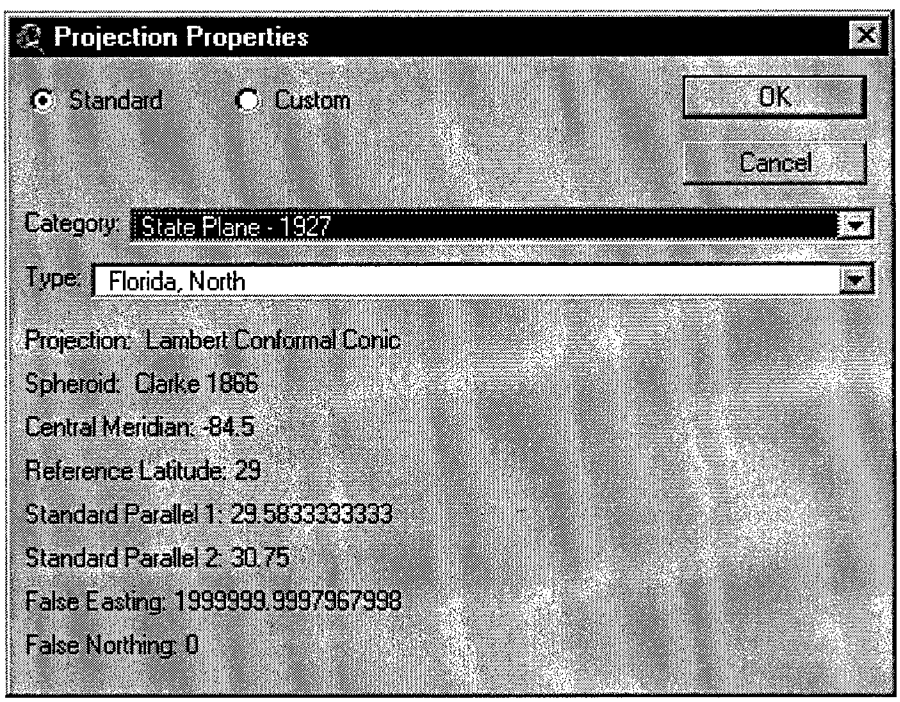


Figure 9. Project selection dialog

Step 4: Add data to view. The final screen prompts the user to locate base map data files in the various formats read by ArcView (Figure 10). The major data classifications are listed in the order that they are usually added to a project. Although data layering is a basic consideration, the order that data are selected is not critical at this point. Users can reorder layers from within the view at a later time. Typically, an aerial image that has been georeferenced to the data projection defined earlier will serve as the foundation of the base map information. On top of this image, users can layer any type of additional base map information, for example, as roads, bridges, or buildings. These data, accessible through the *Browse* button adjacent to *Project Coverages*, can be in Arc/Info coverage format, ArcView shapefiles, or CAD drawing files. Users also have the option to import existing grid data that have been developed in previous Data Manager sessions.

Any files accessible from the user's computer can be incorporated into the project. Networked computers facilitate this type of remote data exchange; data need not reside locally on a user's own workstation to be incorporated in the Data Manager project. A data report can be produced that will list the paths to all data referenced in the project.

After the *Setup Wizard* completes processing data, a dialog box guides the user to the next step, defining the channel geometry.

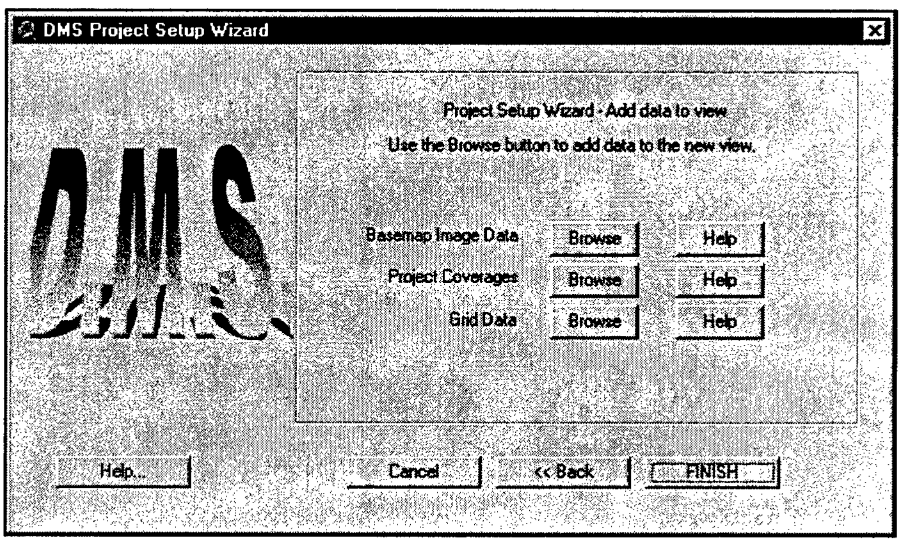


Figure 10. *Setup Wizard*: Add data screen

Channel geometry

The channel geometry includes the authorized channel template, channel centerline, and the channel stations. There are two options for setting up the channel geometry. The data can be imported from coordinate text files or CAD drawings. The next section will guide the reader through the setup of the channel geometry (authorized channel template, stations, and centerline) first by entering coordinates and then using CAD drawings.

Centerline Tool, coordinate data 

The first step of the *Centerline Tool* involves selecting an ASCII file containing coordinates at the turning points of the channel centerline. A browser opens to the project working directory and asks the user to select the file containing the centerline coordinates (Figure 11). Next, the user is asked to define the channel name (Figure 12). The name will be included as an attribute to the centerline theme. The user should be consistent in naming a channel because the channel name will be required to query the Dredging Record Center database.

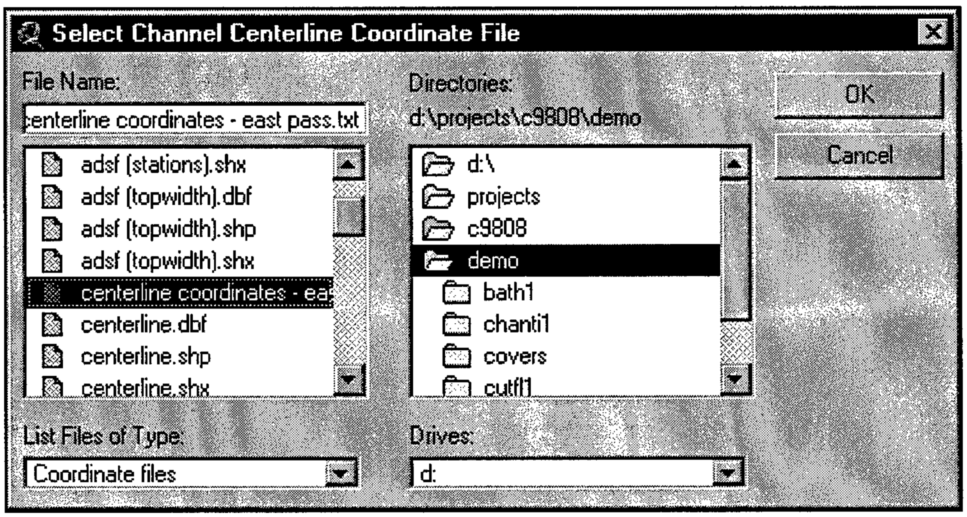


Figure 11. Centerline coordinate file dialog

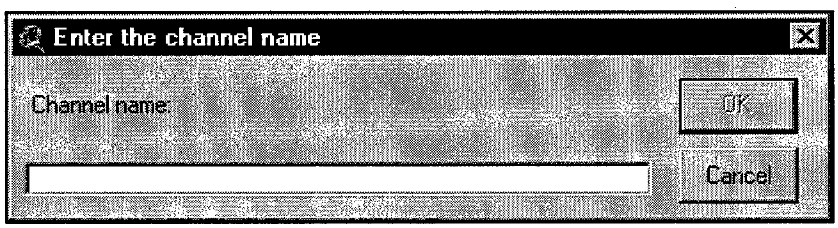


Figure 12. Define channel name dialog

The next dialogue will open the selected ASCII file and display the first five lines (Figure 13). The import dialog displays these lines and provides several options to define the file format. The user can define the order of the data, whether a header line exists in the file, and the delimiter separating values. The result of the *Centerline Tool* is a line shapefile representing the centerline of the channel. The one attribute field will be "channel" and will be populated by the channel name provided by the user. The centerline theme will be saved in the working directory set in ArcView. The final dialogue of the *Centerline Tool* will prompt the user to continue setting up the channel stations.

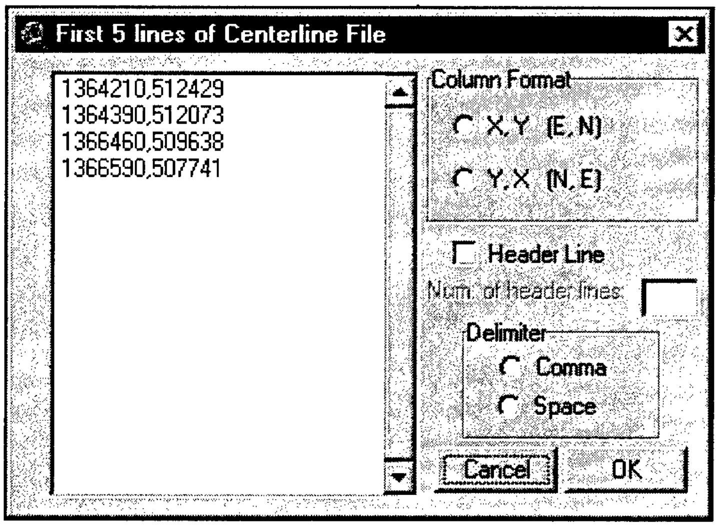


Figure 13. Centerline file format dialog

Stationing Tool, coordinate data

The *Stationing Tool* produces a graphical collection of stations along the navigation channel centerline. The stations created in this step should correspond to the stationing used by the District so that location descriptions can be universally understood. These stations contain channel template information used to pull cross sections from survey data and to perform volume calculations during later project analyses.

The *Stationing Tool* creates channel stations, or cross-section lines, at regular or user-defined intervals along the channel centerline. The tool creates two polygon shapefiles representing the channel bottom and the top width of the channel projected up to the vertical datum along a defined slope. Finally, the tool transforms these polygons into an ArcView grid of the channel template. The grid can then be examined with the analysis tools discussed in the next chapter.

After the centerline is created, the tool asks whether the user wishes to create stations along the centerline. If accepted, the **Station Definitions** dialog opens (Figure 14). The dialog provides three methods for creating stations along the centerline:

a. Select an ASCII file containing station data (station number, left width, right width, depth, and side slope).

b. Create uniform channel cross sections at each whole station along the entire centerline.

c. Enter cross-section data at each individual station along the centerline.

The user can define the starting station number as well as the distance between whole stations (typically 30.48 m (100 ft) or 304.8 m (1,000 ft)). Additionally, the user can define the distance to extend the stationing line beyond the channel template. This option allows the *Cross Sections* tool to display bathymetry adjacent to the authorized channel.

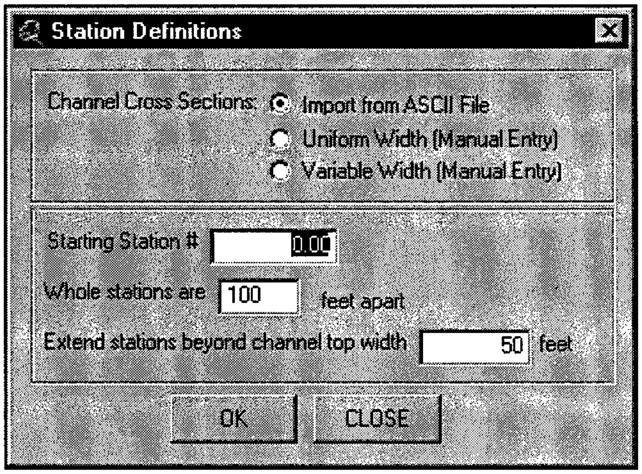


Figure 14. Station Definitions dialog

If the user selects the ASCII file option, the tool opens the file and displays the first five lines in a dialog box (Figure 15). The file should be formatted with the following:

a. Station number.

b. Width of the channel to the left of the centerline.

c. Width of the channel to the right of the centerline.

d. Authorized depth of the channel.

e. Assumed side slope of the channel cross-section template.

All data for a station should be contained on a single line of the ASCII file and separated by a comma. A header line is optional.

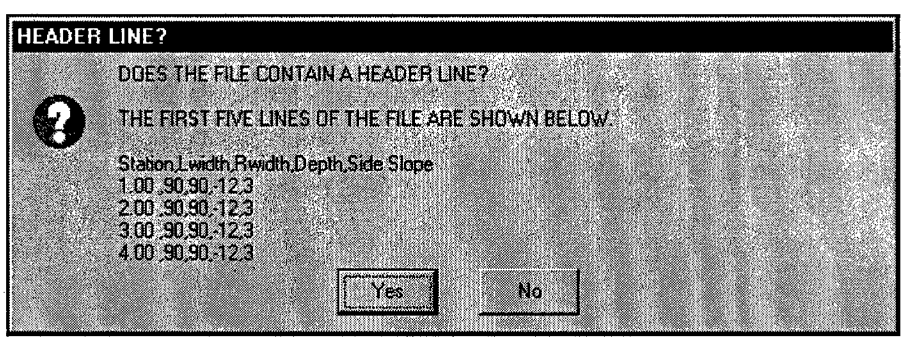


Figure 15. Station file format dialog

If the user selects the uniform cross-section option, the following dialog (Figure 16) prompts to define the cross-section parameters that will be used throughout the channel. The two bottom widths can define skewed channels. The orientation within the Data Manager is always from the lower station number to the higher station number. Typically, this can be thought of as looking downstream or toward the ocean. The depth should be a negative number and correspond to the local authorized project depth. The side slope is used in the channel template (e.g., 3H:1V).

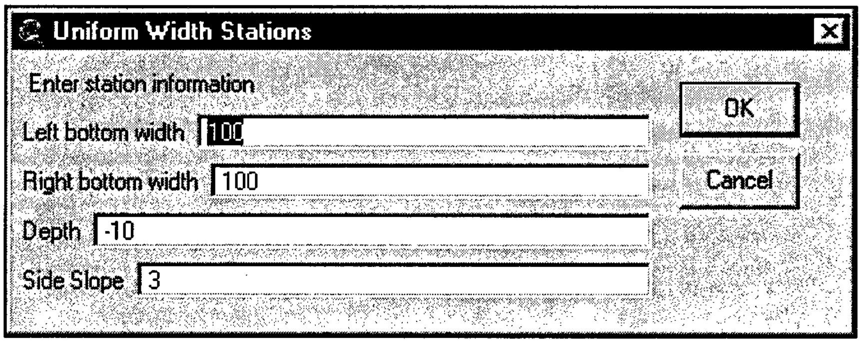


Figure 16. Uniform station dialog

If the user selects the variable cross-section option, the tool displays a series of dialogs similar to the uniform cross-section dialog (Figure 17). Each instance of the dialog applies to the station noted in the title bar of the dialog. The fields apply as previously discussed. To facilitate data entry, any changes made to the dialog are preserved as defaults for the next station. Therefore, several identical cross sections can be entered quickly by simply accepting the default values.

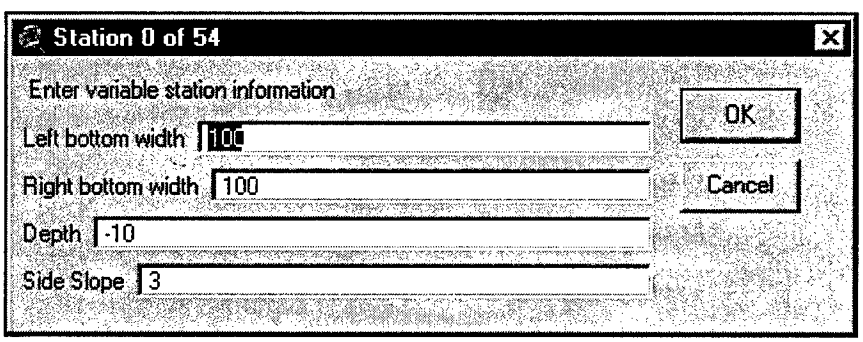


Figure 17. Variable station dialog

The tool then prompts the user to define a name for the output themes (Figure 18). This name will typically describe the channel and/or project and will name several themes. The three themes to be created are a line theme defining the stations [name(stations)], a 3-D polygon theme of the channel bottom [name(channel)], and a polygon theme of the channel projected to the water surface at the previously defined side slope [name(topwidth)]. The channel and top width polygon will be used to create the authorized channel surface.

There are two types of surface that can be created, a triangulated irregular network (TIN) or a grid. The grid will automatically be added to the project, but the user has the option to choose whether a TIN will be added.

