COZOIL

COZOIL (Coastal Zone Oil Spill Model),
Improvement of Model and Linkage to Graphical User Interface

USER'S MANUAL
February 1998

Version 1.1

Submitted by:

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Improvement of Model and Linkage to Graphical User Interface**

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1. Getting Started

Installing COZOIL for Windows

COZOIL for Windows requires an IBM-compatible 586 or better PC, with 16 MB RAM, 30 MB free disk space on the hard drive, a VGA color monitor, and Microsoft-compatible mouse, running Windows 95.

To install:

1.   Insert the installation CD-ROM.

2.   Choose **Run** from the **Start** menu, and type d:setup in the Windows dialog box.

3.   Follow the installation instructions on the screen.

4.   When installation is complete, you will have a new program group labeled COZOIL for Windows, with an icon for the COZOIL model system. **Close this COZOIL for Windows program group, and use the Reboot facility before running the program.**

To remove COZOIL from a Windows 95 platform:

1.   Delete the entire COZOIL directory.

2.   Remove the COZOIL program group.

About This Guide

This manual covers the following topics:

- Installing COZOIL (Chapter 1)
- An overview of COZOIL and its components (Chapter 2)
- How to specify the environmental data sets required by the models (Chapter 3)
- Running the spill model and displaying model results (chapter 4)
- COZOIL auxiliary tools (chapter 5)
- The COZOIL database (chapter 6)

2. The Basics

COZOIL is an oil spill model system used to predict the movement and fate of oil spilled in the marine environment.

The COZOIL model system is comprised of several integrated components. The spill model itself predicts the movement of oil on the water surface and the distribution of oil in the environment (evaporated, in the water column, on the shoreline). For these calculations the spill model relies on environmental data such as wind and currents, physical data such as the proximity of shorelines, and chemical data that defines the type of oil. Each of these types of data can be input and edited using the appropriate COZOIL component.

Although land and water is represented by polygons on the screen, the model actually uses a gridded representation of this land and water boundary to determine:
- Whether oil is on land or water
- What is the shoreline type of the land grid cell?
- What is the depth of the water cell?

The grid uses the COZOIL shoreline database to determine the shore type. To display these shore segments, check the **Display Shore Types** menu on under the Data menu.

Geographic Location

The COZOIL application is specific to a particular geographic location. All data, spill scenarios, and model output are stored within this location. The location consists of an area defined by its outermost longitude/latitude coordinates. The location is given a name and contains a base map depicting land and water. The name of the active location is displayed at the top of the map screen.
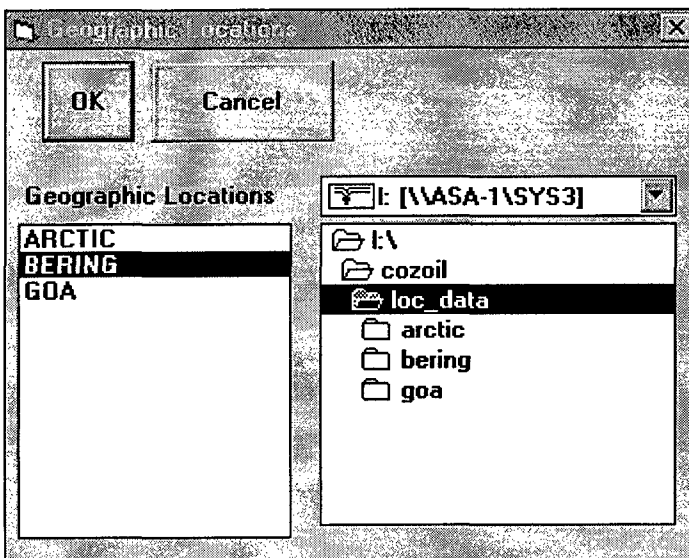
COZOIL has three locations. To move between locations, select **Geographic Location** from the **File** menu. The available locations will be listed. Click on the desired location to make it active, and then click on **OK**.

The Spill Scenario

Spill Scenarios are the means of organizing model data and parameters into unique collections. A spill scenario in COZOIL is a collection of information which defines a model simulation. This information includes a definition of the spill and the environmental data files used in the simulation, saved under a unique scenario name. Typically a scenario specifies the land-water grid, wind file and currents file used in the scenario; and the particulars of the spill itself (date, location, oil type and amount released). Any of the data files which comprise a scenario may belong to a single scenario, or multiple scenarios.

Land-Water Grid	Current Data	Wind Data	Spill Information Spill Location Spill Amount etc.

$$\Downarrow \quad\quad \Downarrow \quad\quad \Downarrow \quad\quad \Downarrow$$
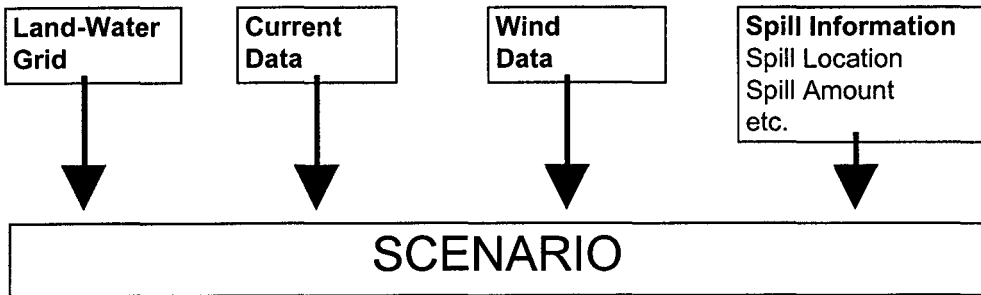
SCENARIO

Before a model simulation, a scenario is only the set of forms inputs defining the input data. After the execution of a model simulation, a scenario also has model output associated, which may be displayed. Thus the term "scenario" is used to describe both the inputs and the outputs of a model simulation.

In COZOIL there is always one **active scenario**. The active scenario name is displayed on the toolbar, and the components of the scenario can be viewed in the map window.

There are several options available under the **File** menu for handling scenarios.

- **New Scenario** is used to specify a new spill scenario. For this option, specify the scenario name, and select the land-water and currents grids. Spill simulation parameters will be set under the Model/Run Model menu.

- **Open Scenario** is used to open a previously defined scenario and the results of the spill simulation. The scenario selected becomes the active scenario. Its name is displayed on the toolbar and the simulation output can be displayed in the map window.

- **Save Scenario** is used to save the active scenario. If any editing has been performed on the currents or land-water grid.

- **Save Scenario As** is used to save the active scenario under a different name.

- **Edit Scenario** is used to change the land-water and currents grids associated with the active scenario. Changes made using Edit Scenario are automatically saved.
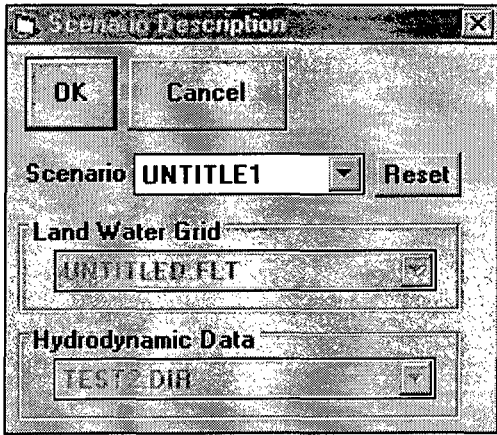
The **RESET** button is availalble when a scenario is being opened and a model simulation has been run previously for this scenario. It will reset all of the scenario parameters back to the state that was used when the model simulation was run. This is useful if, for instance, you edit the scenario and change the active grid or edit some parameters without running the model. The reset button will then set the scenario information back to exactly the parameters that were used to produce the model simulations.

The COZOIL Screen and Toolbar

The standard COZOIL screen consists of three major sections.

- At the top is the standard menu bar:

- Below the menu bar is the COZOIL toolbar. The toolbar contains buttons for various GIS and map functions, and displays the name of the active spill scenario. The toolbar includes buttons to control the display of the active scenario.

Or

Keys which are not active are "grayed out". The toolbar options are described briefly below.

Map Buttons

	To interrogate GIS objects.
	To create a zoom window.
	To zoom out to the previous zoom level.
	To add/edit current vectors.
	To edit land-water grid cells.
	To measure distances and areas.

Oil Spill Animation Buttons

◀	Rewinds the spill simulation to the start.
◀	Displays the spill simulation in reverse.
▷	Displays the spill simulation one timestep at a time.
■	Stops the display of the spill simulation.
▶	Displays the spill simulation.

| 3/9/96 08:00:00 AM ⬍ | Displays the time in the simulation being shown. Click on this box to select a particular time. |
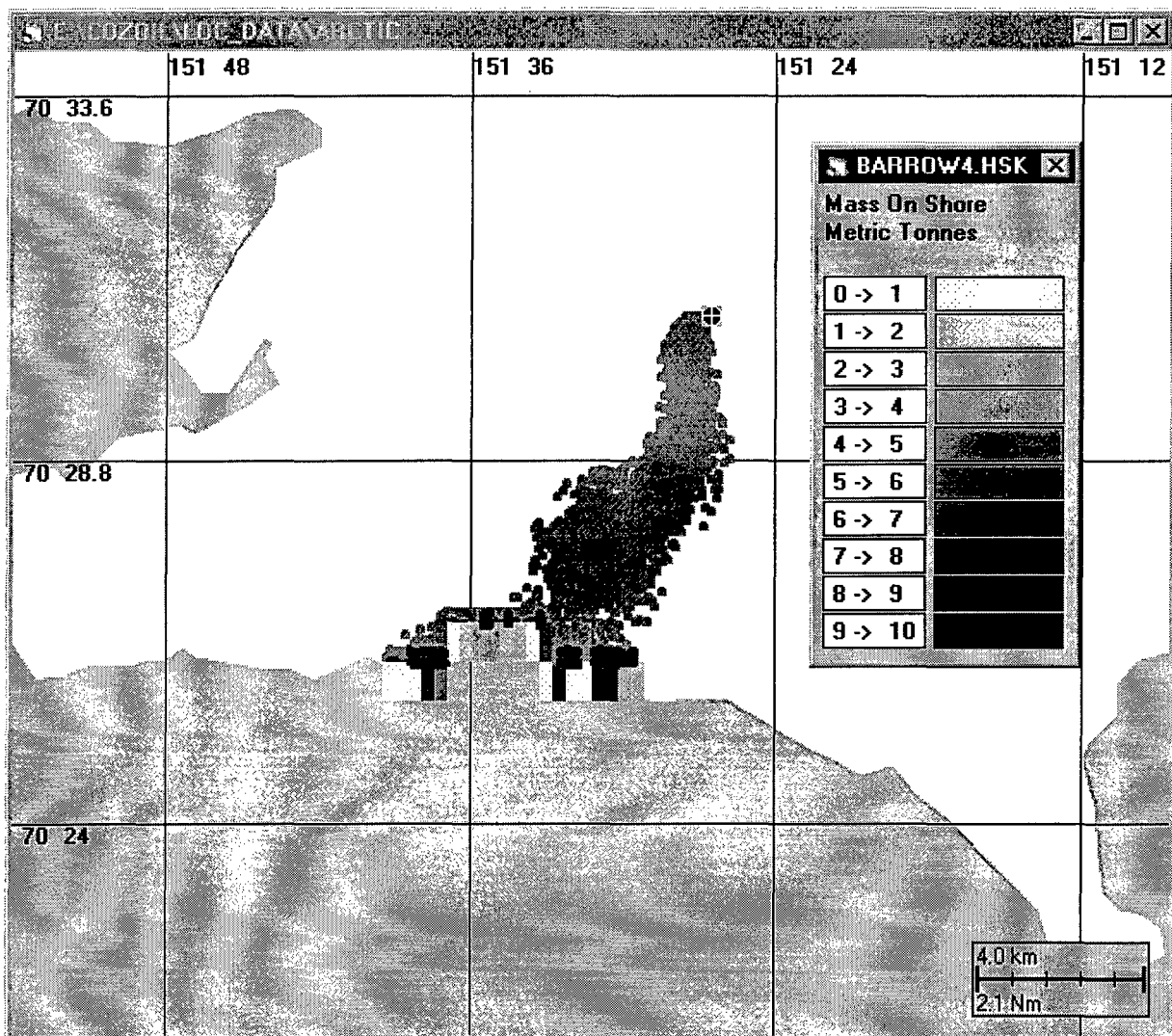
Setting the Map View: Zoom Functions

Several Zoom options are available to change the scale of the map display. Using these options the scale of the map can be increased or decreased, and the center of the map display can be shifted. All these options are available under the **Zoom** menu.

