CHAPTER TWENTY CONCENTRATION-TIME SERIES

20.1 INTRODUCTION

20.1.1. General

Using this application you may create a data base with various chemical constituents related to the time of sampling. This is especially important in cases when the sampling is repeated over a period of time, which is often the case in monitoring the propagation of contamination, or deterioration of ground water quality with time. Likewise in saline water environments such as in coastal aquifers, the sea water intrusion may take place after a prolonged pumping.

The data base is in a form of individual tables, one for a well, plus some general information that may also be a part of the data base. The display is user-designable. You decide whether you wish to display one or more constituents on the same diagram, and whether the scale will be linear of logarithmic. You may display one or more constituents as linear graphs, and another as logarithmic. That is, each constituent may be assigned its own attributes for presentation.

As in other parts of GWW, you may create graphs and save them for later printing.

This application is a part of the Chemistry application. Actually it branches off from Chemistry as shown in Figure 20-1. To activate it, you should select Applications, then Chemistry, and then Concentration-Time.

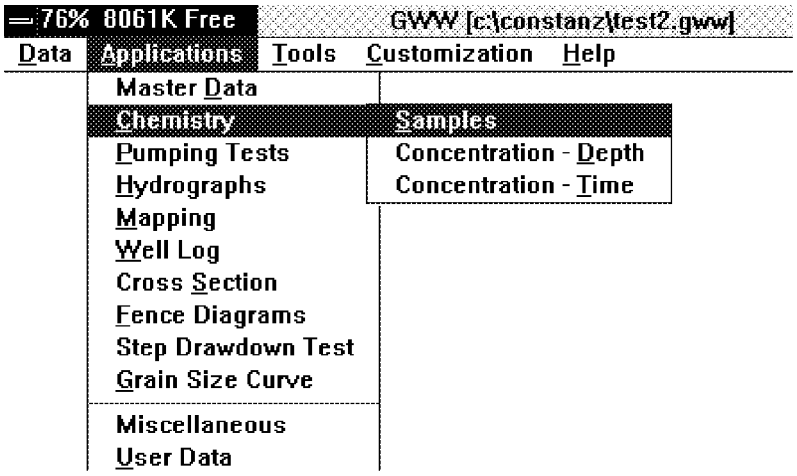

Figure 20-1

20.1.2. Application's Content As shown in Figure 20-2, the Concentration-Time application is comprised of the following major options:

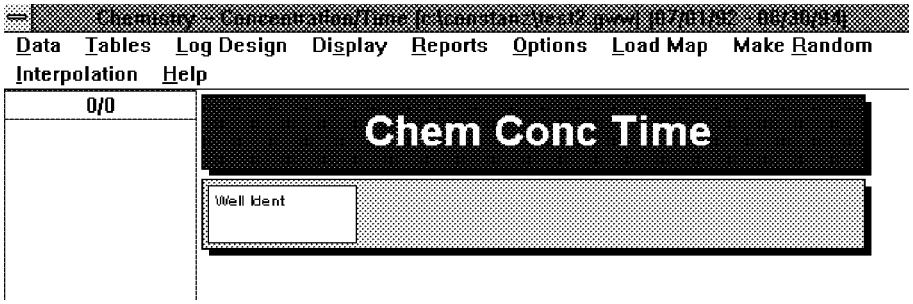

Figure 20-2

- Data
- Tables
- Log Design
- Display
- Reports
- Options

- Load Map
- Make Random
- Interpolation
- Help

Prior to using this application you must modify the file structure for "concentration - time series" to make it compatible with the parameters that you wish to store, display, and retrieve as reports.

From the Main menu on GWW, you should select **Tools**, followed by **Data Structure Design**. This activates the file structure editor. Select **Files**, followed by **Old**. From the list of internal data structures select the one labeled as *Chem_Conc_Time_Tab*. In the default template, GWW.000, which comes on the distribution diskette, the only entry that is prepared is Date. Using the editor create your own list of chemical constituents that you wish to store in the data base. One of such lists is shown below.

Date	10	Date	mm/dd/yy
Cl	10	Num(Und)	Fixed 2
Na	10	Num(Und)	Fixed 2
TDS	10	Num(Und)	Fixed 1
Conductivity	10	Num(Und)	Float 1

As it is prepared, one may store, display and report data on chloride, sodium, total dissolved solids, and on conductivity of water.

The **Data** menu is shown in Figure 20-3. In this menu you select your current working set (reduce a large set to a smaller, thematic set). You may

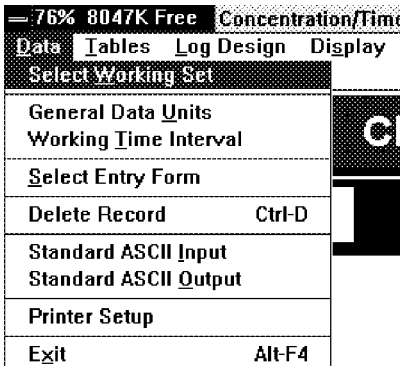

Figure 20-3

check which units are currently used for general data (sampled well coordinates and elevations). You may select one of entry forms that you may have eventually created. You may also delete a record. You may read general data on sampled wells (coordinates, elevations, descriptions, names, etc.) from an ASCII file, or you may save such data to an ASCII file. This menu deals with wells and not with tables. A table is the place in which you type chemical constituents as a function of time. This latter is done using the menu Tables. On this submenu you will select the Time Interval in which you wish to display the data. That is to say, you may create a data base spanning a very large time period. However, when you wish to display or print the data, you may select a smaller time interval to emphasize the time-dependent values.