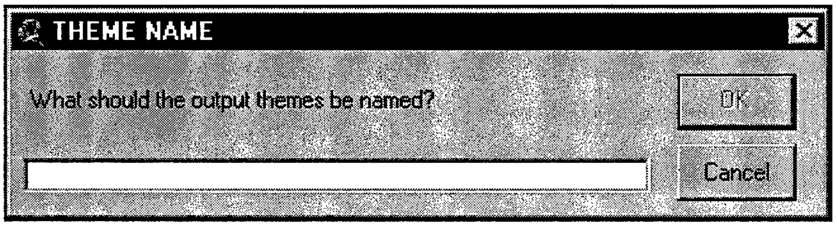


Figure 18. Station theme definition dialog

Prior to creating a grid of the channel template, the user can define the grid cell size (Figure 19). By default, this value is set at 5 units (e.g., ft or m, whichever the view is set to). This relatively small value appears to give an adequate resolution for later analyses; however, limited storage and memory capacity of the host computer may require a larger grid size.

The user is cautioned not to delete any of the newly created themes because they will be needed by the data analysis tools.

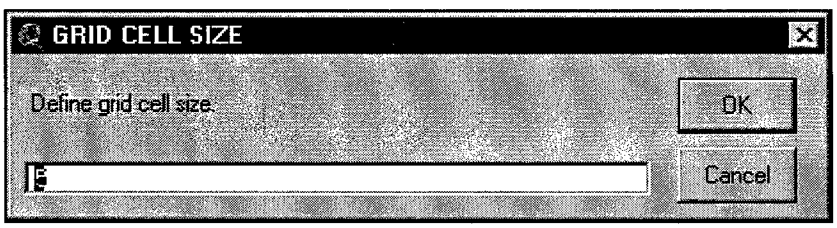


Figure 19. Grid cell size dialog

CAD Importer 

The *CAD Importer* will define a channel centerline, channel template, and stations based on spatial data in the form of CAD drawings. The CAD drawings must contain the sides of the channels. Optionally, the CAD drawings would also contain channel centerlines. The example used here is from the Shark River Inlet, NJ.

There are six steps to create channel geometry in DMS with CAD data (Figure 20). First, the elements in the CAD drawing that define the left side, right side, or centerline of the channel are selected. Second, the orientation of the sides of the channel is checked to make sure they start at the lowest station number. Third, the authorized depth associated with the channel is defined. Step 4 creates *linking polygons*, defined later in this section. Step 5 converts the "multi-part polylineZ" theme, created in Step 3, to a 3-D polygon of the channel bottom and a polygon of the channel at zero elevation. Finally, Step 6 puts all the parts together to create a TIN and grid of the channel. Steps 7 and 8 create channel stations.

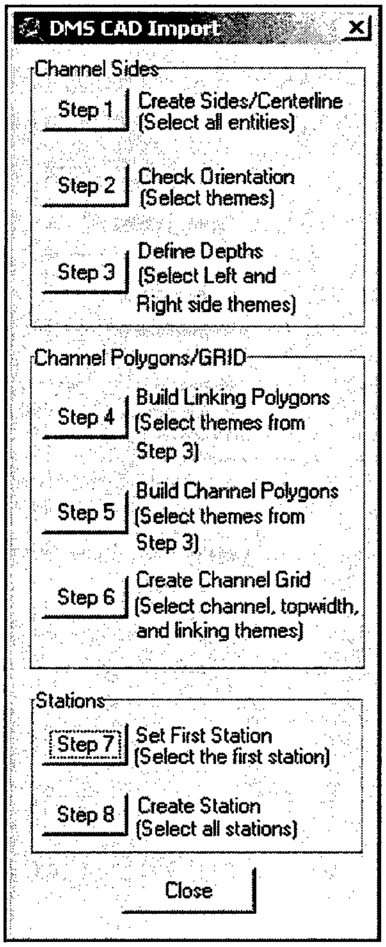


Figure 20. CAD Importer

Step 1: Create sides/centerline. To create a channel side or centerline[1], the user selects all the line elements in the drawing that represent that feature. First, the left side is defined by selecting each element of the left side. The user can zoom in to make selection easier. The user then pans around the view to select other elements. The SHIFT key is held down to make multiple selections. In Figure 21, the first two segments have been selected. The user continues to select all the lines that define the left side of the channel. The left side of the channel will be to the left if looking from a lower station number to a higher station number. Once all the elements are selected, the user clicks on the Step 1 button. The first dialogue will ask what elements have been selected. Here, the user should choose **Left Side** (Figure 22).

[1] The centerline should have the same location as the centerline used by the USACE District. This will allow new volumes and cross sections created in the Data Manager to be compared to previously reported values.

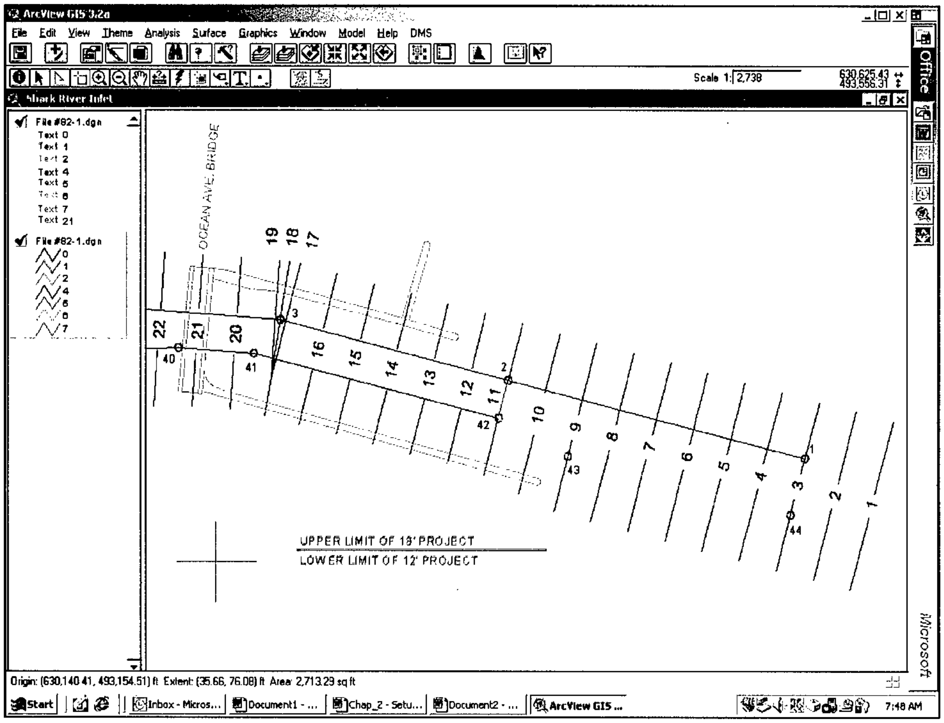


Figure 21. Create a channel side, Step 1

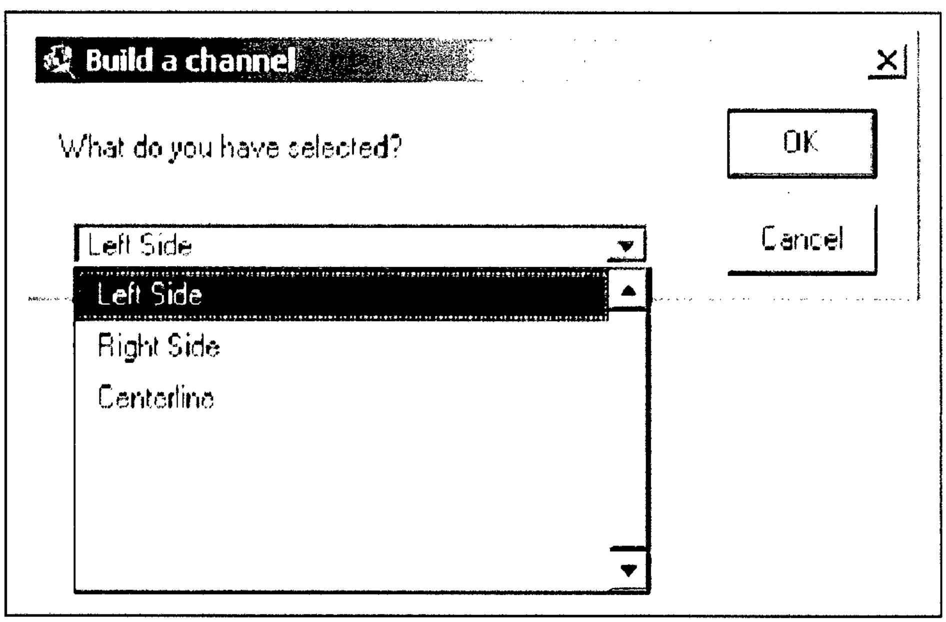


Figure 22. Choose a side or centerline

If the user has chosen to create a centerline, next he or she is asked to name the theme. Then the centerline theme is added to the view. This theme will be the same as the one created by means of the coordinate file.

In order to continue creating the channel sides for the authorized channel template, all the line elements selected in Step 1 must be connected. Unfortunately, if digitizing techniques were inaccurate, this will not be the case. If the lines choosen are not connected, the Data Manager will alert the user with the **Multi-part Polygon Selected** message (Figure 23). The user should pay particular attention to the part that says "NOTE: There are 2 separate entities that need to be joined." This most likely means that the nodes were not snapped when the drawing was originally created. This situation can be fixed as described in the following paragraphs. The channel should be named. In this example the channel is the Shark River Inlet, so the channel will be called "Shark" (Figure 24). The resulting shapefile will be a polyline representing that side of the channel. The theme will be called channel (left side), in this case "shark (left side)." The shapefile will be saved in the current working directory.

The user now creates the right side, described previously. Two themes will be added to the view, channel (left side) and channel (right side). The right side also has two nodes that do not line up.

Before going on to Step 2, the user may need to edit the channel sides manually to ensure they are continuous polylines. The following discussion provides one method to join the segments together – other methods exist. The user should experiment with the data to determine the preferred method. However, the result must be one polyline for the left side of the channel and one polyline for the right side of the channel.

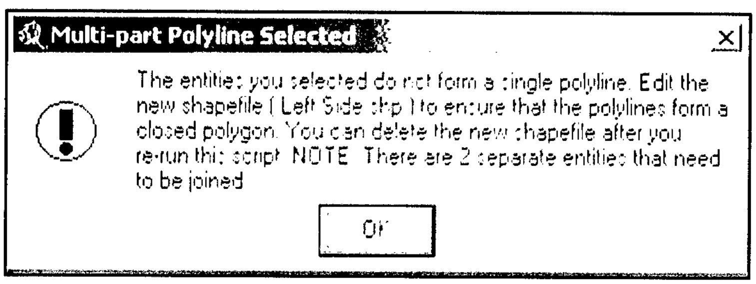


Figure 23. Multi-part Polygon Selected message

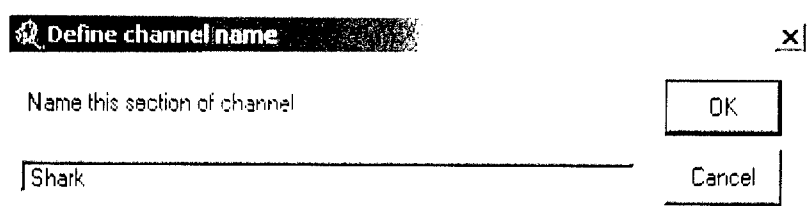


Figure 24. Defining the channel name

To start editing the left side of the channel, the user makes the left-side theme active and editable (*THEME|START EDITING*). The line is selected by right-clicking on the line and selecting **Shape Properties** from the pop-up menu (Figure 25). This shows the coordinates of each node in the polyline (Figure 26). The **Shape Type** is Multi-Polyline. This should be converted to a simple polyline. The user should scroll down the list of nodes. There will be one or more multi-part separators in the list. As the user moves through the list, the view updates the active node location by displaying a point at the current vertex. The multi-part separator indicates a break in the line. The user can determine where the break is by locating the nodes surrounding the multi-part separator and zoom in on the area. It may take considerable zooming to see where the break actually occurs.

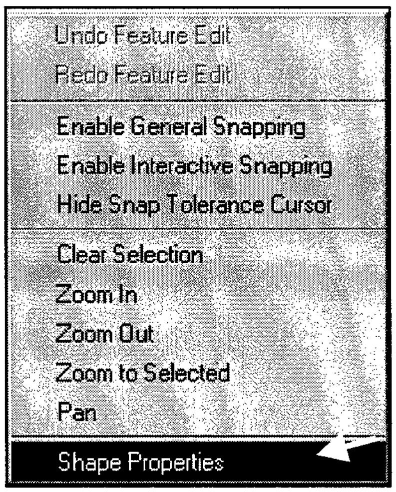


Figure 25. Pop-up menu

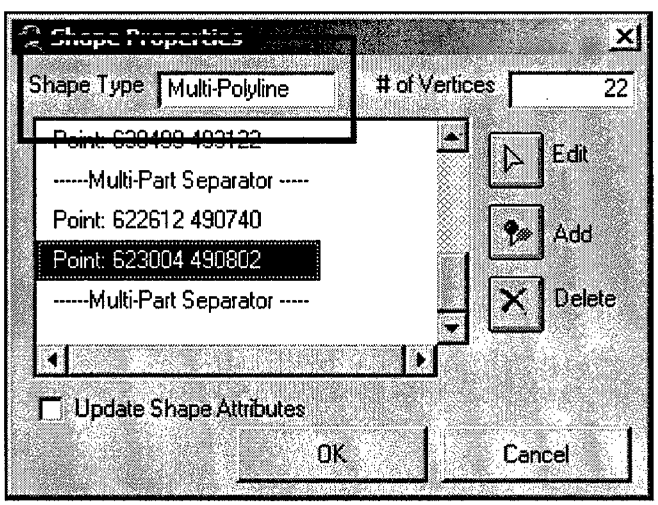


Figure 26. Shape properties

General Snapping can be turned on by right-clicking in the view and selecting **Enable General Snapping**. The snap tolerance is set by clicking the snap tool and drawing a circle in the view. See the ArcView manual for additional details.

In editing a line, ArcView does not allow snapping to any vertices on that same line. So a temporary line is drawn to snap to. The user draws a polyline with three vertices; the middle vertex should snap to one end of the channel polyline (Figure 27). Next, the user moves the other end of the channel polyline and snaps it to the middle vertex of the new temporary polyline, which coincides with the other end of the channel polyline (Figure 28). Now, the user selects the temporary line and deletes it (Figure 29). The user then checks the **Shape Properties** dialog again. The shape type should be "Polyline" (Figure 30). The user saves the edits and edits the right-side theme.