Zoom	
<u>C</u>reate Zoom Window	Ctrl+W
Zoom <u>I</u>n Previous	Ctrl+I
Zoom <u>O</u>ut Previous	Ctrl+O
<u>U</u>nZoom All	Ctrl+U
<u>P</u>an Point to Point	

To zoom in on an area of the map display:

1.   Select **Create Zoom Window** from the **Zoom** menu - OR - click on the Create Zoom Window icon 🔍 on the COZOIL toolbar.

2.   Move the mouse cross-hair to one corner of the area to zoom into.

3.   Hold down the mouse button and drag a box around the area to zoom into.

4.   Release the mouse button, and the new zoom window will be created.

To return to a previous zoom window at a larger scale:

1.   Select **Zoom In Previous** from the **Zoom** menu.

2.   Each time you select **Zoom In Previous**, the zoom window created at a larger scale than the current window will be displayed.

To return to a previous zoom window at a smaller scale:

1.   Select **Zoom Out Previous** from the **Zoom** menu - OR - click on the Zoom Out icon on the COZOIL toolbar.

2.   Each time you select **Zoom Out Previous** or click the Zoom Out icon, the zoom window created at a smaller scale than the current window will be displayed.

To return to the original map scale:

1.   Select **Unzoom All** from the **Zoom** menu.

To re-orient the zoom window:

1.   Select **Pan Point to Point** from the **Zoom** menu.

2.   Click the mouse cross-hair on the map to set a reference point to move. Then move the cross-hair to a new point on the screen where you want the previous point to be displayed, and click. For example, if an island appears at the lower left of the map display and you want to re-orient the display so the island is in the center, click on the island, move the cross-hair to the center of the display and click again. The window will be redrawn at the same scale with the island in the center.

Customizing the Map Display

Display Settings

OK	Cancel

Land Color
Water Color
Land Outline Color
Lon/Lat Grid Color
Current Vector Color
User Defined Vector Color
Display Lon Lat Grid   [X]
Display Distance Scale   [X]
Degree Representation   DD MM.MM
Vector Units   knots

Map Projection
  ○ XY Cartesian
  ● Mercator
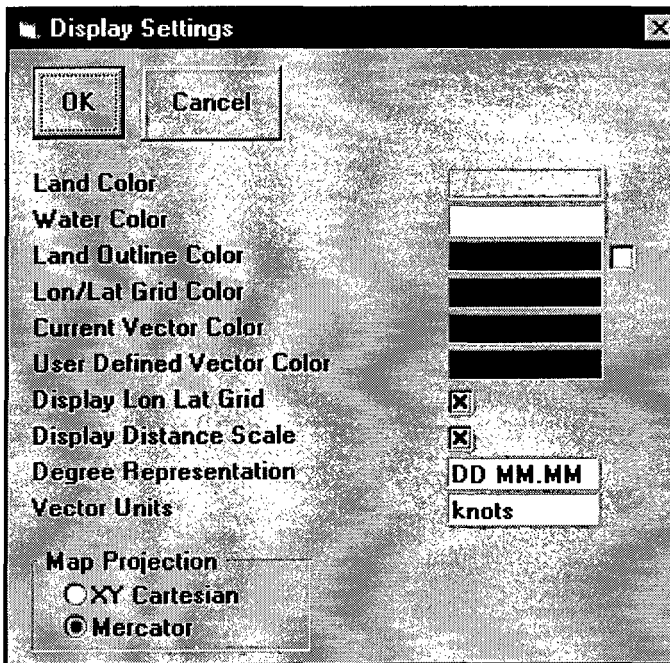
Several options are available to adjust the COZOIL map display. These options include the colors and measurement units used, and the map projection.

Most of the map settings that can be changed are accessed through the **Display Settings** option of the **File** menu. This option brings up a form to:

- select the colors used for land, water, current vectors, and the longitude/latitude grid. To select colors, click on the color box to bring up a color menu.

- Specify whether a longitude/latitude grid is shown on the map. Toggle the field between Yes and No.

- Specify the units longitude and latitude are presented in. Toggle the field between decimal degrees (DD.DD), degrees and decimal minutes (DD MM.MM), and degrees-minutes-seconds (DD MM SS).

- Specify the units current vectors are presented in. Toggle the field between mm/s, cm/s, m/s, and knots.

- Specify whether a distance scale is displayed on the map. Toggle the field between Yes and No.

- Specify whether to use No Projection or a Mercator Projection for the map.

Measuring Distances & Areas

To get the distance between two points, select the Distance Measure icon on the toolbar. Click on the point from which to measure distance. This sets one end of the measurement line. As you move the cursor around, the distance between the set point and the cursor's position is given at the lower left of the map. Clicking again with the left button will start another measurement line segment. The total cumulative distance of all the line segments is displayed on the status bar. *Click with the right mouse button to close the polygon and get the area of the polygon.* Hit escape to exit the distance measurement mode.

3. Specifying Environmental Data

Overview of Required Data

In this chapter the steps required to create the environmental data files used by the spill models in COZOIL are described. Subsequent chapters present the individual models and describe how to specify the scenario, run the models with the defined inputs, and display the results of these model simulations.

The spill models require several types of input data.

| Land-Water Grid | Current Data | Wind Data | Spill Information Spill Location Spill Amount etc. |

SCENARIO
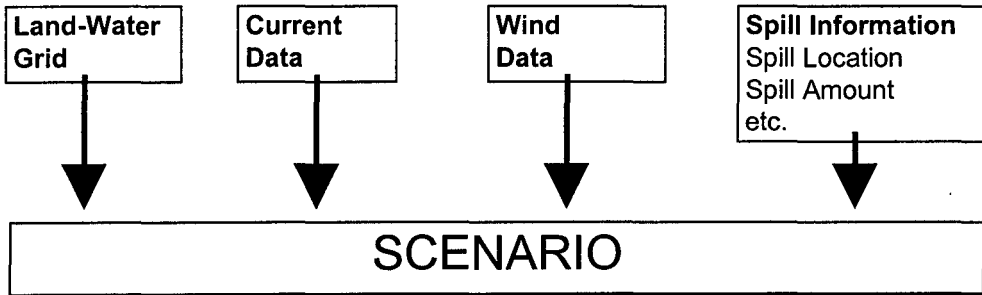
See the appropriate section later in this chapter for complete information on how to specify each type of data.

1. **A land-water grid**. The land-water grid covers all or some part of the base map in the active location. The grid should cover the spill site and the surrounding area of interest (oil which moves outside the grid is not tracked). The land-water grid is used by the models to determine which areas are land and which are water and to determine what type of shoreline (ie. Sandy beach, Rocky shore, etc.) is along a coastline.

2. **Wind time series**. The wind time series provides the model with wind data measured and/or forecast in the vicinity of the spill. The wind data consists of wind speed and direction for a period covering the spill simulation.

3. **A current field.** Current data is provided with COZOIL and is based on the the COZOIL database values. See the COZOIL Database chapter for more details.

4. **The oil characteristics.** COZOIL contains a library defining the characteristics of several standard oil types. If desired, additional oils can be added to this database, or the characteristics of the existing oils can be changed.

5. **The spill scenario**. The spill scenario contains the data that uniquely describe the inputs to a particular simulation to be run. It includes the spill location, spill date/time, type of oil, amount spilled and length of release, and specifies the land-water grid, wind data, and currents used in the simulation. Spill scenarios are saved with a user-defined name and the model results are given the same name (with a different extension). Defining the spill scenario is described in Chapter 4.

In order to run a spill simulation, you must have a land-water grid to define what is land, what is water, and what are the characteristics of the shoreline. The grid is a square mesh of individual cells covering the area of interest. Each cell in the land-water grid is classified as either land, water, or coastal. Each coastal cell has a code that indicates what shoreline type is dominant in the grid cell. Each water cell has a value that indicates the depth of the water in that cell. Each cell is the same size (in degrees), although they may not appear that way on the screen based on the latitude and the map projection.
The maximum grid size is 250 by 250 cells.

Displaying a Land-Water Grid

Grid GRID1		Currents UNTITLED	
☐ Cells ⬇	☐	Tidal :M2 ⬇	▦

The name of the selected land-water grid is displayed in the data tool bar (Use **Edit Scenario** in the **File** menu to change the selected land-water grid). Select **Cells** to display the grid cells and check the display box to the left on.

Grid GRID1	
☒ Cells	⬇

Creating a Land-Water Grid

The land-water grid is created by the following sequence of steps:

1. Select **Create Grid** from the **Data** menu.

2. While holding down the left mouse button, drag a box on the map defining the area to be covered by the grid.

3. Enter a name for the grid file and the number of grid cells in the X (east-west) and Y (north-south) directions. There can be a maximum of 250 grid cells in each direction; the minimum is 1 cell.

4. Click **OK** to save the grid.

New Grid

OK   Cancel

Grid File Name: Untitled

Grid Dimensions
Cells in X-Direction   100
Cells in Y-Direction   48
Cell Size (degrees)   0.00513
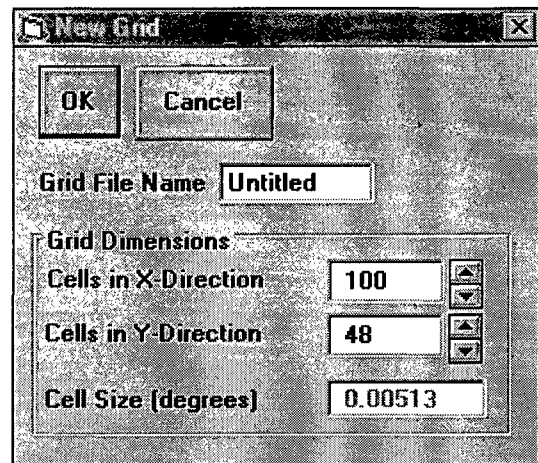
A land-water grid will automatically be created for the area selected. When the process is complete, you may automatically include this new grid as part of your Active Scenario.
See the previous section, Displaying a Land Water Grid or how the display this new grid.

Examine your newly created grid closely to be sure the delineation of land and water is appropriate for your model simulation. As an example, make certain the cell size is small enough to resolve narrow inlets as water cells and that small islands are flagged as land. If the grid is not appropriate, remake it using a larger or smaller cell size or edit the grid to change the classification of individual cells.