The Tables menu is shown in Figure 20-4. Using this menu you either type your data, edit table, add or re-

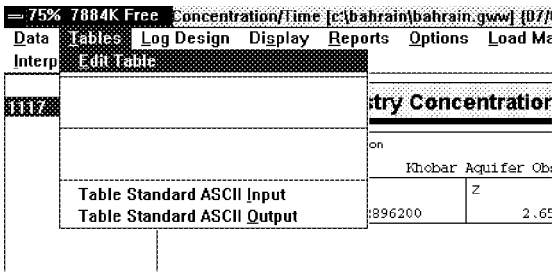

Figure 20-4

move some rows in the table, save data, and exit (close) table. Just the same as in other applications, you may save your tables (time-concentration data) and/or import them as ASCII files.

NOTE. One table is saved in one ASCII file.

The **Log Design** menu is shown in Figure 20-5. The commands on this menu are used to customize the display and printout. The customization means, first, which constituents from a table you wish to display. For example,

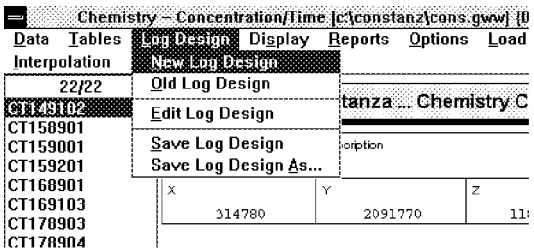

Figure 20-5

although you may have entered the values for Na, Cl, TDS, and conductivity, you may decide to display and/or report only total dissolved solids. Second, you may assign some attributes to the constituents to be displayed: line and fill color, linear or logarithmic display, minimum and maximum concentrations to display, etc. You may also control widths of individual columns used to display constituents.

NOTE. The control of fonts used to label a graph is accomplished from Customization, which is one of commands on the Main menu of GWW.

On this current menu you design a "display" log, you edit it, save it, or select one of available designs.

The command **Display** does not have any other subcommands. It does what it says. It displays a graph with data from table connected to a currently highlighted sample, using the design for the graph as currently selected.

The **Reports** menu is shown in Figure 20-6. Using the commands on this menu, you may print a graph, or save it for future printing, or mixing with other graphs.

The **Options** menu allows you to switch between parts per million (PPM) and equivalents per million (EPM). Of course, this will apply only to charged ionic constituents

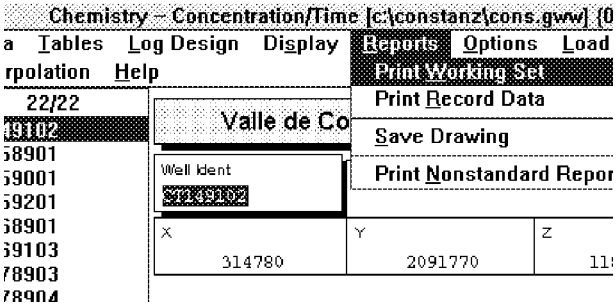

Figure 20-6

for which conversion factors are available in the auxiliary file PPMTOEPM.TBL.

The **Map** menu is explained in Chapter 5, Section 5.3.2. It is used to load a map and select sampled points directly from the map.

The **Make Random** menu is also explained in details in Chapter 5, Section 5.6. It will be used for creating location or site maps showing sampling points at which time-variable chemical data are available.

20.2. DATA MENU

The routines on this menu are equivalent to similar routines in other applications. See, for example, Hydrographs application, especially for selecting the Working Time Interval.

NOTE. Remember that the currently selected Working Time Interval is displayed in the title bar next to the name of the data base file.

20.3. TABLES MENU

Using the commands on this menu you are creating your data base as it refers to concentration of selected constituents with time. You may import an already created table as an ASCII file, one for a sample, or you may use the GWW editor.

20.3.1. Edit Table

When you select the **Edit Table** command for a new sample, the editor displays an empty table listing all constituents that you have listed in the Data Structure on the Tools menu. In the case when only three constituents are selected (say, EC, NO3, and NO2), the table may look as shown in Figure 20-7. If you are going to edit an existing table filled with data, the display may look as shown in Figure 20-8.

MW-1 Chemical Constituents

Year	Month	Day	hh:mm	EC	NO3	NO2

Figure 20-7

CT149102 Chemical Constituents

Year	Month	Day	hh:mm	EC	NO3	NO2
1993	3	1	12:0	764	0	0
1993	4	1	12:0	890	189.2	0.02
1994	2	1	12:0	905	50.61	0.05

Figure 20-8

To edit data, you use standard GWW commands: TAB to move from one field to next, Shift+TAB to move backwards, CTRL+I to insert a line, CTRL+D to delete a line. The program checks the sequence of time entries. You are expected to use the logical sequence, from early time to later.

20.3.2. Save Data

When you finish typing the data you will save them using one of two ways. The first is to press the Ctrl key and simultaneously press the S key. The other way is to use the mouse and click on **Tables** on the menu bar and click again on **Save Data**.

