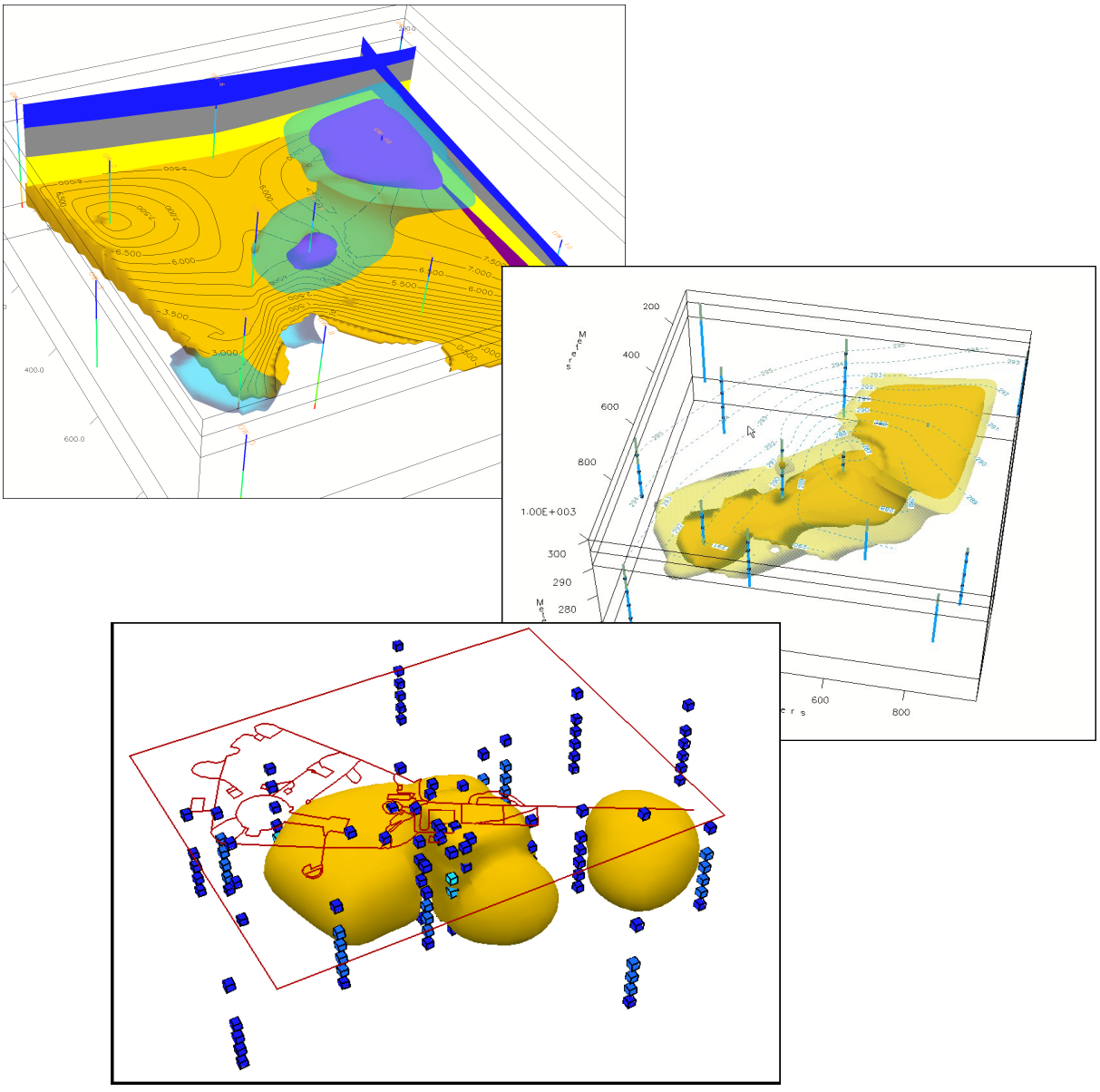
Visual Groundwater Demo

A hands-on approach for analyzing field investigation and monitoring data with a state-of-the-art 3D animation and visualization tool.



Waterloo Hydrogeologic, Inc. 2001

Visual Groundwater Demo

Welcome to the Visual Groundwater Demo (VisGW)! This documentation will illustrate how quickly-and-easily you can analyze your collected field data in its true 3D spatial orientation. Using a provided data set, this tutorial will allow you to examine various lithologic, soil, and groundwater samples collected from the field.

