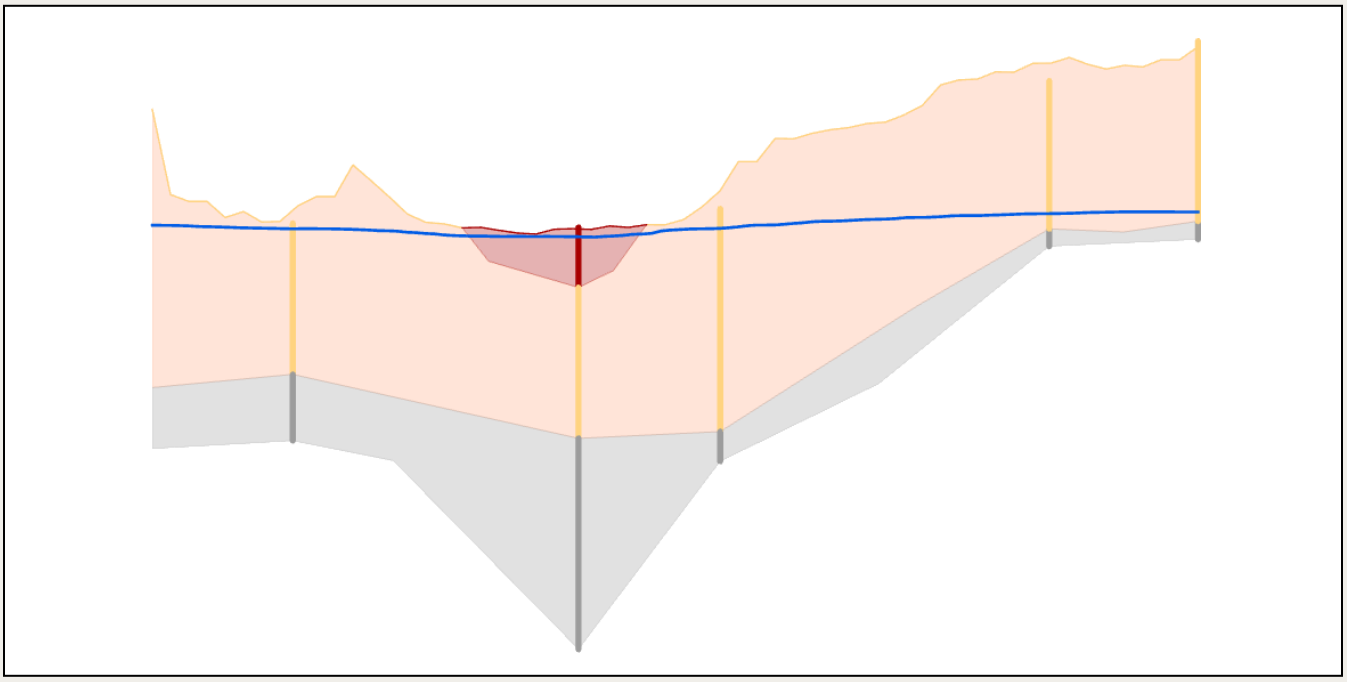
*AHGW Pro 1.0 Tutorial*

# *Subsurface Analyst – Creating 2D Cross Sections*

Create 2D cross sections using Arc Hydro Groundwater in ArcGIS Pro



## Objectives

Learn how to use Arc Hydro Groundwater Pro tools to create cross sections by combining data from different sources.

### Prerequisite Tutorials

- None

### Required Components

- ArcGIS Pro
- 3D Analyst
- Subsurface Analyst
- Groundwater Analyst

### Time

- 40–65 minutes

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# 1 Introduction

Arc Hydro Groundwater Pro (AHGW Pro) is a geodatabase design for representing groundwater datasets within ArcGIS Pro. The data model helps to archive, display, and analyze multidimensional groundwater data. This includes several components to represent different types of datasets such as representations of aquifers, wells, boreholes, 3D hydrogeologic models, temporal information, and data from simulation models.

The *Arc Hydro Groundwater Pro* tools help to import, edit, and manage groundwater data stored in an AHGW Pro geodatabase. *Subsurface Analyst* is a subset of the AHGW Pro tools that is used to manage 2D and 3D hydrogeologic data and create subsurface models including generation of borehole representations, cross sections, surfaces, and volumes. This tutorial will demonstrate how to create cross sections by combining data from different sources including geologic maps, surfaces, and borehole stratigraphy.

*Subsurface Analyst* includes tools for creating 3D cross sections and volumes from a set of surfaces. The workflow and tools for creating 3D features are described in a separate tutorial.

## 1.1 Background

Data used in this tutorial are based on data from a study in the city of Woburn conducted by the USGS. The data were modified for the purposes of the tutorial. The site location is shown in (Figure 1).

 

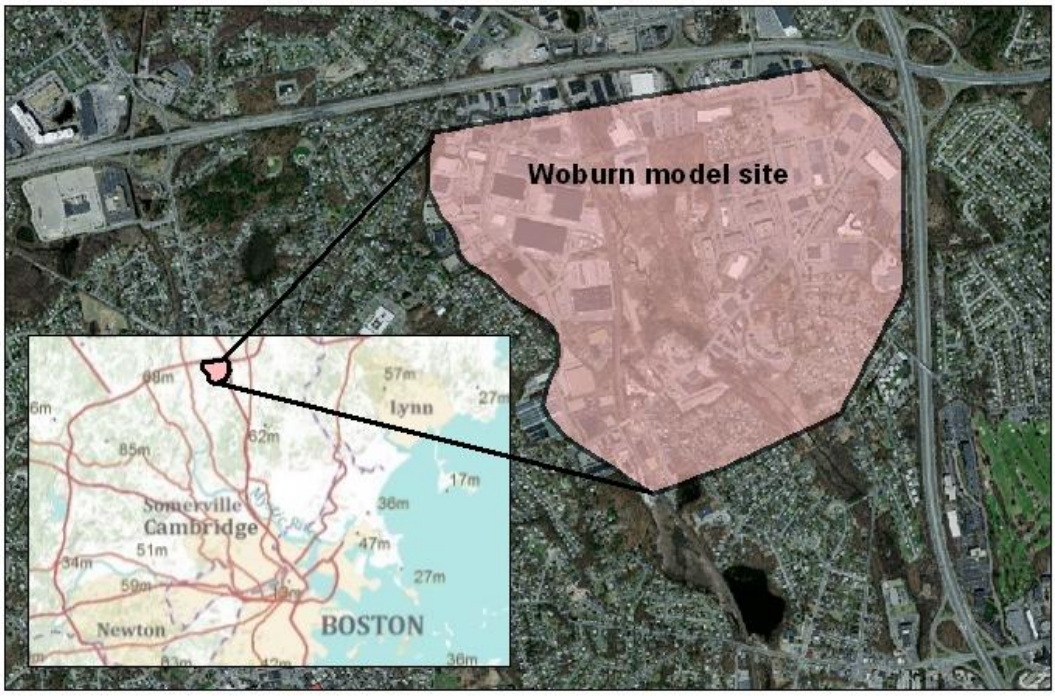


*Figure 1 Location of the Woburn Model*

For the purpose of this tutorial, three primary hydrogeologic units were defined. The base of the model domain is deep gravel, the middle part is alluvium consisting of sand and silt, and the top unit is a peat layer that is limited to the river area. Figure 2 shows the sequence of formations used in the model. Each of the units is indexed by a hydrogeologic unit identifier (HGUID), and the unit properties are defined in the HydrogeologicUnit table.