Shoreline types will also be assigned to each coastal cell from the COZOIL database of shore types. An interpolation method is used to determine the closest shoreline segment to each coastal cell and the type of that segment is assigned to the cell. To display these actual shore segments, check the **Display Shore Types** menu on under the Data menu.
Depth data is also interpolated from the COZOIL database.

Editing a Land-Water Grid

Any existing grid can be edited to change:
- the depth of water cells
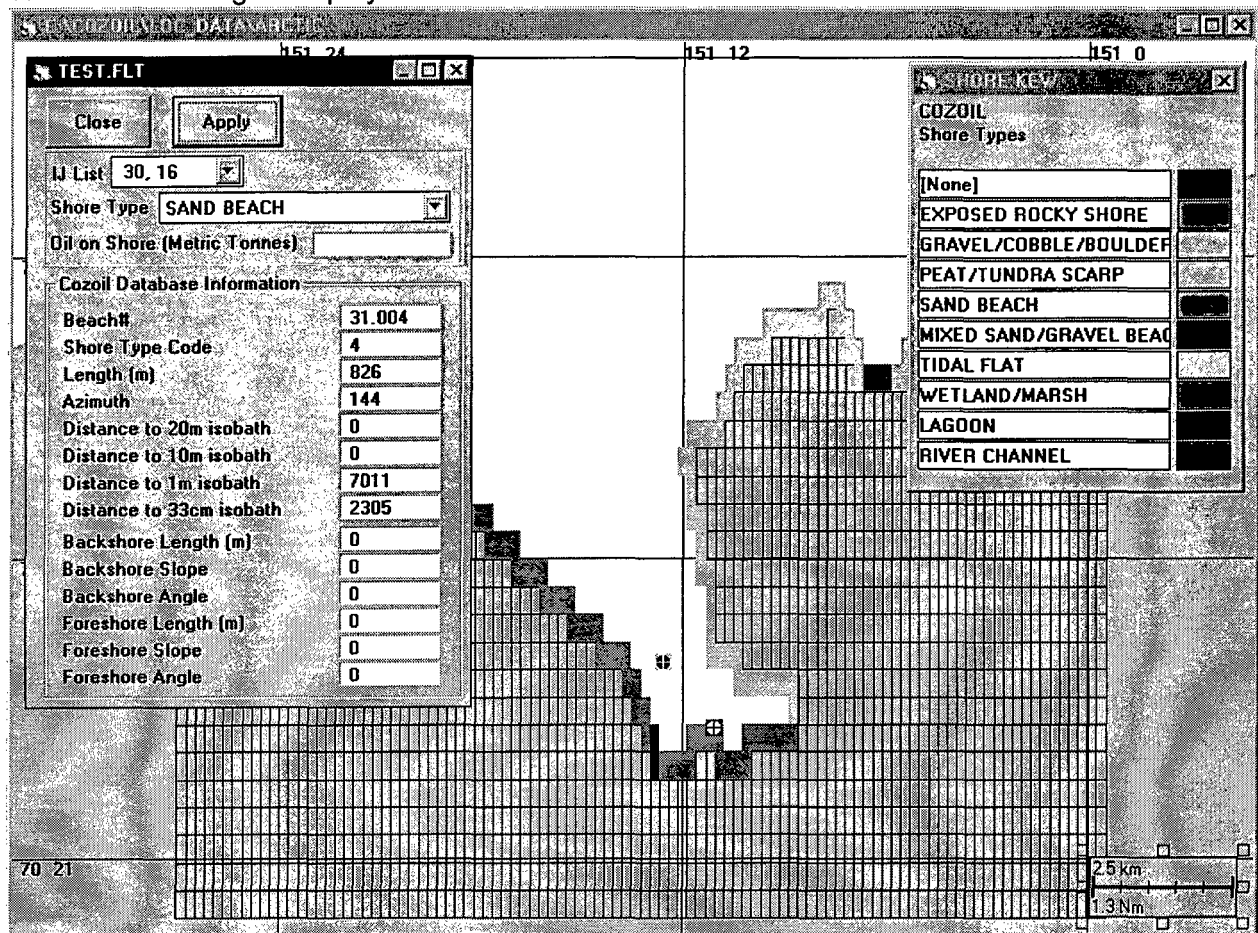- the shore type of coastal cells.

From the data tool bar, select the cell classification that you wish to view.

You may choose:
- Cells
- Depths

Editing cannot be used to increase or decrease the area covered by the grid or the number of grid cells. To change either of these parameters requires creating a new grid.

With the desired grid displayed:

1.	Select **Edit Land-Water Grid Cell** from the **Data** menu, or click on the Edit Grid Cell icon on the toolbar.

2.	It is often helpful to zoom in on the area being edited.

3.	Click in any cell of the grid. Hold down the CTRL key to select multiple grid cells.

4.	Use the cell edit window to edit the characteristics of the cell.
	Click Apply to apply the new type to the cell(s). If more than one cell is selected, then Apply will alter the characteristics of all the selected cells.

5.	If a water cell is selected, then you may also edit the depth of the cell.

6.	Once all editing is complete, select **Save Scenario** under the **File** menu. You will be prompted to save your changes to the grid.

Currents

Current data is required to run a spill simulation; the model will not run without a current field. Current data is provided and is based on the data in the COZOIL database. However, the COZOIL database lacked information such as phase (ie. when is high tide) and direction. So, current fields were generated based on the current speed stored at each shore segment. A vector was generated and assumed to be parallel to the shoreline. **This data has no phase information and has artificial direction information.** Tidal period was also obtained from the COZOIL database and the system will suggest which tidal period to use based on the location of the spill site and the tidal period in that region.

A current sketching tool is provided so that these currents may be edited manually. These currents can then be **spread** over the area of interest to create a rough estimate of the current field. **The current painting capability is designed as a temporary measure to pictorially represent general current features. It does not replace hydrodynamic model output, and can lead to the description of flow patterns which are clearly not mass conserving.**

The name of the current file that is loaded with the active scenario is shown on the data tool bar.

Grid GRID1	Currents UNTITLED	
☐ Cells ±	☐	Tidal :M2 ± ▦
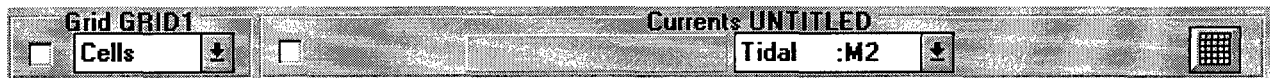
Types of Currents

The COZOIL currents have two components:
- M2 tidal currents (two high tides a day, period approximately 12.4 hours)
- K1 tidal currents (one high tide a day, period approximately 23.9 hours)

Tidal currents are time-varying currents caused by the ebb and flood of the tide. The vectors that are entered are assumed to be max flood stage. By setting the time of high tide in the spill form, the model will initialize at different times in the tidal cycle. However, the COZOIL database

does not have current direction so direction of high tide is not known. So, setting the high tide time will affect the point in the tidal cycle that the simulation begins, but it is _artificial_ as we do not know the true direction of maximum flood (only assumed) and no phase information is available.

Viewing Current Data

The current vectors in any currents file can be displayed. To display a current field it must be specified as part of the active scenario. Use **Edit Scenario** in the **File** menu to change the selected current file for the active scenario.

Current Grid

Display Vectors　　　　　　**Component**　　　**Display Current Scale**

- To specify the current component to be viewed, select from the list of current types. Check the display box to the very left <u>on</u> to view the current vectors on the map. Use the Play buttons to animate/step the current vectors in time. The time label will give the time in hours into the animation.

- To display the current **grid**, check the grid icon to the right of the tool bar <u>on</u>.

- Click the Scale icon to bring up the Scale Window
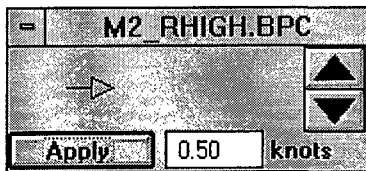
This window may be used to scale the presentation of the current vectors on the map.
<u>It does not change the actual current values.</u>

To scale the size of the displayed current vectors, click on the up/down arrows at the bottom of the window to increase/decrease the vector size. The vector to the left of the up/down arrows shows the size that a current vector will be displayed on the map. The velocity of this vector is shown at the bottom right of the window. Its units depend on the Vector Units setting under the **Display Settings** option of the **File** menu. Once the representative arrow is of the desired size, click on **Apply** to change the display scale of the currents on the base map. This does not change the value of the data, only its representation.

Editing a Currents Grid

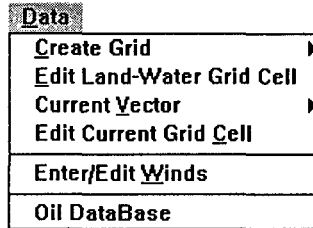Any existing grid can be edited to change the designation of individual cells as land or water. Editing cannot be used to increase or decrease the area covered by the grid or the number of grid cells. To change either of these parameters requires creating a new grid.

To edit a currents grid it must be specified as part of the active scenario and it must be displayed.

With the desired grid displayed:

1.   Select **Edit Current Grid Cell** from the **Data** menu.

```
 Data
 ┌─────────────────────────────┐
 │ Create Grid               ▶ │
 │ Edit Land-Water Grid Cell   │
 │ Current Vector            ▶ │
 │ Edit Current Grid Cell      │
 ├─────────────────────────────┤
 │ Enter/Edit Winds            │
 ├─────────────────────────────┤
 │ Oil DataBase                │
 └─────────────────────────────┘
```

2.   Click in any cell of the grid to toggle its designation from water to land or from land to water. Continue to toggle grid cells until the grid has been adjusted to your satisfaction.

3.   Once all editing is complete, select **Save Scenario** under the **File** menu. You will be prompted to save your changes to the grid.

Adding/Editing Current Vectors

Currents are entered into the currents grid as vectors, which are displayed as arrows whose length represents the speed of the current. The vectors point in the direction the current is moving.

To add current vectors to a currents grid follow the steps below:

1.   Select the type of current to be added (M2 or K1).

2.   It is often helpful to zoom in on the currents grid or some portion of the grid before entering current.

3.   Select **Current Vector** from the **Data** menu, then select **Add Current Vector**; or click on the Add Current Vector icon on the toolbar.

4.   Tidal currents are specified at maximum flood. The tide is assumed to be rectilinear, i.e., ebb tide is the opposite of flood tide.

5.   Position the cross-hair cursor in any grid cell to anchor the current vector in that cell. Depress the mouse button and drag the cursor away from the anchor point to draw a vector defining the current speed and direction. The speed and direction (in degrees clockwise from North) of the vector are displayed at the bottom left of the map window. Release the mouse button to set the end of the vector when the desired speed and direction are displayed.

> Note that as the mouse is moved over current grid cells, the value for the current vector in that cell will be displayed in the status section at the bottom of the screen.

6.   To edit an existing vector, click on the existing vector position and draw in a new vector. This will replace the previous vector. Note that as you move the mouse over grid cells that contain vectors, the exact speed and direction of each vector is displayed in the status bar on the bottom of the screen.

> A right-click on any current grid cell will allow entry of the current vector values exactly. This allows the user to enter exact values for specific cells.

7.   Repeat steps 5 & 6 to enter as much data as you have available. Optimally the data will establish the basic flow pattern.

When done, save your changes. Select **Save Scenario** from the **File** menu to save changes.

If the grid is only partially filled with currents and not suitable for use by the spill model, the final step is to fill the empty grid cells based on the vectors just entered. See **Filling the Current Field** section.