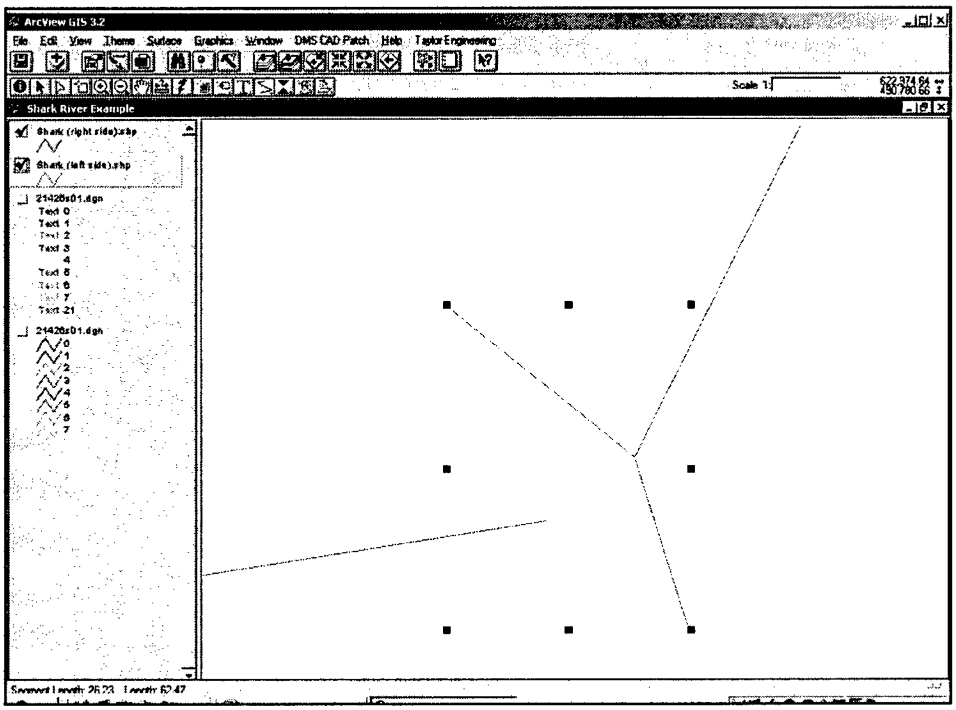


Figure 27. Connect lines, draw temporary polyline

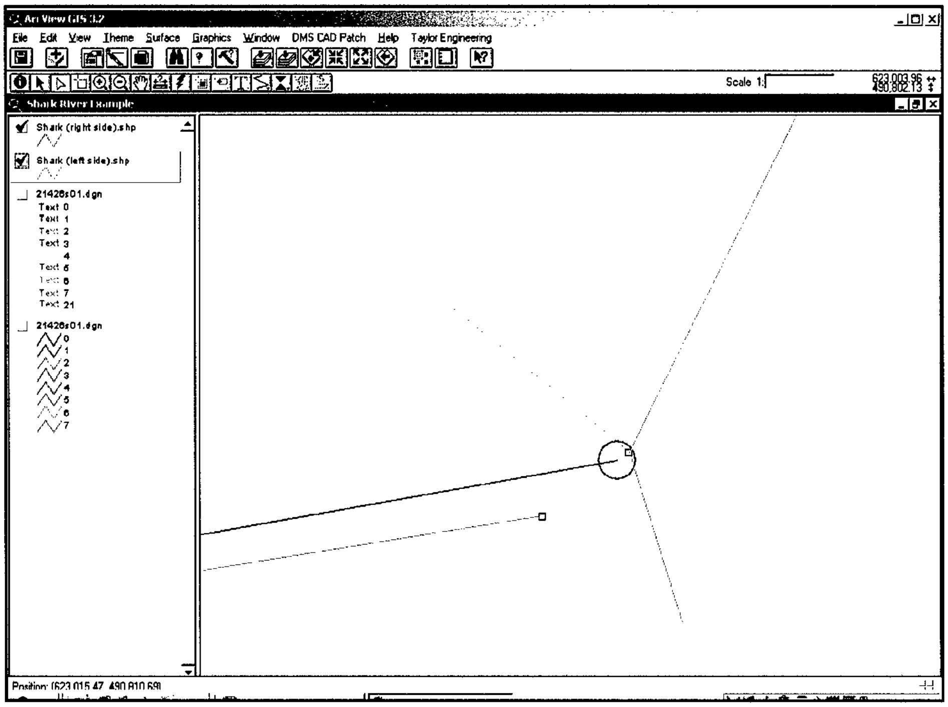


Figure 28. Connect lines, connect channel vertex to temporary polyline

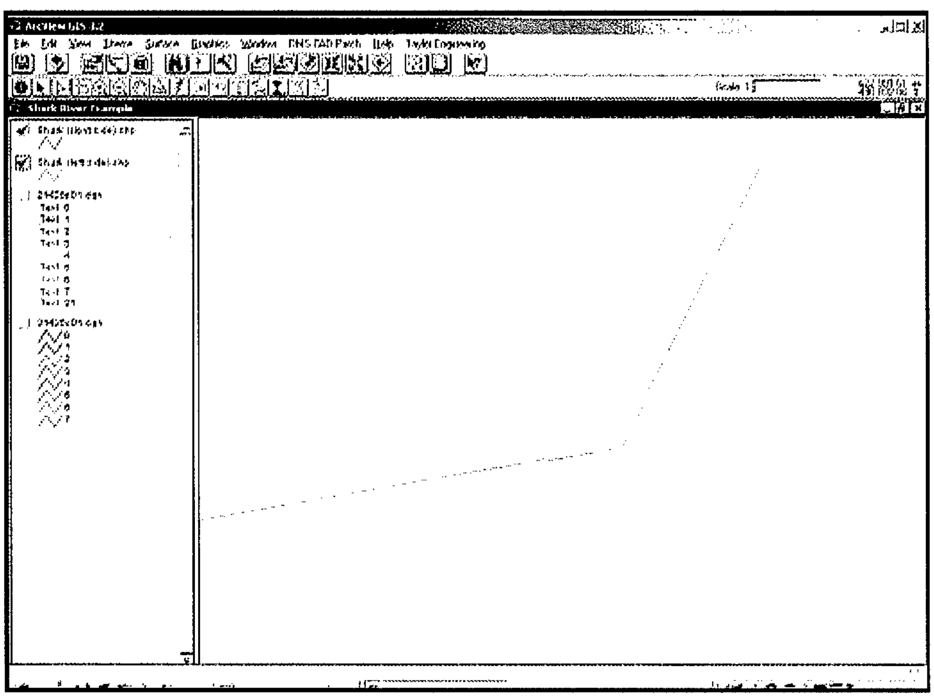


Figure 29. Connect lines, temporary polyline deleted

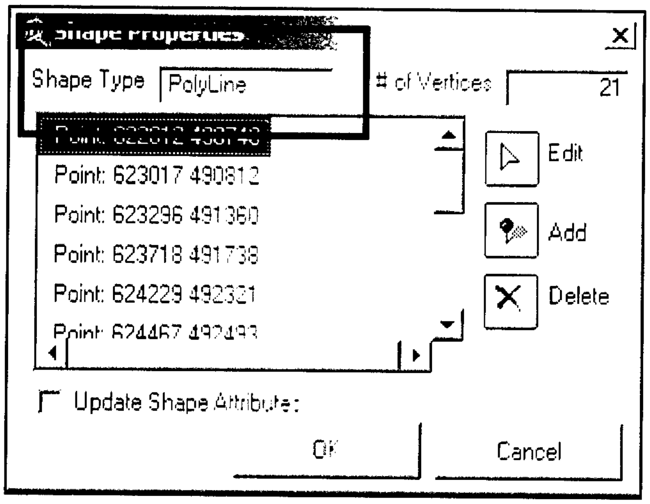


Figure 30. Shape properties, polyline

Step 2: Check orientation. Now, the orientation of the new themes is checked. The user selects the left-side and right-side themes in the Table of Contents (TOC) and clicks Step 2. A red cross appears near the first point in the polyline (Figure 31). If the red cross located is near the beginning of the channel (lowest station number), the user clicks **Yes**, or if not, **No**. Clicking **No** will flip the line orientation so if Step 2 is rerun, the red cross should appear at the opposite end of the line.

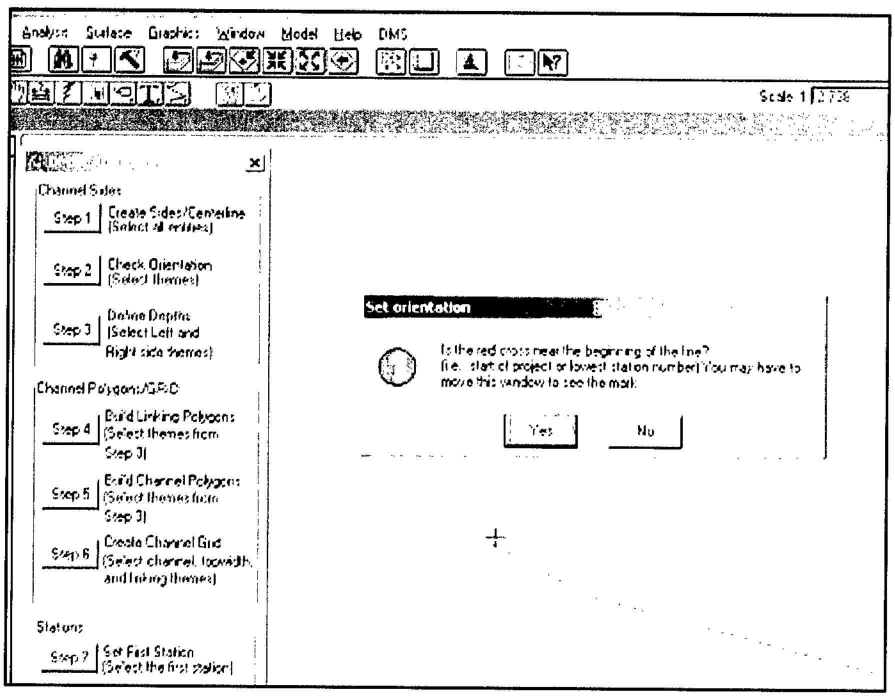


Figure 31. Check line orientation

Step 3: Define depths. Step 3 takes the right-side and left-side themes and combines them into a 3-D line. The user activates both themes and runs Step 3 (Figure 32). First, the authorized depth is defined (Figure 33). The authorized depth for this channel is 30 ft (9 m) mean lower low water (mllw). This value should be entered as a positive number. The user enters a name for the new theme; "Shark" will be used again in this example (Figure 34). A 3-D polyline theme is added to the view (Figure 35). The z-value for this theme is the depth defined by the user.

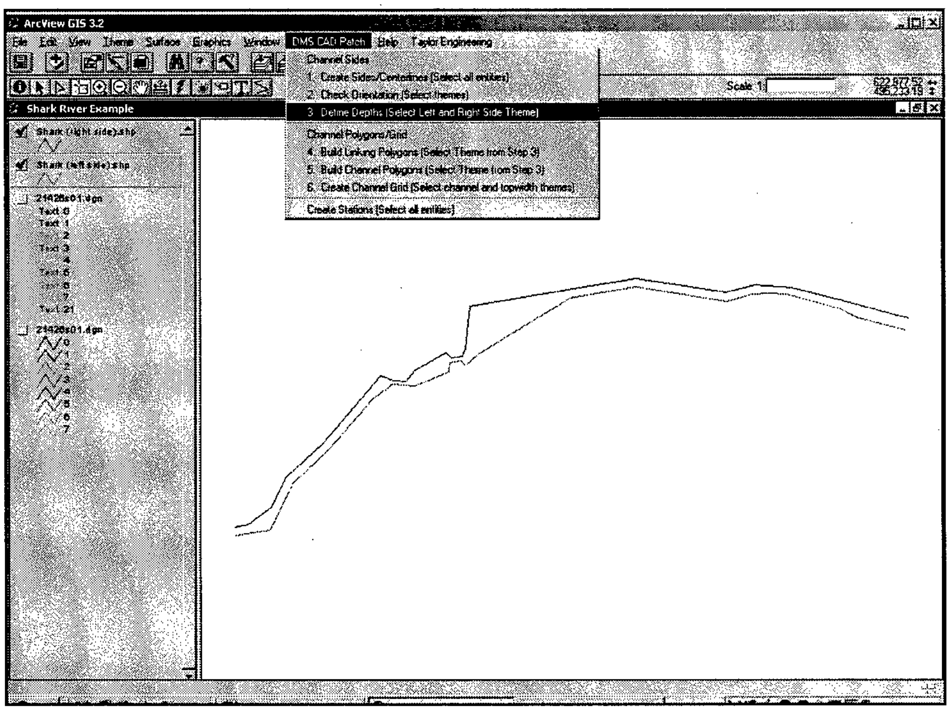


Figure 32. Left- and right-side themes

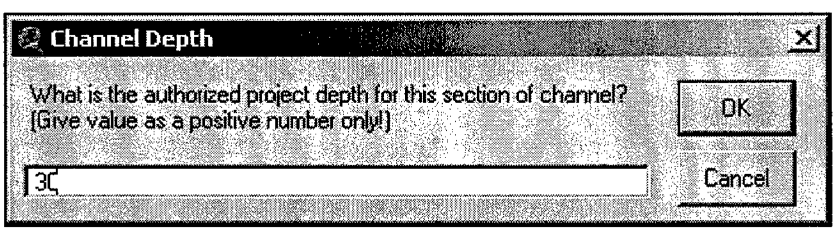


Figure 33. Define channel depth

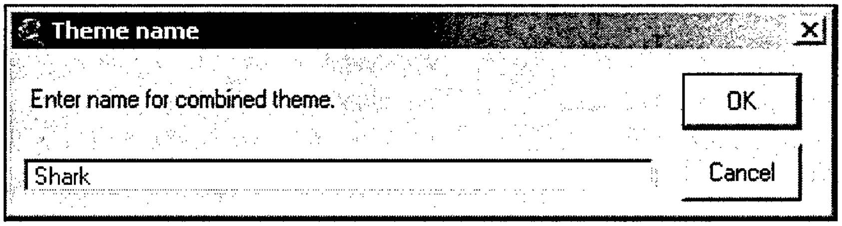


Figure 34. Theme name

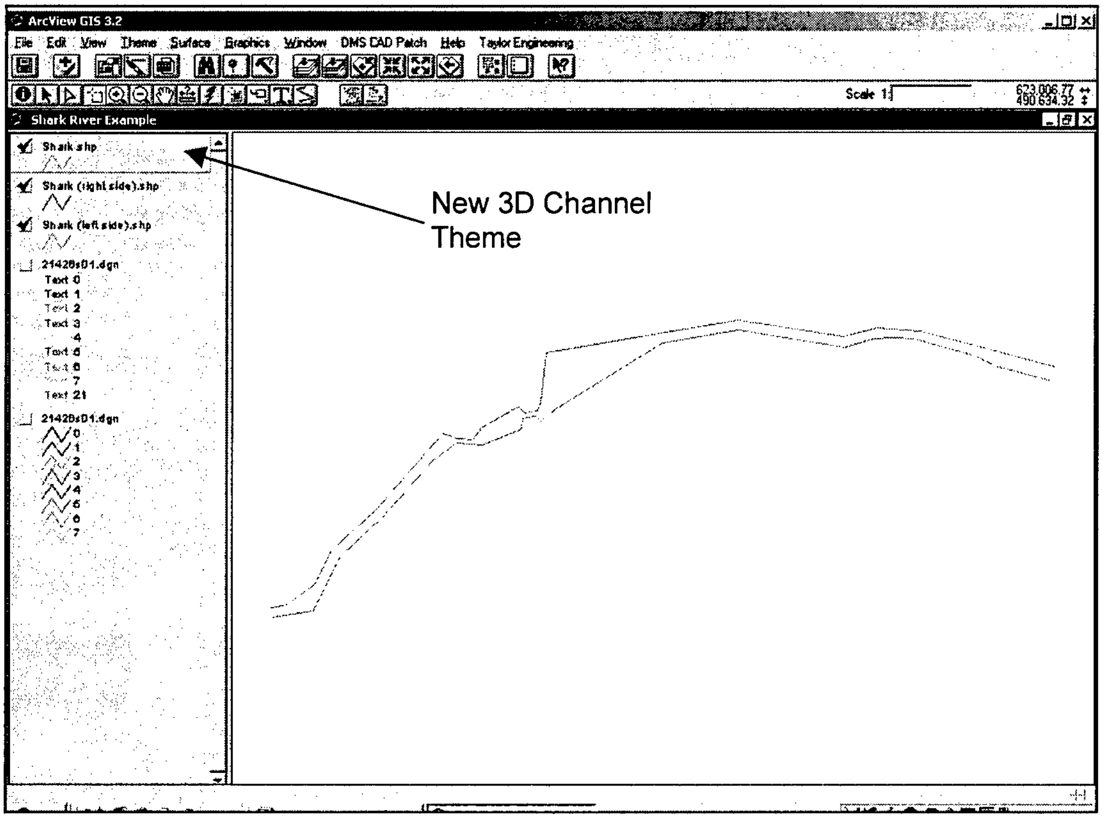


Figure 35. Combine channel theme

Step 4: Build linking polygons. Step 4 is necessary only if the authorized channel depth changes within the project. Steps 1-3 are repeated for each channel section with a constant depth. For instance, because the Jacksonville Harbor project has three different authorized depths (42, 38, and 34 ft (13, 12, and 10 m)), polyline channel themes (Steps 1-3) will be created for each of the three sections. Because ArcView TINs cannot accept true vertical faces, the Data Manager will offset the channels slightly to create steeply sloped polygons, called *linking polygons,* to connect the different segments. Linking polygons define the theoretical vertical walls connecting the different portions of the project. Unless there are large changes in depth or extreme horizontal offsets in channel alignment, these polygons will appear nearly vertical.

To create separate sections for each authorized channel depth, the channel polyline theme must be split at all depth changes. For help, see Chapter 18, Creating and editing spatial data, in the ArcView Users Manual. For each section follow Steps 1, 2, and 3 in the DMS CAD import.

The user now makes all channel polyline themes active and clicks Step 4 to create linking polygons. The user will have to select the order of the themes from the beginning of the channel (lowest station) to the end (Figure 36). The 3-D linking polygons ("link polygons.shp") are saved to the current working directory set in the Data Manager. There will be one 3-D polygon for each transition zone. Each polygon is only 0.3 m (1 ft) wide. The z-coordinates for each linking polygon will be the same as the authorized depth in the adjacent channel section.

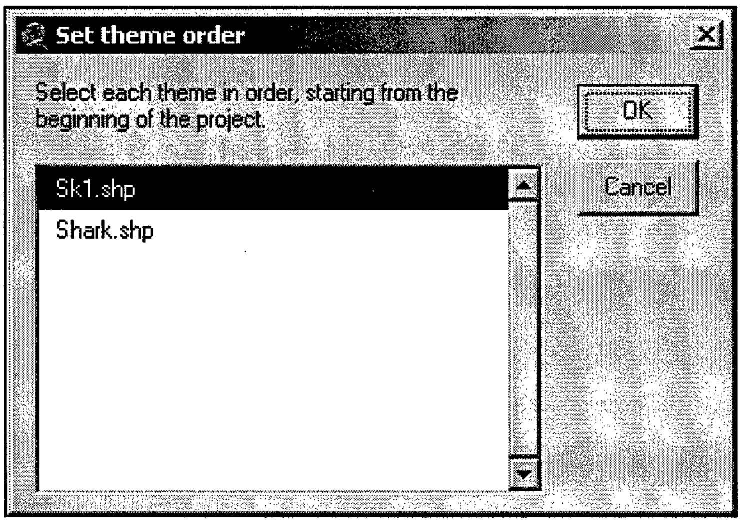


Figure 36. Linking polygons, select theme order

Step 5: Build channel polygons. In the View's TOC, the user selects the 3-D theme created in Step 3 and any linking polygons created in Step 4, then runs *Build Channel Polygon* (Step 5). The user chooses the sides of the channel created (Figure 37). The options are **Left and Right, Left only, Right only**, or **None**. Usually, **Left and Right** is selected. The inverse side slope is defined (Figure 38). Two new themes are added to the view. The user should move the channel theme above the topwidth theme (Figure 39). The channel theme is slightly smaller and represents the boundary of the channel on the bottom. The topwidth theme is the channel projected from the bottom to the vertical datum at the slope specified by the user. The channel theme is 3-D while the topwidth theme is 2-D. Both themes will be saved in the current working directory.