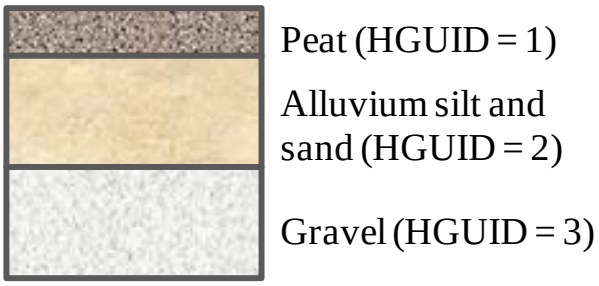


*Figure 2 Hydrostratigraphic units in the model area*

## 1.2 Outline

The objective of this tutorial is to introduce the basic workflow and tools for creating 2D cross sections (XS2D). It will cover the following tasks:

1. Reviewing the structure of the data model classes needed for working with 2D cross sections.
2. Sketching section line features.
3. Running the XS2D Wizard to set up a new XS2D data frame and corresponding feature classes.

4. Creating XS2D Lines representing the intersection of the ground surface DEM with a set of outcrop polygons.
5. Sketching cross section panels in the XS2D data frame in ArcGIS Pro.
6. Adding an XS2D Line representing the water table to the cross section.
7. Building 3D GeoSections from the sketched cross section, and visualize the new GeoSection features in ArcGIS Pro.

### 1.3 Required Modules/Interfaces

The following components should be enabled in order to complete this tutorial:

- ArcGIS Pro license
- 3D Analyst
- Arc Hydro Groundwater Pro Tools
- Arc Hydro Groundwater Pro Tutorial Files

The AHGW Pro Tools require that there is a compatible ArcGIS Pro service pack installed. Check the AHGW Pro Tools documentation to find the appropriate service pack for your version of the tools. *3D Analyst* is required for the last section of the tutorial for visualizing 3D features. If *3D Analyst* is not available, skip these parts of the tutorial. The tutorial files should be downloaded and saved on a local drive.

## 2 Getting Started

Begin by opening a project containing some background data for the Woburn project..

1. If necessary, launch *ArcGIS Pro*.
2. If on the ArcGIS Pro start page, select **Open another project** in the bottom right corner of the window to open the *Open Project* dialog.
3. If already in the user interface, use the **Open** macro to open the *Open Project* dialog.
4. Browse to the location with tutorial files for this tutorial.
5. Select the file “xs2d.aprx” located in the *SubsurfaceAnalystPro/XS2D* folder.
6. Click **OK** to import the project.

Once the file has loaded, a map of the model area will appear (Figure 3). The map includes a boundary of the model domain, polygons representing outcrops, and wells within the model domain that have related borehole stratigraphy. A Digital Elevation Model (DEM) raster representing the land surface elevation over the model domain and a raster representing the water table surface are also available.

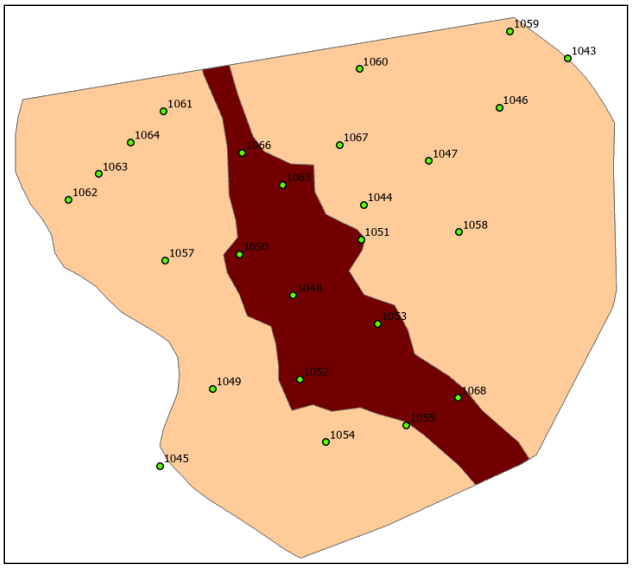


*Figure 3 Model domain*

Before continuing, ensure that the AHGW Pro tools are correctly configured.

1. In the *Catalog* pane, expand the *Toolboxes* folder.

The *ArcHydroGroundwater.pyt* toolbox should appear under the list of toolboxes. If toolbox is not visible, complete the following:

2. In the *Catalog* pane, right-click on *Toolboxes* and use the **Add Toolbox** command to open the *Add Toolbox* dialog.
3. Browse to the location of *C:\Program Files\Aquaveo\ AHGW_ArcGIS_Pro_Python_Toolbox* directory and select and open the *ArcHydroGroundwater.pyt* file.
4. Click **OK** to close the *Add Toolbox* dialog.

With the *ArcHydroGroundwater.pyt* toolbox available, access the Groundwater Analyst tool.

5. Expand "ArcHydroGroundwater.pyt".

When using geoprocessing tools, it's possible to set the tools to overwrite outputs by default, and automatically add results to the map/scene. To set these options:

6. At the top of the *ArcGIS Pro* window, select the *Project* tab. From the list on the left, select **Options** to open the *Options* dialog.
7. Select *Geoprocessing* from the list under *Application* on the left of the dialog.
8. Ensure that *Allow geoprocessing tools to overwrite existing datasets* and *Add output datasets to an open map* are turned on.
9. Select **OK** to exit the *Options* dialog.
10. Using the arrow in the upper left corner, return to the main screen.

# 3 Representing 2D Cross Sections in the AHGW Pro Data Model

Before starting to create cross sections, it is helpful to review the component of the AHGW Pro Data Model we will be using. The AHGW Pro Data Model includes a number

of components used for different purposes. The Hydrostratigraphy component includes data structures for representing 2D and 3D hydrostratigraphy, including the creation of 2D cross sections (Figure 4).