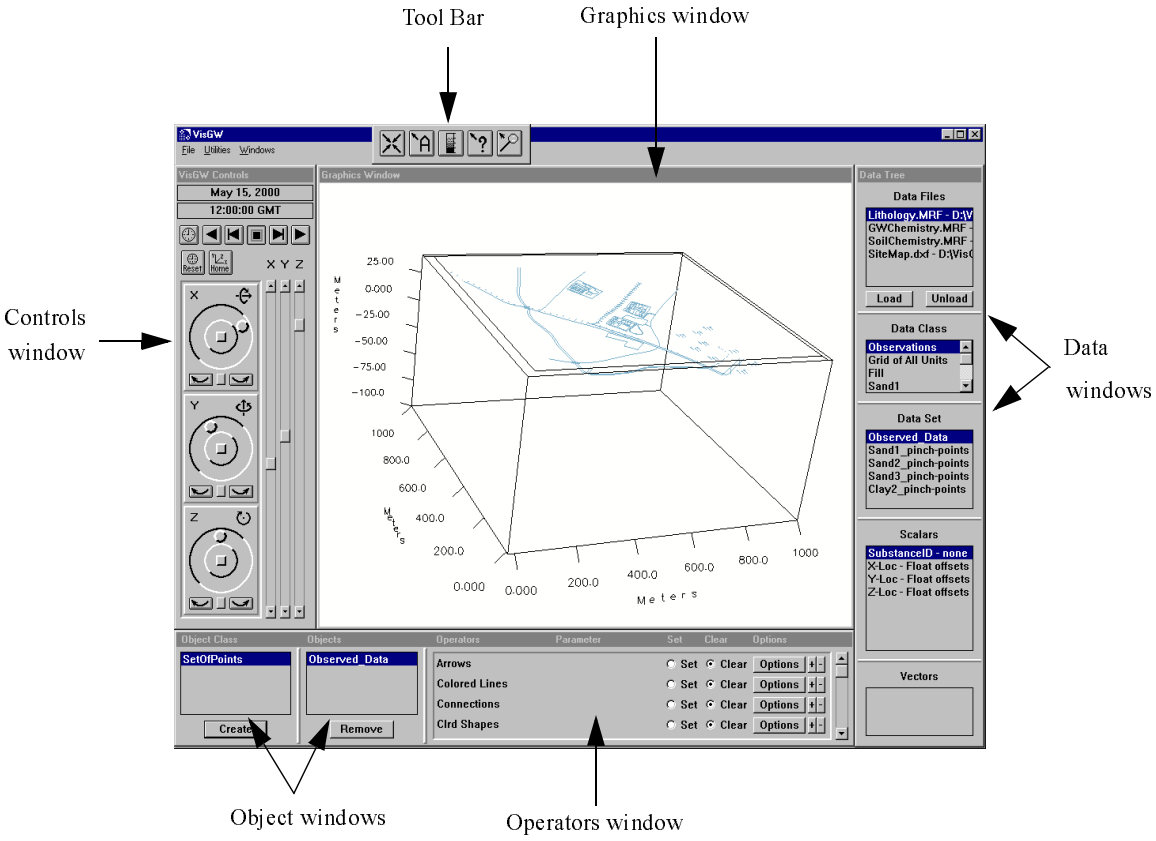
To begin, this tutorial will focus briefly on the various controls contained within the VisGW interface. There are numerous dials and slider bars that allow you to easily analyze a set of data from countless perspectives.

In addition this tutorial will introduce you to a series of pre-defined configuration files, or views, that focus on different aspects of the data set. By loading these configuration files, you will be able to quickly and easily examine a large amount of field data.

NOTE: *The configuration files have been set-up on the premise that the VisGW Demo was installed in the* ***'C:\VisGW230_Demo\'*** *directory. If you have installed the program in a different location, then simply start the VisGW Demo from the* ***'Start/Programs/WHI Software/Visual Groundwater 2.3.0 Demo'*** *menu. Once opened, click '****File/Load Config File'****. Navigate to the '****Tutorial'*** *directory and load up the appropriate .cfg file (see below for more information). From there, you should be able to follow along with the rest of the tutorial.*

The Visual Groundwater Interface

To begin the VisGW demo, **double click** on the **VisGW230_Demo.cfg** icon that was created on your desktop during the installation.
(*A warning message will appear, asking if you want to continue. Click on Yes to proceed*). When the program has loaded, you will be presented with the following screen:



NOTE: *The background color of these images has been changed to white for the purpose of this demo. (From the Main Menu bar, go to Utilites/ Settings - here you can place a check mark in the White Background box to activate this setting.) A white background is also more appropriate for printing purposes, or for use in a report. However, a black background is ideal for overhead presentations. When the background color is switched, VisGW will automatically reverse the color of the foreground scales, labels, grid lines, and text boxes; a quick and convenient option for the user.*

The VisGW interface is densely packed with controls and boxes of information that have been carefully designed to give you maximum control over your data. The VisGW interface includes the following windows and controls:

ToolBar
Provides quick access to the following five tools:

Centering Tool: Centers the display on any chosen point.
Annotation Tool: Allows text to be added to the display.
Color bar Tool: Creates a legend for the current data set.
Locator Tool: Provides coordinates for any chosen point on the display.
Data Inspection Tool: Displays the scalar values for the selected point.

To activate one of the tools, select it with your mouse. Note that only one tool may be active at a time. While the cursor is in the Graphics window, it takes the shape of the active tool.

Controls Window
The controls window is divided into two sections: time controls and spatial controls. Time controls affect which timestep you are viewing and allow for both forward and backward movement of the timestep shown. Spatial controls allow you to rotate and shift the contents of the graphics window. There are two types of controls: dials and sliders.
The dials are the three circles on the left side of your display, and allow the user to rotate the grid in the X, Y, and Z planes. Click-and-hold the small round circle within an individual dial, and drag the circle to the left or right to see the effect on the graphics window.
The sliders are the three vertical bars located beside the dials, and allow the user to affect horizontal and vertical position (X and Y), as well as zoom in or out (Z slider). Click on one of the small squares within a slider, and drag it up or down to see how the display changes.

Object Window
Displays the available object classes of the current data set, and allows the user to create an object from the data set. Objects can be observed data, 2D slices, or 3D isosurfaces.

Operators Windows
In the operators windows, the user can turn on /off various features of a given object. The operator can be turned on or off for various features, and the impact on the display in the graphics window can be seen. Examples of operators include contour lines, colored shapes, and monitoring well labels.

Data Windows
The Data Windows list the data files currently in use. These can include data files for groundwater chemistry and water level data, soil chemistry, lithology, and site maps. Also in this section is the data class (the type of data) and the data set. For example, a data class may be a lithological sand unit, while the corresponding data sets may be ‘top of sand’, ‘bottom of sand’, or ‘grid of sand’.
Finally, this section contains ‘scalars’ which display the available scalar variables for the selected data set. For example, for the previous

lithological sand unit, the available scalars would be ‘thickness’ and ‘elevation’.

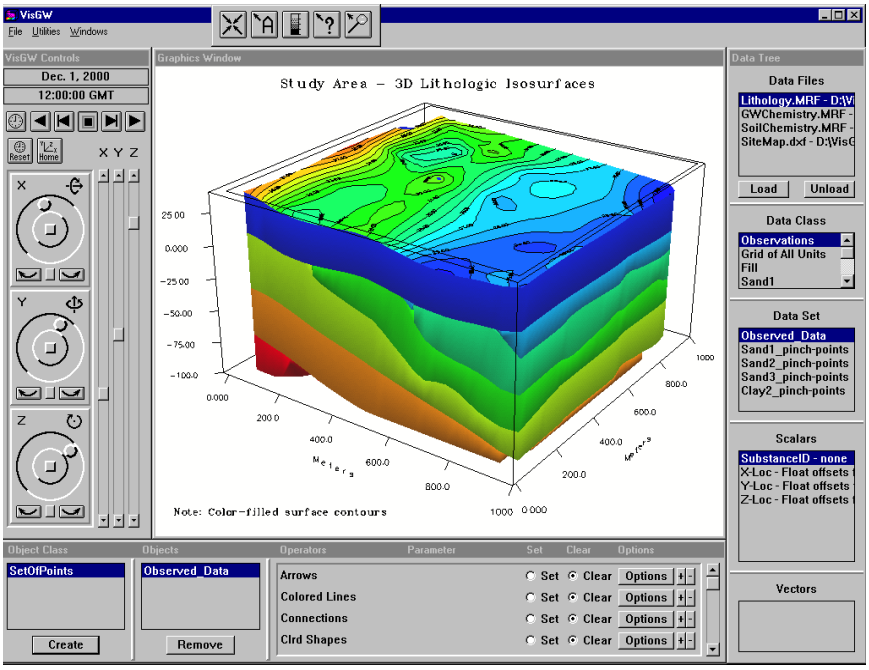
Graphics Window
The large window in the center of the screen in the Graphics window. All operators which are set will appear in the Graphics window.