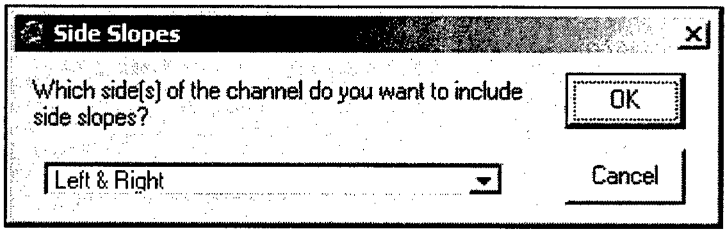


Figure 37. Side slopes

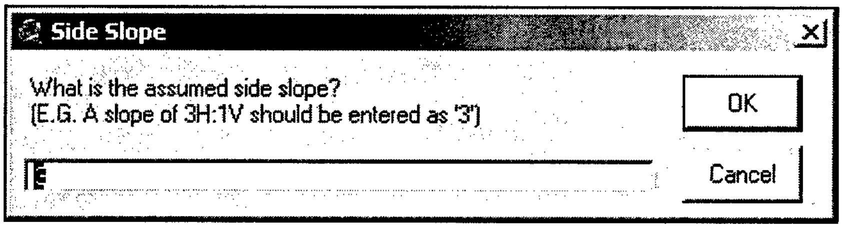


Figure 38. Side slope

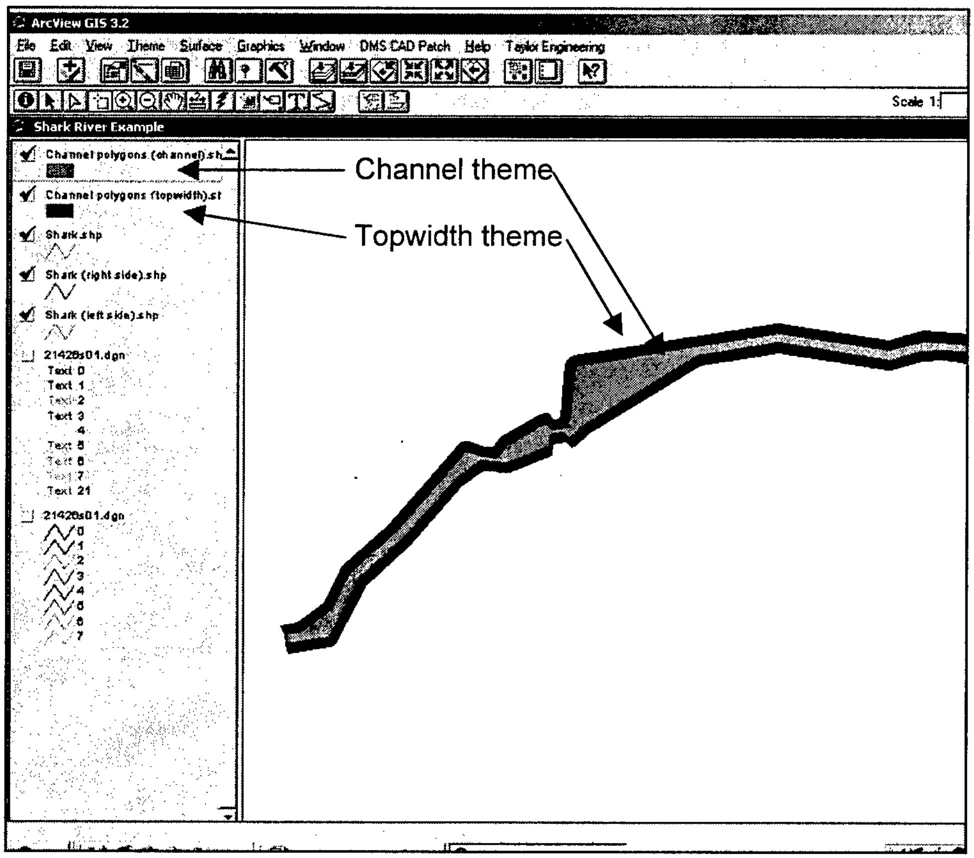


Figure 39. Channel theme and top width theme

Step 6: Create channel grid. Now the channel theme and the topwidth theme will be used to create a grid and optional TIN of the authorized channel. The user activates the channel and topwidth themes. If the channel has more than one authorized depth, the user should also select the linking polygon theme created in Step 4. A name for the channel grid and TIN is defined (Figure 40). The grid and TIN will be called "channel (channelGRID)" and "channel (TIN)," respectively. The user decides whether to include the TIN in the view. In this example, **Yes** is selected (Figure 41). The TIN is added to the view (Figure 42). Finally, the cell size for the grid is defined. The grid is added to the view (Figure 43).

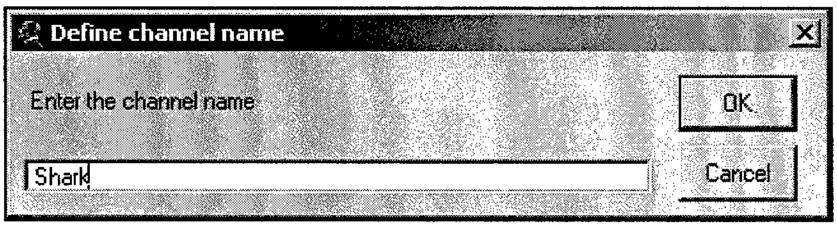


Figure 40. Create channel grid, channel name

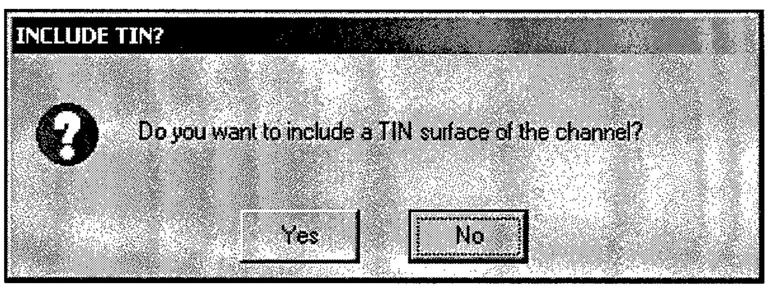


Figure 41. Create channel grid, include TIN

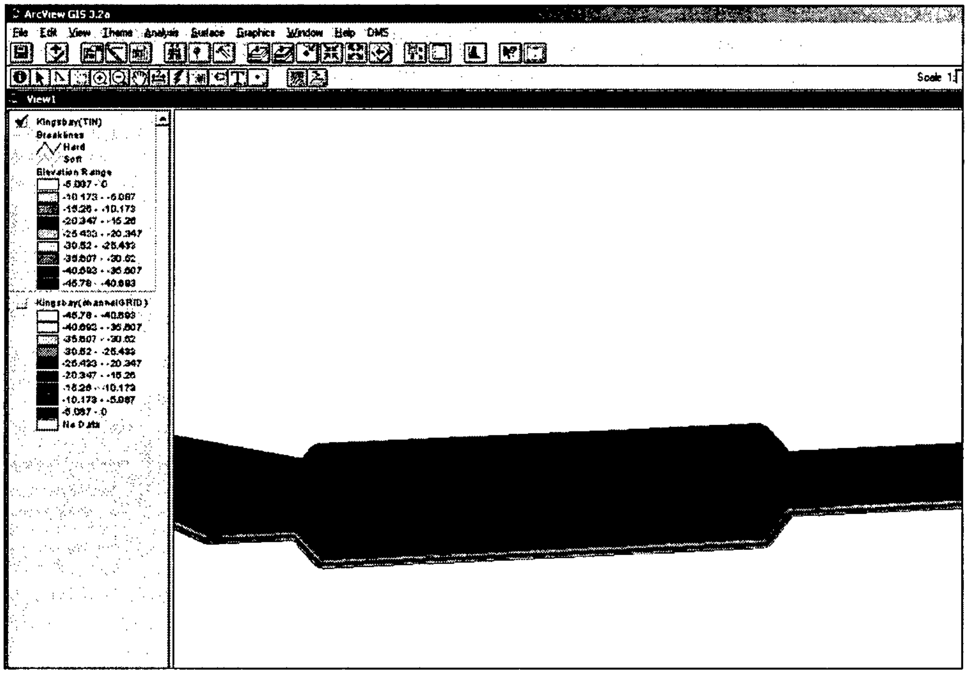


Figure 42. Authorized channel TIN

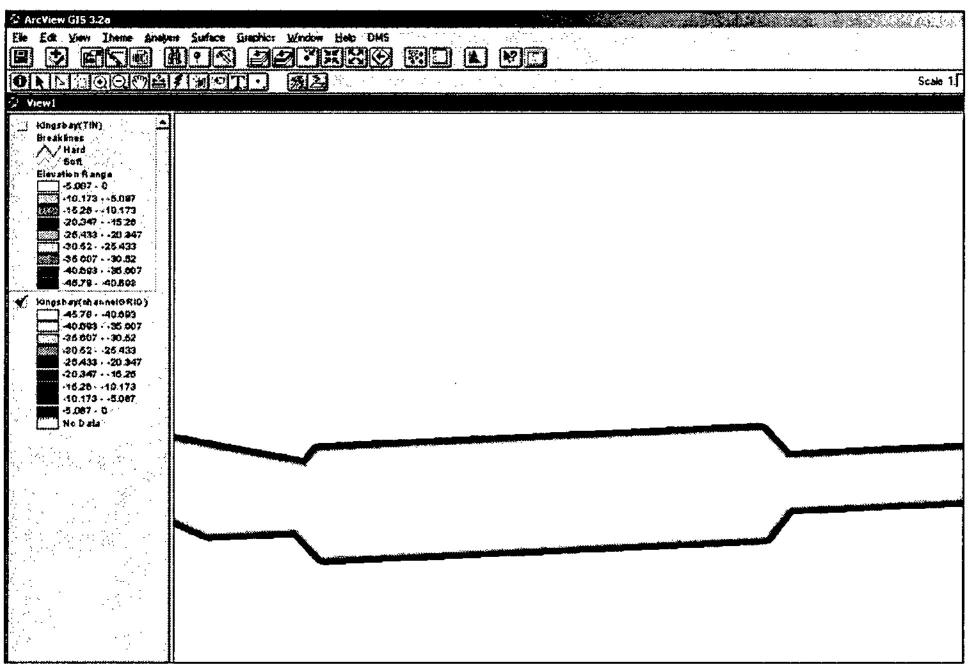


Figure 43. Authorized channel grid template

Step 7: Set first station. The CAD importer may also be accessed to create the channel stations. The user begins by setting the first station; this will be the station with the lowest station number. The user activates the CAD drawing and selects the first station, then clicks **Set the First Station**. Now the Data Manager will know where to start numbering the stations.

Step 8: Create station. To create the remaining stations, the user activates the drawing and selects all the stations. The user clicks **Create Stations**, and names the station theme with the channel name, selects the channel polygon theme, and sets the station numbering, the first station number, the side slope of the channel, and the distance between the stations. The options for station numbering are **Exact stations, Whole number stations**, and **Manual entry** (Figure 44). The option **Exact stations** uses internally calculated (exact) distances along the centerline to define station numbering. In recognition that slight variations in actual distances may not coincide with the accepted station numbering, two additional methods are available. First, **Whole number stations** rounds each station number to the nearest whole number to smooth unintended variations. This method is most appropriate for cases where intermediate stations do not exist. Second, **Manual entry** allows the user to specifically enter all station numbers. This method is best for complicated geometries with multiple intermediate stations. The final station shapefile will be a line theme called "channel (stations)" (Figure 45).

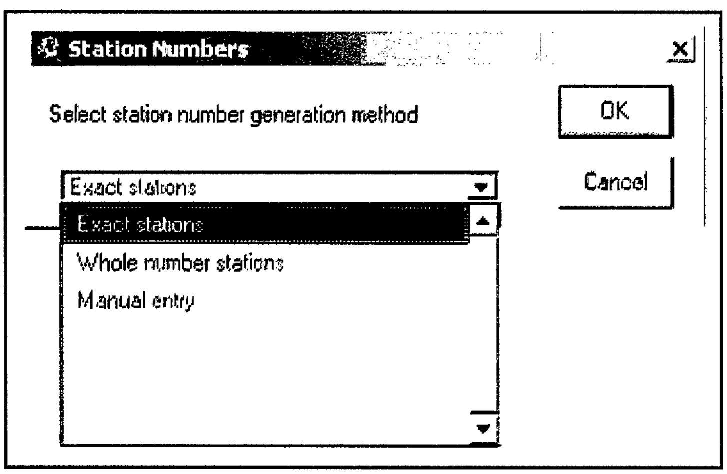


Figure 44. Set station numbering

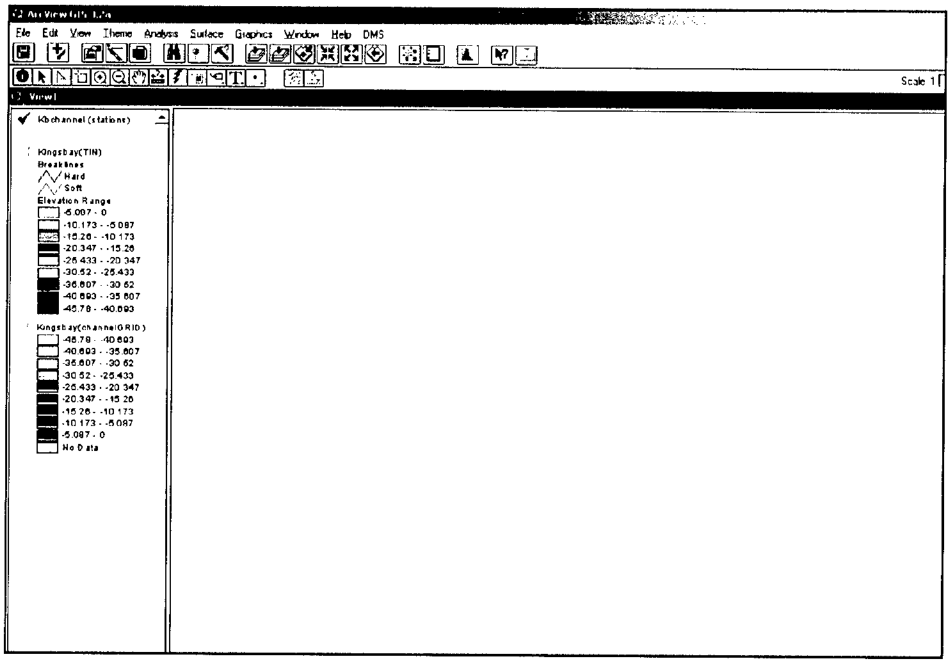


Figure 45. Channel stations

Import Bathymetry tool

The *Import Bathymetry* tool takes hydrographic survey data and produces point shapefile and interpolated surface[1] representing the underlying bathymetry. Many survey types can be processed with the *Import Bathymetry* tool including condition surveys, pre- or post-dredging surveys, centerline surveys, and Light Detection and Ranging (LIDAR)/Scanning Hydrographic Operational Airborne LIDAR Survey (SHOALS) surveys. The resulting bathymetric grid is analyzed in the following paragraphs with the *Cross Sections* and *Volume Calculator* analysis tools.

The initial dialog for the *Import Bathymetry* tool presents the data format options available to users (Figure 46): several ASCII formats, previously created ArcView TINs and Grids, and 3-D CAD files in DXF format. These options are discussed in the following paragrphs.

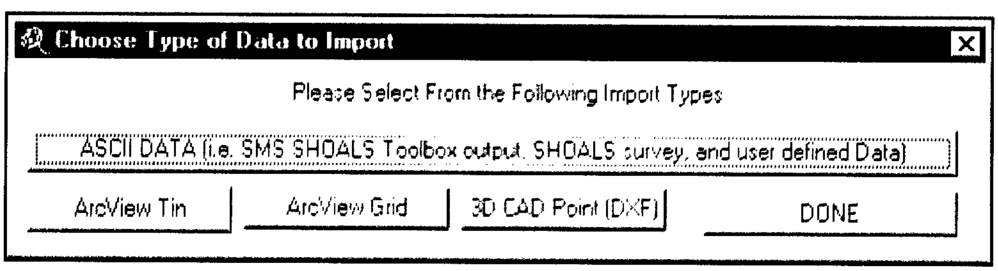


Figure 46. Import data format options dialog

[1] In this report, a "surface" refers to a grid or TIN created from bathymetric data.