SectionLine is the central feature class used to manage cross sections. Each SectionLine represents a cross section in map view. SectionLine features are indexed with a HydroID, which uniquely identifies them within the geodatabase. To create a vertical (profile) view of the cross section along the SectionLine, each SectionLine feature is associated with multiple feature classes representing the two-dimensional cross section, and these are given the "XS2D" prefix.

Common XS2D feature classes are:

- XS2D_Panel – polygon features representing cross section "panels".
- XS2D_BoreLine – vertical lines representing hydrostratigraphy along selected boreholes adjacent to the SectionLine.
- XS2D_PanelDivider – vertical guides showing the location where a SectionLine changes direction.
- XS2D_MajorGrid and XS2D_MinorGrid – grid lines showing the vertical and horizontal scales in an XS2D data frame.

Additional feature classes can be added to represent items such as land surface elevation, water table, faults, etc.

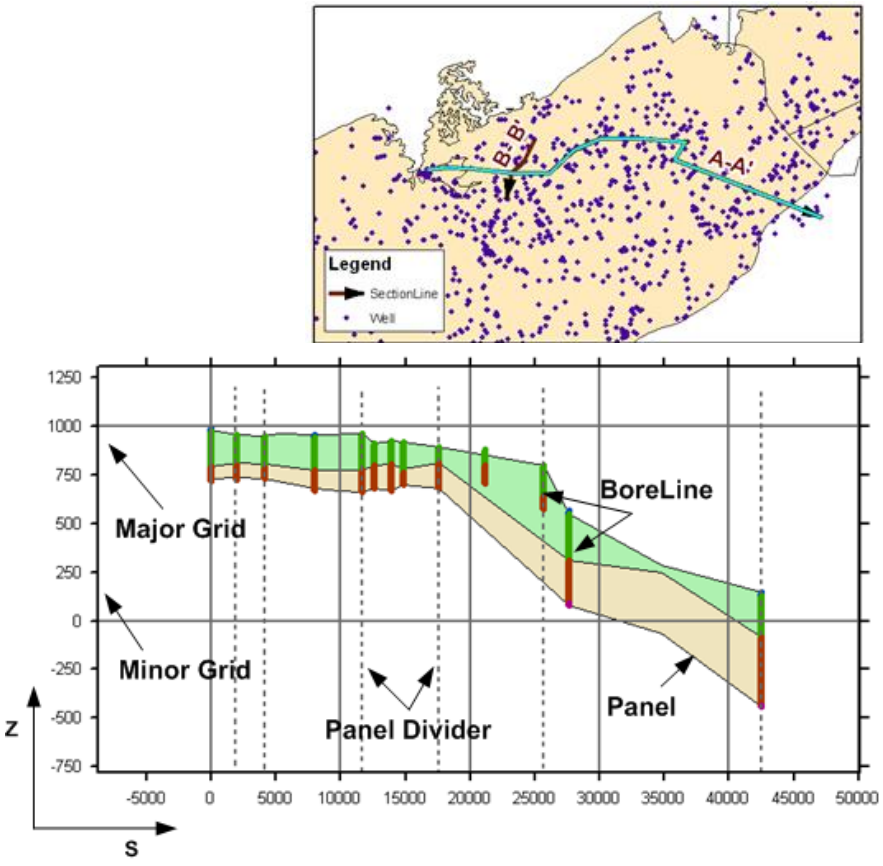


*Figure 4 Datasets used for creating 2D cross sections*

Each of the 2D cross sections is generated in a separate data frame in ArcGIS Pro. The XS2D feature classes are created in an {S, Z} coordinate system that is unique for each

cross section. The S coordinate represents the length along the SectionLine (equivalent to the x-direction in the XS2D data frame) and the Z coordinate represents the vertical dimension (the y-direction in the XS2D data frame). In addition, XS2D features can be scaled (exaggerated) in the Z dimension for better visualization. *Subsurface Analyst* includes a number of tools for transforming features between a "real" coordinate system (X, Y, and Z) and a 2D coordinate system (S, Z), and for scaling features.

The XS2D_Catalog table is used for managing XS2D feature classes. The Catalog lists the XS2D feature classes related with each SectionLine feature. The SectionID field in the XS2D_Catalog references a HydroID of a SectionLine feature, thus creating a relationship between SectionLines (defined in real world coordinates) and XS2D feature classes. An example of a typical XS2D_Catalog table is shown in Figure 5. Notice that all feature classes in the catalog end with a number (in this example 1) that references the HydroID of the related section line.

XS2D_Catalog

Field: Add Calculate Selection: Select By Attributes Zoom To Switch Clear Delete Copy Ro

| | OBJECTID * | Section Line... | SectionID | SName | Feature Class Name | XS2D Type |
|---|---|---|---|---|---|---|
| 1 | 3 | SectionLine | 2 | BD-BD' | XS2D_Panel_2 | Panel |
| 2 | 4 | SectionLine | 2 | BD-BD' | XS2D_PanelDivider_2 | PanelDivider |
| 3 | 5 | SectionLine | 2 | BD-BD' | XS2D_MajorGrid_2 | MajorGrid |
| 4 | 6 | SectionLine | 2 | BD-BD' | XS2D_MinorGrid_2 | MinorGrid |

*Figure 5 Example XS2D_Catalog used for managing XS2D feature classes and establishing a relationship between the XS2D features and a SectionLine feature*

# 4 Sketching SectionLine features

The first step will be to create a set of section line features from which the 3D features will be derived. The section line features will be drawn on the model map. The map includes a boundary defining the extent of the 3D model, well features, and outcrops as shown in Figure 6.

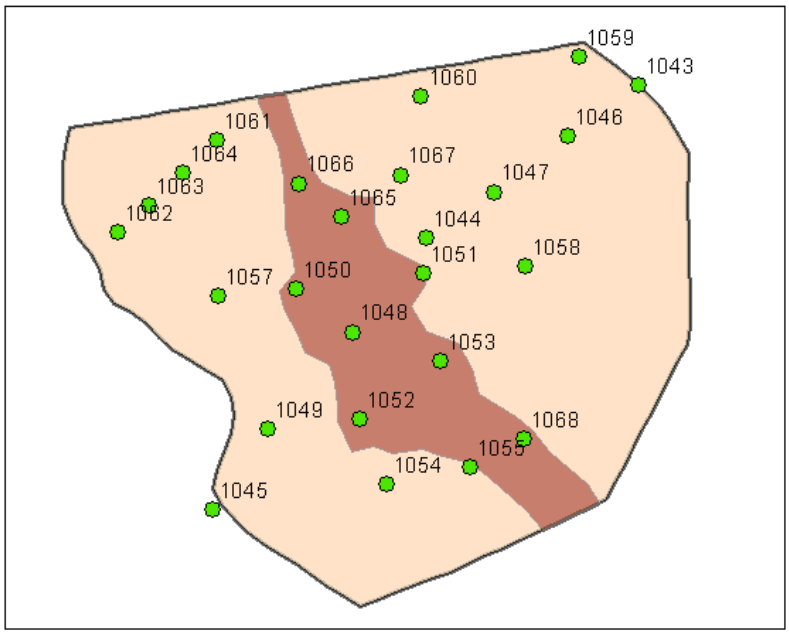


*Figure 6 Map containing the model boundary, wells, and outcrops*

To start sketching section lines:

1. On the ribbon, select the *Edit* tab.
2. Select the **Edit** button to start editing.
3. Select the **Create** button.
4. In the *Create Features* pane select the "SectionLine" item. This will enable editing of section lines.
5. Select the **Line** tool from the *Editor Toolbar*.
6. Sketch two section lines covering the model domain, as shown in Figure 7 starting with the sketch line labeled "A-A'". Make sure that the section lines do not extend beyond the model domain.

Tip: The direction of digitization defines the orientation of the cross section data. The 0 grid line (representing the beginning of the section line) will be on the left side of the data frame. For section lines going east-west, start the sketch on the west side and sketch to the east side. This will ensure that the cross section and map data are visually compatible.

7. Right-click on "SectionLine" in the *Contents* pane and select **Attribute Table** to bring up a *SectionLine* table pane.
8. In the *SName* attribute, enter "A-A'" for the first sketched section lines and "B-B'" to the second sketched lines.

At this point the map should be similar to the one shown in Figure 7.

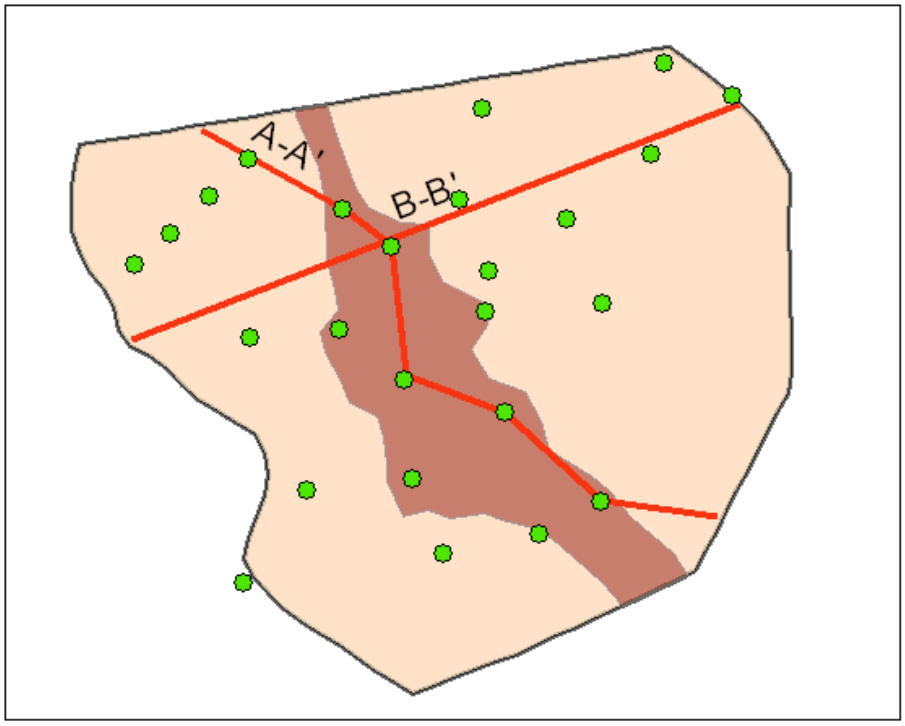


*Figure 7 Section lines sketched within the model boundary*

Next, assign vertical exaggeration values to the section lines. The cross section features will be scaled based on the vertical exaggeration attribute.

9. In the *SectionLine* table, click **Clear** to clear the selection.

10. Right-click on the *Vertical Exaggeration* field and select **Calculate Field** to open the *Calculate Field* dialog.
11. In the *VertExag2D*= field, enter "20" for the vertical exaggeration value**.**
12. Click **Apply**, then **OK** to exit the *Calculate Field* dialog.
13. Close the *SectionLine* table.
14. Select **Save Edits** in the *Manage Edits* section of the *Edit* tab.
15. If a dialog appears asking to confirm the save, click **Yes**.
16. Select **Edit** in the *Manage Edits* section of the *Edit* tab to stop editing.

After creating the features, HydroID values need to be assigned to them. The HydroID is the unique identifier of the feature within the geodatabase, and is used to create relationships between tables and feature classes. There are tools to help you manage your HydroIDs. The tool uses a UniqueID table to track the addition of HydroIDs in the geodatabase (The table has already been created using the Create Unique ID Table tool available in the Groundwater analyst toolset).

17. In the *Catalog* pane, expand "ArcHydroGroundwater.pyt".
18. Expand "Groundwater Analyst".
19. Double-click "Assign HydroID GW" to open the *Assign HydroID GW* pane.
20. Set *Input UniqueID Table* to "UNIQEID".
21. Set *Input Features to Assign HydroID* to "SectionLine".
22. Set *HydroID Field of Input Features* to "HydroID".
23. Select **Run** to execute the tool.

If desired, open the attribute table of the SectionLine layer to see that HydroIDs were assigned to the features.

# 5 Using the Create XS2D Cross Section Tool

The *Create XS2D Cross Section* tool creates a new set of feature classes for representing a 2D cross section based on a specific SectionLine feature. The wizard creates a new data frame to which the XS2D feature classes (XS2D_Panel, XS2D_BoreLine, XS2D_PanelDivider, XS2D_MajorGrid, and XS2D_MinorGrid) are added. Using a separate data frame for each 2D cross section allows us to visualize the features from each cross section independently.

Before actually running the *Create XS2D Cross Section* tool, select a set of wells to be included in the process of creating a 2D cross section. Borehole data related to these wells will help guide the cross section dimensions and borehole stratigraphy will be added to the cross section.

1. Select the *Map* tab in the ribbon.
2. Select SectionLine A-A' using the **Select Features** tool.
3. Select **Select By Location** to open the *Select By Location* dialog.
4. In the *Input Features* section, select the "Well" item.
5. In the *Relationship* section, select the "Within a distance" item.
6. In the *Selecting features* section, select the "SectionLine" item.