Now that you have become acquainted with the VisGW interface, it’s time to load up some sample data sets, and examine the various configuration files that have been prepared for this demo.

From the Main Menu, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **lith_iso.cfg** file. Click ‘yes’ when prompted to ‘unload the current data’ and proceed.

Site Lithology

When the config file has loaded, you will see the following screen:



In this image, you can see the different color-coded units or isosurfaces, that represent each soil layer.

NOTE: *An isosurface is a 3D object drawn for a given value in space. It can be thought of as a skin or shell enclosing all data points at or above the specified value.*

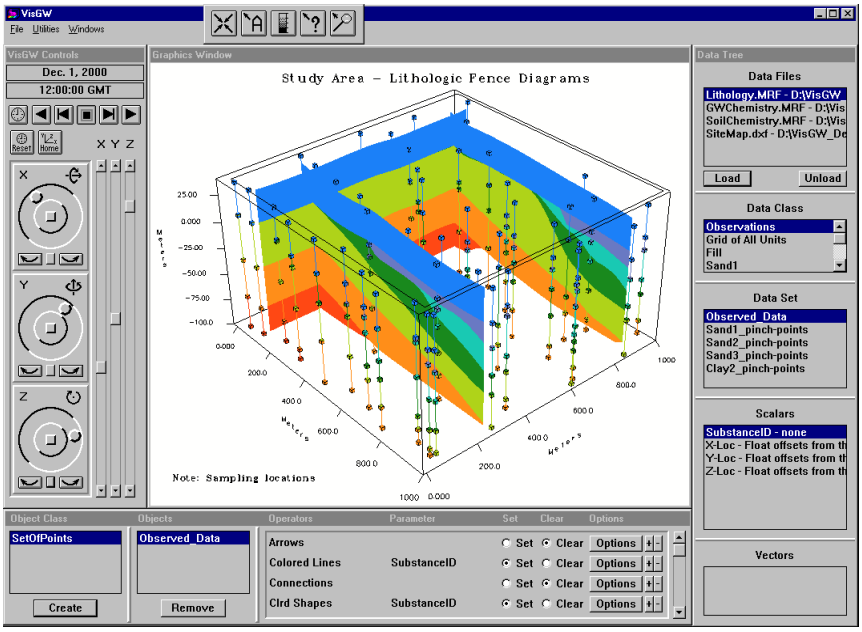
In this display, there is a colored isosurface to represent each of the lithologic units (fill l, sand 1, sand 2, sand 3, clay 1, sand 4, and clay 2). These seven isosurfaces overlay each other giving the user a 3D perspective of the site lithology.

On the ground surface, there are surface contour elevations which are labelled and color shaded to show elevation changes. To zoom in on the contour labels, click on the z-slider (located left of the graphics window,) and slowly drag it downward.

Feel free at this time to experiment with the different spatial controls available. You'll quickly notice that you can 'auto-rotate' the image in multiple directions at once, which provides a truly unique perspective. If at any time you 'lose track' of your location, or simply would like to return to the starting position, click on the 'home' icon (located above the spatial controls). Once you've obtained a particular desired view, you can save this configuration for future use. To do so, click **'File/Save Config File'** from the Main Menu bar. In the **'Save Configuration File'** window that appears, type a descriptive name in the **'File Name'** field, then click **'Save'**. You can now change the view, load different files, etc., and return to this exact perspective by loading the file just created.

Next you will load another configuration file to examine the lithologic field data in a different manner. From the Main Menu bar, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **lith_slices.cfg** file.

When the config file has loaded, you will see the following screen:



In this display, you can see three cross-sectional slices depicting the various lithological layers. There are two slices in the X-Z plane and one in the Y-Z plane. Again, the colors correspond to changes in the lithology at the site indicating the fill, sand and clay units.