Three forms of ASCII data may be imported into the Data Manager. These are generic ASCII formats containing X, Y, Z data, output files directly from a SHOALS (Lillycrop, Parson, and Irish 1996) survey, and bathymetric output from the Surface-Water Modeling System (SMS), http://chl.wes.army.mil/software/sms/docs.htp.

To import an ASCII file, the user first chooses **ASCII DATA** (Figure 46), then chooses the type of data to be imported (Figure 47), and then locates and selects the file with the browser.

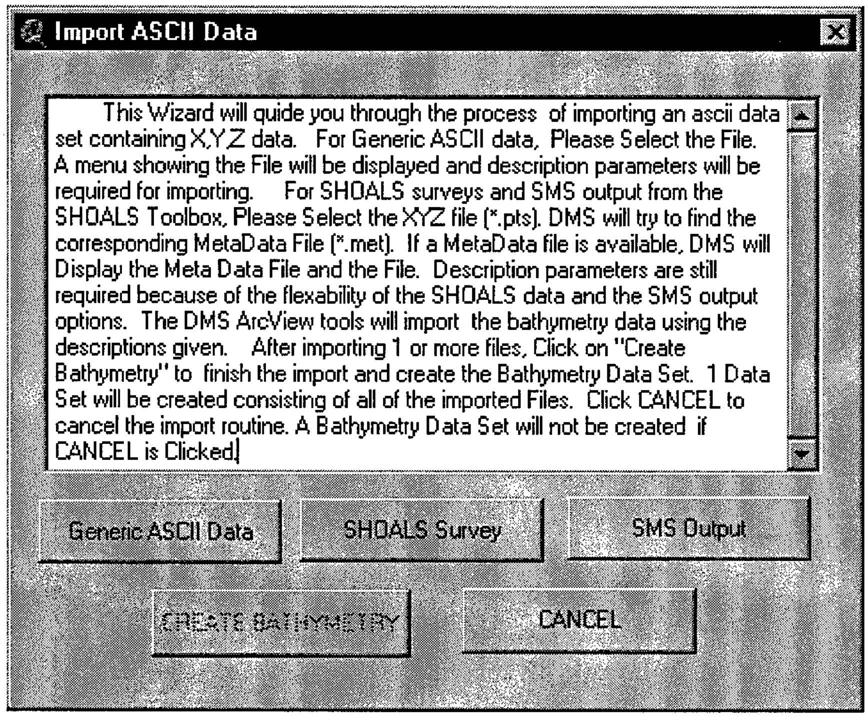


Figure 47. Import ASCII Data options dialog

After the user selects a file to import, the tool opens a dialog that helps determine the underlying structure of the data (Figure 48). Raw data lines are displayed in the window on the left side. If a metadata file can be located for the file, the information is displayed below the raw data. The user will define the file format through options located on the right side of the dialog. Users may note the number of header lines, the type of data delimiter, and the columns containing the X, Y, and Z values. When finished, the user should click on the **Import The File** button to begin the import process.

After the file has been imported into the Data Manager, the user may then create a theme from these data. Note that the **Create Bathymetry** button is now enabled on the **Import ASCII Data** dialog (Figure 49). Clicking this button begins the computationally intensive process of creating a bathymetric surface from the data. The user can create up to two themes from the data. First, a grid of the actual bathymetric data can be defined. Users may set the name in the

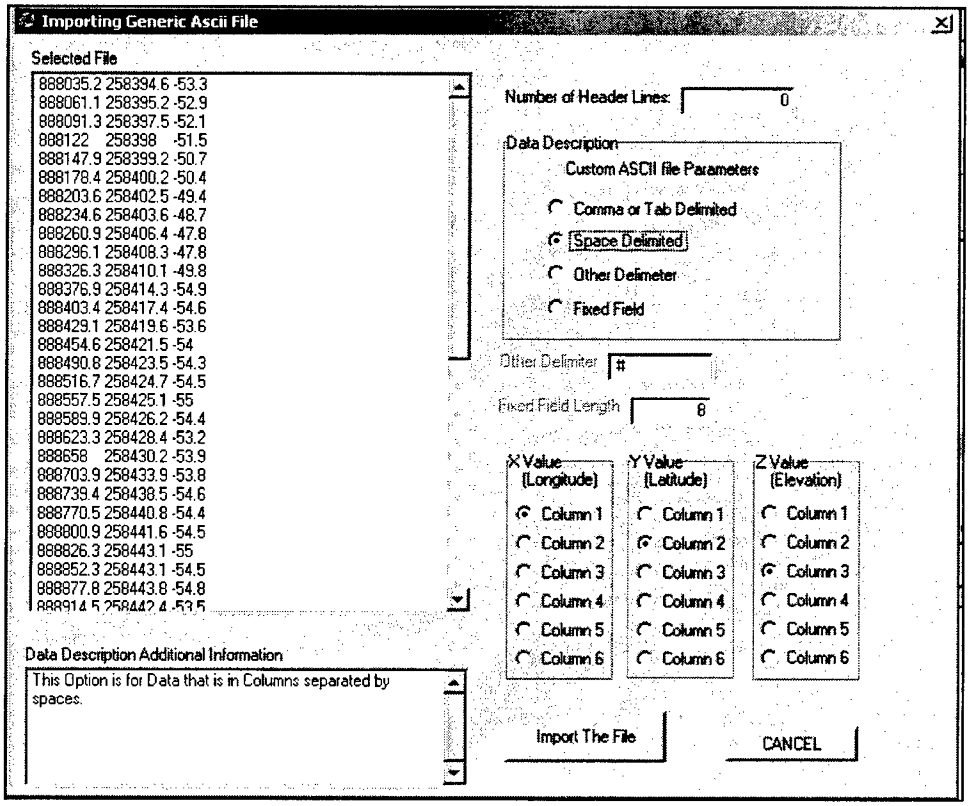


Figure 48. Generic ASCII file format dialog

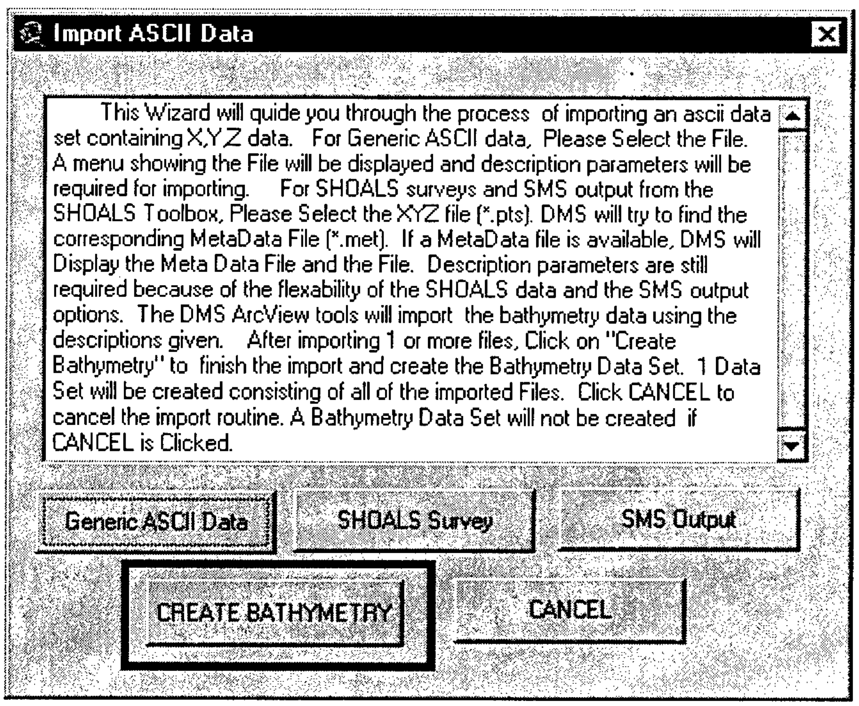


Figure 49. Import ASCII Data

dialog box (Figure 50). The user can also create a point theme from the data. Again, the theme name can be defined in the dialog box. If the user has chosen to create a grid theme, the final step will be to define the cell size and extent of the resulting grid. The appropriate values are selected from the drop-down boxes in the dialog (Figure 51). For more information on creating TINS and grids, consult the ArcView 3D Analyst users guide (ESRI 1999).

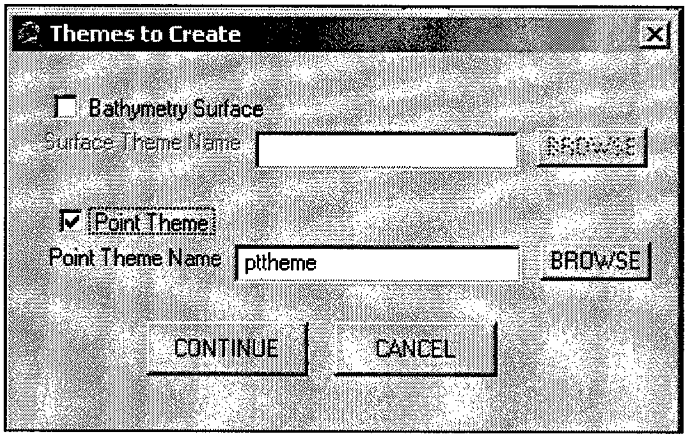


Figure 50. Create themes dialog

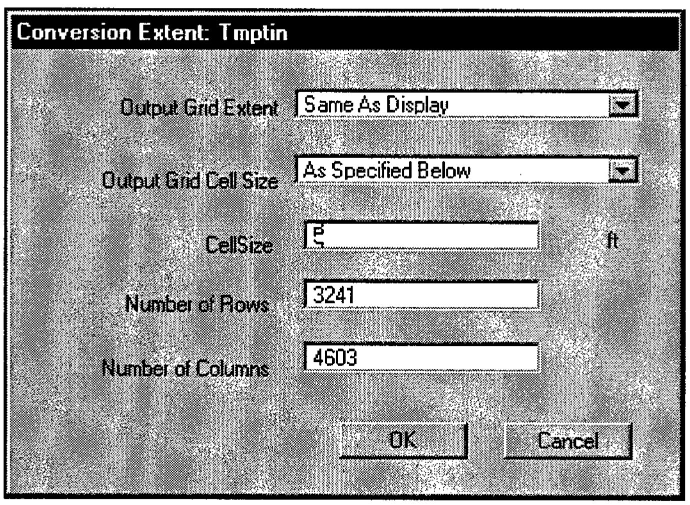


Figure 51. Grid definition dialog

The Data Manager can incorporate previously created ArcView TINS in the Data Manager. Selecting the **ArcView Tin** button (Figure 52) on the Data Import dialog opens a browser. From here, the user can select any available TIN data. Once selected, the TIN will be added to the current view and available for examination with the analysis tools.

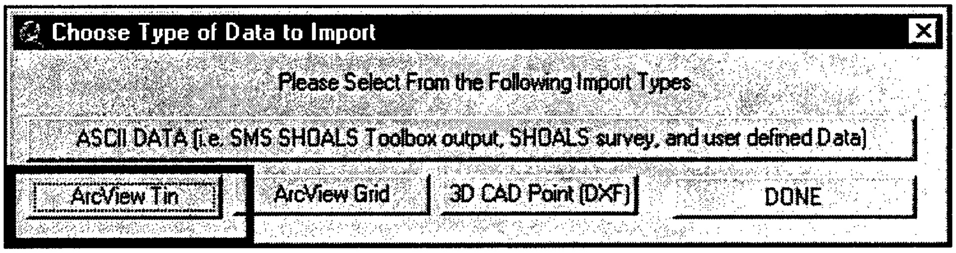


Figure 52. Import data format options dialog: ArcView TIN option

Previously created grids can also be added to an ArcView project. Selecting the **ArcView Grid** button (Figure 53) on the Data Import dialog opens a browser dialog box. From here, the user selects any available grid data. Once selected, the grid will be added to the current view and available for examination with the analysis tools.

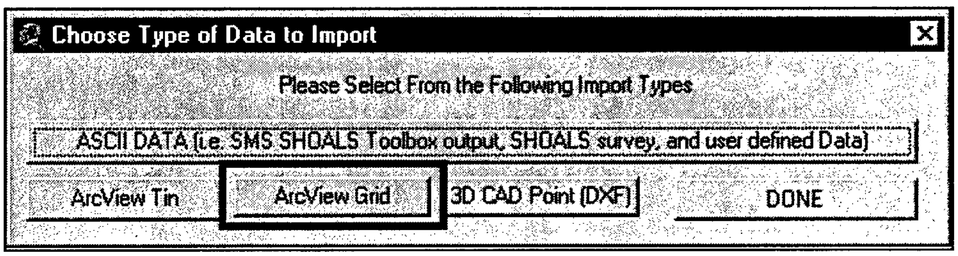


Figure 53. Import data format options dialog: ArcView Grid option

Finally, users can import 3-D CAD point data in DXF format. Most CAD packages have the ability to export data in the industry standard DXF format. Selecting the **3D CAD Point (DXF***)* button (Figure 54) on the Data Import dialog opens a file dialog box. From here, the user can browse and select any available 3-D CAD Point (DXF) data. Once selected, the 3-D CAD Point (DXF) data are imported, and the user is given the option to create themes (grid and/or point) from the data. Similar to the ASCII file import process, the final step defines the cell size and extent of the resulting grid. This grid will be added to the current view and available for examination with the analysis tools.

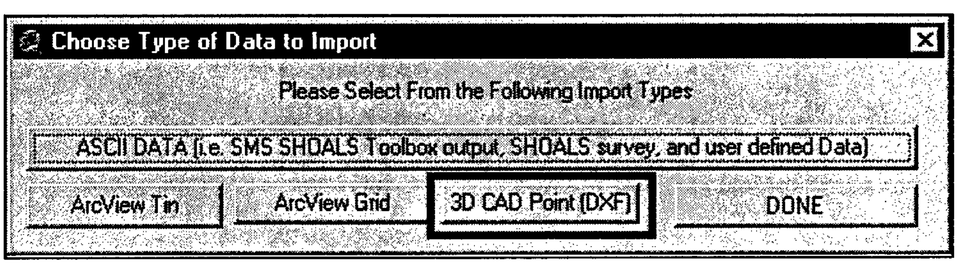


Figure 54. Import data format options dialog: 3-D CAD Point (DXF) option

4 Analysis Tools

Introduction

The four Data Manager analysis tools are the *Cross Sections* tool, the *Volume Calculator*, the *Dredging Record Center*, and the reporting tools. The first two tools access the themes developed with the Project Setup tools to assemble information about a project condition. The *Dredging Record Center* is an autonomous database containing historic dredging records relative to a particular project. The reporting tools summarize these data for user-specified areas within a project. These tools are discussed in this chapter.

Analysis Tools

Cross Sections tool 

The *Cross Sections* tool pulls cross sections from a bathymetric surface. The tool can work on multiple surfaces simultaneously, pulling elevation and distance data from the same geographic locations on each surface. Various project information can be obtained by evaluating the channel cross section. For instance, a comparison of pre- and post-dredge surveys can determine the cross-sectional area removed during maintenance dredging. Also, a post-dredging survey can be compared to a later condition survey grid to determine the shoaling rate in the navigation channel. To create a cross section, the user must determine where the transect will be and what bathymetric surfaces are to be included in the cross section.

Step 1: Define bathymetry. The *Station Profile Display Tool* allows the user to specify the bathymetric surfaces from which the cross section will be extracted (Figure 55). The surfaces are set on the left side of the dialog box. If the **Authorized Channel**, **Bathymetry Theme**, and **Stations Theme** are not correct, the user can click **Select New** to choose the correct theme from a list of all themes in the view TOC. If the user would like to include more than one bathymetry theme for the cross section rather than the authorized channel and one bathymetry theme, he or she should check the box at the bottom of the dialog labeled **Use Active (Selected) themes from the View Table of Contents (TOC**). Once this box is checked, the authorized channel and bathymetry theme will merge into one large button stating that the active themes from the TOC are being used (Figure 56). Now, any active theme will be included in the cross section.

