

Arc Hydro Groundwater Toolbar

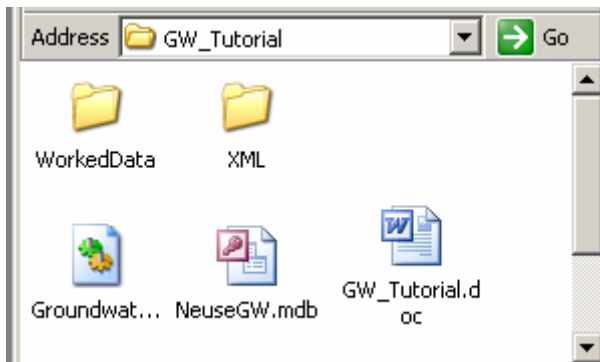
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University of Texas at Austin
September 2005

Goal

The goal of this exercise is to introduce the ArcHydro groundwater toolbar developed at CRWR. In this exercise the users will construct 3D models of the subsurface within ArcScene and visualize subsurface information.

Computer and Data Requirements

To carry out this exercise, you need to have a computer, which has desktop ArcGIS (ArcView and ArcInfo) with spatial analyst and 3D analyst extensions. The data are provided at ftp://ftp.crwr.utexas.edu/pub/outgoing/vmmerwade/CUAHSI/Prototype/GW_Tutorial.zip. Download the zip file and unzip it on a local drive. After unzipping the data you will see the following folders and datasets:



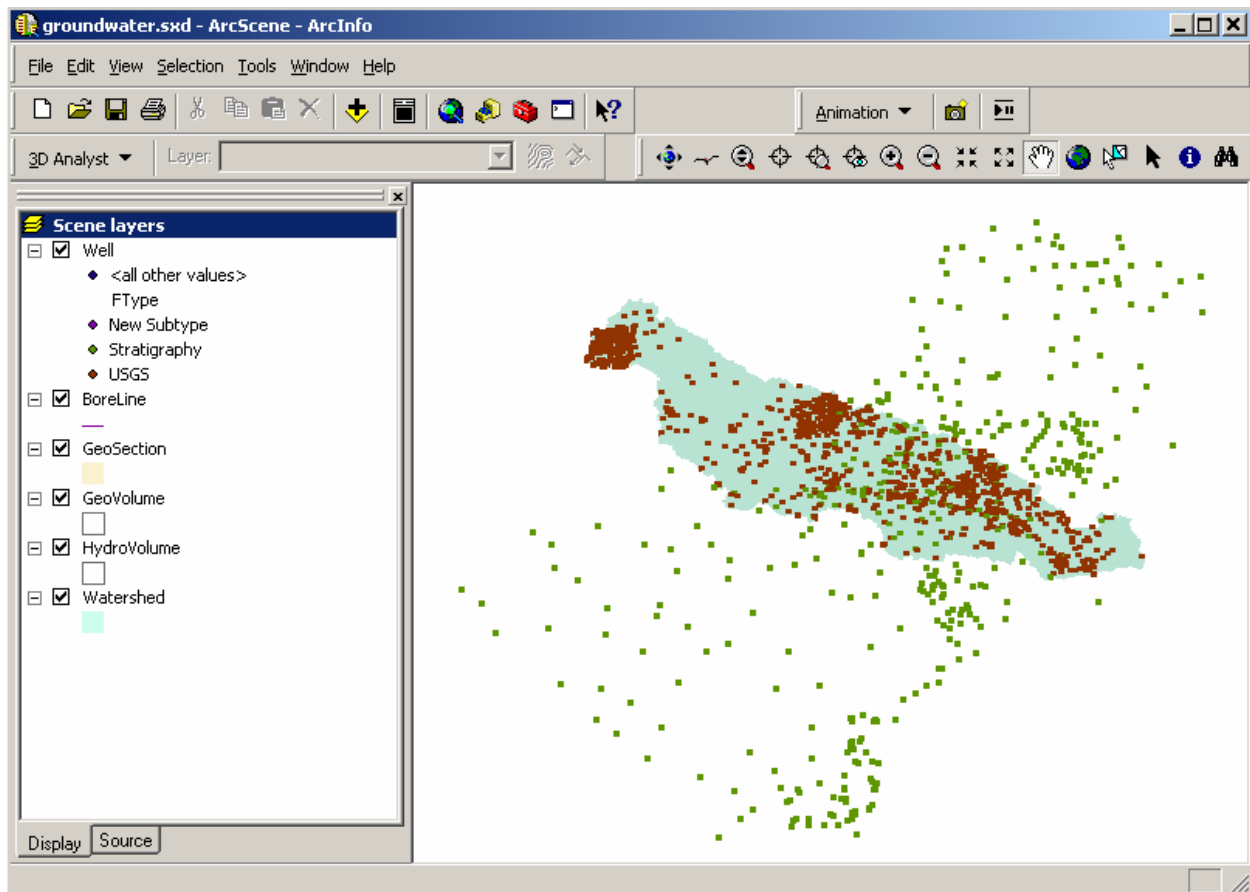
- 1) The WorkedData folder contains the results from this tutorial.
- 2) The XML folder contains XML files with geologic information extracted from an external groundwater model.
- 3) GroundwaterToolbar09192005.dll is the Groundwater ArcHydro Toolbar.
- 4) NeuseGW.mdb is a geodatabase containing hydrogeologic information for the Neuse basin. We will use the Boreline, GeoSection, GeoVolume, HydroVolume, Watershed and Well feature classes from this geodatabase
- 5) GW_Tutorial.doc is a word document containing this tutorial.

Getting Started

The Arc Hydro groundwater tools work with ArcScene. Since we will deal with 3D surfaces, which require a lot of computer resources, the following tips may be useful when applying groundwater tools in ArcScene.