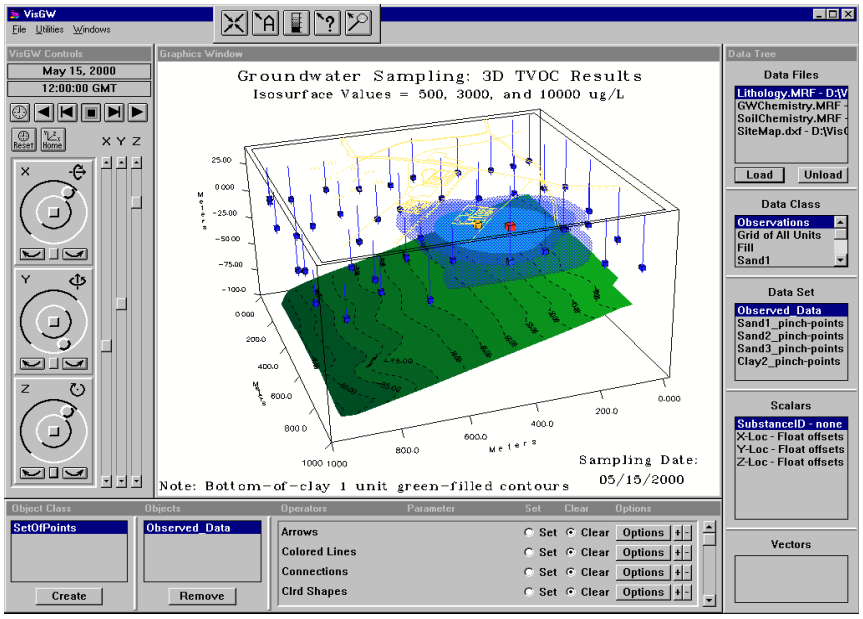
Also in this file, you can see that the sampling locations are identified. The vertical lines running through the grid indicate the locations of the 44 boreholes that were drilled at the site. The small squares along each borehole represent the sampling location, and the colors of these squares correspond to the type of soil encountered at that specific depth and location.

Next you will examine the groundwater elevations and groundwater chemistry data for the site.

Site Groundwater Elevations and Chemistry

From the Main Menu bar, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **gw_plume.cfg** file.

When the **gw_plume.cfg** file has loaded, you will see the following screen:



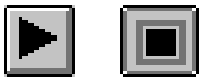
NOTE: *For printing purposes, the background color for this configuration file has been changed to white. In your display, the background color will be black.*

This configuration file allows the user to see many of the features VisGW has to offer. A site map is defined in yellow, and has been draped over the ground surface. The blue vertical lines indicate the location of the groundwater wells, while the small blue squares represent the screen location where the groundwater samples were taken.
In the center of the graphics window, there are three blue isosurfaces that represent a TVOC plume. The highest concentrations of TVOC are found in the centre of this plume, shaded the darkest blue. This isosurface encloses all locations where the concentration of TVOC is greater than or equal to 10,000 ug/L. Working outward from the centre, the next isosurface value is 3,000 ug/L, and encloses all locations where the TVOC concentration is greater than or equal to 3,000 ug/L. Finally, the outermost isosurface represents a value of 500 ug/L indicating all locations with a TVOC concentration of at least 500 ug/L.

The transparency levels of each isosurface can be altered under the operators section. To do so, click on the **GWchemistry.mrf** file under **Data Files** (located in the top right of your display); it will become highlighted. Then under **Data Class**, click on **3D_Gridded** to highlight it. Then in the bottom left corner of your display, under **Object Class**, select **Isosurface** to activate it. Next, beside the **Object Class** window, under the **Objects** window, you will see the three isosurfaces listed. Select one of these isosurfaces, and immediately to the right of this window, (in the **Operators** window) you will find the options for that isosurface.

You can turn this isosurface on or off by pressing the set or clear buttons, respectively. Click on the options button, and the isosurface options window will appear, that allow you to specify the isosurface value and edit the colors. To edit the transparency level of the isosurface, click-and-drag the scroll bar located under **Transparency Level** value, and slide it to the right/left to increase/decrease the transparency level. Then click on the **Apply** button, and you will see the changes reflected in the isosurface. You can edit the other isosurface colors in a similar fashion until you have achieved a desirable display.

The user can then animate the plume by pressing the play and stop buttons located in the top right corner of the VisGW controls window.