20.3.3. Exit without saving

You may have decided only to view the data without saving them. When you are done with viewing the data, you may exit in one of the two ways. The first is to press the Ctrl key and simultaneously press the X key. The other way is to use the mouse and click on **Tables** on the menu bar and click again on **Exit (Don't save)**.

20.3.4. Standard ASCII Input and Output

The data tables can be created outside the GWW package using a text processor. The format is similar to the format in other applications. One such table is reproduced below.

<yyyy/mm/dd> <Cl> <Na> <Conductivity>

1983/04/25	500.0	200.0	2200.0	2650.0
1983/06/22	750.0	340.0	3300.0	4010.0
1983/08/04	468.0	188.0	2100.0	2550.0

The first line is the header line which tells GWW what are the numbers that follow. As in any other part of GWW, you must be consistent in declaring the field names (time, Cl, etc.). These must be typed exactly the same as they are typed in Data Structure (in Chem_Conc_Time_Tab). The first entry is the date and time. You supply the format of data input (yyyy/mm/dd), which you must follow in the data below the header line. You may reverse the order of "date" input to one of date formats that are acceptable in GWW.

The date/time format can be any of the following: yy/mm/dd, yyyy/mm/dd, -mm-yy, .mm.yy, etc. It is important that the data that follow the header line must be typed according to the format declared in the header.

Using the command Standard ASCII Input you can import data tables created with a text processor or a spreadsheet program. (If you use spreadsheets, you must print such tables to a file. Any spreadsheet program, when instructed, creates normally ASCII files, which then can be directly imported into GWW.)

Using the command Standard ASCII Output you are saving the data tables in ASCII format, such as the one shown above.

20.4. LOG DESIGN MENU

On this menu you have five options:

- New Log Design
- Old Log Design
- Edit Log Design
- Save Log Design
- Save Log Design As

After you have created data table you will want to display graphs showing how concentration of one or more constituents changes with time. Before you can display a graph, you need to create, modify or edit the design of such presentation. The "Log Design" is used in other parts of GWW implying a vertical presentation of data. Here, it implies a "diagram" design of chemical data presentation with time.

20.4.1. New Log Design

When you select New Log Design GWW opens a dialogue box as shown in Figure 20-9. The right side of the

dialogue lists all available constituents (taken from Data Structure or from the internal file Chem_Conc_Time_Tab). You may select one or more constituents to display, and by clicking on the button Attributes control how each constituent will be presented.

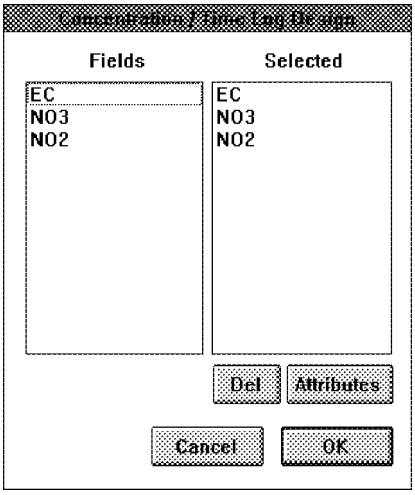

Figure 20-9

You are selecting or unselecting a constituent by highlighting it. If you highlight a constituent on the left side, that is within "Fields" part of the box, such constituent will be moved to the "Selected" side. If you highlight a constituent on the "Selected" side and press the button **Del**, this constituent will be deselected and will disappear from the list of selected constituents.

20.4.2. Attributes

When you select a constituent or a chemical diagram parameter, you may control the way in which this particular constituent or parameter will be displayed. You will use the button **Attributes**. The dialogue box as shown in Figure 20-10 will be opened.

The entry "Column Heading" will offer the name of the constituent as found in the internal file Chem_Conc_Time_Tab. However, you may override this

offer and type a different name (e.g. in another language).

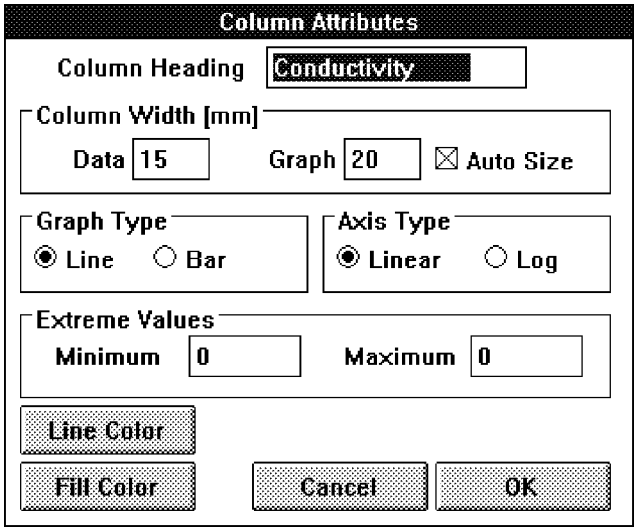

Figure 20-10

The options for column and graph width allow you to increase or reduce the size of vertical columns in which data (concentrations of a constituent) and graph (its graphical presentation) are displayed. While you may select the width for data, you are advised to keep the box **Auto Size** checked. GWW will then automatically select the size for the column in which the graph is displayed.