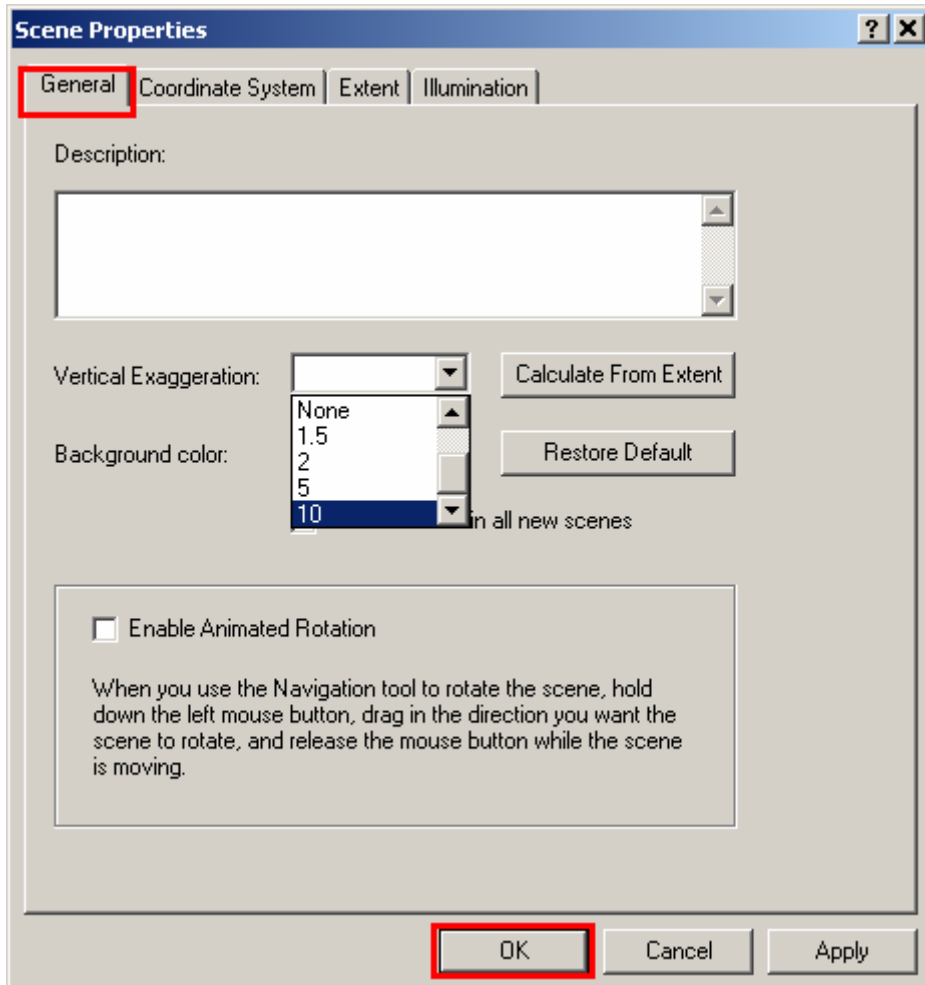
- Save the Arc Scene document frequently. The application takes a lot of processing power and may crash while processing.
- Sometimes layers in ArcScene do not refresh and do not show in the scene view. You can refresh a layer by *selecting the layer in the content window > Right Clicking > Refresh*.
- If the refresh does not help, you may try closing the document and reopening, or removing the layer from the document and adding the layer again.
- You cannot edit in ArcScene. If you wish to delete features, you can use the *Delete Feature* tool in the Arc Toolbox to delete features from a layer.

Open an empty ArcScene document by going to Start→Programs→ArcGIS→ArcScene. Save the document as groundwater.sxd. Add Boreline, GeoSection, GeoVolume, HydroVolume, Watershed and Well feature classes to ArcScene.



Only Watershed and Well feature classes are populated. The well features are colored based on their FType attribute. We will now use the Groundwater toolbar to populate the other feature classes.

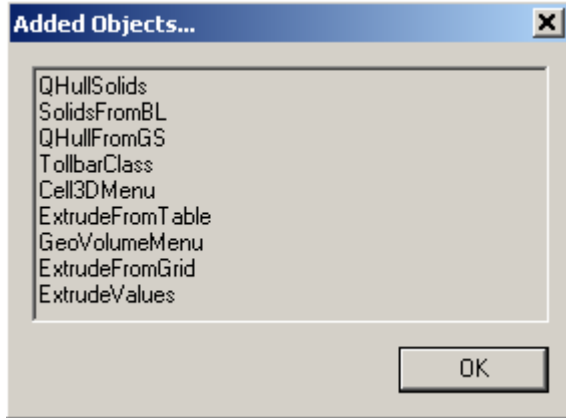
To get an exaggerated view of objects in three dimensions, change the view setting by selecting View→Scene Properties..., and setting the vertical exaggeration to 10 as shown below:



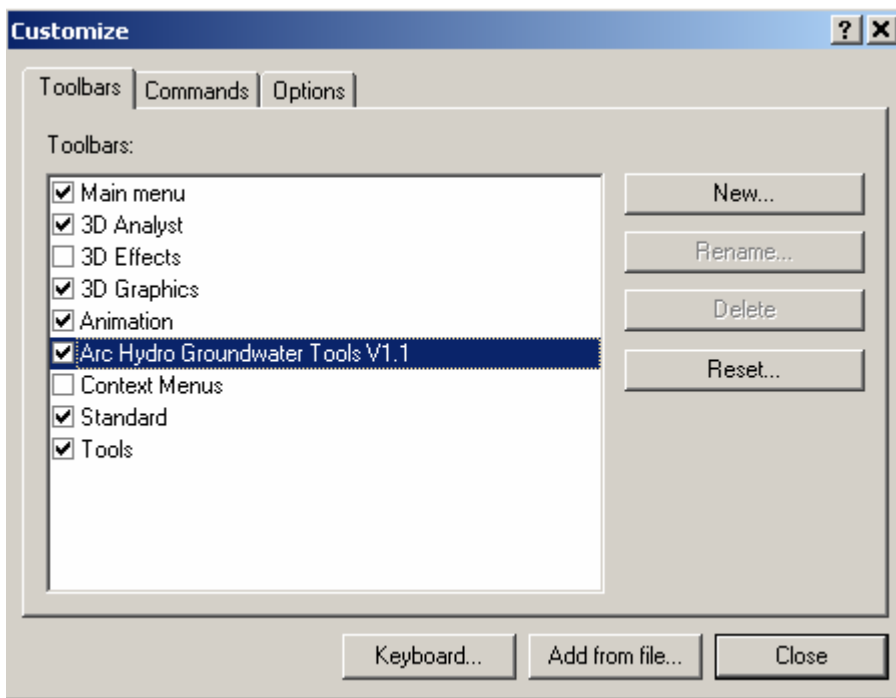
Click OK to close the scene properties window.

Arc Hydro groundwater toolbar

In this section we will use the Arc Hydro groundwater tools to populate the geodatabase with 3D subsurface features. First you will need to load the toolbar. In ArcScene, go to Tools→Customize→Add from file... Navigate to the location of the GroundwaterToolbar09192005.dll file and select it. Wait until the following message appears.



In the Toolbars tab, you should see Arc Hydro Groundwater Tools V1.1 as shown below. Check the box next to it to activate the Arc Hydro Groundwater Toolbar.



Click *Close*. The following toolbar should appear in the Scene.