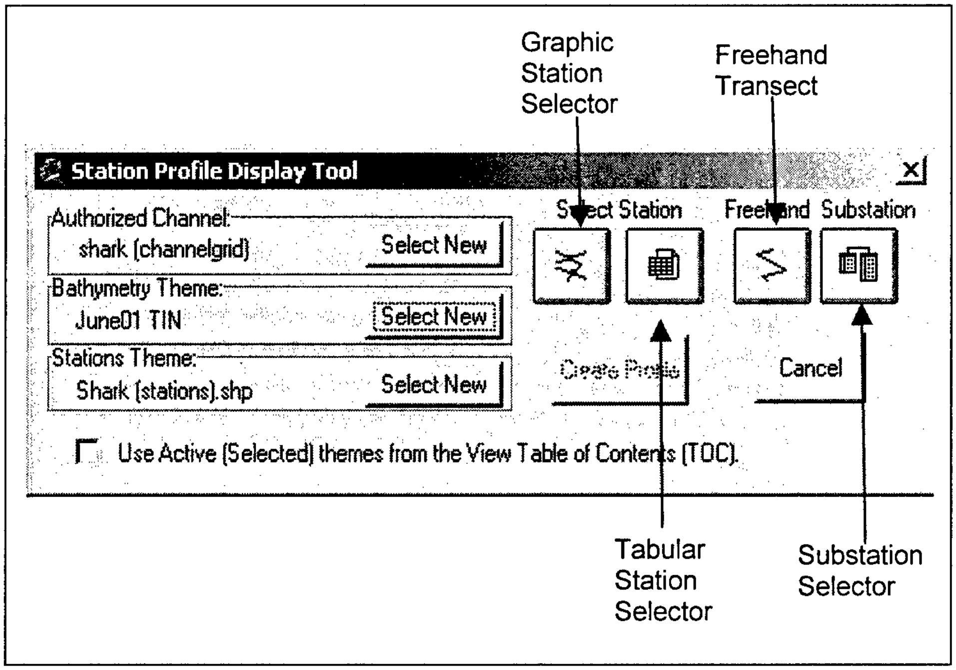


Figure 55. *Cross-sections* tool dialog

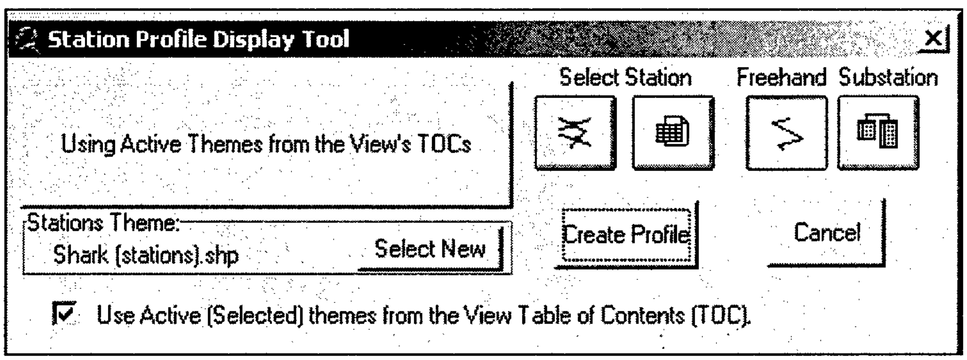


Figure 56. *Cross-sections* tool dialog with all active bathymetry themes

Step 2: Define transect location. After the bathymetry themes are chosen, the location of the transect must be determined. Cross-section transects can be located along lines drawn graphically in the view or predetermined stations. There are four options when choosing a location for the transect: graphic station selection, tabular station selection, drawing a freehand transect, or substation selection (Figure 55). In order to choose a location referenced to a station, the station theme must be set in the S*tation Profile Display Tool.* The Data Manager attempts to identify a previously created station theme based on the theme names in the active view. Alternatively, the Data Manager will prompt the user to define the station theme if it is not found. Choosing a station graphically allows the user to select a feature from the station theme for the transect location. The transect location can be chosen from a list of stations if the tabular option is selected. A freehand transect can be drawn at any orientation to the channel.

The final selection method, substation, allows the user to define a substation as the transect location. In order to specify a substation, the distance between the stations must be supplied.

Step 3: Create Profile. Once both the transect location and the bathymetry themes are specified, the cross section can be created. To create a cross section, click the **Create Profile** button. After the user selects this button, the first dialog box to appear asks the user to define a name and path for the cross-section export file (Figure 57). This file will allow the cross-section data to be imported to spreadsheet or graphics programs outside ArcView. The export file is a comma-delimited text file (Figure 58). The data are listed in columns as easting/latitude (x), northing/longitude (y), distance from the starting point, and elevation (z). The last header will indicate the bathymetry theme to which the values belong. If the data are not to be exported, the user should click **Cancel** and proceed.

The next dialogue allows the user to set graph formatting options (Figure 59). The user can enter the overall graph title, as well as the X- and Y-axis titles. Default values for the minimum and maximum extents of the Y-axis match the data extents; however, they can be set to any value. Grid lines can be defined for both axes as well. The default vertical exaggeration is calculated to distribute all the data evenly across the graph. The orientation of the cross section is determined and labeled on each end of the X-axis. The results, seen in Figures 60 and 61, are saved as a layout within the ArcView project. Figure 60 is a cross section with the authorized grid (red line) and one bathymetry theme (blue line, based on survey data). Figure 61 is a cross section of all the active themes selected by the user in the TOC. The second graph (Figure 61) also has a legend on the left-hand side of the plot.

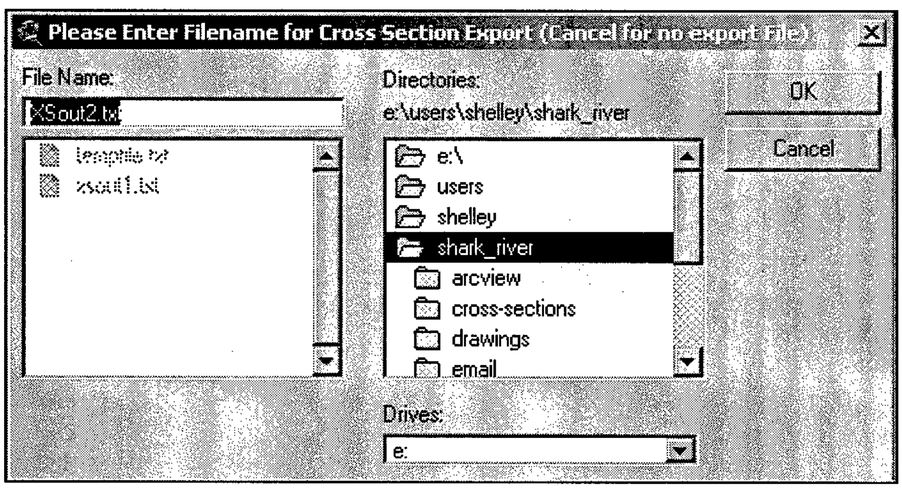


Figure 57. Cross-section export file

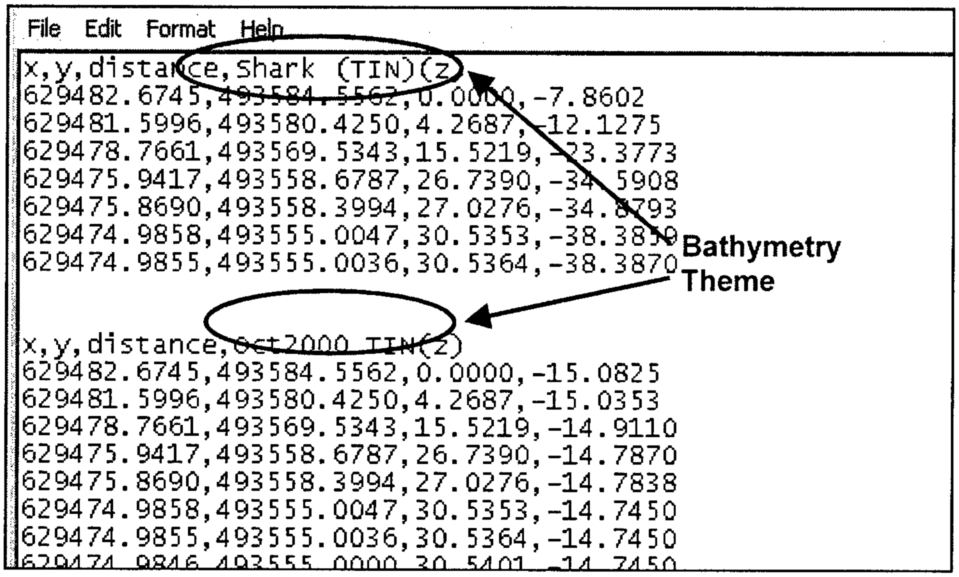


Figure 58. Cross-section export file format

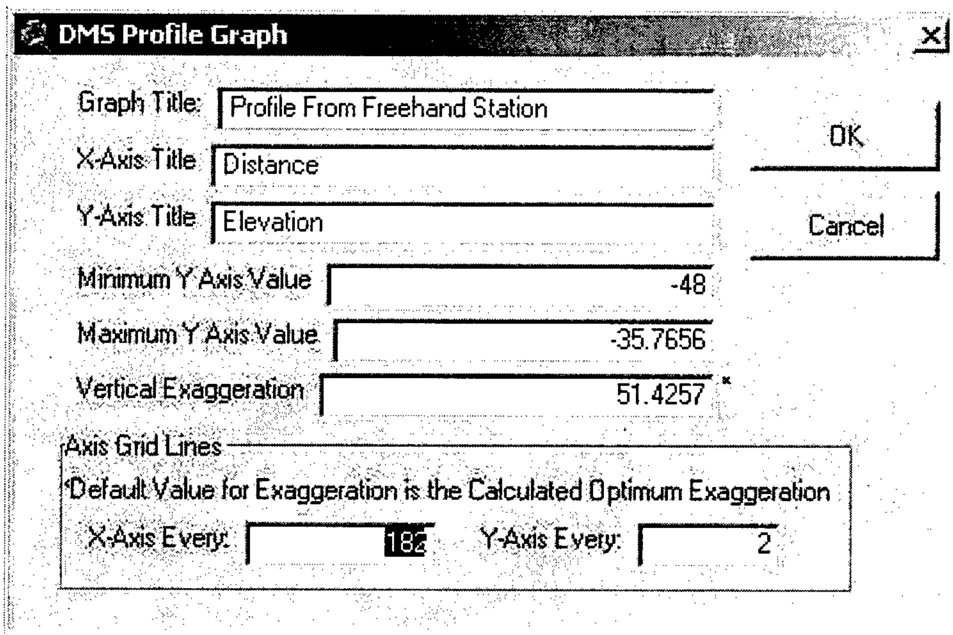


Figure 59. DMS profile graph

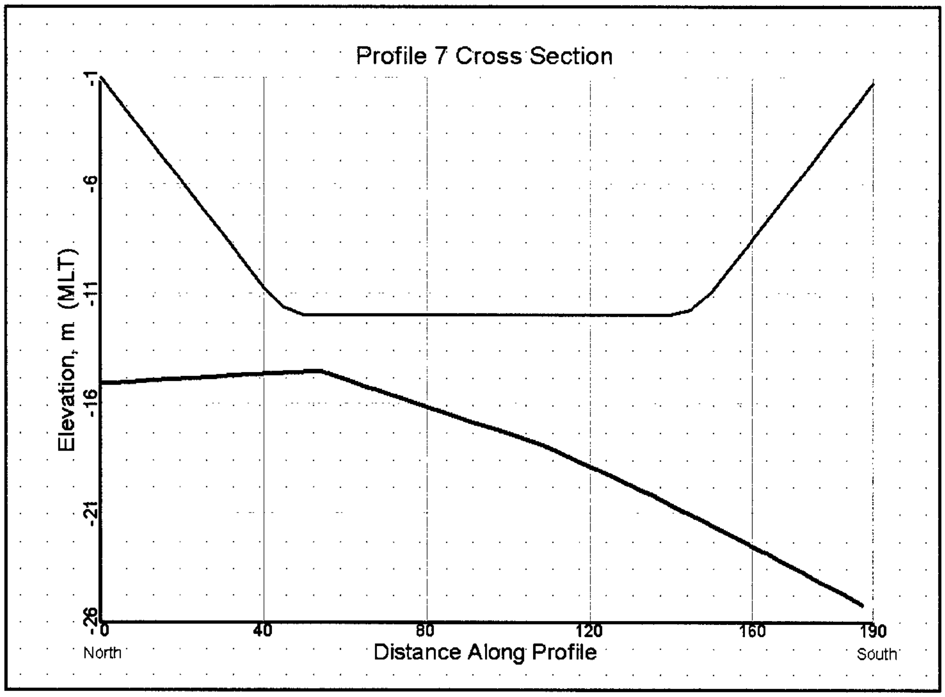


Figure 60. Cross section with authorized channel (red line) and bathymetry theme (blue line, based on survey data)

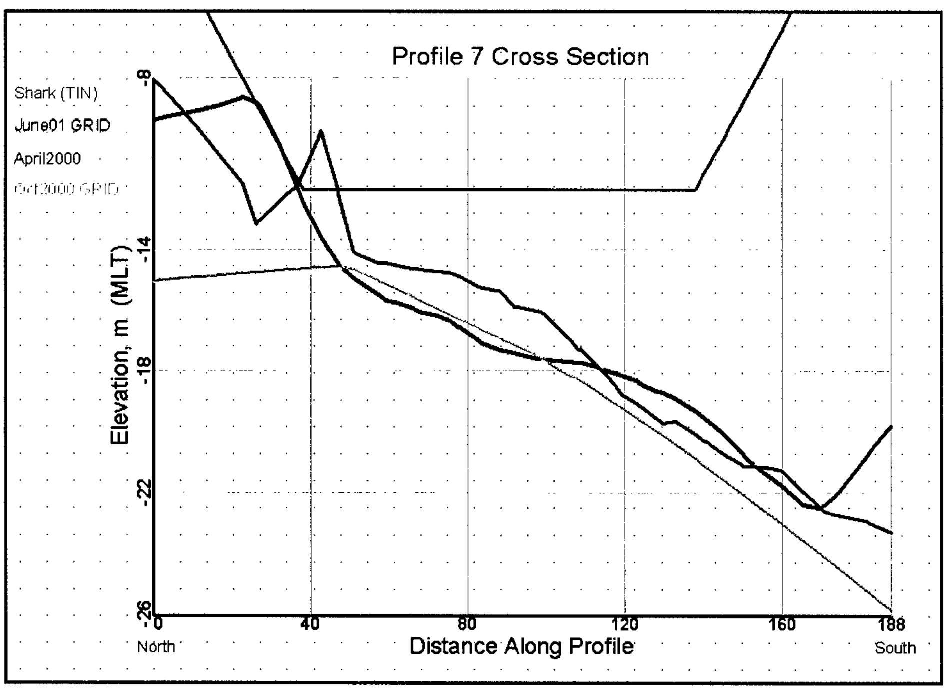


Figure 61. Cross section with multiple bathymetry cross sections. The red line is the authorized channel

Volume Calculator

The *Volume Calculator* approaches volume calculation from the planform perspective. Working with two bathymetric grids, the tool uses the elevation differences associated with each grid cell and the area of the grid cell to calculate volume changes between surfaces. The result is a volume change grid that can be displayed with customized color schemes to identify unknown or emphasize known problem areas.

Step 1: Define themes. Selecting the *Volume Calculator* button on the DMS toolbar opens the *Volume Calculator Wizard.* The first step requires the user to define the two surfaces to be analyzed in the volume calculations. The surfaces can be the following options:

a. The authorized channel grid and a bathymetric theme (Figure 62).

b. A bathymetric surface and a specified surface elevation (Figure 63).

c. Two bathymetric themes (Figure 64).

To choose *b* or *c*, the appropriate box must be checked.