The **Axis Type** option allows you to display data as linear or logarithmic series. The **Extreme Values** (minimum and maximum) option lets you select the range of concentration you wish to display.

For each constituent you may select color for lines and for fills.

20.4.3. Old Log Design

Since you may create one or more designs for displaying various constituents and save them by assigning names, you may also retrieve and use one of pre-created designs. When you select the option **Old Log Design**, the

list of all available designs will be listed, as shown in Figure 20-11.

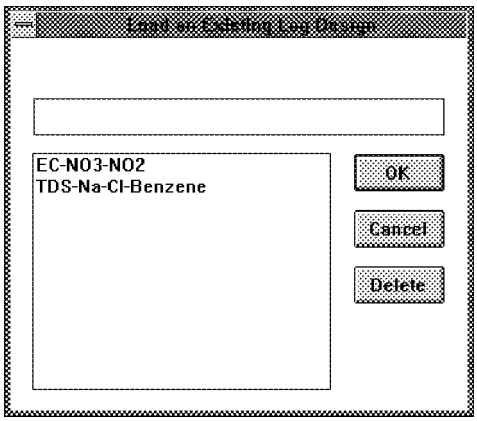

Figure 20-11

20.4.4. Save Log Design and Save Log Design As

When you finish editing an existing log design, you may save it under the name it was opened. GWW will not prompt you for a name. It will assume you want to use the old name.

You may save a design under a different name. For this you will use the option **Save Log Design As**.

20.4.5. Edit Log Design

The same dialogue box as the shown in Figure 20-9 will be displayed and you may proceed with its editing in the same way in which you have created a new design.

20.5. DISPLAY

Figure 20-12 displays a graph with conductivity as the only parameter selected. Figure 20-13 displays a graph with three different constituents and / or parameters.

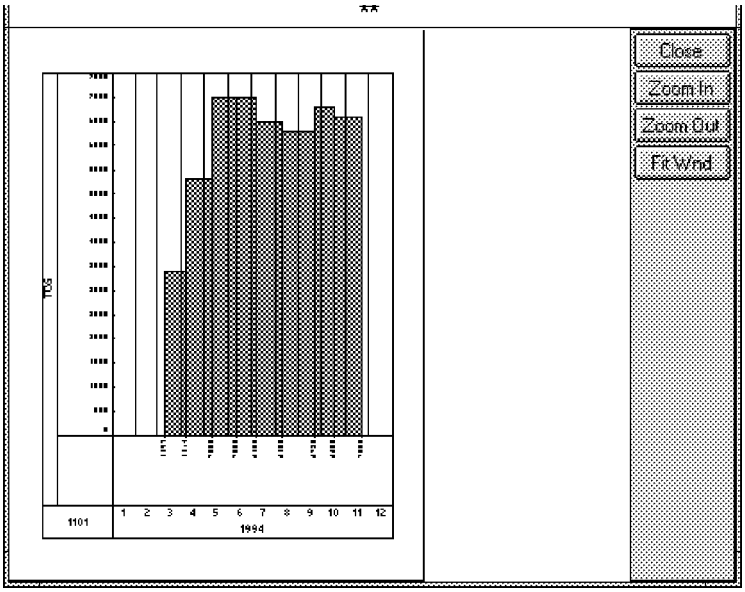

Figure 20-12

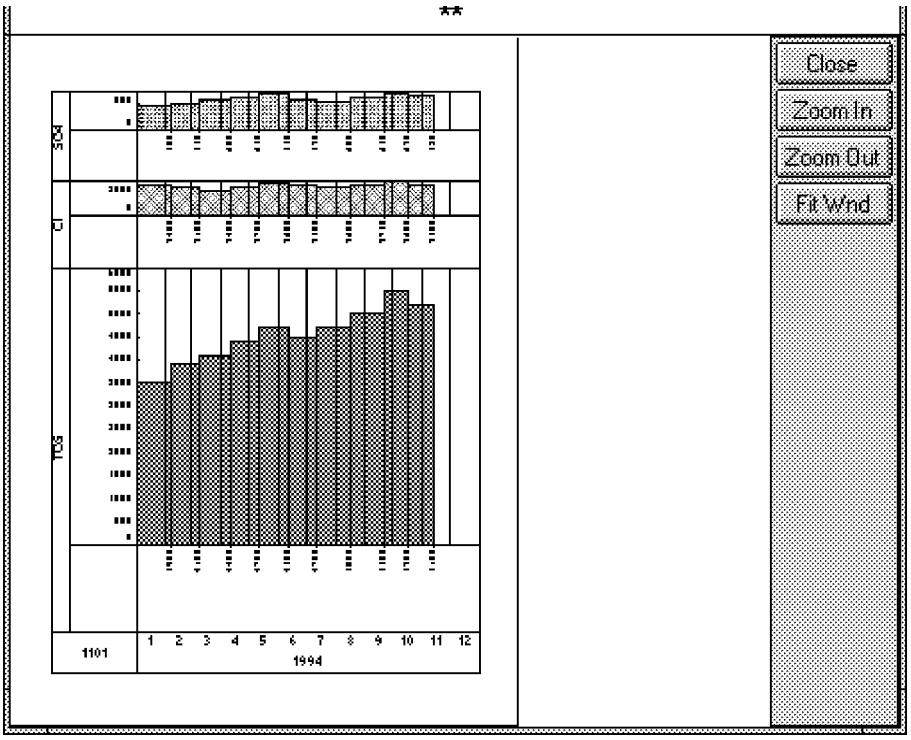

Figure 20-13

NOTE. When you select the option Interpolation/Set Connection Span and type a relatively small number of days, the samples that are taken beyond the span selected (that is, at greater intervals than specified) will be shown as vertical bars.