A few tips regarding the use of the toolbar:

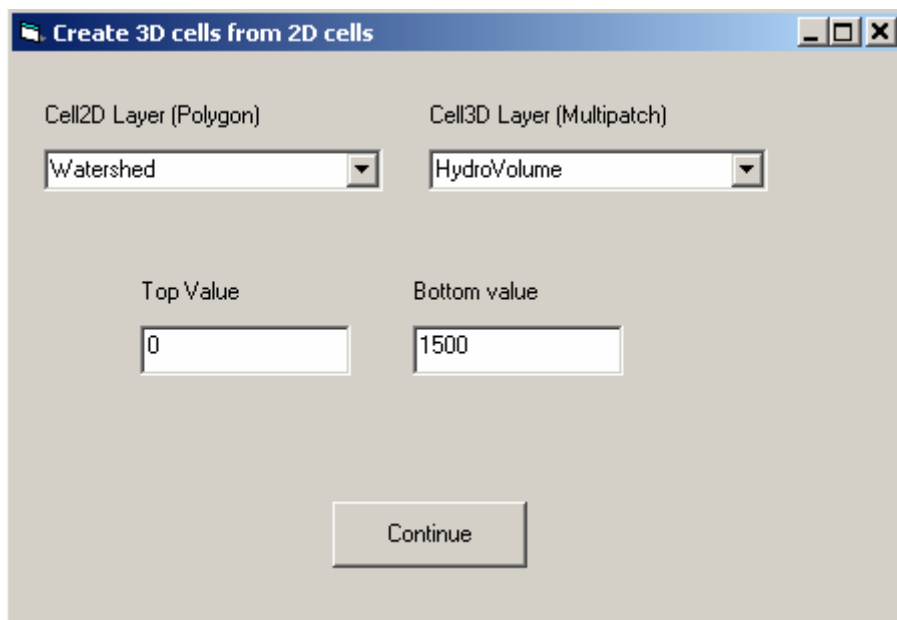
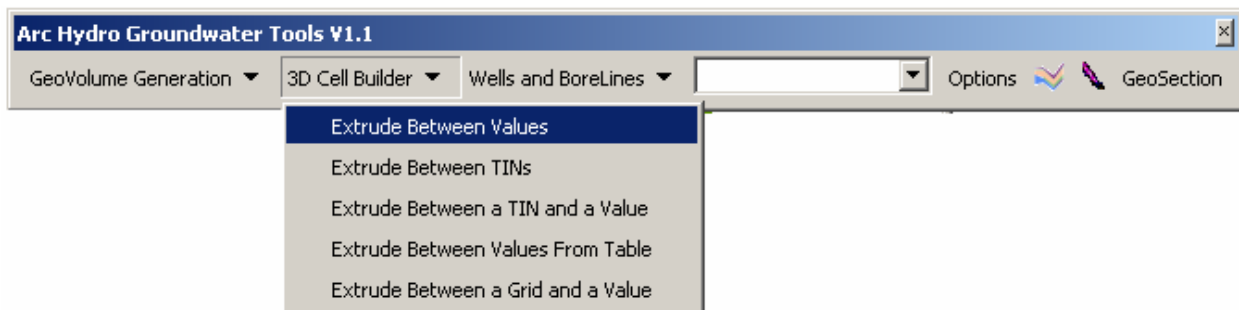
- Be patient and careful with the tools as they are still under development, and will crash easily. Some of the tools require some processing time.
- If you get an error message do not get intimidated. Click OK and close the error log window.
- 3D features may not show up and you might need to refresh the layers or reload the layer into the scene to view results.

If a tool's interface is not working, try closing the scene and reopening it.

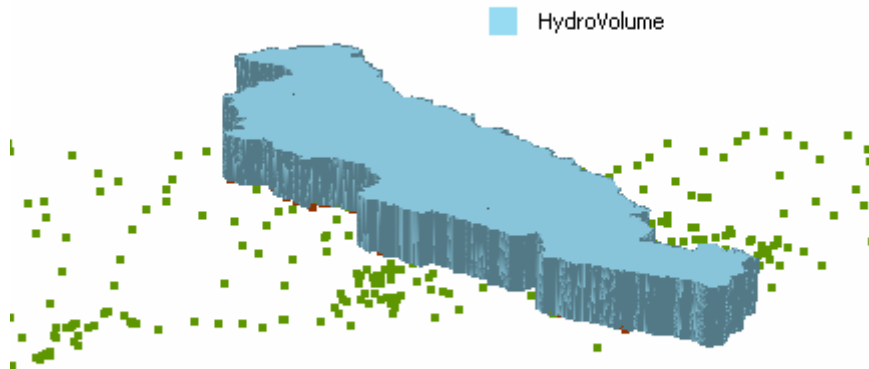
It is highly recommended to save the scene document after each step.

Creating HydroVolume for the Neuse basin

ArcScene can extrude vector objects in the vertical dimension. By extruding objects vertically, points can be converted to lines, lines to polygons and polygons to volumes. We will extrude the Neuse basin (polygon) to create a volume, and store it in the HydroVolume feature class. Select the watershed feature using the select  button. On the Arc Hydro Groundwater Toolbar, select 3D Cell Builder→Extrude Between Values as shown below:

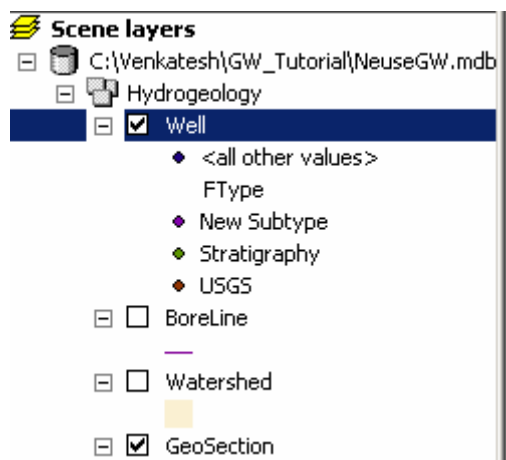


This process may take a while to finish. If the HydroVolume does not appear after a minute, refresh the HydroVolume feature class to see the HydroVolume for the Neuse basin as shown below:



Creating Bore Lines from Wells

In this section we will create bore lines from wells. Bore lines are three-dimensional objects that represent the hydrostratigraphy along a drilled well. For computational efficiency, turn off Watershed and HydroVolume layers. Add VerticalMeasurements table to the scene document. This table contains information on top and bottom elevations observed at each hydrostratigraphic unit in the wells. We will use the well feature class in conjunction with VerticalMeasurements table to create bore lines from wells. In the ArcScene table of contents, select the Well feature class as shown below:



In the definition query box on the Groundwater toolbar, select Stratigraphy as shown below:

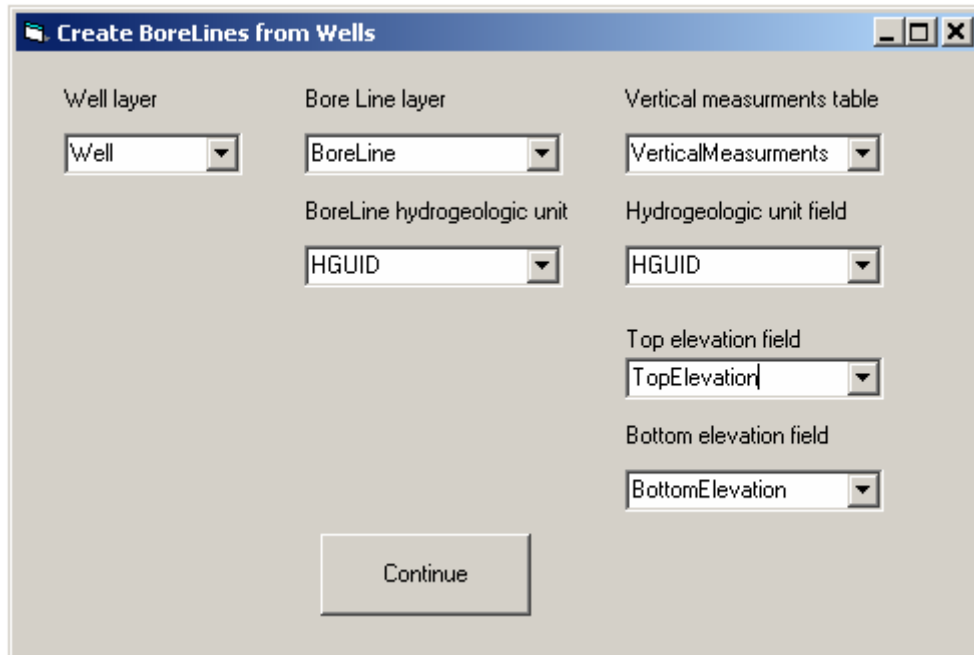


This performs a definition query on the Well feature class using the FType attribute, and selects only those features whose FType = Stratigraphy. You will also notice that ArcScene now displays only wells that satisfy this definition query (only wells that have stratigraphic information are displayed).

Now select Wells and BoreLines → Make BoreLinesFromWells as shown below:

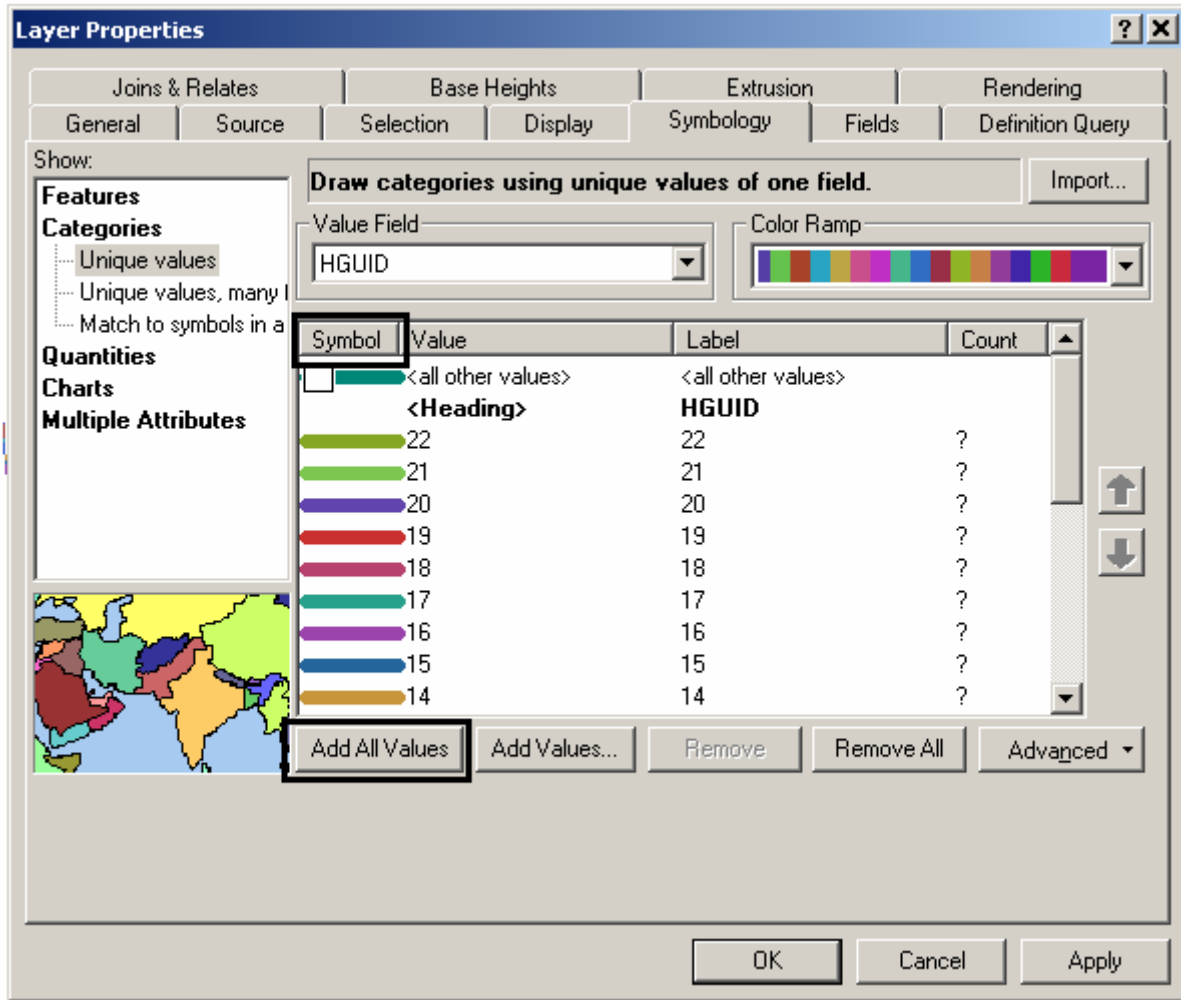


Choose Well for Well layer, BoreLine for Bore Line Layer, HGUID for BoreLine hydrogeologic unit, VerticalMeasurements for Vertical measurements table, HGUID for Hydrogeologic unit field, TopElevation for Top elevation field, and BottomElevation for Bottom elevation field as shown below:

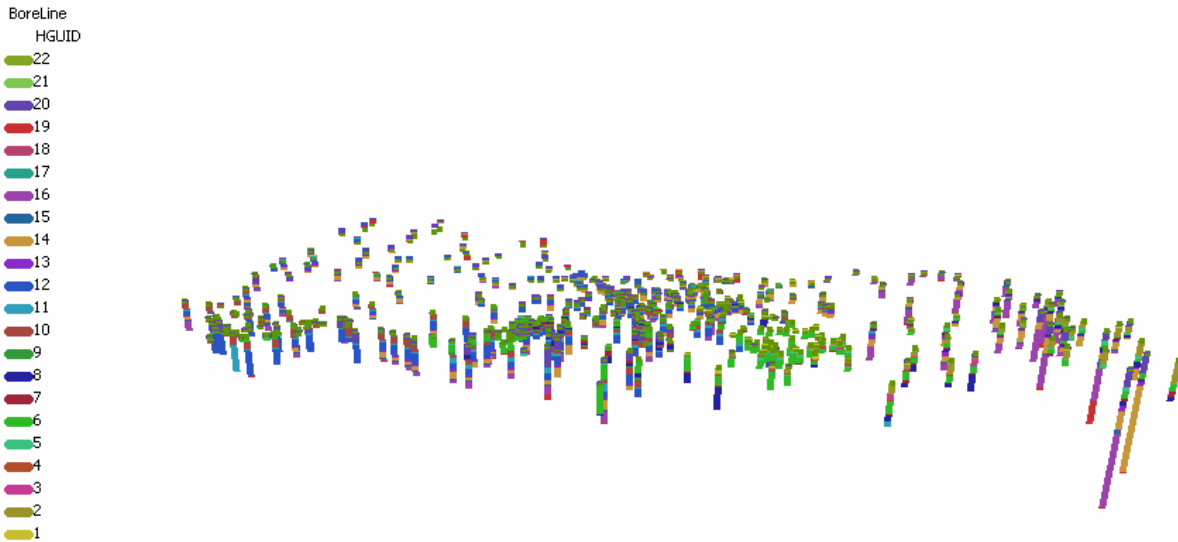


Click Continue. Click OK to “Create borelines for all wells?” message box. The tool will create bore lines from wells and store them in the BoreLine feature class. Right click, and refresh the

BoreLine feature class to see the bore lines. Change the symbology of the bore lines by doing a right-click on the feature class, and selecting Properties→Symbology. Select Unique Values under categories, HGUID for Value Field, and then select Add All Values button. Change the width (thickness) of the features to five by selecting the Symbol tab and selecting properties for all symbols option.



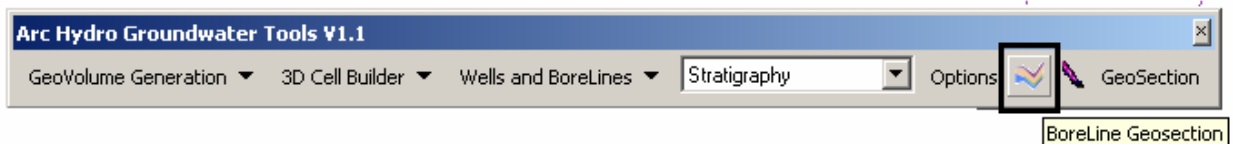
Click Apply and then OK to see the bore lines as shown below:



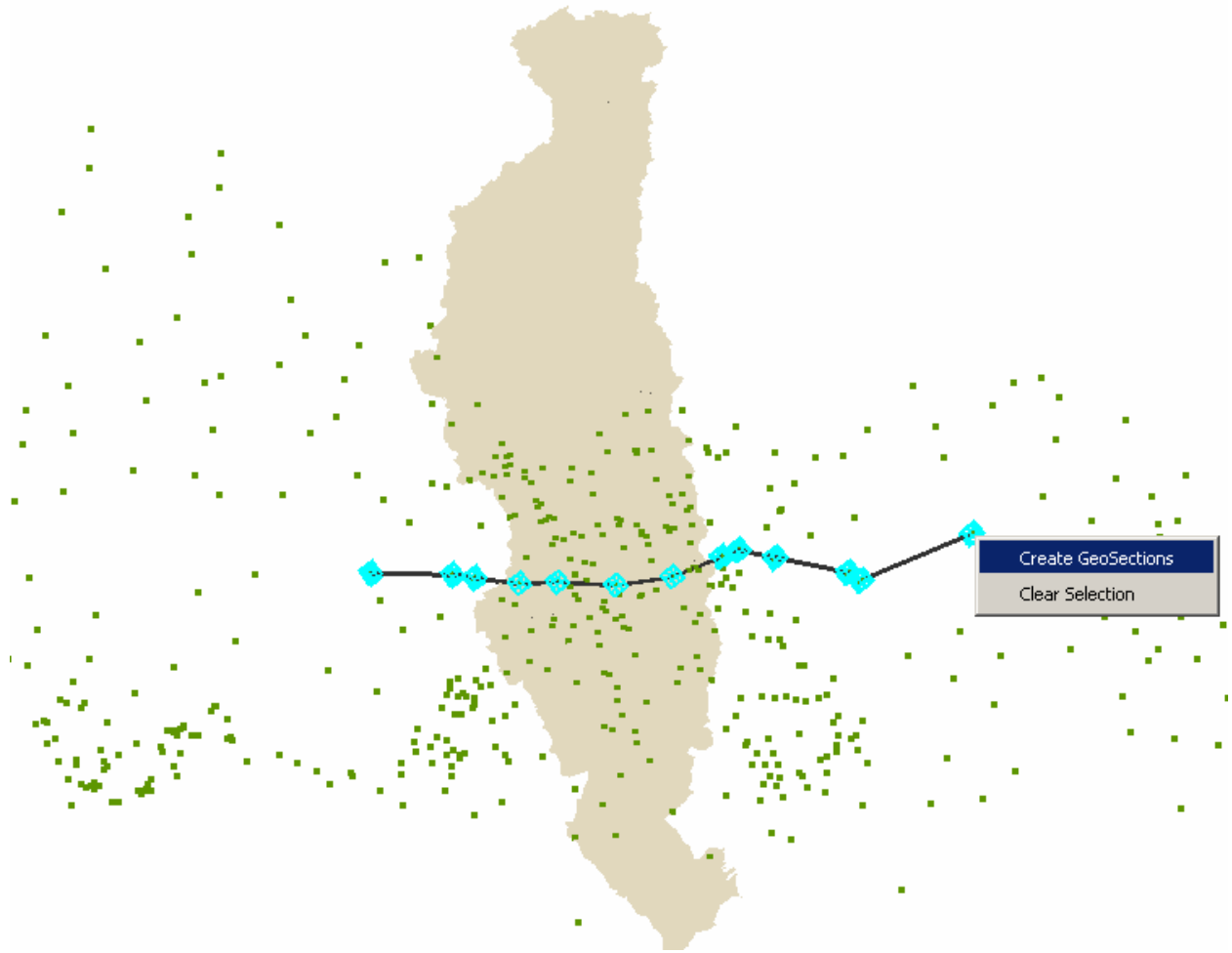
Creating GeoSections from BoreLines

You will now create GeoSections from the BoreLines. A GeoSection is a cross section of the geologic stratum to explore and create views of the stratigraphy information.