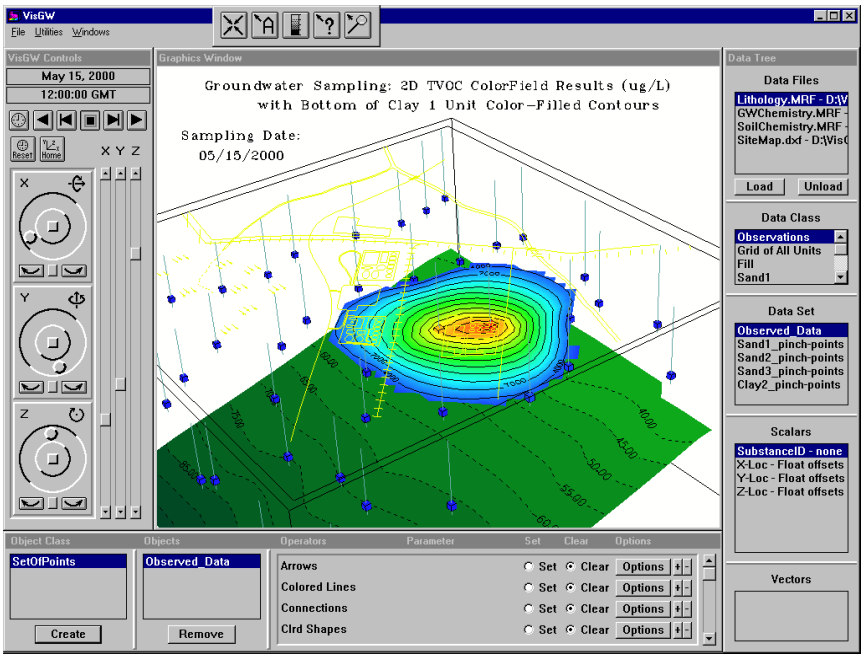


Let the data set animate through a few times series to get a feel for how the plume evolves over time. As the plume is animated, the date under the time window changes with the corresponding sampling period. Rotate the dataset to see it from different perspectives. Use the time control buttons to stop, reverse, or slow down the animation and play it frame-by-frame. You can also set the **'Maximum Frames Per Second'** under the **'Main Menu/Settings'** option, should you want to slow down or speed up the animation.

Also seen in this configuration file is the bottom of the clay layer, which has been colored green. The color intensity of this horizontal slice in the X-Y plane reflects changes in elevation. The labels represent the depth to the clay layer from the ground surface.

Once you have thoroughly examined this perspective, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **gw_contours.cfg** file.

Once the config file has loaded, you will see the following screen:



NOTE: *For printing purposes, the background color for this configuration file has been changed to white. In your display, the background color will be black.*

In this display, you get a closer view of the site map, sampling locations, and TVOC contamination. The site map overlays the ground surface in yellow, which allows the user to quickly relate the subsurface contamination to reference points on the surface. The TVOC contamination is displayed as a 2D slice in the X-Y plane, and the concentrations are delineated by contour lines in ug/L.

This slice can also be animated by using the play and stop buttons, located in the time controls section:



The locations of the groundwater sampling wells are represented by light blue lines in this display. Each well also has an associated colored cube that represents the sampling location. The colored cubes increase in size to correspond with an increase in contaminant concentration at that sampling location. This grid also includes a lithological slice to show the location of the top of the sand layer. Contour labels on this slice show the depth from the ground surface to the bottom of clay 1 layer.

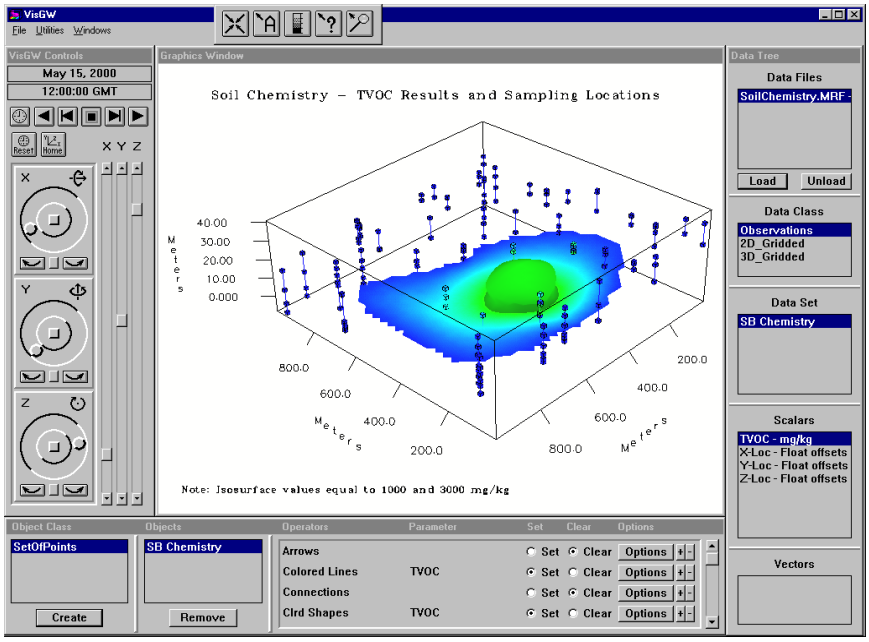
If you stop the animation at any time step, you can revert back to the initial time step by pressing on the **'Reset'** button (located in time controls section.)