20.6. REPORTS

You may print a time-concentration graph using the option **Report** from the application's menu bar. As shown in Figure 20-14 you will have to select between two reporting options:

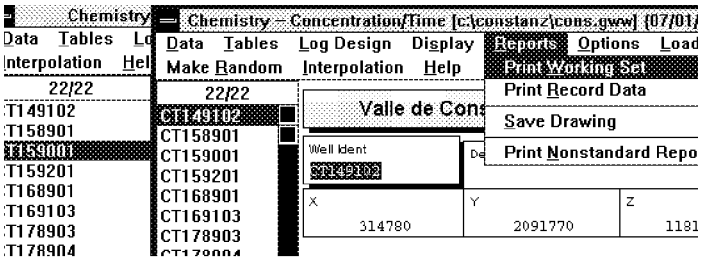

Figure 20-14

- Print Working Set
- Print Record Data

The option **Print Drawing** will print the graph of the sample currently selected. The option **Print Working Set** will print information, in a tabular form, for all wells/samples that comprise the current working set. The information which will be printed will depend on what you have declared in the report form. When you select to print using one of options in the upper two lines of the menu, the program will prompt you to select a reporting form.

You may also save a time-concentration graph for placing it on a nonstandard reporting form, eventually mixed with other graphics. For this, you use **Save Drawing** option, followed by **Print Nonstandard Report** from this or another application.

20.7. OPTIONS

Using this command, you may switch between parts per million (PPM) and equivalents per million (EPM). This is important in two instances. The first is the way in which constituents will be displayed. If you select EPM, the values displayed will be converted to equivalents per million, and vice versa. This option is also important to correctly import data tables as ASCII files. Depending on whether the data are prepared as ppm or epm, you need, prior to importing ASCII files, select the compatible mode of input. So, if your data have been prepared as ppm, you may use the default which is ppm. However, if the data have been prepared as epm, you should follow the sequence:

1. Select Options and select Show EPM values.

2. Select Table and select Standard ASCII Input.

20.8. LOAD MAP

The **Load Map** option is a general option for selecting wells to make a **Working Set** of wells.

20.8.1. Select Working Set from Map

The sequence is normally:

1. Click on **Data** to open the menu.
2. Click on **Select Working Set** and Unselect all wells. This is important because any selection adds new wells to the existing working set.
3. Click on **Load Map** to open the menu. Wait for the dialogue box to list available maps.
4. Select one of maps listed.
5. Select wells to make a working set using either Rectangle, Points, or Area. In the case of Points, use other buttons on the right side to complete the selection (End Points). In the case of an Area, after you circle an area (remember, in clockwise direction you are selecting within the area; in the counterclockwise direction outside the area!) you should close the area (End Point) followed by End Digitizing button. The wells (samples) will be listed in the left-side identification window.

20.9. To Setup a Printer

Selection of printers and attributes related to printing is normally a Windows operation. You may set up your printer parameters from Windows, prior to running the GWW program. To do this:

1. From **Main Group** select **Control Panel**.
2. Select **Printers**.
3. Select one of installed printers as a default printer, or add some more printers to match your hardware.
4. Select **Setup** and modify whatever you want to modify.
5. Click on **Set as default**.
6. Close **Printers** and Control Panel.

You may do about the same from inside the GWW. From within the GWW you use **Printer Setup** to change the orientation of printout, portrait (vertical) or landscape (horizontal), the printing medium, the quality of print, number of copies, colors for a color printer, and many more. You cannot change the default printer!

The dialogue box for selecting printer parameters is shown in Figure 20-15 for Hewlett Packard Laserjet 4/4M printer.

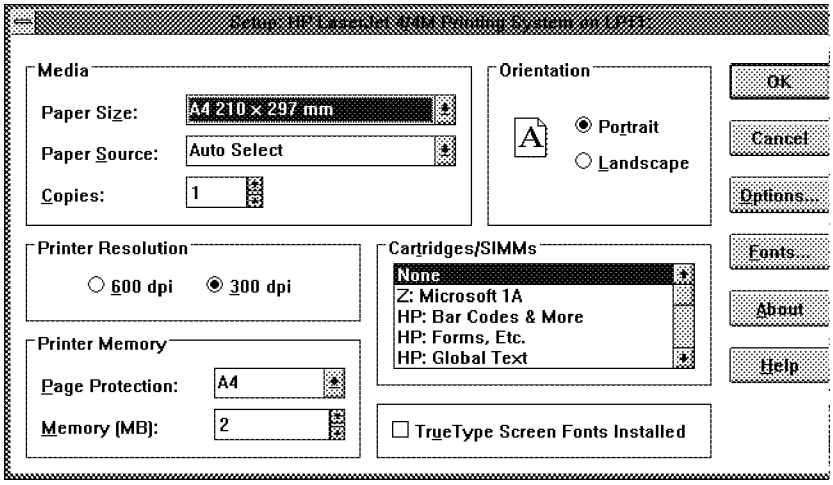

Figure 20-15

20.10. Interpolation

Same as in the Hydrographs application, you may create a random data file to be used to create a grid file and a contour map, for any chemical constituent at any time within the current Working Time Interval. You will select Interpolation on the menu bar. The display is as shown

in Figure 20-16. Select **Interpolate**. The dialogue box as shown in Figure 20-17 opens prompting you for the year, month, and day for which you wish GWW to interpolate