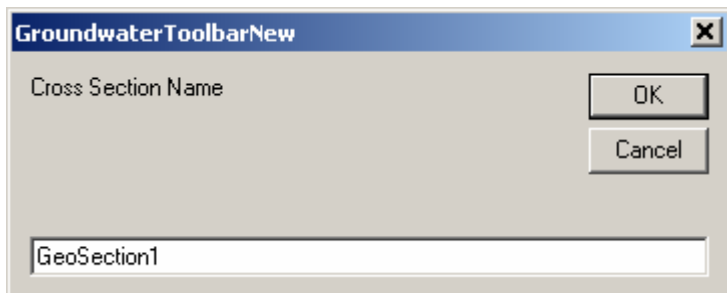
Activate the *BoreLine GeoSection* tool by selecting the BoreLine GeoSection button as shown below:



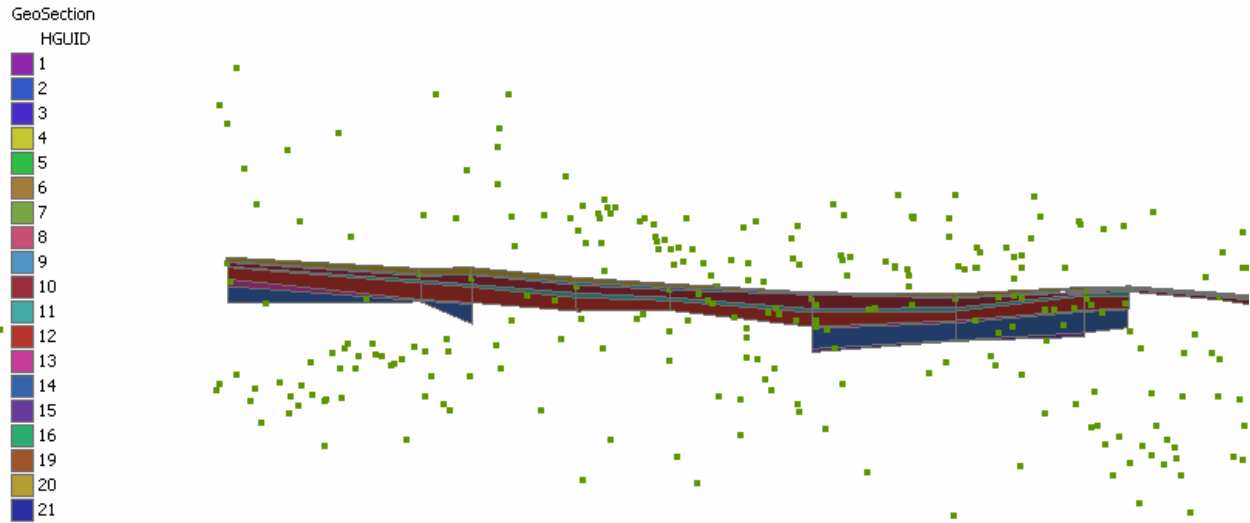
Use the cursor to specify a cross section by selecting a number of wells along the desired section line (it might be easier to see the wells if you unselect/turn off the BoreLine layer). Select few wells in a sequence and then right-click to get the menu (Create GeoSections) as shown below (Note: Watershed is shown in the background just to give a perspective. It's best if only wells are present in the map while creating geo sections from wells):



Click on Create GeoSections. The tool will prompt you to specify a name for the GeoSection. Name the section as GeoSection1 as shown below:

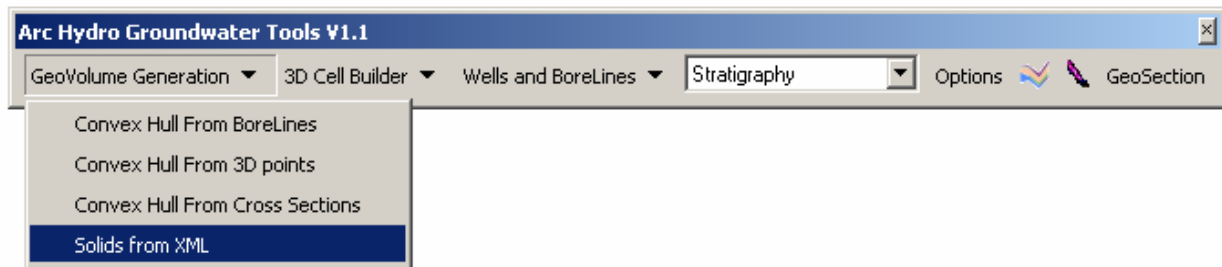


Click OK. A GeoSection will be created and added to the map. GeoSections are polygon features where each feature is a vertical polygon drawn between two borelines (for Well1 and Well2). Change the symbology of the features based on HGUID. The following figure shows GeoSection created from the above operation.