7. Set the *Search Distance* to “200” feet.
8. Click **Apply** and review the selected wells. Note that it might be necessary to modify the buffer distance depending on how the section line is sketched to select 5–6 wells.
9. Click **OK** to close the *Select by Location* dialog.

After applying the selection you should have six wells selected in the map as shown in Figure 8.

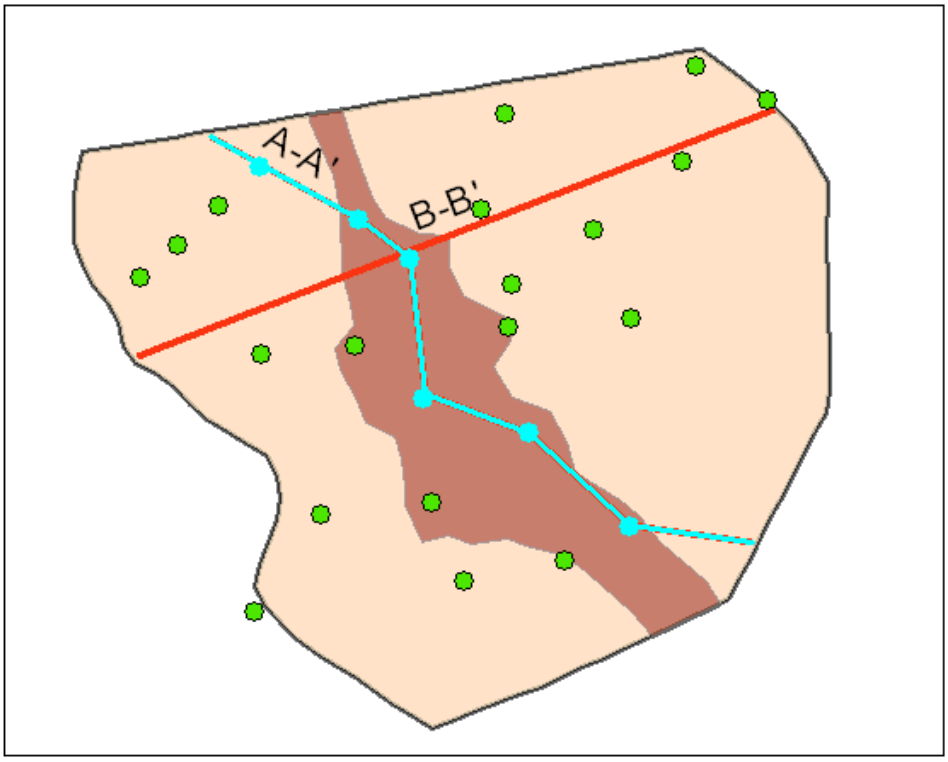


*Figure 8 Selected features after applying the Select By Location with a buffer of 200 feet*

Next, run the *Create XS2D Cross Section* tool to create a new cross section. The *Create XS2D Cross Section* tool is based on a selected section line and the wizard runs one cross section at a time. To start the *Create XS2D Cross Section* tool:

10. Select the *Arc Hydro Groundwater* tab on the ribbon.
11. Select the **Create 2D Cross Section** to open the *Create XS2D Cross Section* pane.

The *Create XS2D Cross Section* tool will create a set of feature classes and a new data frame for the selected SectionLine.

The tool is used to set up the appropriate panel, boreline, and panel divider feature classes. It can also specify the elevations for drawing panel dividers. Default values, based on the borehole data, are set for the minimum and maximum elevations of the panel dividers. The default values can be kept or modified.

12. In the *SectionLine Layer* section, select “SectionLine”.
13. In the *Wells and Borehole Log* section, turn on *Use well and borehole log data*.
14. Fill out the *Wells and Borehole Log* sections as follows:

- *Well Layer* set to “Well”.
- *Well Unique ID Field* set to “HydroID”.
- *Boreholelog Table* set to “BoreholeLog”.
- *WellID* field set “WellID”.

15. Click the **Select** tool located in the *SectionLine Layer* section to fill in the *ID*, *Length*, and *Name* options.

The tool is also used to create major and minor grid lines. The grid extent and spacing can be automatically specified based on the length of the selected SectionLine and borehole data, or they can be set manually.

16. In the Panel Divider Elevation section, click **Suggest Values from Well Data**.
17. In the Grid Extent section, click **Suggest Grid Extent**.
18. In the Grid Spacing section, click **Suggest Grid Spacing**.

At this point the inputs should be similar to the ones shown in Figure 9.