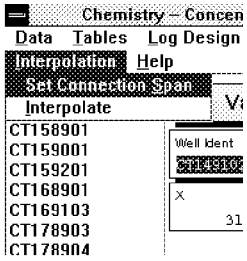

Figure 20-16

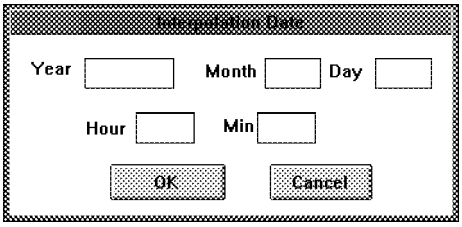

Figure 20-17

the data. Next you will be prompted to select one of available constituents, as shown in Figure 20-18, of which you wish to create a random file. (Remember that you need to have X and Y coordinates for all wells/samples in the data base. The random file consists of the following columns: X, Y, concentration at a certain date, well identification.)

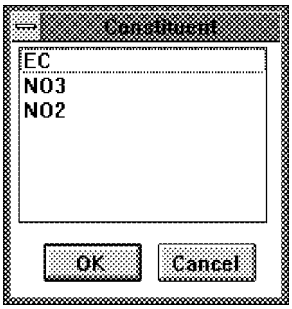

Figure 20-18

You may also select a "connection span", which is the maximum number of days that you allow to elapse if the two successive values are to be connected.

EXAMPLE

In the following example you will create data structure, use the default entry form supplied by GWW, and enter data with the following time-dependent constituents: Na, Cl, TDS, and Conductivity.

The data to input are the following (in the order after the date: Na, Cl, TDS, and Conductivity).

1984/05/01 100.0 250.0 2500.0 3000.0

1984/06/01 150.0 300.0 3500.0 4000.0

1984/07/01 250.0 400.0 5000.0 5368.0

1984/08/01 200.0 340.0 4500.0 4988.0

1984/10/01 250.0 410.0 5000.0 5800.0

1984/10/15 200.0 386.0 4500.0 5300.0

1. To start with, from the GWW Main menu you will click on **Tools**, followed by **Data Structure Design**.

2. Wait until the new menu bar is displayed. Select **File**, then **Old**. Locate the internal file titled **Chem_Conc_Time_Tab**.

3. Notice that there is only one entry, Date.

4. Select **New**. Type Na. Use TAB to move to the next field. Accept the default width of the field as 10 characters. Move down the dialogue box and check Numeric (do not check on Numeric dimensioned since concentration of a chemical is a nondimensioned number!). Click on **OK**. In the next dialogue box se-

lect OK accepting all defaults (2 decimal digits, fixed point arithmetics). Notice that Na is displayed in the list of constituents.

5.Repeat the same for Cl.

6.Repeat the same for TDS and for Conductivity, but select floating point for the data type, and decrease the number of decimal digits to 1. The list should now contain 5 parameters as shown in Figure 20-19.

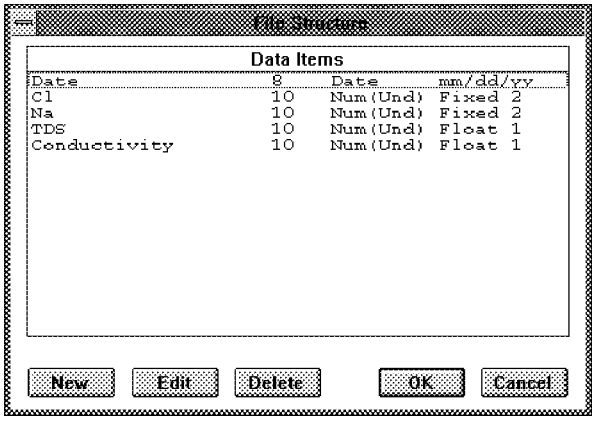

Figure 20-19

7.Close the dialogue box by selecting **OK**, select **File** and **Exit**. The new data structure for the time-concentration portion of the data base is created.

8.Click on **Applications** on the GWW Main menu, then on **Chemistry**, and then on **Concentration - Time**.

9.GWW will display an entry form which will have only one field, Well Identification. The cursor will be in this field.

10.Type the well number, say MW-1. Now finish the input by pressing Page Down key once to complete the entry, and second time to highlight this well and make it active. Alternatively select this well using the mouse.

11.Select **Tables** and click on **Edit table**. The display will be as shown in Figure 20-20. There will be five col-

MW-1 Chemical Constituents

Year	Month	Day	hh:mm	Cl	Na	TDS	Co

Figure 20-20

umns (Time, Na, Cl, TDS, and Conductivity), each with an empty field. GWW automatically create an entry field for hour and minutes, which you may ignore. The noon time will be automatically assumed. Fill in the values as prepared for this example. The table will look as shown in Figure 20-21.