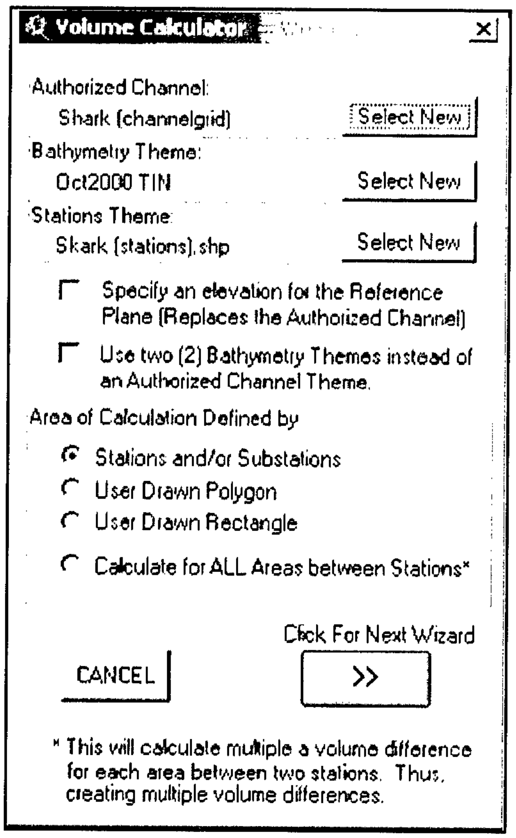


Figure 62. *Volume Calculator*, authorized channel and bathymetry theme

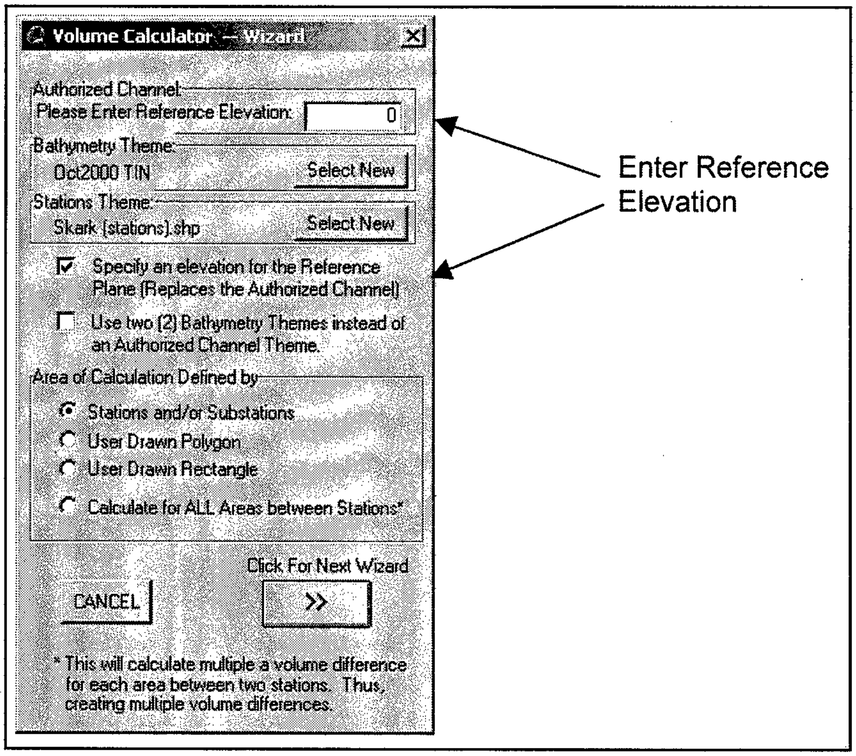


Figure 63. *Volume Calculator*, bathymetry theme and reference elevation

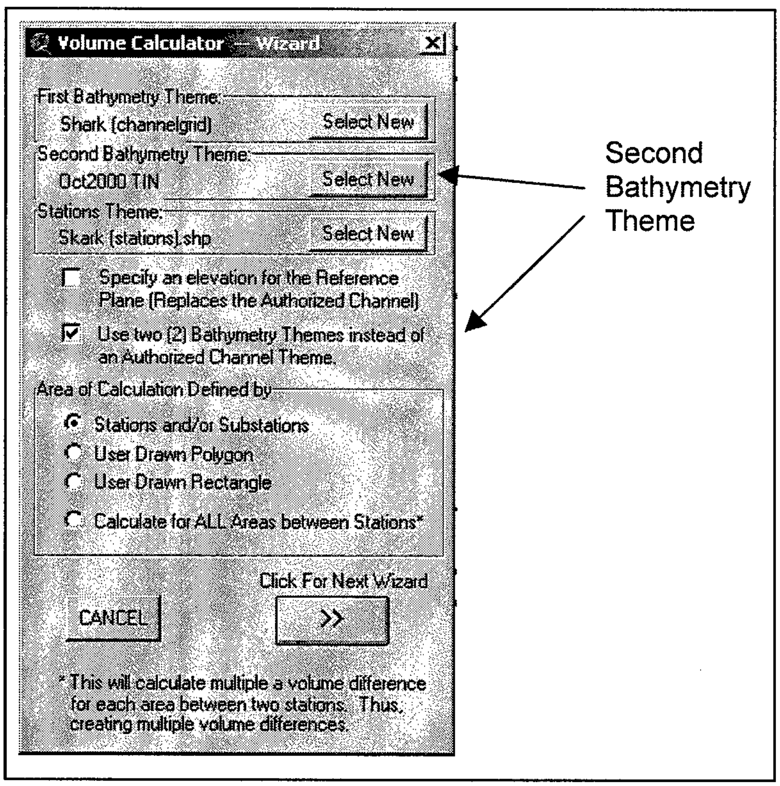


Figure 64. *Volume Calculator*, two bathymetry themes

Step 2: Select area of calculation. The three methods for defining the area of calculation vary from selecting stations and/or substations to graphically selecting an area. These methods are discussed in the following sections. As with the *Cross Sections* tool, the station theme must also be defined. The user defines the area of the volume calculation by selecting one of the four radio buttons under the heading **Area of Calculation Defined by**. The area can be defined between two stations or with a user-drawn polygon, a user-drawn rectangle, or the area between each station. Clicking the bottom right button guides the user through the area definition process with the chosen method.

Stations and substations can be used to define the area of calculation. In a two-step process, the starting and ending stations are defined separately (Figure 65). Station selection options include graphically choosing an existing station from the view, choosing an existing station from a list box, or entering a station/substation number in a text box (Figure 66). An example of a volume calculator result is displayed in Figure 67.

Users can select any overlapping area between the two surfaces by graphically drawing an irregular polygon or a rectangle on the current view. Polygons allow examination of specific sections of the authorized channel or a particular area of interest.

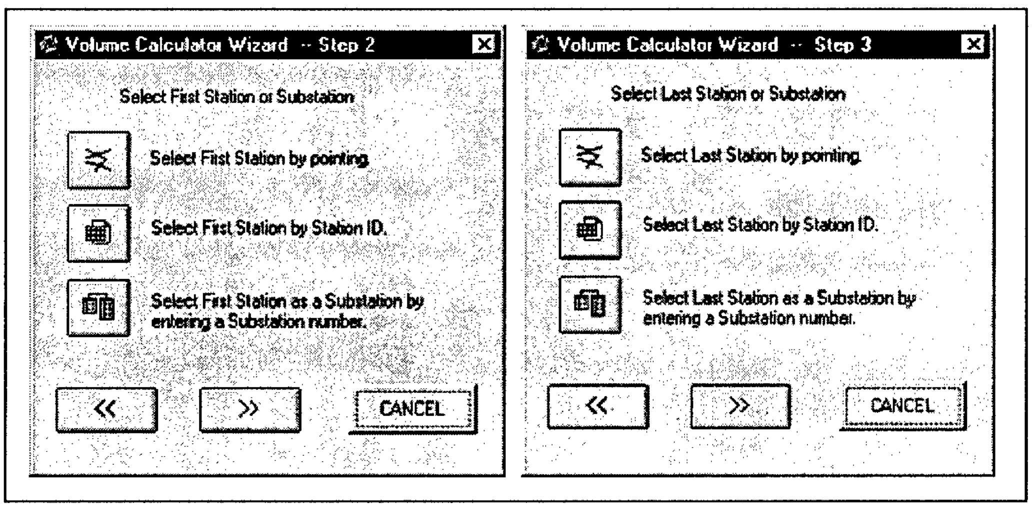


Figure 65. *Volume Calculator.* Station selection dialog

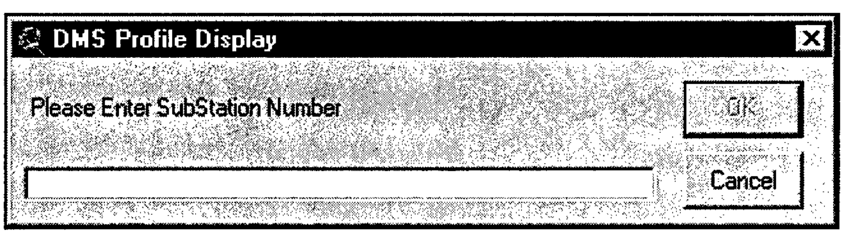


Figure 66. *Volume Calculator.* Substation data entry box

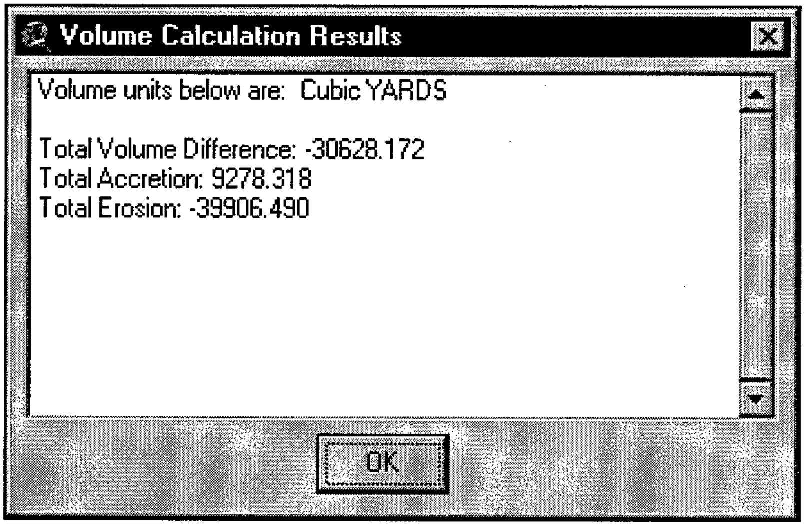
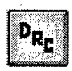


Figure 67. *Volume Calculator* results dialog

Dredging Record Center 

The *Dredging Record Center* (DRC) provides a means for users to create and maintain a relational database of historic dredging records and tie these records to the geographic locations of the dredging. The database maintains several categories of data including dredging operational data, contract and cost information, contractor information, and dredge-specific parameters. The DRC operates somewhat independently from the other analysis tools in that it is a Microsoft Access database with a Visual Basic interface that communicates with the Data Manager graphical user interface (GUI) to reference geographic locations.

Launching the DRC opens a splash screen with general information on the program (Figure 68). The Data Manager passes the name of the current channel, as defined with the Project Setup tools in the channel centerline theme, to the DRC. The database is queried with the channel name to select only the records corresponding to the current channel. If the channel name cannot be determined, a dialog will ask the user to supply the name.

The opening DRC screen presents a data summary for the queried channel records (Figure 69). All identified dredging events are listed in a drop-down box. Users may select any event in the drop-down box to view the detailed data for that event. The following data are included for each dredging event: total cost, design volume, pay volume, contract number, starting and ending date, contractor, dredge and dredge type.[1] Each project can consist of several dredged areas; these are summarized in the grid near the bottom of the screen. Areas are identified by the channel station. This dredging record summary form can be accessed at any time from within the DRC by clicking the **Open Dredging Records** icon (Figure 70).

[1] The DRC is populated by the user, so the information available will depend on the information provided.

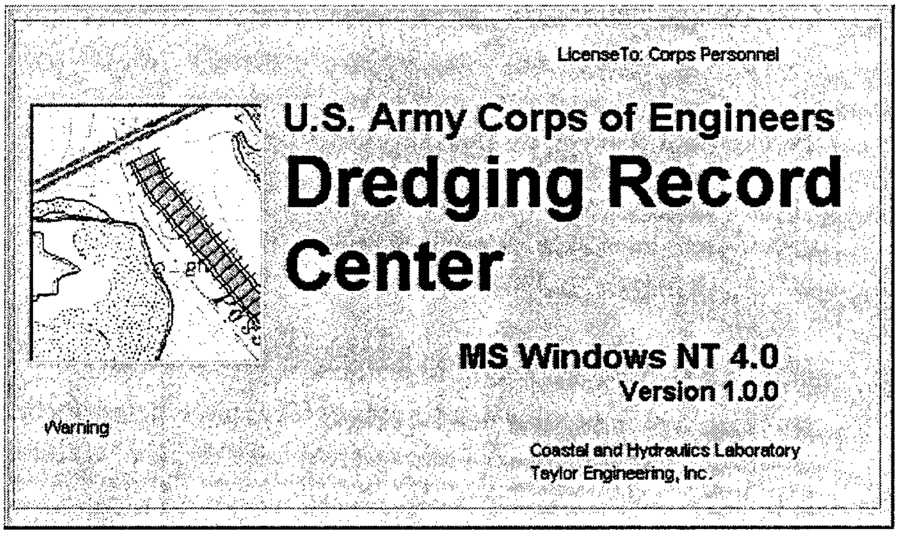


Figure 68. DRC splash screen

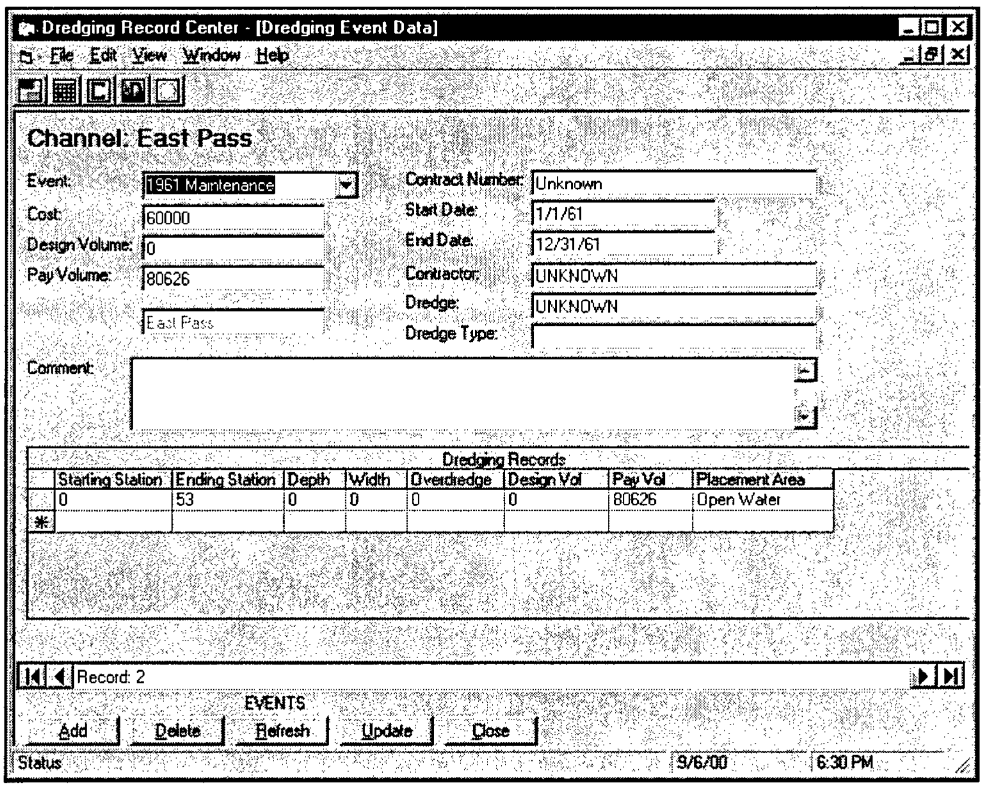


Figure 69. DRC data summary screen

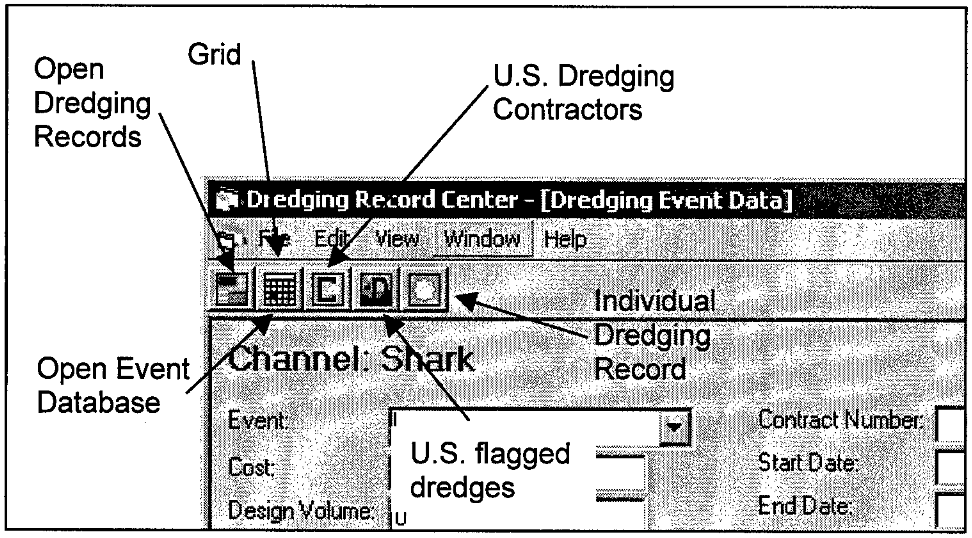


Figure 70. DRC buttons

Data entry

Users enter new dredging event data through the Dredging Event Data Screen by clicking on the **Add** button (Figure 69) or the **Open Event Database** icon (Figure 70). This opens the **Event Database** entry form (Figure 71). Fields in the **Event Database** entry form are not editable by default. Select the **Add** button and a new, blank, and editable record is added to the database. Enter the appropriate data in the fields and select a contractor and dredge from the drop-down boxes. Click the **Update** button when finished. The database now contains the user's new event.

Existing records can be edited only after clicking the **Edit** button. Similarly, records may be deleted from the database by clicking the **Delete** button. The form may be closed at any time by clicking the **Close** button.

Individual dredging records can be entered by clicking on the **Individual Dredging Record** icon (Figure 70). This icon opens the **Individual Dredging Records** data entry form (Figure 72). Again, the user may add, edit, delete, and update records by selecting the appropriate button at the bottom of the form. Fields in the **Individual Dredging Records** data entry form are not editable by default. When the **Add** button is selected, a new, blank, and editable record is added to the database. After the correct event from the drop-down box is selected, the user enters the appropriate data in the fields. The user clicks the **Update** button when finished and the database includes the user's dredging record.

Existing records can be edited only after clicking the **Edit** button. Similarly, records may be deleted from the database by clicking the **Delete** button. All records in the database can be viewed in grid format by clicking the **Grid** button (Figure 70).