Filling the Current Field

Two utilities are provided to fill the current field with the user-input current vectors. The **Spread** option interpolates/extrapolates your input currents to empty cells; the **Smooth** option spatially smooths the differences between the current vectors. Additionally, the **Smooth** operation constrains the flow so that no flow occurs across a closed boundary (i.e., land). Thus, after smoothing, a current grid cell with two closed boundaries will not have any associated current.

The **Spread** option should always be selected to fill empty cells. It should be done first. The **Smooth** option is generally done once to create a more uniform current field.

It is often helpful to display your input currents and the **Spread/Smooth** currents in different colors. Use **Display Options** in the **File** menu to change the vector colors.

To **Spread** current vectors over a grid:

1.   Select **Current Vector** from the **Data** menu, then select **Spread Vectors**.

2.   The user-defined vectors will be used to interpolate/extrapolate current vectors into empty grid cells.

To **Smooth** current vectors in a grid:

1.   Select **Current Vector** from the **Data** menu, then select **Smooth Vectors**.

2.   To smooth only the interpolated/extrapolated vectors and leave the user-defined vectors unchanged, select **Only Interpolated Vectors**. To smooth all the current vectors in the grid, select **All Vectors**.

When done, select **Save Scenario** from the **File** menu. You will be prompted to save the changes. The completed grid contains background and/or tidal currents saved in a file with a DIR extension. This file can now be used in a spill simulation.

Currents Display Options

- To change the units speed. Select **Display Settings** from the **File** menu. Click on the units box to the right of Vector Units to toggle through the options available.

- To change the color of your input current vectors. Select **Display Settings** from the **File** menu. Click on the color box to the right of User Defined Vector Color and select the desired color.

Scaling Current Data

Once a current field has been entered, the magnitude of all the current vectors in the field can be increased or decreased by a constant scale factor.

To scale a current field it must be specified as part of the active scenario and the current component to be scaled must be selected.

From the **Data** menu select **Current Vector** and then **Scale Vectors**. In the Vector Scaling window, enter the scaling factor to be applied to all current vectors. For example, a factor of 1.20 will increase the magnitude of all current vectors in the selected current component by 20%. To decrease the magnitude of the vectors, enter a number less than 1.0.
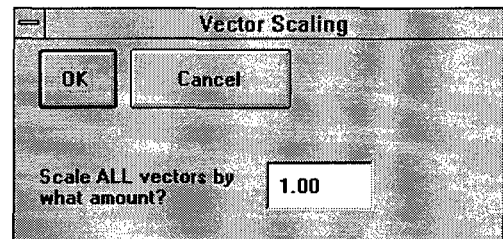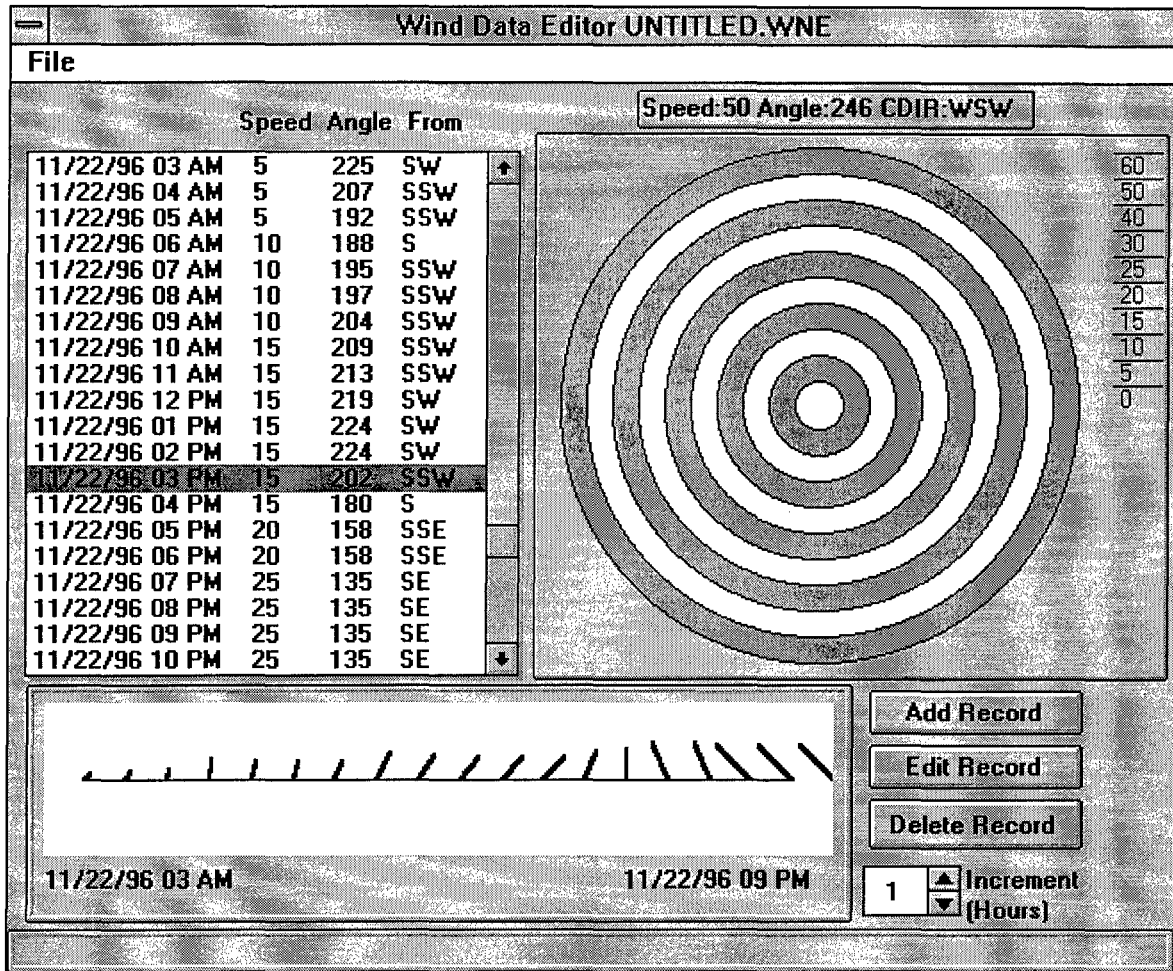

Winds

The wind data required for a model simulation consists of a series of wind speeds and directions covering the time period being modeled. COZOIL contains a Wind Data Editor to facilitate the task of entering wind data.

Alternatively, the user may select **Climatological Wind** to run the model with and a wind time series will be generated automatically based on the average wind speed for the month of the spill in that region. The system will find the COZOIL shore segment nearest to the spill site to get the average wind speed and standard deviation and use a Poisson distribution to create a wind time series.

The Wind Data Editor

The Wind Data Editor contains tools to input and display wind data. A "dart board" is used to input wind speed and direction with a simple "point and click" technique. Alternately speed and

direction can be manually entered. A time increment setting is available so that wind data do not need to be input at hourly intervals. To view the data in the wind file a listing of each wind speed and direction entered is provided, and a stick plot showing the wind data is presented.

The dart board is the quickest way to enter wind data. The rings of the dart board correspond to different wind speeds (in knots), increasing in speed away from the center. The direction from which the wind is blowing is indicated by the clockwise angle (0 to 360 degrees) around the rings of the dart board. As you move the mouse around the dart board, the wind speed and direction corresponding to the mouse's position are displayed in the text box above the dart board. Clicking the mouse on the dart board adds a wind record to the wind file.

The wind data you enter is assumed to follow the meteorological convention: the direction is the direction FROM WHICH the wind is blowing. The stick plot which displays the wind data follows the oceanographic convention: the direction is the direction TOWARD WHICH the wind is blowing.

Entering Wind Data

The following steps describe the process of creating a new wind file.

1.   Start the Wind Data Editor by selecting **Enter/Edit Winds** from the **Data** menu.

2. Select **New File** from the Wind Data Editor's **File** menu. Enter a name for the wind file and set the start date and time for the new file. Clicking in the box for the date/time entry brings up a calendar from which the date and time can be selected. The default coordinates for the wind station will be the center of the map.

To use the calendar click on the desired year, month and day of month on the calendar display. To select the current day's date, click on the **Today** button located below the monthly calendar. Use the up/down arrows to the right of the hour and minute boxes at the bottom of the calendar to select the time the wind record is to begin. Click on **OK** to save the selected date/time and return to the New Wind File window.

3. Set the time Increment (in hours) at which data will be entered. At the lower right of the Wind Data Editor window is the Increment box with up/down arrows to increase/decrease the increment. The time increment is the duration that each wind speed/direction entry will last. For example, a 6 means that each wind observation is valid for the next six hours. At any point while entering wind data, the time increment can be changed. Therefore you can enter known hourly wind data (Increment equals 1) for a period of time.

4. Enter wind speed and direction records by either clicking on the dart board, or selecting the **Add Record** button. This will allow manual entry of wind values

To use the dart board, place the mouse on the dart board at the desired wind speed and direction, and click. Each click of the mouse on the dart board generates one entry in the time series. The wind data entry is added to the table to the left of the dart board and to the stick plot graph at the lower left of the Wind Data Editor window.

5. When all data have been entered, select **Save File** from the **File** menu to save the file. The table and the stick plot will clear.

6. Exit the Wind Data Editor by selecting **Exit** from the **File** menu.

Editing Wind Data

The following steps describe the process of changing an existing wind file. Existing wind data entries in the file can be changed and new wind records can be added to the end of the file.

1.   Start the Wind Data Editor by selecting **Enter/Edit Winds** from the **Data** menu.

2.   Select **Open File** from the Wind Data Editor's **File** menu. Select the name of the wind file to be edited. Click **OK** to continue.

3.   To change existing wind data entries:

   •   Scroll through the wind record listing to the date and time for which wind data will be changed. Click on the data entry to be changed (it will be highlighted).

   •   To use the dart board to change the wind speed and direction, place the mouse on the dart board at the desired wind speed and direction, and click. The speed and direction corresponding to the mouse's position are shown in the text box below the dart board.

   •   To change data by typing the speed and direction, double click on the entry to be edited (or highlight the entry and select **Edit Record**).

4.   To add more wind data to an existing wind record:
   •   Scroll to the end of the wind record listing.
   •   Add wind records by clicking on the dartboard or by using the Add Record button.

5.   When all changes have been made, select **Save File** from the **File** menu to save the file. The table and the stick plot will clear.

6.   Exit the Wind Data Editor by selecting **Exit** from the **File** menu.

Importing Wind Data

A wind data file can be created in the ASW format (see Appendix) using a text editor and imported into COZOIL for use in the spill models.

To import an ASW wind file:

1.   From the **Data** menu select **Enter/Edit Winds**.

2.   From the **File** menu of the Wind Data Editor select **Import ASW File**.

3.   Select the file to be imported.

The Oil Database

COZOIL contains a library defining the characteristics of several types of oil. The standard oils are:

> gasoline
> diesel
> light crude oil
> medium crude oil
> Prudhoe Bay crude
> heavy crude oil
> Bunker C (fuel oil #6)
> JP-4 (fuel oil #1)

The parameters stored in the oil database affect the spreading, evaporation, and mousse formation algorithms of the COZOIL fates routines during spill simulations.

Any of the parameters can be changed. New oils may also be added to the database. Oil data are stored by geographic location, so any changes made to the oil database are specific to the oil database in the geographic location active when making the changes.