19. Select **Create XS2D Data** to run the tool.

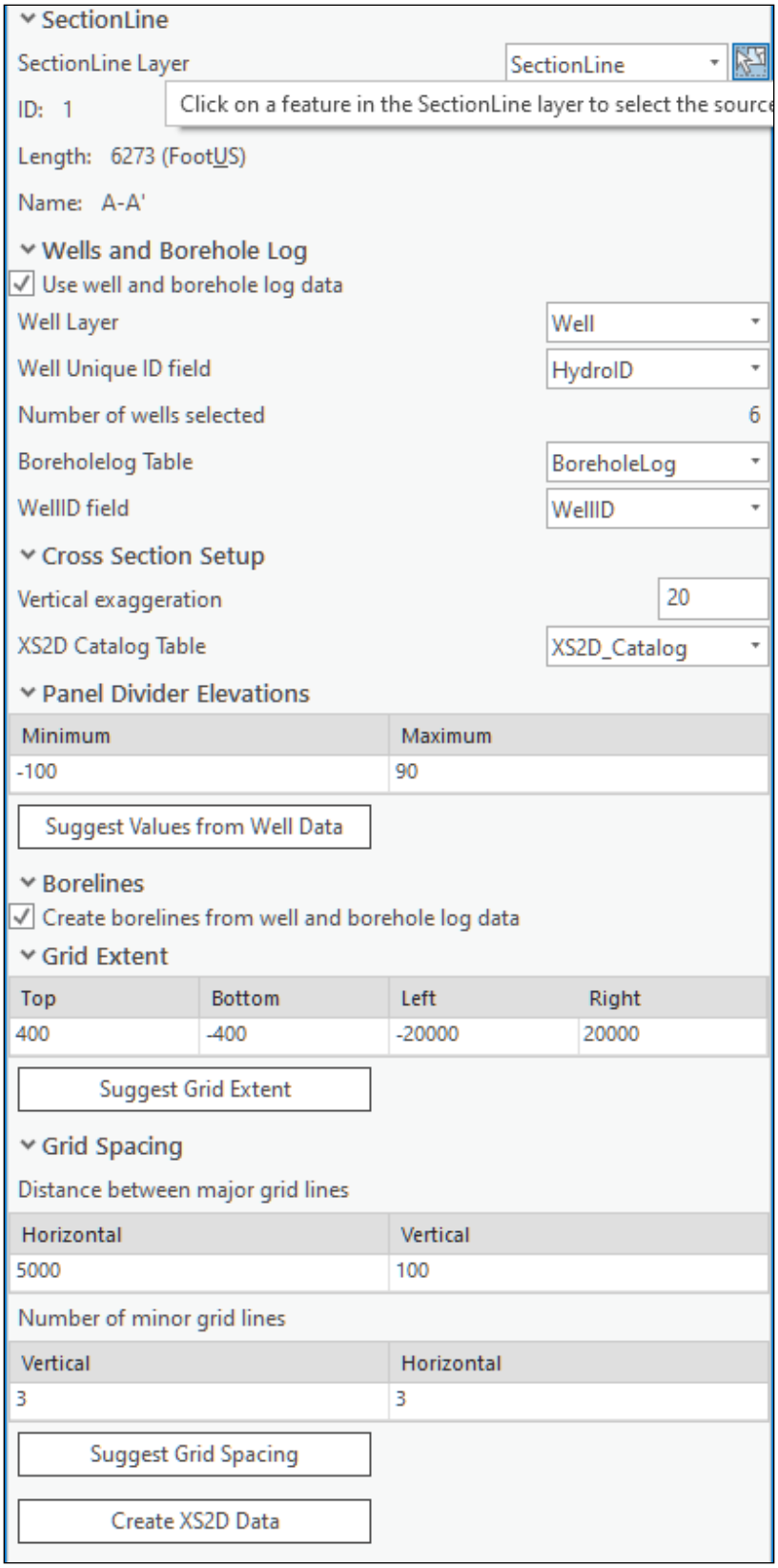


*Figure 9 Settings for the Create XS2D Cross Section tool*

A new Data Frame (Section A-A') should be added to the map (be sure to be in layout view to be able to view both data frames). Notice the grid lines, the panel dividers, and the boreline features. Boreline features are automatically symbolized by the *HGUID* to differentiate between the hydrogeologic units. In addition, the borelines are symbolized by the *Offset* field such that borelines from wells closer to the cross section are wider. Also, notice that grid lines showing the vertical and horizontal dimensions were added to the data frame.

Resize the A-A' data frame and move it within the map layout such in order to see both data frames. To better view the XS2D feature created:

- Using **Explore** tool, move the Section A-A' data frame within the map layout and resize it.
- Use the zoom tools ( ) to focus on the data within the cross section.

Use the *HGU Color Manager* to manage colors within the cross section data frames:

20. In the *Contents* pane, switch to **List By Data Source**.

Now to load the hydrogeologic unit table to the A-A' data frame.

21. Select **Add Data** to open the *Add Data* dialog.
22. Browse to and open the "Woburn.gdb" geodatabase.
23. Select the "HydrogeologicUnit" file and click **OK** to import the table and close the *Add Data* dialog.
24. Select the *Arc Hydro Groundwater* tab in the toolbar.
25. Select the **HGU Color Manager** macro to open the *HGU Color Manager* pane.
26. Change the settings to be as follows:
    - *HGU Table* to "HydrogeologicUnit".
    - *HGU ID Field* to "HydroID".
    - *HGU Name Field* to "HGUName".

If desired, modify the colors by using the color picker buttons in the *Symbology* column to pick a color for each of the HGUID values (listed in the *HGU ID* column).

27. Click **Apply Symbology** to apply the changes.

Note that the selected color scheme has been applied to all of the selected scene layers.

Increase the width of the XS2D_BoreLine features by:

28. Right-click on the "XS2D_BoreLine_1" layer and select **Symbology** to open the *Symbology* pane.
29. Select the *Class* tab and open the *More* drop-down menu to select the **Format All Symbols** to go to the *Format Multiple Line Symbols* dialog.
30. Select the *Properties* tab and adjust the symbol *Line Width* to a value of "5.0".
31. Click **Apply**.

At the end of this process, there should be an XS2D data frame that is similar to the one shown in Figure 10.

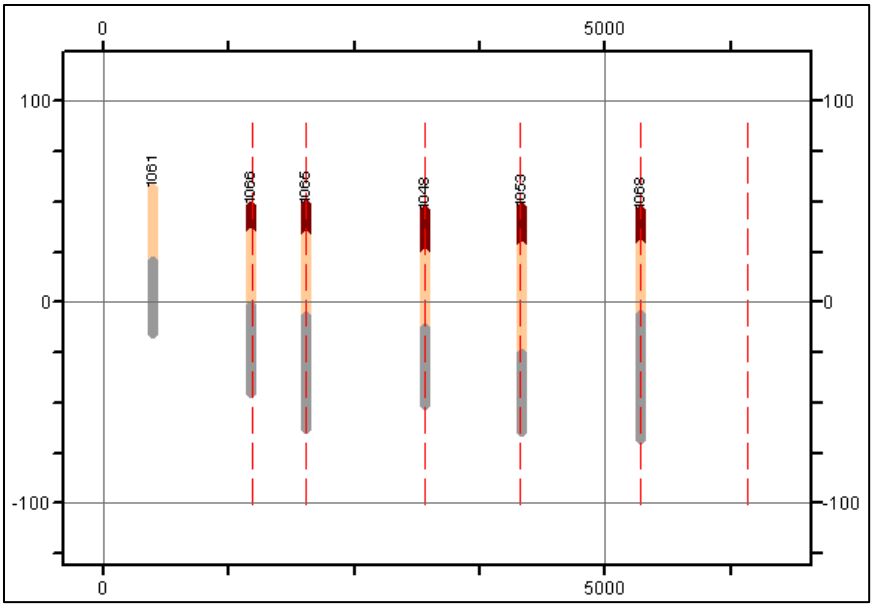


*Figure 10 Initial XS2D data frame with XS2D features created by the Create XS2D Cross Section tool*

Before continuing, create an additional cross section data frame for section line B-B'.

32. Repeat steps 1–31 to create an additional XS2D data frame for section B-B'. Note that the buffer distance may need to be changed to enable the selection of 4–5 wells adjacent to section line B-B'.

If desired, add text boxes to define sections A-A' and B-B' within the map layout. At the end of this process the map layout should be similar to the one shown in Figure 11.