MW-1 Chemical Constituents

Year	Month	Day	hh:mm	Cl	Na	TDS	Conductivity
1984	5	1	12:0	100	250	2500	30
1984	6	1	12:0	150	300	3500	40
1984	7	1	12:0	250	400	5000	53
1984	8	1	12:0	200	340	4500	49
1984	10	1	12:0	250	410	5000	58
1984	10	15	12:0	200	386	4500	53

Figure 20-21

12. When you finish typing, leave the cursor in the last typed row, and press the combination Ctrl S. (Alternatively, you may click on Tables, and then on Save.) If your time entries are not in sequence, GWW will beep on you, display a message Invalid Date/Time order!, and will place the cursor in the line that is out of the time sequence.

13. Now you will create your own log design. Select **Log Design** on the menu bar. Select **New Log Design**. The screen will display four constituents as "selected fields", as shown in Figure 20-22. Since you will accept the

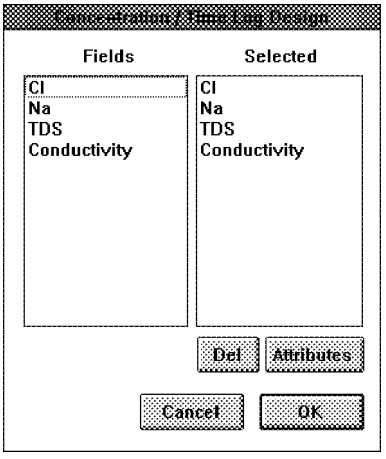

Figure 20-22

defaults, click on OK to close this dialogue box.

14. Now you may see immediately the graph. Click on **Display**. The default parameters are used to display this graph. The display is as shown in Figure 20-23.

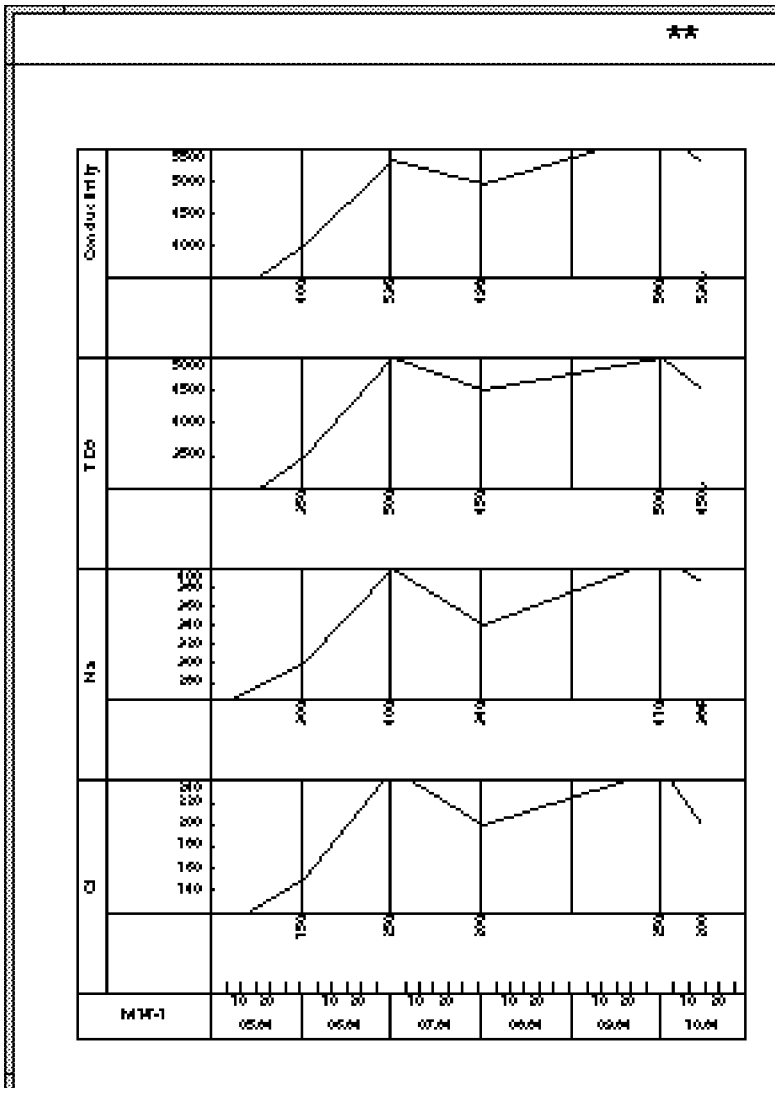

Figure 20-23

Click on the button **Close** to remove this graph.

15. Modify the graph design. Select **Log Design**, then **Edit Log Design**. Click on TDS on the right side of the dialogue box. The constituent TDS will be high-

lighted. Now click on the button **Attributes**. In the new dialogue box in boxes for Minimum and Maximum type 1000 and 5000, respectively. Click also on Fill color and select a color. Now replace the word TDS in Column Heading box with TDS in ppm. Click on OK to close the Attributes dialogue, and again on OK to close the Log Design dialogue.