Oil Characteristics

The oil database contains a name and eight parameters identifying each oil. The oil parameters are used by the spill models to characterize each oil's behavior. Each type of data in the oil database is described below.

Oil Name - a unique name up to 20 characters long to identify the oil.

Density - the density of the whole, unweathered oil (gm/cm^3).

Viscosity - the dynamic viscosity of the oil at 25°C (cP).
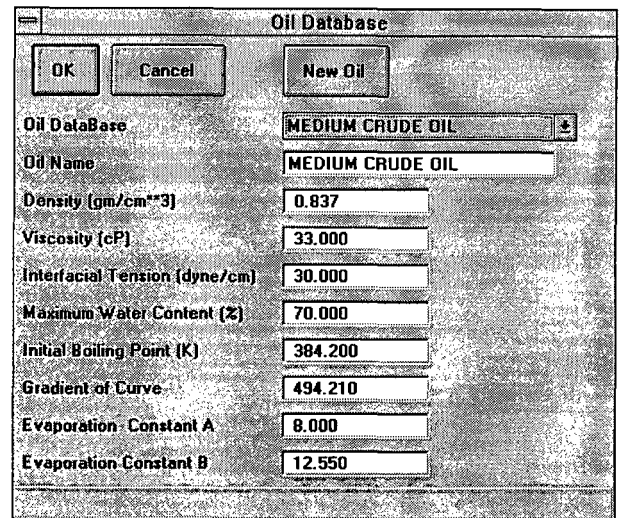
Interfacial Tension - the oil-water interfacial tension (dyne/cm).

Maximum Water Content - the maximum water content of emulsified oil (%). Enter 0 if the oil does not emulsify.

The final four parameters are used to define the evaporation characteristics of the oil. These parameters are inputs for Mackay's evaporative exposure approach used to model evaporation.

Initial Boiling Point and **Gradient of Curve -** Determine these values for the oil by plotting the oil's liquid (not vapor) temperature in degrees Kelvin versus the fraction of oil condensed (the modified distillation curve). If only the vapor temperature is available for the distillation curve, a rough approximation of the liquid temperature can be obtained by adding 30° C to each vapor temperature. Enter the initial boiling temperature (degrees K) for the first parameter and the slope of the distillation curve for the second parameter.

Oil Database	
OK Cancel	New Oil
Oil DataBase	MEDIUM CRUDE OIL
Oil Name	MEDIUM CRUDE OIL
Density (gm/cm**3]	0.837
Viscosity [cP]	33.000
Interfacial Tension [dyne/cm]	30.000
Maximum Water Content [%]	70.000
Initial Boiling Point (K)	384.200
Gradient of Curve	494.210
Evaporation Constant A	8.000
Evaporation Constant B	12.550

Evaporation Constants A and **B** - These values are determined by plotting ln(H) versus T_B/T. The relationship between H and T_B is

$$ln(H) = A - B * (T_B/T)$$

where

H = Henry's Law constant
T_B = Boiling temperature (K)
T = Ambient temperature (K).

Values of A = 6.3 and B = 10.3 generally provide reasonable results for most oils.

Editing an Oil

The name and parameters defining any oil already in the database can be changed. The parameters are described in the previous section *Oil Characteristics*.

To edit an oil:

1.   Select **Oil DataBase** from the **Data** menu.

2.   Click in the first field of the Oil Database window to display the list of available oils. Select the oil to be edited.

3.   Click on the field containing the property to be changed. Any of the parameters, including the oil name, can be changed. Enter the desired value. TAB or click to move to a new field.

4.   Repeat step 3 to change all desired properties.

5.   To save changes and exit the Oil Database window, either click **OK** at the top of the window or press the ENTER key after entering data in a field. To exit without saving changes, click on **Cancel** at the top of the window.
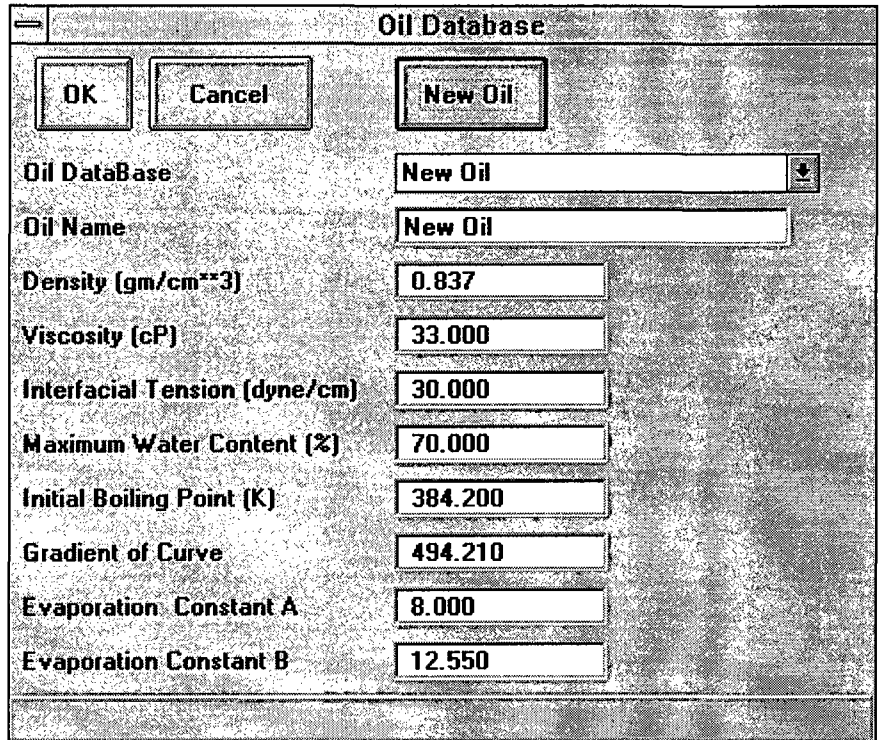
Adding an Oil

To add a new oil to the database you must specify the parameters defining the oil's characteristics. Default values are provided based on the previous oil listed. The oil parameters are described in the section *Oil Characteristics*.

To add a new oil:

1. Select **Oil DataBase** from the **Data** menu.

2. Click on **New Oil** at the top of the Oil Database window. This will fill the fields Oil Database and Oil Name with the name "New Oil". The other fields will contain the values for the oil which was listed when **New Oil** was selected.

3. Click in the Oil Name field and replace the name "New Oil" with the name of the new oil to be entered. No check is performed to verify that this name is different

	Oil Database
OK　Cancel	New Oil
Oil DataBase	New Oil
Oil Name	New Oil
Density (gm/cm**3)	0.837
Viscosity (cP)	33.000
Interfacial Tension (dyne/cm)	30.000
Maximum Water Content (%)	70.000
Initial Boiling Point (K)	384.200
Gradient of Curve	494.210
Evaporation Constant A	8.000
Evaporation Constant B	12.550

from other names in the oil database. Therefore, unless you mean to have two oils with the same name, be certain to enter a unique name.

4. Move to each of the fields containing the values to be changed. Enter the desired value TAB or click to move to a new field.

5. Repeat step 4 to change all desired properties.

6. To save changes and exit the Oil Database window, either click **OK** at the top of the window or press the ENTER key after entering data in a field. When you save the changes, the name in the Oil Name field is added to the list of oils in the Oil Database. To exit without saving changes, click on **Cancel** at the top of the window.

4. Running the Oil Spill Model

The **COZOIL trajectory and fates model** tracks the surface movement of oil and determines the oil's distribution in various environmental compartments: water surface, atmosphere, water column, and shoreline. The model has specific focus on the oil-shoreline interaction and algorithms are included that combine oil information, shore type, wind speed/direction, and tidal information to provide analysis on how the oil interacts with the shoreline.

Quick Start

There are a number of simple steps to running a new spill simulation.

1. From the **File** menu, select the **New Scenario**, type the scenario name.

2. From the **Model** menu, select the spill site on the map.

3. From the **Model** menu, select the Run Model option.

4. Fill in all the appropriate values on the spill form tab windows (see **Specifying the Input Data** section for more details). Be sure to select a land-water grid, current grid, and wind file. See the **Specifying Environmental Data** chapter for information on how to create these files.

5. Click the **Run Model** button and let the model run the simulation. The **Simulation Complete** message box will let you know that the model is complete.

6. Use the tools on the top toolbar to view the results.

Specifying the Input Data

The input data required by the spill trajectory model includes a land-water grid, a wind time series, a current field, and a spill scenario that describes the conditions of the spill. The first three of these types of input and the steps involved in specifying the files are described in detail in Chapter 3. Specifying the spill conditions is described below.

The spill scenario is the information that uniquely describes the conditions of the spill simulation. Included in the spill scenario are such data as the spill location, amount and type of oil spilled, environmental conditions, and various model parameters.

Two steps are involved to specify the spill scenario. The first locates the spill site, and the second specifies the rest of the scenario information.

To set the spill location:

1. From the **Model** menu, choose **Select Spill Site**.

2. Position the mouse cursor on the map over the spill site. The coordinates of the cursor are displayed in degrees at the lower right of the map window, and change as the cursor is moved about the map. Click when the mouse is positioned on the site of the spill.

To specify the spill scenario:

From the **Model** menu, choose **Run Trajectory Model**.

Set the scenario name at the top right of the window, or select an existing scenario to fill the form with the values used for that scenario. Specify a new name if you don't want to replace the existing scenario with the new simulation.

The Trajectory Model window contains three tabs: one each to specify scenario information, environmental data, and model parameters. Both the scenario information and environmental data tabs must be filled out to completely specify the spill scenario. The model parameters tab controls certain model variables for the simulation, but does not specify spill specific information. The fields in each tab are described below.

Once the necessary input data has been specified and the spill scenario has been defined, the model can be run. While still in the Trajectory Model window, click on the **Run Model** button at the top of the Spill Information form.

A separate process with its own window will display a tabular output of the oil mass distribution in the environment as the simulation proceeds. When the simulation is complete, view the model output as described further in this chapter.

Scenario Information:

Description - an optional description of the scenario.

Latitude, Longitude - the spill location. These coordinates correspond to the spill site selected using the mouse, and can be adjusted here. To the right is the option to specify the latitude

and longitude in decimal degrees (DD.DD), degrees and decimal minutes (DD MM.MM), or degrees-minutes-seconds (DD MM SS).

Spill Start Time - the date and time the spill starts. Click in the field to bring up a calendar on which to specify the date and time. To use the calendar click on the desired year, month and day of month on the calendar display. To select the current day's date, click on the **Today** button located below the monthly calendar. Click on **OK** to save the selected date/time and return to the Trajectory Model window.

Oil Spill Amount - is followed by three fields to specify the amount spilled, the units of the amount spilled, and the type of oil spilled, respectively.

Spill Duration - the length of time (hours) that oil is being released at the spill site. An instantaneous spill (all oil released at once) has a spill duration of 0.

Model Duration - the length of the spill simulation (hours), i.e. how long the model will make a prediction for.

Number of Stochastic Runs – If this is specified as more than 1, the COZOIL will run in stochastic mode and, based on randomizing climatological wind information, will produce a probability table of where the oil will impact land.

Environmental Data

Air Temperature/Water Temperature - average air/water temperature over the length of the simulation. This is retrieved from the COZOIL database.

Grid File - specifies the land-water grid to be used in the simulation.

Wind File - the wind data file to be used in the simulation. The list includes the

names of all available wind files, and the beginning and ending times of each wind record. To run the simulation with climatological wind, toggle the **Use Climatological Wind** option. To run the simulation (stochastic only) with a markov matrix, toggle the **Markov Matrix** option. Click the **Wind File** button to access the Wind Data Editor to edit or create wind files.