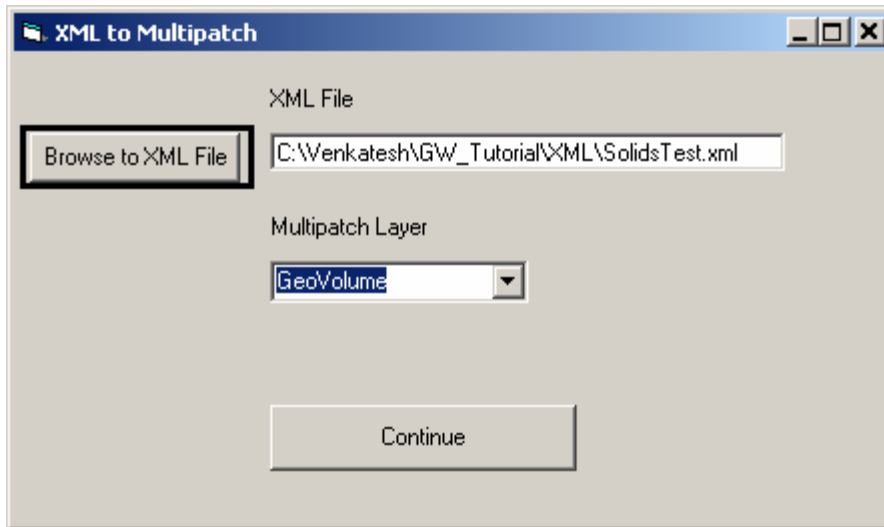


Creating GeoVolume from Model Output

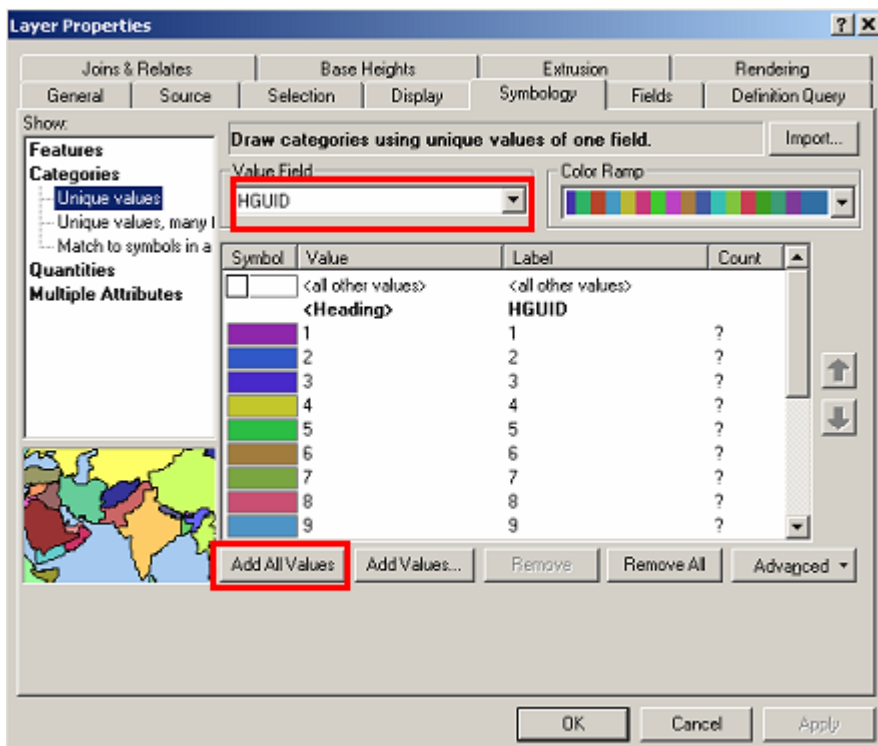
In this section, we will create solid objects (GeoVolume) for the sub-surface by using results from an external model. The groundwater toolbar has the utility of reading results from external models (GMS, in this case) that are stored in an XML file. We will use the output from GMS for this area to create a three-dimensional geo volume. On the groundwater toolbar, select GeoVolume Generation → Solids from XML as shown below:



Click on Browse to XML File button and browse to SolidsTest.xml in the XML folder as shown below:

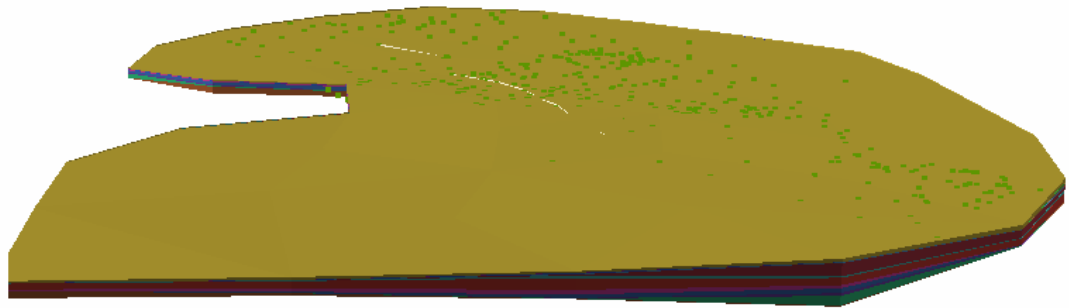


Select GeoVolume for the Multipatch Layer and press Continue. The tool will create GeoVolume using the data from the XML file. Right click on the GeoVolume feature class and refresh it to see the new three-dimensional feature added to the scene document. Change the symbology of the GeoVolume to see different hydrogeologic units by coloring them using the HGUID attribute as shown below:



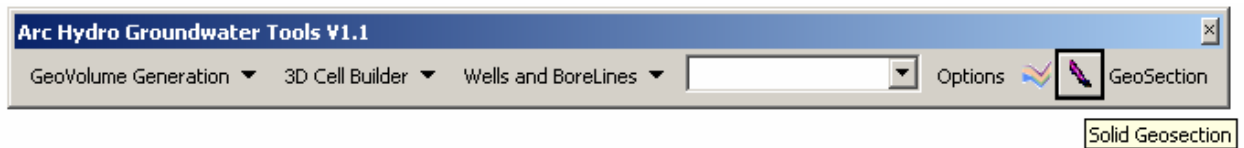
The resulting GeoVolume is shown below:


- GeoVolume
- HGUID
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15
- 16
- 19
- 20
- 21

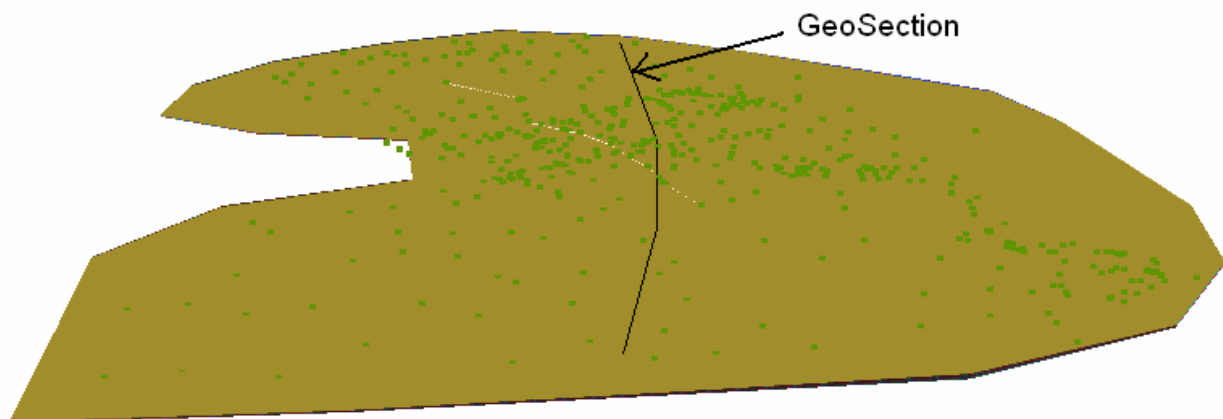


Creating GeoSection from GeoVolume

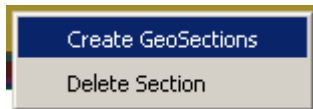
In this section, we will create cross-section (GeoSection) for the GeoVolume. On the groundwater toolbar, select the solid geosection button as shown below:



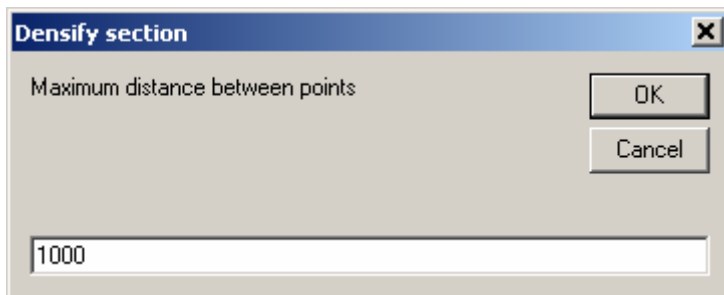
With the solid geosection button highlighted , create a cross-section along the geovolume by clicking at a couple of points on it as shown below:



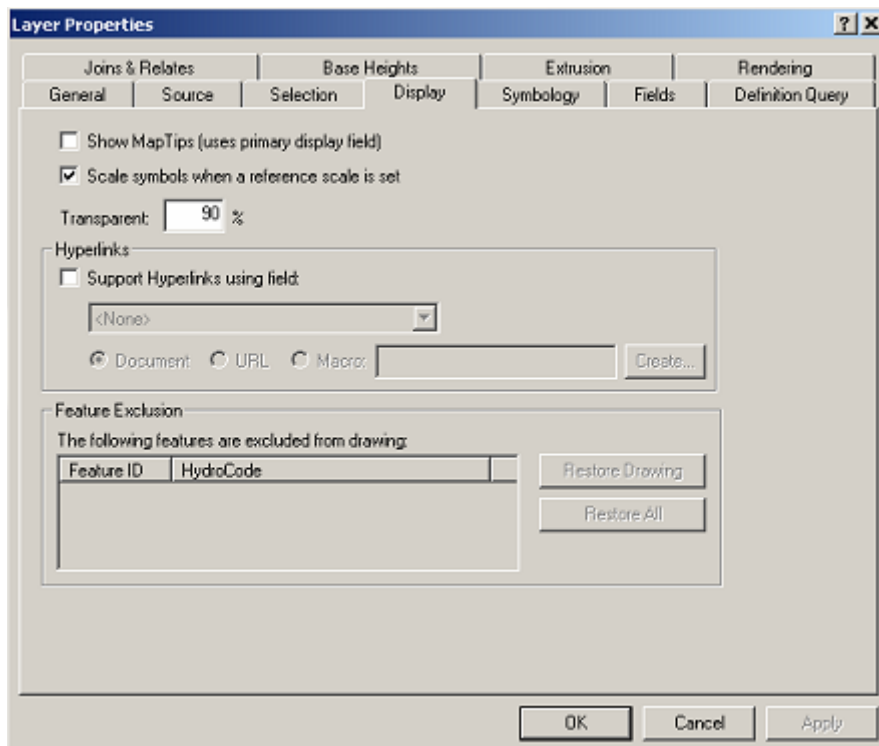
Then right click to get the following options:



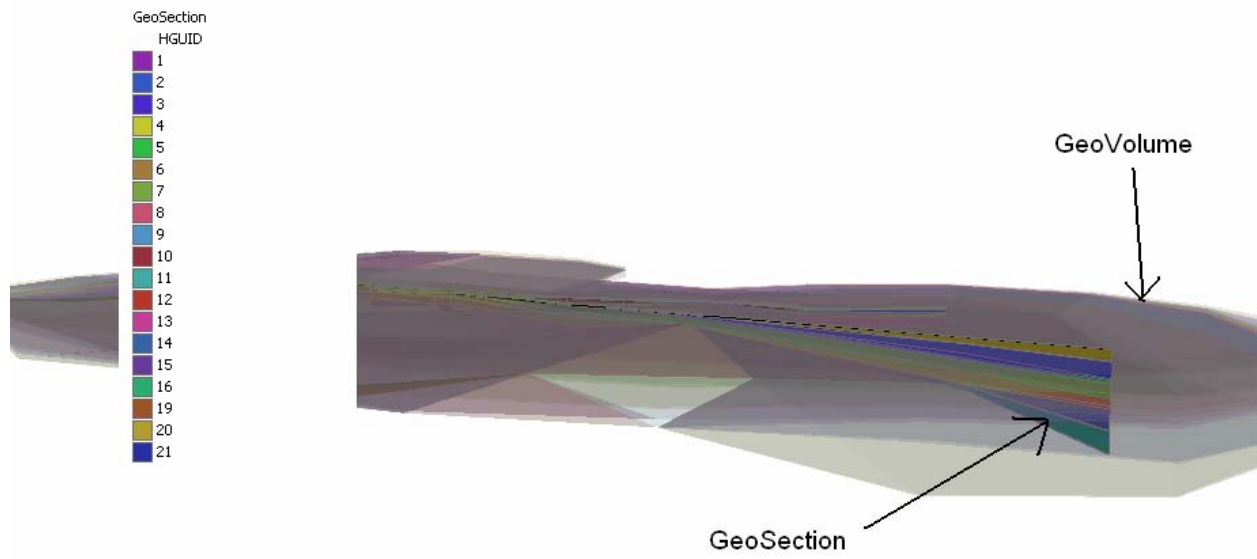
Press Create GeoSections, and accept the default value of 1000 for maximum distance between points. This means the tool will sample the GeoVolume at every 1000 units to get the stratigraphy information for creating a section. Press OK.



To see the GeoSection inside the GeoVolume, make GeoVolume transparent by changing the display properties. Right click on the GeoVolume layer, select Properties→Display, and make the layer 90 percent transparent as shown below:



Also change the symbology of the GeoSection layer to color the layer using HGUID. You can then see the GeoSection within the GeoVolume as shown below:



Pretty cool!! OK, now you are done.