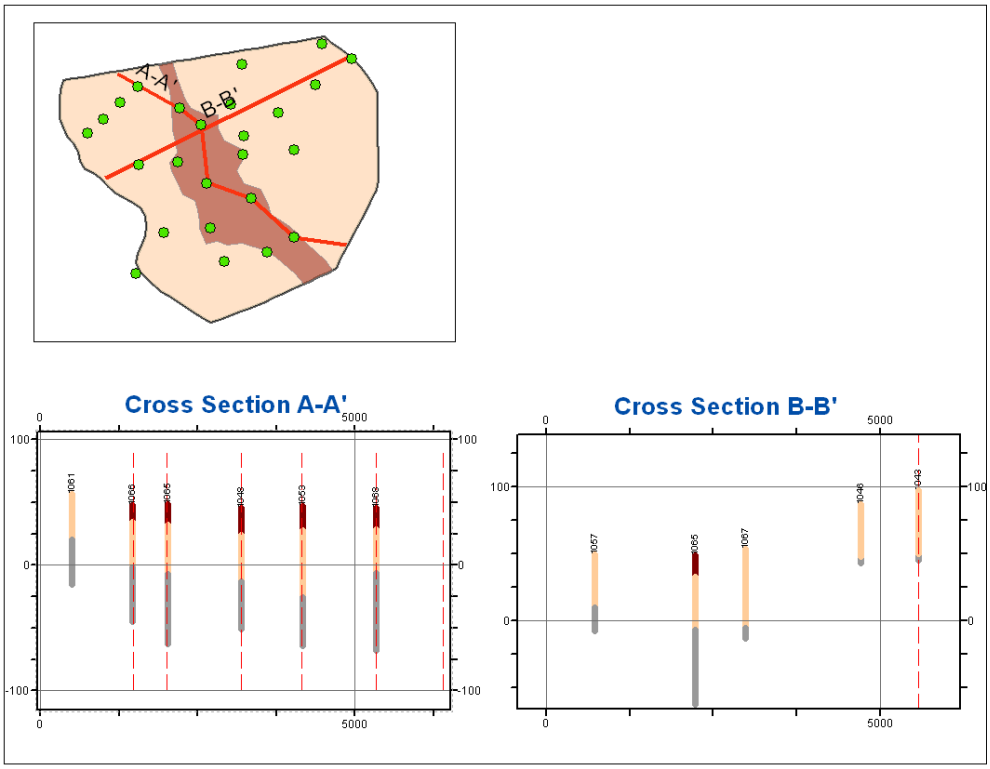


 

*Figure 11 Map layout containing cross sections A-A' and B-B'*

This is a good starting point for digitizing cross sections by connecting borehole data. But before sketching cross sections, add additional data that will guide the process for creating cross sections.

# 6 Adding Data from Geologic Maps

An important source of data to use while sketching cross sections is outcrop information from geologic maps. Geologic maps describe the outcropping of rock units (the coverage of a rock unit over the land surface). When combined with a digital elevation model, the geologic map data provides additional information to include in a cross section. The map includes a set of polygon features that represent outcrops of the peat and alluvium formations defined within the model.

Before continuing, create a new line feature class to which the output XS2D Lines will be written.

1. Switch to the "Map" view.
2. Select the *Map* tab on the ribbon.
3. In the *Selection* section, click the **Clear** macro.
4. In the *Catalog* pane, expand the "Subsurface Analyst/XS2D Editor" toolset under the "ArcHydroGroundwater.pyt" toolset.
5. Double-click on the "Create XS2D Line Feature Class" tool to open the *Create XS2D Line Feature Class* pane.

This tool will create a new XS2D line feature class for each of the selected SectionLine features. If no section line is selected it will create feature classes for all section lines in the SectionLine feature class.

6. For *Input Section Line Features* select "SectionLine".
7. For *XS2D_Catalog Table* select "XS2S_Catalog".
8. For *XS2DType value of the XS2D line feature* enter "Outcrop".
9. For *Feature Class Name Prefix* enter "Outcrop".

The feature classes created will include the prefix specified and the HydroID of the section line feature (e.g. Outcrop_1).

10. Click **Run** to execute the *Create XS2D Line Feature Class* tool.

Two new feature classes named "Outcrop_1" and "Outcrop_2" should be added to the *Contents* pane.

Next, add XS2DLine features to the feature class just created. Each line in the feature class represents the intersection of the section line with a surface (raster). The values from the raster are usually scaled in the Z dimension, so they can be better visualized.

To add geologic map data along the cross sections:

11. In the *Catalog* pane, expand the "Subsurface Analyst/XS2D Editor" toolset, double-click on " Transform Polygons to XS2D Lines" tool to open the *Transform Polygons to XS2D Lines* pane.
12. For *Input Polygon Features* select "Outcrops".
13. For *Input Section Line Features* select "SectionLine".

14. For *Input XS2D_Catalog Table* select “XS2D_Catalog”.
15. For *XS2DType* select “Outcrop”.
16. For *Ground Surface DEM* select “dem100ft”.

The *Discretization Spacing* should be automatically populated after selecting the raster. The default spacing is equal to the raster cell size.

17. Specify a *Discretization Spacing* of “100”.
18. For *FType value of the features to create* enter “Outcrop”. This is an optional value that enables classifying the XS2DLine feature created.

The *Overwrite* parameter should be enabled automatically, such that before writing new features, the tool clears the target feature class. If it is disabled, then new features will be appended to the feature class.

19. Click **Run** to execute the *Transform Polygons to XS2D Lines* tool.

When the tool is done a new set of lines is added to the Outcrop_1 and Outcrop_2 feature classes. To view the lines within the cross section data frames:

20. Switch to the “ Section A-A’” map view.
21. In the *Catalog* pane, expand the “ woburn.gdb” item under the “ Databases” item.
22. Expand the “ Data” item, then right-click on the item and select **Refresh**.
23. Drag the “ Outcrop 1” item into the “ Section A-A’” map view.

Next, use the HGU Color Manager to modify the symbology of the outcrop lines:

24. Select the *Arc Hydro Groundwater* tab in the toolbar.
25. Select the **HGU Color Manager** macro to open the *HGU Color Manager* pane.
26. Click **Apply Symbology** to apply the changes.

Note that the selected color scheme has been applied to the outcrop lines.

27. Repeat steps 20–26 for the B-B’ cross section data frame.

At this point the XS2D data frames (A-A’ and B-B’) should be similar to the one shown in Figure 12.