Current File - specifies the currents to be used in the simulation. Next select the current components (tidal and/or background) to be used in the simulation. The default value will automatically be set by finding the tidal period for the region of the spill. The database is searched to find the shoreline reach nearest to the spill and the period is used from that reach.

> Remember that COZOIL tidal currents have vectors for maximum flood stage. The time of high tide entered here allows the model to phase these currents for the oil spill calculations. Time of high tide is the time when the water elevation is the maximum.

Tide range may manually be entered. The default value is retrieved from the COZOIL Database. The database is searched to find the shoreline reach nearest to the spill and the range is used from that reach.

Model Parameters:
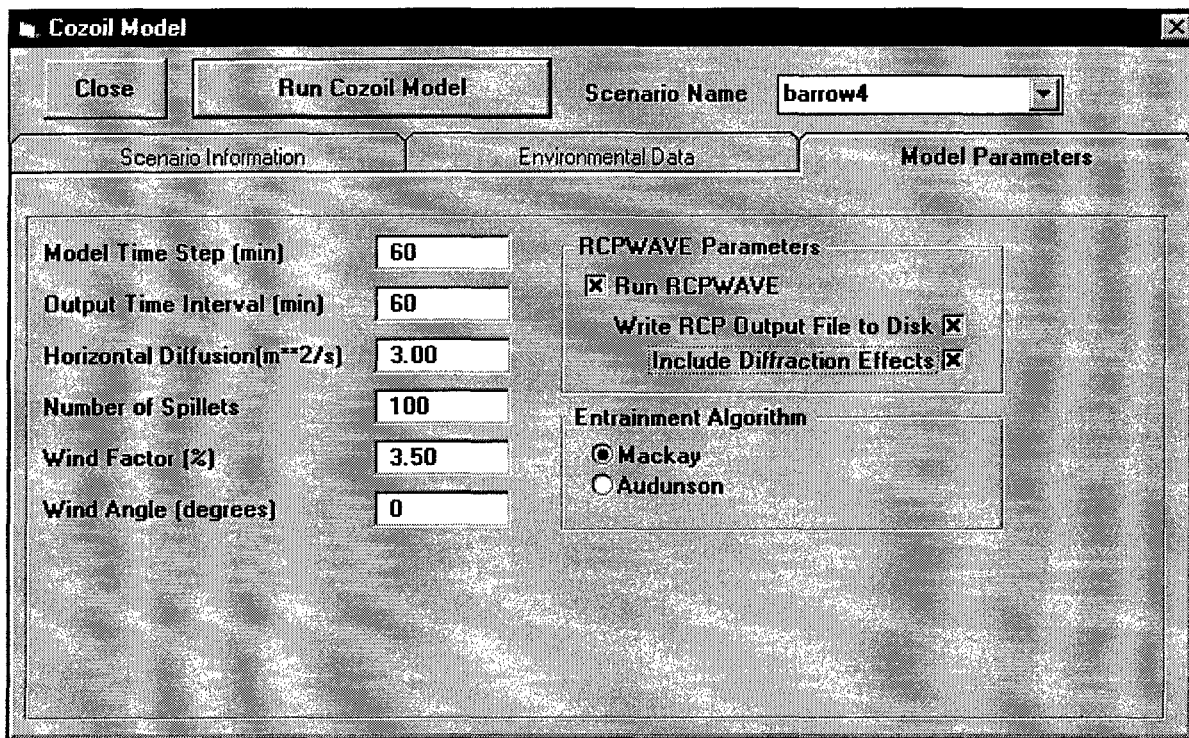
Model Time Step - the time step for model calculations (minutes).

Output Time Interval - the time interval at which model calculations are saved (minutes). It should be a multiple of the model time step.

Horizontal Diffusion - controls the random horizontal component of the oil's movement (m²/s).

Number of Particles - the number of individual spillets used to represent surface oil.

<u>Wind Factor</u> - the wind drift factor (%).

> *Note*: The animation sequence will be re-displayed to the currently selected output time when the map is redrawn. To turn off the animation, click on the **Rewind** button to set the simulation to the very beginning.

<u>Wind Angle</u> - the angle oil moves relative to the wind (degrees).

<u>Spreading Coefficient</u> - controls the rate of surface slick spreading (/sec).

<u>Mousse Coefficient</u> - controls the rate of emulsification.

<u>Minimum Thickness</u> - controls the minimum thickness to which oil can spread (mm).

<u>Run RCPWAVE</u> – Run the model with/without wave calculations. (see technical manual)

<u>Entrainment Algorithm</u> – Select which entrainment algorithm to use. (see technical manual)

Viewing Trajectory Model Results

Once a model simulation is complete, the spill trajectory can be viewed at any time as an animation sequence. The output from a model simulation is saved as part of a scenario. The name of the active scenario is displayed on the toolbar.

> If the scenario was run with the Number of Simulations greater than 1,
> the model was run in stochastic mode and animations are not available.

Select the scenario to be displayed. The name of the active scenario is shown at the center of the top toolbar. To select a different scenario for display, use **Open Scenario** under the **File** menu to open an existing scenario. The five buttons to the right of the scenario name on the toolbar control the display of the spill animation. Use the buttons on the toolbar to start, stop and rewind the animation.

Rewind the animation to the start of the simulation.

Display the animation in reverse.

Step through the animation, one time step at a time.

Stop the animation sequence.

Run the animation sequence.

3/9/96 08:00:00 AM The simulation date and time corresponding to the animated trajectory display are given at the right side of the toolbar. As the spill animation progresses, the date and time are updated accordingly. To display a particular time during the simulation, select from list of available simulation times.

Oil Spill Display Settings ☒

OK   Cancel

Model Display Options
☒ Display Surface Spillets
☒ Display Swept Area
☒ Display Oil on Shore Amounts
☐ Display Wind Vector
☒ Display Spill Site

Display Colors
Oil Surface Spillets
Oil Shore Hits
Surface Swept Area
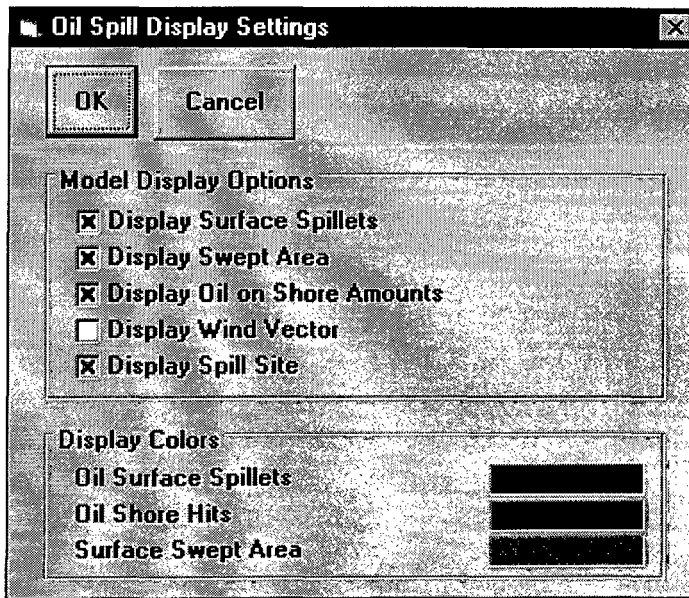
From the main menu, use the **Oil spill Display Settings** window to set the oil spill colors and display options for trajectory animations.

Displaying the Oil Mass Balance

Oil Spill Model Weathering Information

Oil Spill Weathering/Fates

● ━━━   Surface
■ ■ ■ ■   Ashore
▲ ━━ ━━   Water Column
▼ ━━ ■   Evaporated
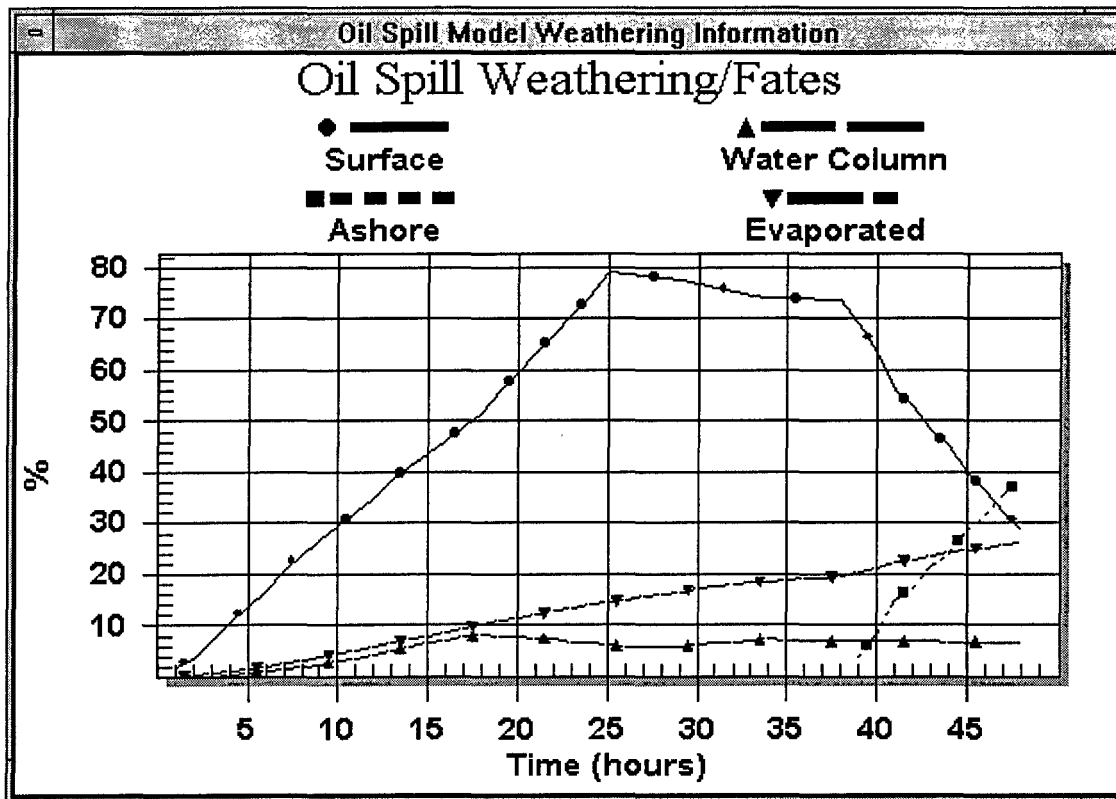
The oil's distribution in the environment over the period of the simulation can be displayed graphically. From the **Model** menu select **Fates Calculations**.

Fates Listing will create an ASCII file of the fates information.

Fates Graph will display a window with a graph showing the mass of oil on the water surface, in the atmosphere (evaporated), in the water column (dispersed), and on the shoreline. The x-axis of the graph is the time into the simulation; the y-axis is the oil mass %.

Double clicking, or right-clicking, on this graph brings up customization options for the graph presentation, printing, and data export options.

This data is stored in a dBase file in the **FATES** directory under the location and may be important to other applications such as Access or Excel for further analysis.

Oil-Shore Output provides a summary listing of the shoreline impacts.

Exporting Model Results to Other Applications

The trajectory model output file is written in a standard dBase file format for use by other applications. This data is stored in a dBase file in the **TRAJ** directory under the location with a filename of *scenario*.**DBF**. It may be used by other applications such as Access or Excel for further analysis.