16. Select **Display** again. The screen looks as shown in

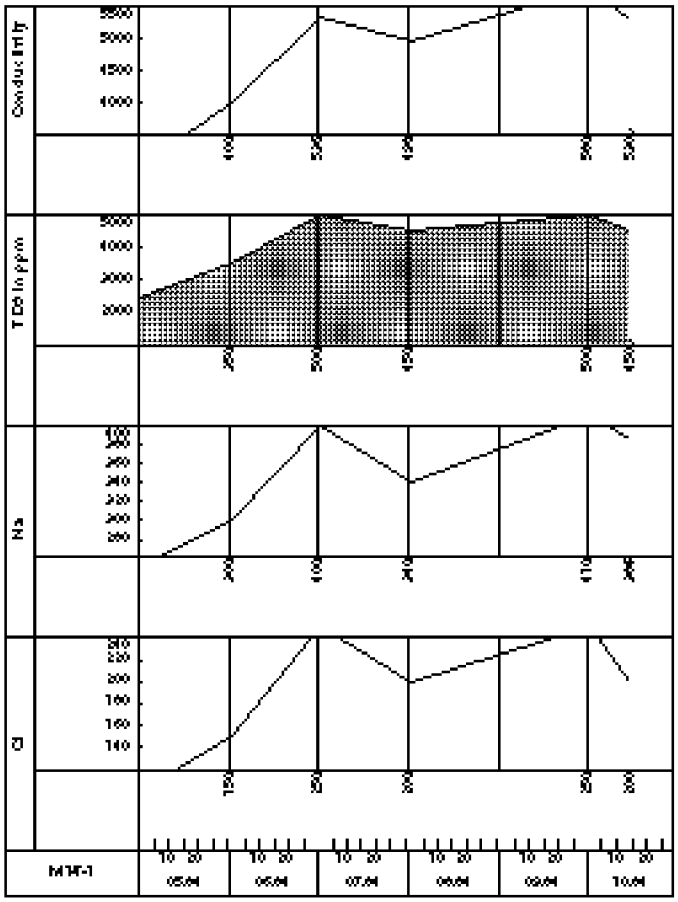

Figure 20-24

Figure 20-24. Save this log design. Close the display. Select **Log Design**, followed by **Save Log Design As**. Type a name for this design.

17.The task now is to have only TDS displayed and/or printed. Select **Log Design**, then **Edit Log Design**. Highlight Na and click on Del. Repeat the same with Cl and Conductivity. Only TDS remains in the "selected" list. Highlight TDS and click on Attributes. Notice that the width of the graph field is still 25 mm. Close this dialogue, close the log design editing dialogue, and display the graph by selecting **Display**.

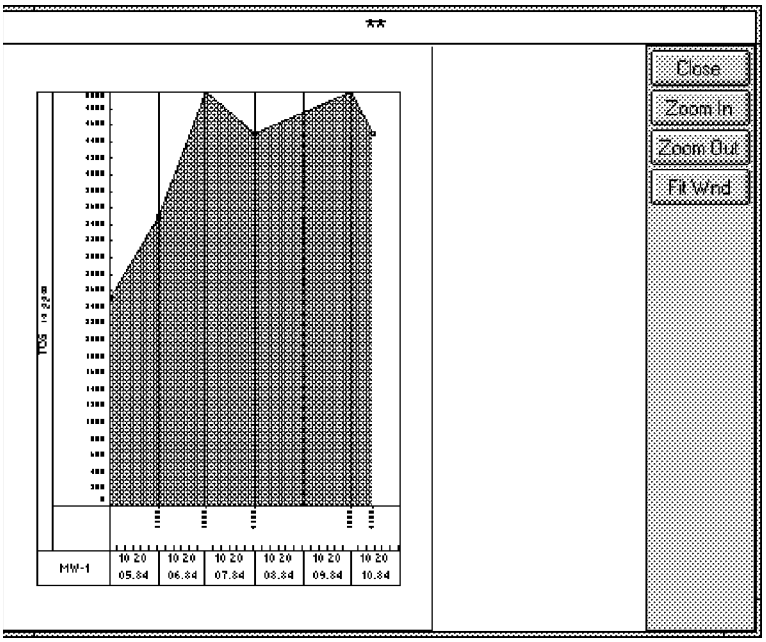

Figure 20-25

Notice that the TDS graph fills the whole screen. The display is shown in Figure 20-25. To check the width which is automatically selected because you left the

Auto Size box checked, close this display, and select **Edit Log Design** again. Highlight TDS, select **Attributes**, and notice the new size, something like 144 mm.

Figure 20-26 shows the zoomed time axis. This is the lower part of the drawing.

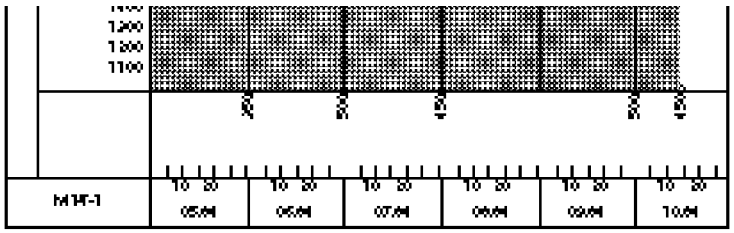

Figure 20-26

18.Exit the application, and exit GWW.

This ends this example.

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