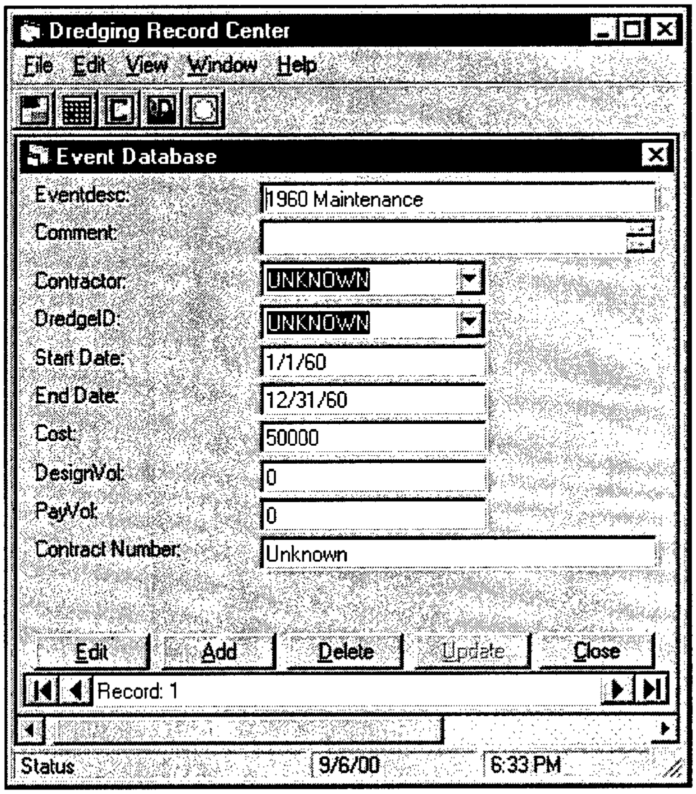


Figure 71. Event Database entry form

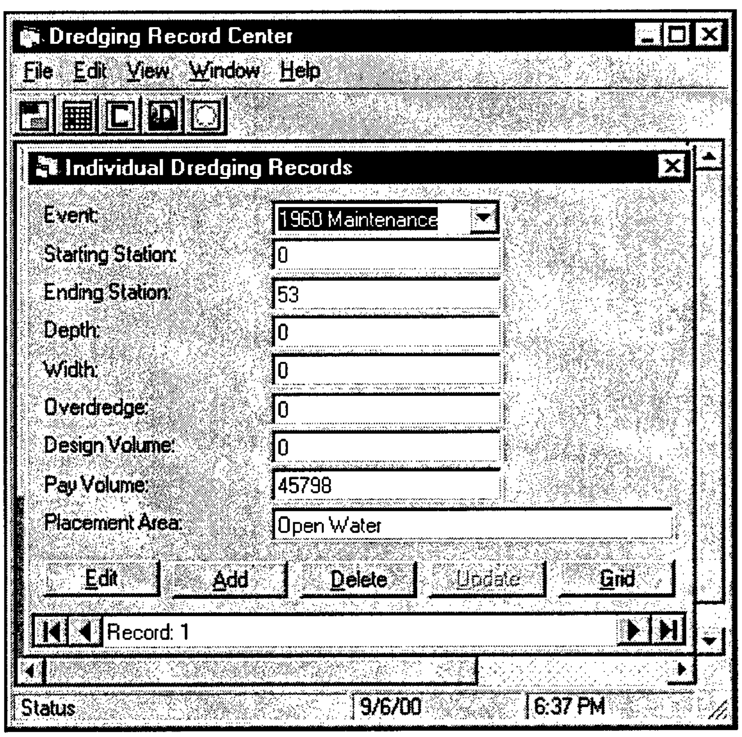


Figure 72. Individual Dredging Records data entry form

Contractor and dredge databases

The DRC contains the complete list of U.S. dredging contractors and U.S. flagged dredges as listed in the 1999 Directory of Dredge Owners and Operators in *International Dredging Review* (1999). These data can be accessed by clicking one of the icons shown in Figure 70.

The dredging contractors database includes mailing address, phone, fax, and e-mail information where available (Figure 73). If the contractor has established a Web site and Internet access is available, the user can visit the site from within the DRC via the DRC's own internal Web browser (Figure 74).

As previously noted, the **Dredge Database** contains all U.S.-flagged dredges (Figure 75). The dredge types can be determined by referring to Table 1.

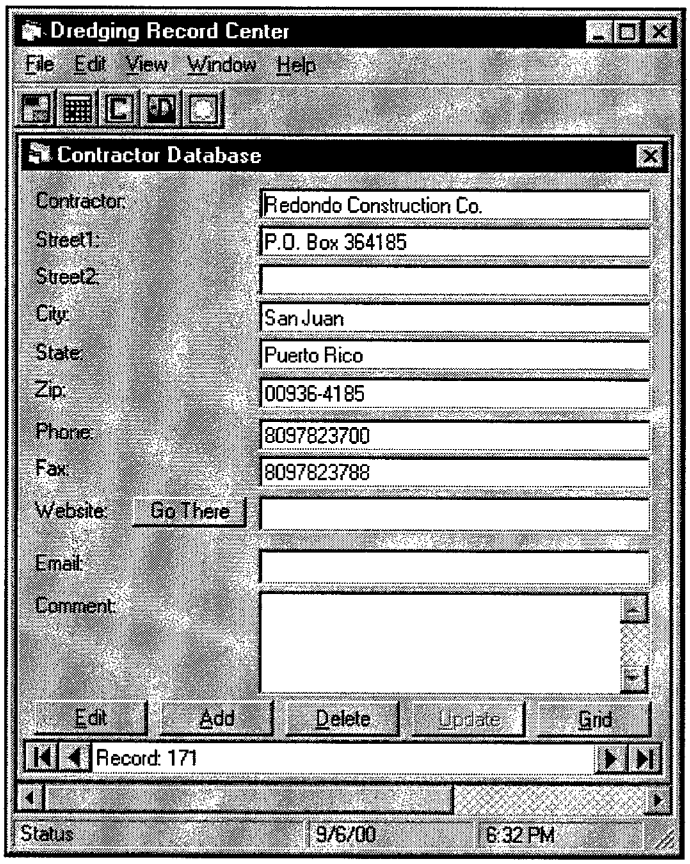


Figure 73. Dredging Contractor Database form

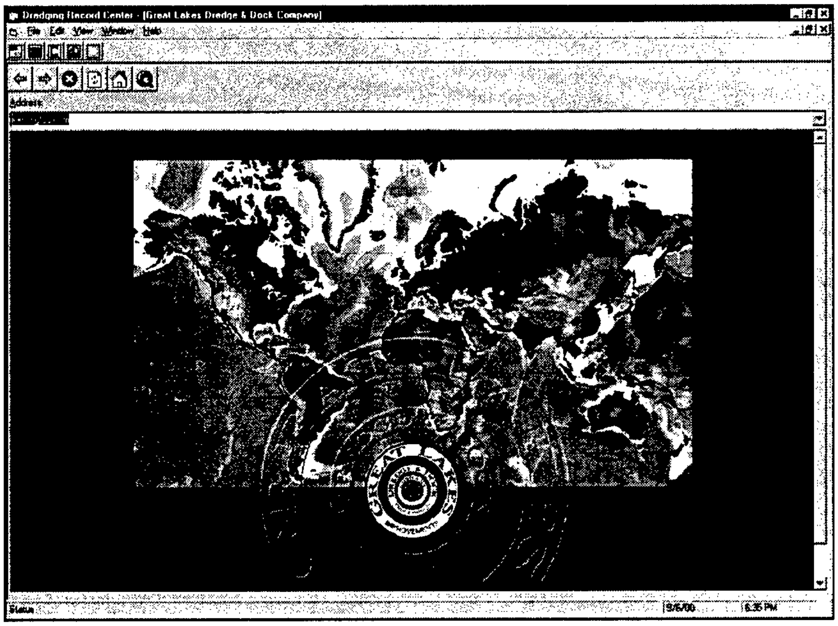


Figure 74. Internal DRC Web browser

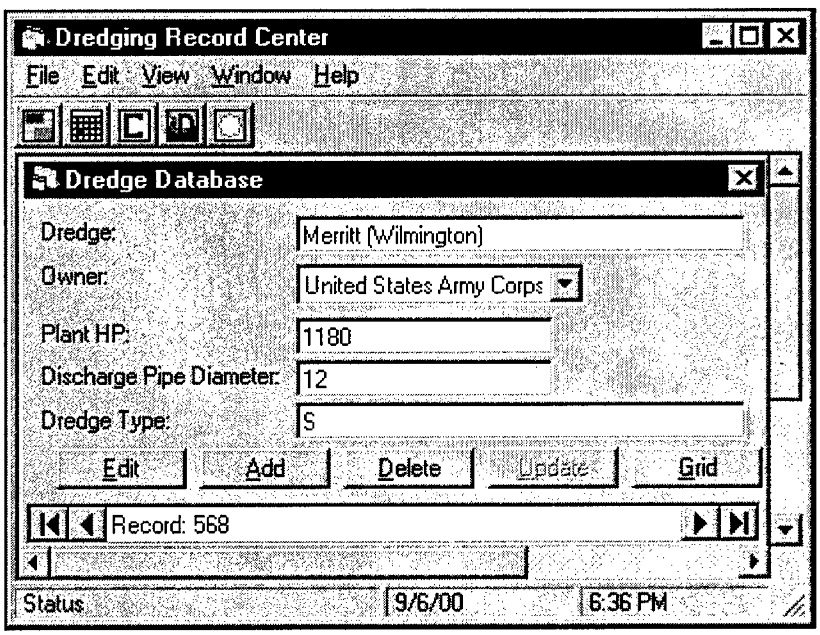


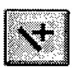
Figure 75. United States flagged Dredge Database form

Table 1
Dredge Type Abbreviation Key

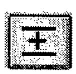
Abbreviation	Dredge Type
AU	Auger
BH	Backhoe
BL	Bucket Ladder
BW	Bucketwheel
CH	Cutterhead
CL	Clamshell (Grab)
CR	Chain Ladder
DI	Dipper
DP	Dustpan
H	Hopper (Trailing Suction)
S	Suction

Reporting

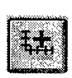
The Data Manager can produce three formatted reports: a single station report, a multiple station or area report, and an overall project report. Each report contains graphical representations of volumes dredged, project costs, and shoaling rates from the appropriate area. The reports are accessed from the DMS toolbar and menu, not from within the DRC.

Station Report 

Selecting the *Station Report* button on the DMS toolbar activates the station selection tool. The user can then click on any previously created station to produce a report of all dredging activity listed in the DRC for that station. The report includes graphs of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event.

Area Report 

Selecting the *Area Report* button on the DMS toolbar activates the area selection tool. The user can then draw a polygon around any group of previously created stations to produce a report of all dredging activity listed in the DRC for those stations. The report includes graphs of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event.

Project Report 

Selecting the *Project Report* button on the DMS toolbar automatically queries the DRC database for all dredging activity that has occurred within the project. The report includes graphs and tables of the dredged volumes and project costs for each dredging event returned from the database. The report then shows details for each dredging event.

5 Summary

The DMS Data Manager is a GIS-based software application developed to organize and analyze data associated with Federal navigation projects. This user's guide presents the functionality of the custom setup and analysis tools.

The DMS Data Manager, a component of the DMS, has been developed to assist USACE personnel design, operate, and maintain the Nation's waterways. It is also of potential utility to the cooperating sponsors of Federal navigation projects. The Data Manager is a customized extension to the commercially available GIS software package ArcView. The tools developed for the Data Manager allow users to create and centralize extensive project-related databases and provide a user-friendly GUI with which to interact with the data. Hydrographic survey data are interpolated onto standard ArcView grids or TINs for subsequent cross-sectional and volumetric analysis. With these tools, the objective is to provide a simple, standardized way for users to organize project data and apply independent analysis methods as well as those developed in the DMS.

To run the Data Manager, an intermediate knowledge of ArcView is necessary. The processes completed with the customized tools should always be quality checked with common sense because misuse of the tools can lead to incorrect interpretations. The results from analysis within the Data Manager, even if completed correctly, are subject to any error inherent in the initial data and final results should be reported as such.

The Data Manager can be downloaded from the DMS website (http://www.taylorengineering.com/DMShome/DMSDefault.htm).

References

Craig, K. R., Gosselin, M. S., Cook, D. S., and Pratt, T. P. (2001). "DMS: Diagnostic Modeling System; Report 3, The DMS data manager--A user's guide," Technical Report ERDC/CHL TR-99-19, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Environmental Systems Research Institute, Inc. (1999). *ArcView GIS, 3D Analyst*. Redlands, CA, 340 pp.

Environmental Systems Research Institute, Inc. (1996). *ArcView GIS, the geographic information system for everyone*. Redlands, CA, 340 pp.

Gosselin, M. S., and Craig, K. R. "Estimating flows and sediment transport near tidal entrances — ebb jet calculator" Technical Note (in preparation), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Gosselin, M. S., Craig, K. R., and Taylor, R. B. (2000). "Representation of hydrodynamic model results through graphical displays," Technical Note ERDC/CHL CETN-IV-27, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Gosselin, M. S., Craig, K. R., and Taylor, R. B. (1999). "DMS: Diagnostic Modeling System; Report 2, Reduction of sediment shoaling of the entrance channel at East Pass, Florida," Technical Report TR CHL-99-19, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Gosselin, M. S., Cranston, E. A., and Carvalho, A. "DMS: Diagnostic Modeling System; Report 5, Jacksonville Harbor Navigation project, Jacksonville, Florida," ERDC/CHL-99-19 (in preparation), U.S. Army Engineer Research and Development Center, Vicksburg, MS.

International Dredging Review. (1999). *1999 Directory of Dredge Owners and Operators and Buyer's Guide*. Fort Collins, CO.

Johnston, S. J., Kraus, N. C., Brown, M. E., and Grosskopf, W. G. (2002). "DMS: Diagnostic Modeling System; Report 4, Shoaling analysis of St. Marys Entrance, Florida," ERDC/CHL-99-19, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Kraus, N. C., Johnston, S., Taylor, R. B., Gosselin, M. S., and Craig, K. R. "DMS: Diagnostic Modeling System; Report 6, The DMS Manual" (in preparation), ERDC/CHL TR-99-19, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Kraus, N. C., Mark, D. J., and Sarruff, S. (2000). "DMS: Diagnostic Modeling System; Report 1, Reduction of sediment shoaling by relocation of the Gulf Intracoastal Waterway, Matagorda Bay, Texas," ERDC/CHL TR-99-19, U.S. Army Engineer Research and Development Center, Vicksburg, MS.

Lillycrop, W. J., Parson, L. E., and Irish, J. L. (1996). "Development and operation of the SHOALS Airborne Lidar Hydrographic Survey System," *Laser remote sensing of natural waters: From theory to practice.* V. I. Feigels and Y. I. Kopilevich, ed., SPIE-The International Society for Optical Engineering, Bellingham, WA, 2964, 26-37.

Pratt, T. C., and Cook, D. S. (2000). "Hydraulic processes analysis system (HyPAS)," Coastal Engineering Technical Note ERDC/CHL CETN-IV-23, U.S. Army Engineer Research and Development Center, Vicksburg, MS, http://chl.wes.army.mil/library/publications/chetn.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. **PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.**

1. REPORT DATE *(DD-MM-YYYY)* August 2002	**2. REPORT TYPE** Report 7 of a series	**3. DATES COVERED** *(From - To)*
4. TITLE AND SUBTITLE DMS: Diagnostic Modeling System; Report 7, The DMS Data Manager — Updated User's Guide		**5a. CONTRACT NUMBER** **5b. GRANT NUMBER** **5c. PROGRAM ELEMENT NUMBER**
6. AUTHOR(S) Shelley Johnston, Kenneth R. Craig		**5d. PROJECT NUMBER** **5e. TASK NUMBER** **5f. WORK UNIT NUMBER** 33129
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer Research and Development Center Coastal and Hydraulics Laboratory 3909 Halls Ferry Road Vicksburg, MS 39180-6199 Taylor Engineering, Inc. 9000 Cypress Green Drive Jacksonville, FL 32256		**8. PERFORMING ORGANIZATION REPORT NUMBER** ERDC/CHL TR-99-19
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers Washington, DC 20314-1000		**10. SPONSOR/MONITOR'S ACRONYM(S)** **11. SPONSOR/MONITOR'S REPORT NUMBER(S)**

12. DISTRIBUTION / AVAILABILITY STATEMENT

Available for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

The Diagnostic Modeling System (DMS) Data Manager is an ArcView 3.2 extension designed to work with bathymetric surveys and dredging records. The DMS Data Manager includes a suite of tools developed to aid in analysis of bathymetric surveys and dredging records. It should be used with the DMS Manual and DMS Analytical Toolbox to develop a channel maintenance plan with a holistic approach. The DMS Data Manager tools include the bathymetry importer, station and centerline tool, CAD importer, cross-section tool, volume calculator, and dredging record center.

This report is a step-by-step guide to help new users set up a DMS ArcView Project.

15. SUBJECT TERMS

ArcView
Bathymetric
Dredging
Shoaling

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			**19b. TELEPHONE NUMBER** *(include area code)*
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED		63	