A listing of this file is available under the **Trajectory Table** option of the Model menu. The file includes data for each spillet at every output interval. The data given in the file are:

- Time – time into the simulation (hours).
- DateTime – the calendar date (month/day/year) and hour (24-hour time).
- ParticleID – an identifying number for the spillet. This number is not necessarily a unique identifier because when spillets combine with other spillets, go totally ashore, or move outside the model grid, their ID number can be re-used and the particle ID array is compressed.
- Longitude – the spillet longitude location (decimal degrees). A negative value is used to denote west longitude.
- Latitude – the spillet latitude location (decimal degrees). A negative value is used to denote south latitude.
- Oil Mass – spillet mass (metric tons).
- Thickness – spillet thickness (meters).
- Radius – spillet radius (meters).
- Viscosity – spillet dynamic viscosity (centiPoise).
- Status – a code indicating the status of the spillet (0 = ashore, 1 = water surface, 2 = in ice (not used), 3 = outside model grid).

Displaying Stochastic Results

When a scenario is selected that was run in stochastic mode, then this toolbar will be available instead of the animation controls. Select the check box and select either **Impact Probability** or **Amount Ashore** to display the color coded probability grid on the map.

A text listing of the stochastic output is also available under the **Model** menu.

SHORELINE
PROBABILITY
OF OILING

| 1 -> 10 |
| 10 -> 20 |
| 20 -> 30 |
| 30 -> 40 |
| 40 -> 50 |
| 50 -> 60 |
| 60 -> 70 |
| 70 -> 80 |
| 80 -> 90 |
| 90 -> 100 |
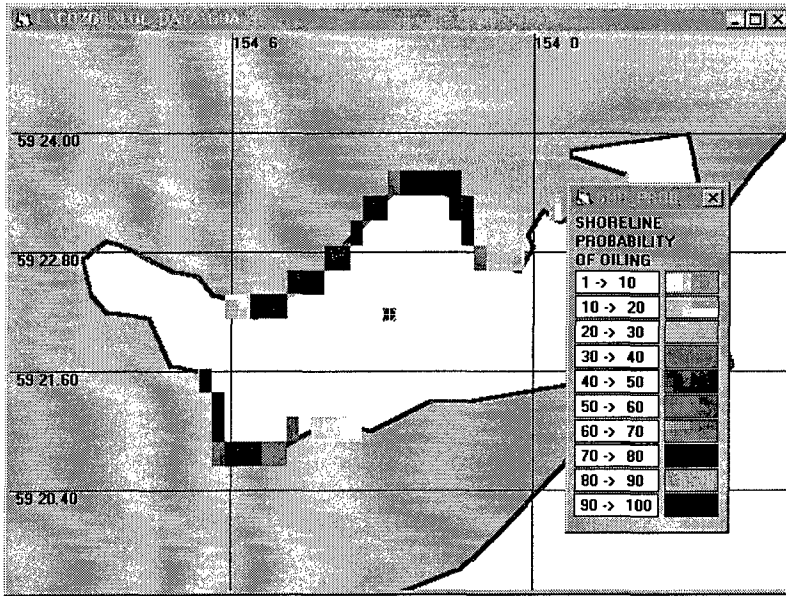
I	47
J	29
ITYPE	5
Probability	100
Viscosity	22434.86
Foreshore Surface Oil	2.50137
Foreshore Sediment Oil	2.79587
Backshore Oil	0
Oil in Groundwater	4.592793
Oil In Surf Zone	2.978725E-03

Probability grid cells may
be clicked on to obtain
more detailed information.

5. COZOIL Tools

Deleting COZOIL Files
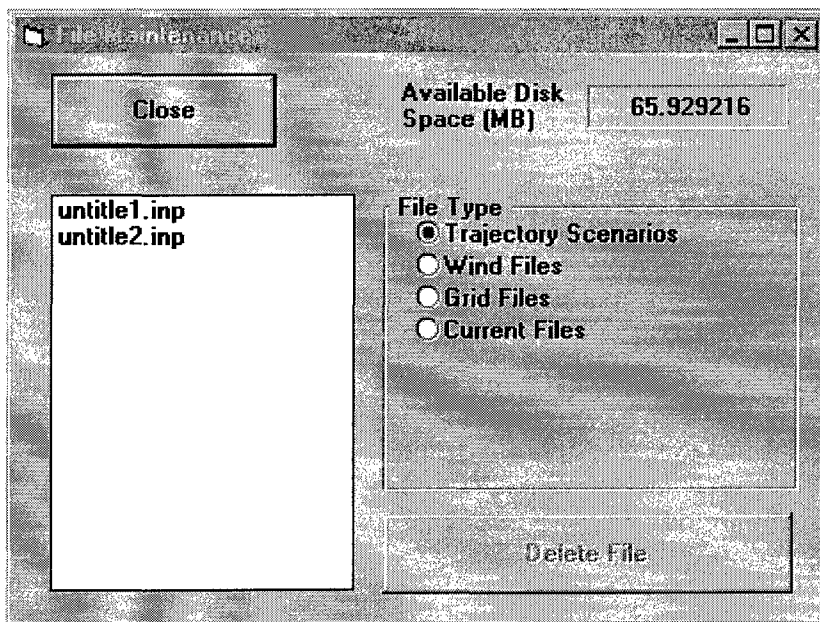
To delete unwanted files created by COZOIL, select **File Maintenance** from the **Tools** menu. This brings up the File Maintenance window. Select the type of file to be deleted and all existing files of that type will be listed. From the list select the file to be deleted and then click on the **Delete File** button. You will be asked to verify that you really want to delete the selected file.

Color Keys/Legends
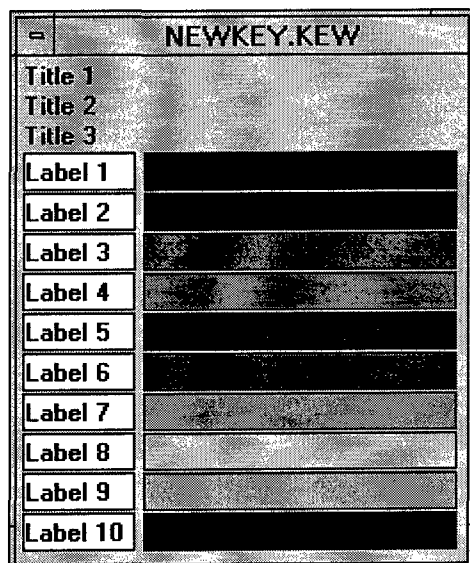
To edit a color key, double-click on one of the color key divisions and the Legend editor will activate.

The Legend Editor allows the user to edit the:

- titles
- each division's name and color.

Click **New Division** to add a new division. Double-click on an existing division to delete the division.

You may open existing and save color combinations with the **Open Color File** and **Save Color File** buttons.
The **Auto** button may also be used to create a new color combination.
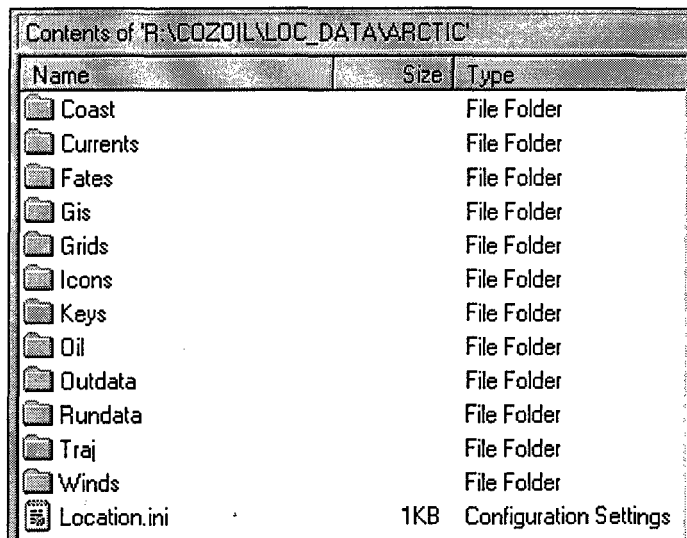
If the legend contains number ranges, (i.e., 0;2 2;4), then the **Auto Division** button allows you to set the first number and the very last number and create an even set of ranges between these two numbers.

Legend Editor

| OK | Cancel | Open Color File |
| | | Save Color File |

PROBABILITY CONTOURS

FOR TIME OF TRAVEL

IN DAYS

| Auto Division | New Division | Auto |

| 0;.2 |
| .2;.4 |
| .4;.6 |
| .6;.8 |
| .8;1 |
| 1;1.2 |
| 1.2;1.4 |
| 1.4;1.6 |
| 1.6;1.8 |
| 1.8;2 |
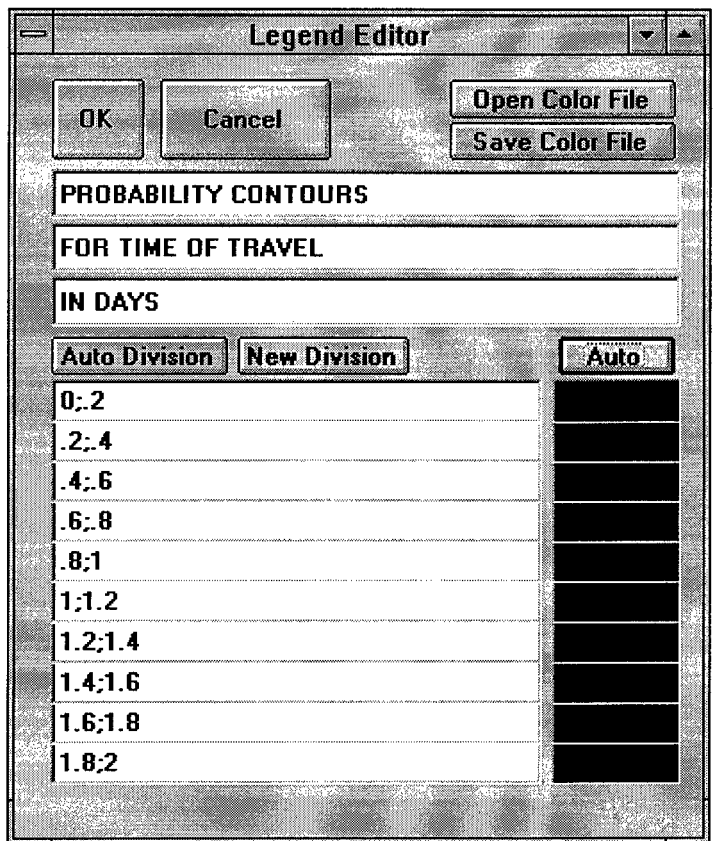
6. The COZOIL Database

The COZOIL interface and model use the COZOIL database extensively to obtain environmental conditions for the region of the spill in the appropriate time of year. This contract did not edit or change the original COZOIL database in any way.

The directory structure for each location (Arctic, Bering, Goa) in COZOIL is as follows:

Contents of 'R:\COZOIL\LOC_DATA\ARCTIC'		
Name	Size	Type
Coast		File Folder
Currents		File Folder
Fates		File Folder
Gis		File Folder
Grids		File Folder
Icons		File Folder
Keys		File Folder
Oil		File Folder
Outdata		File Folder
Rundata		File Folder
Traj		File Folder
Winds		File Folder
Location.ini	1KB	Configuration Settings

The COZOIL database files reside in the Coast directory and are:

    Arc_def.del
    Arc_fech.txt
    Arc_lagn.del
    Arc_shor.del
    Arc_temp.del
    Arc_tide.del
    Arc_type.del
    Arc_wind.del

(Replace Arc_ with Goa_ for Gulf of Alaska and Ber_ for the Bering Sea.)
Exact descriptions of these files may be obtained by reviewing the original COZOIL documentation. The way this information is used is summarized below.