Next you will examine the soil chemistry configuration files for the site.

Site Soil Chemistry

From the Main Menu bar, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **soil_plume.cfg** file.

Once the **soil_plume.cfg** file has loaded, you will see the following screen:

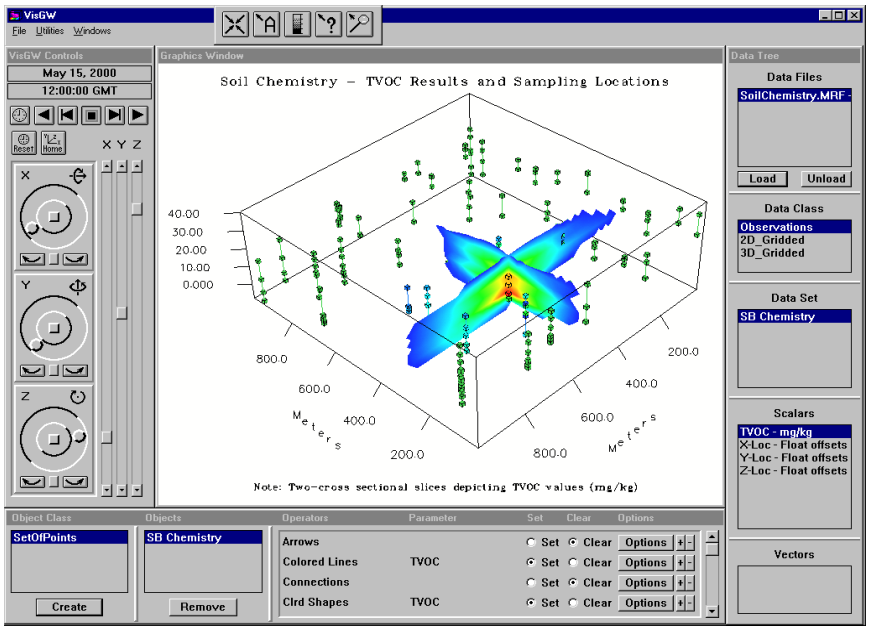


This configuration file shows the location of the boreholes taken at the site, and the shapes along each borehole represent the location and depth of the soil samples. The TVOC contamination is represented by an isosurface and a slice. The green centre represents a soil concentration of

at least 3,000 mg/kg. The blue-green outline is a slice that represents soil concentrations of at least 1,000 mg/kg.

You can then experiment with the **Data Inspection** tool (click on the small magnifying glass button located in the tool bar, above the graphics window). Click on a location in the isosurface. A **'Data Inspection'** window will appear, listing the TVOC concentration in the soil at that specific X, Y, Z location. You can use this tool to view the soil concentrations at various locations in your grid. A very practical and effective tool!

To load up the next file, go to **File/Load Config File**. Browse to the **tutorial** folder, and open the **soil_slices.cfg** file.



This is another method of visualizing the soil contamination at the site. The lines and squares show the location of the boreholes and soil samples. There are two cross-sectional slices of the site that show the TVOC contamination and the site 'hot-spot'. There is a chart title at the top of the graphics window, and a section with descriptive notes. To add notes or a chart title, click on the **'Annotation Tool'** icon (the **'A'** icon located in the tool bar). Then left-mouse-click anywhere in the graphics window, and an **'Annotation'** window will appear, which will allow you to type in any descriptive words, and then manipulate the text size and location.

Conclusions

Thank you for evaluating the VisGW demo. We hope you've gained a greater understanding of how easily you can visualize and interpret your collected field data in its true 3D spatial orientation!

If you have any further questions regarding the capabilities of VisGW, or would like to purchase a full-working version of the program, please contact us by phone, fax, or e-mail:

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We look forward to hearing from you!