Coastline
The Arc_shor.del file contains the segments and sub-segments for the location. These data are in ASCII format and are not polygonized. ASA used ArcInfo to process these data so that land polygons may be represented on the map. The Arc_shor file is loaded at initialization and the segments may be plotted on the map and color coded by shoreline type. Note that the resolution of the data is less than satisfactory in certain areas.

Shoreline Characterization
Similar to the original COZOIL, a grid system is used to characterize land/water, shoreline type, and depth. The original COZOIL created a 25x25 grid "on-the fly"; COZOIL 97 uses a predetermined grid that automatically interpolates shore types and depths from the Arc_shor

file. Shoreline cells are assigned the type of the nearest coastal segment in the COZOIL database. Characteristics are used for each shoreline type based on the COZOIL values.

The grid may be up to 250x250 cells and the interface allows the user to create, review, and edit grids for use by the model. Islands are easily incorporated in the grid. The format of this grid is the ArcView grid export format (HDR/FLT format). This allows grids to also be created and edited within ArcView.

Depths
Using the distance offshore values for 1m, 10m, and 20m, the grid creation process determines the depths of the water cells in the grid. Cells beyond the 20 m bathymetry contour are given the default depth value specified by the user.

Tidal Range
Tidal range is automatically retrieved from the Arc_tide.del file. The database is searched to find the shoreline reach nearest to the spill site and the range is used from that reach. The user may override this value in the model input form.

Currents
The Arc_tide.del file contains tidal current velocity, amplitude and period for each segment. Similar to the original COZOIL, a current grid was created and values for coastal cells (water cells beside land) were obtained from the database. However, the COZOIL database lacks information such as phase (timing of high tide) and direction. Therefore current fields were generated based on the current speed stored for each shore segment. A vector was generated and assumed to be parallel to the shoreline (following the original COZOIL). **These data have no phase information and have artificial direction information.** Tidal period was also obtained from the COZOIL database and the COZOIL interface suggests which tidal period to use based on the location of the spill site and the tidal period in that region.
The coastal cell current values were interpolated over the entire grid field. **However, there is no offshore current information and these data are not reliable.**

Winds
The use has two options for wind data:
- Create a wind time series manually,
- Use climatological mean wind speed and direction from the database to generate a wind time series statistically.

The database is searched to find the shoreline reach nearest to the spill and the wind values (mean wind speed and direction, and standard deviation of the wind direction from Arc_wind.del) are used from that reach for the month of the spill.

Air Temperature and Water Temperature
The database is searched to find the shoreline reach nearest to the spill and the temperature values (from Arc_temp.del) are used from that reach for the month of the spill. The user may override these values.

Wind Fetch
The database is searched to find the shoreline reach nearest to the spill and the wind fetch values (from Arc_temp.del) are used from that reach for the month of the spill.

Input File
The COZOIL interface creates an input file called "Scenario".INP in the RUNDATA directory under the location directory. This file contains the input parameters for the spill.

An example listing is:

```
[COZOIL]
Scenario=test1
Description=description
Spill Lon=-154.068336011064
Spill Lat=59.1785182315071
Start Year=97
Start Month=4
Start Day=30
Start Hour=10
Start Minute=0
Release Duration=6
Amount Spilled=10000
Simulation Length=24
Number Of Wind Files=1
Climatological Wind=0
Current File=GOA.DIR
Current Components=1
High Tide=6
High Tide Minute=0
Tide Range=4.42
Grid File=SAMPLE.FLT
Oil Name=MEDIUM CRUDE OIL
Oil Units=5
Air Temp=2
Water Temp=4
Ideltat=60
out_intvl=60
ddxy=3
nsp_rls=100
wspil_min=10
wndfactor=3.5
wndangle=0
C_spread=150
thkmin=.0001
c2_mousse=.000002
Nsims=1
Make DBF=-1
Nearest Segment=50.071
Fetch1=10.41
Fetch2=72.66
Fetch3=128.38
Fetch4=0
Fetch5=0
Fetch6=0
Fetch7=0
Fetch8=.89
Wind Speed=1.29
Wind Direction=145
Wind Standard Deviation=85
Windfile1=ZERO_WND.WNE
Wnd1lon=-158.522170509435
Wnd1lat=57.6442738233146
```

APPENDIX

.ASW Import Wind File Format

line 1:	station latitude	(decimal degrees)	Real *4
line 2:	N or S	(is latitude North or South)	Character *1
line 3:	station longitude	(decimal degrees)	Real *4
line 4:	E or W	(is longitude East or West)	Character *1
line 5:	description of data	(optional, can be blank)	Character *80
line 6:	year, month, day, hour wind record start	(leave a space between each)	Integer *2
line 7:	year, month, day, hour wind record ends	(leave a space between each)	Integer *2
line 8:	station height, units	(height at which measurements made, in meters and units of wind file, supports KNOTS & M/S)	Integer *2, character
line 9:	year, month, day, hour, direction, speed	(Direction, 0°-360°, Speed in m/sec)	Integer *2
	•		
	•		
	•		
	•		
	end		

Example

53.4144134521484
N
 5.50178252160549E-03
W
DEMONST.WNE
 96 3 9 7
 96 3 11 15
10 KNOTS
 96 3 9 7 22 15
 96 3 9 8 22 15
 96 3 9 9 68 15
 96 3 9 10 68 15
 96 3 9 11 112 15
 96 3 9 12 112 15

SHRCHAR3.DAT Shoreline Characteristics File Format
(in COZOIL\location\COAST directory)

ASCII file

Line	Variable	Comments	Variable type
1	Shoretype name	e.g., marsh, rocky shore	Character *20
2	Maximum oil thickness (mm) on beach for oil with kinematic viscosity = 0-30, 30-2000, >2000 cSt	3 values, leave a space between each	Real*4
3	Foreshore length(m), foreshore angle, backshore length (m), backshore angle	4 values, leave a space between each	Real *4
4	Fraction of oil partitioned to groundwater, specific yield of sediment, porosity of sediment, 50th percentile grainsize (m), fractional organic carbon content of sediment	5 values, leave a space between each	Real *4

Repeat these four lines for each shoreline type.

Example

EXPOSED ROCKY SHORE
0.5 2.0 2.0
35 14.0 15 16.9
0. .9 .00001 .000001 .001
GRAVEL/COBBLE/BOULDER
2.0 9.0 15.0
40 6.3 15 5.8
.05 .14 .16 .16   .001

.WAV Offshore Wave Input File Format
(in COZOIL\location\CURRENTS directory)

Unformatted sequential access file

Line	Variable	Comments	Variable type
1	Wave_tide	True if file contains tide height, False otherwise	Logical*1
2	Wave height (m), wave period (sec), wave direction (from North), wave duration (hrs), [tide height (m)]	4 [or 5] values	Real*4

Repeat line 2 for duration of wave record to span length of simulation.

.MKV Markov Matrix File Format
(in COZOIL\location\WINDS directory)

ASCII file

Line	Variable	Comments	Variable type
1	First day and last day of year for which data are valid, hourly interval of original data from which matrix derived	3 values, leave a space between each	Integer
2	Maximum wind speed (m/s) in each of 5 speed bins	5 values, leave a space between each	Real*4
3	Probability that next wind vector will be from state J, given that present vector is from state I (I = row number = present wind state, J = column number = subsequent state)	41 values, leave a space between each	Real *4

Repeat line 3 for each direction/speed bin (for a total of 41 times). See the original COZOIL User's Manual (Reed et al., 1988) for a complete description of how a Markov matrix is generated.

Example

```
1  366   1
   2.00    4.00    6.00    8.00   15.00
.1538 .1538 .0000 .0000 .0000 .0769 .0769 .0000 .0000     | The first row of the matrix. The 41
.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0769 .0000     | values are the probabilities of the
.0000 .0000 .0000 .0769 .0000 .0000 .0000 .0000 .0000     | subsequent wind speed/direction
.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0769     | for wind currently from the North
.0769 .0000 .0000 .0000 .2308                             | in the first (< 2 m/s) speed bin.
.0138 .3825 .0968 .0092 .0000 .0092 .1659 .0507 .0000     | The second row of the matrix.
.0000 .0000 .0276 .0184 .0046 .0000 .0000 .0138 .0092
.0000 .0000 .0000 .0046 .0000 .0000 .0000 .0000 .0046
.0046 .0000 .0000 .0000 .0046 .0000 .0000 .0000 .0092
.1060 .0230 .0000 .0000 .0415
.0000 .1203 .4023 .0902 .0113 .0038 .0376 .0902 .0226     | The third row of the matrix.
.0000 .0000 .0000 .0038 .0000 .0000 .0000 .0000 .0000
.0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000 .0000
.0000 .0000 .0000 .0000 .0075 .0000 .0000 .0000 .0000
.0526 .1165 .0414 .0000 .0000
```

.DIR Currents Input File Format
(in COZOIL\location\CURRENTS directory)

Unformatted direct access file

Line	Variable	Comments	Variable type
1	File record length, Number of records in file (including header), Number of cells in E-W direction in currents grid, Number of cells in N-S direction in currents grid, Sequence number, Number of u,v velocity pairs in record (NVREC)	6 values. Minimum file record length is 12.	Integer*2 (all)
2	Currents grid cell size in E-W direction, Currents grid cell size in N-S direction, Currents grid cell origin in E-W direction	In degrees longitude In degrees latitude In degrees longitude	Real*4 (all)
3	Currents grid cell origin in N-S direction, Number of tidal constituents, Tidal constituent name 1, 2, 3*	In degrees latitude In degrees latitude 3 possible values	Real*4 Integer*2 Character*2 (all)
4	Tidal constituent name 4,5,6,7,8,9*	6 possible values	Character*2 (all)
1 for each non-tidal component	Background current name		Character*10
1 for each grid cell with current data	Sequence number, Grid cell number in E-W direction (I), Grid cell number in N-S direction (J), Grid cell flag (1=water), Currents in grid cell as U,V pairs (in cm/sec) with tidal components first in list		Integer*2 (all)

*Tidal constituent name must be one of the following 2-character names:

M2, S2, K1, O1, N2, P1, K2, Q1, MF.

The following lines of code are used to read the .DIR file:

```
READ(NCHYDR,REC=1) NRECL,NDMAX,IMAXC,JMAXC,NSEQ,NVREC

READ(NCHYDR,REC=2) DLONC,DLATC,OLONC
READ(NCHYDR,REC=3) OLATC,NTIDE,(CTIDE(N),N=1,3)
READ(NCHYDR,REC=4) (CTIDE(N),N=4,NINE)


NONTID = NVREC - NTIDE*2

NDREC = 4


IF (NONTID.GE.1) THEN

   DO N=1,NONTID

      NDREC = NDREC + 1

      READ(NCHYDR,REC=NDREC) CBAK(N)
   ENDDO
ENDIF

NDREC = 4 + NONTID          ! 4 + NONTID lines of header

DOWHILE (NDREC.LT.NDMAX)

   NDREC = NDREC + 1

   READ(NCHYDR,REC=NDREC) ISEQ0,I,J,IFLG0, (IU(N),IV(N),N=1,NVREC)

ENDDO
```