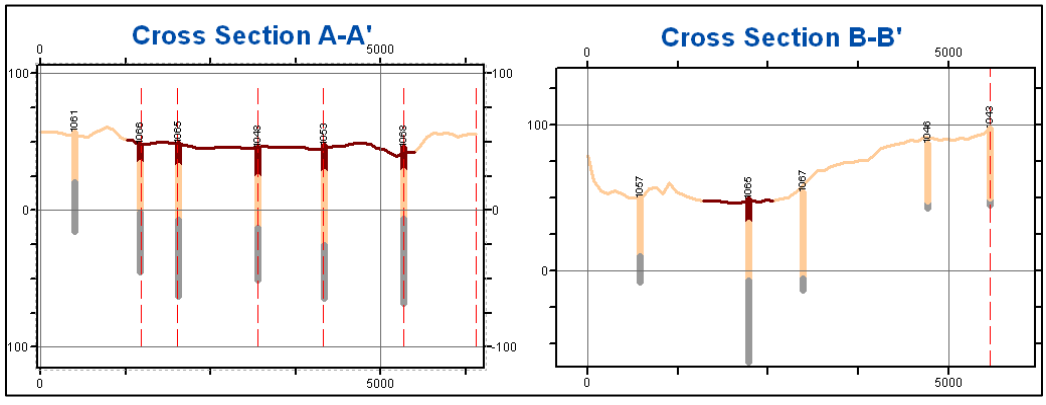


*Figure 12 Cross section data frames with borelines and outcrops*

The borelines and outcrops will be used while digitizing new cross sections.

# 7 Sketching Cross Section Panels

In this section, new cross section panels will be sketched. Use the boreline data and outcrops as guides while utilizing the advanced editing capabilities available in ArcGIS Pro.

## 7.1 Creating a New Template for Editing XS2D Panel Features

First create a template for the XS2D Panel feature class:

1. Switch to the "Section A-A'" map view.
2. In the *Contents* pane, select "XS2D_Panel_1" then right-click and select **Symbology** to open the *Symbology* pane.

Before creating a template, make sure that the symbology of the panels is setup correctly. The XS2D_Panel symbology should have already been set using the *HGU Color Manager* in previous steps of this tutorial. The symbology of the XS2D_Panel layer should be similar to the one shown in Figure 13. If the symbology is not set correctly, set it using the *HGU Color Manager* as shown in section 5.

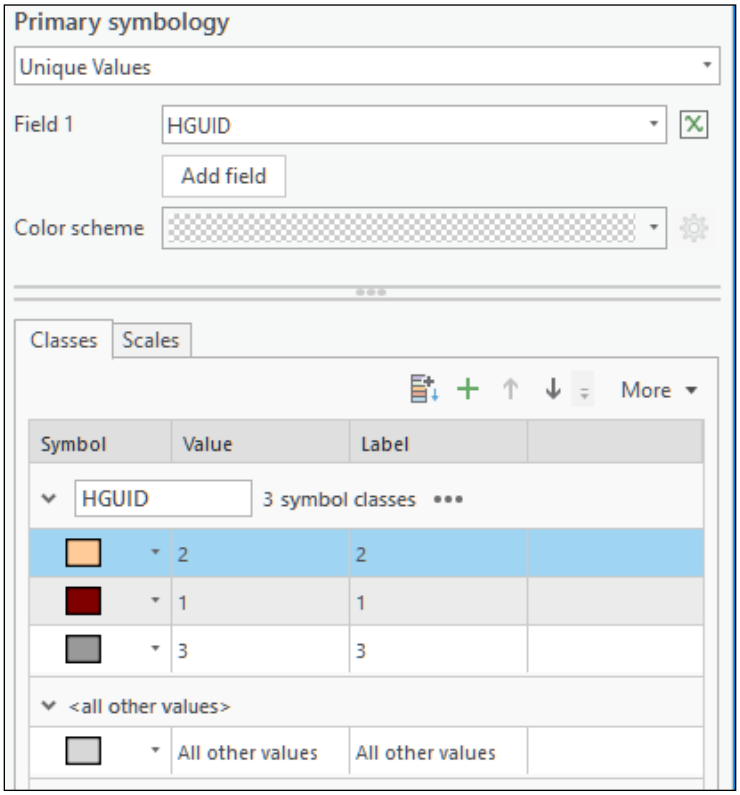


*Figure 13 Symbology for the XS2D_Panel layer*

Next, define a new feature template:

3. Select *Edit* tab in the ribbon.
4. In the *Features* group, click the **Create** button to open the *Create Features* pane.

The *Create Features* window should include a template for the XS2D_Panel_1 layer, as shown in Figure 14.

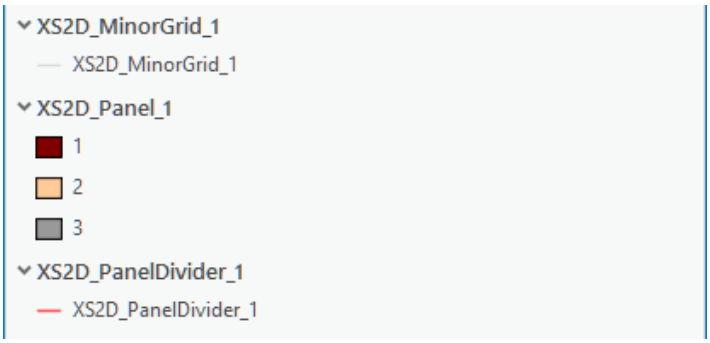


*Figure 14 The Create Features pane after adding a template for XS2D Panel features*

Next, set the snapping environment.

## 7.2 Setting the Snapping Environment Options

Make sure the Section A-A' map view is still activated and the *Create Features* pane is open.

For this tutorial activate the snapping option. To enable this option:

1. In the *Snapping* section of the *Edit* tab on the ribbon, select the down arrow under **Snapping** to open up a menu.
2. Select the **Snapping** icon to turn snapping on if it is not on already.

## 7.3 Sketching Panels

1. Zoom to the right end of the cross section and zoom in on the outcrop representing HGUID = 2 (Alluvium).
2. In the *Create Features* pane, under "XS2D_Panel_1", select the feature symbology for HGUID = 2.

Notice that the *Construction Tools* window contains a list of the available tools for creating new panels.

3. Make sure the **Polygon** tool is selected.

The *Trace* editing tool will be used to trace the outcrop as part of the cross section creation.

Tip: while sketching, use the zoom and pan tools to focus on certain elements of the cross section.

4. In the *Editor* pane, select the **Trace** tool.
5. Trace the outcrop defining HGUID = 2. Start tracing from the right side by clicking on the edge of the line, then drag the mouse over the outcrop line. A new line should appear while moving the mouse to the left side of the outcrop. When the end of the outcrop line is reached, click on the edge to create a vertex.

The sketch should be similar to the one shown in Step 1 of Figure 15.

6. Using the **Line** tool, and continue sketching a cross section panel. Use the boreline edges as a guiding point. The sketch tool should automatically snap to the end of the boreline features while digitizing. Make sure to also snap to the panel dividers defining the start and end of the cross section.

7. Change between the **Line** and **Trace** tools to follow the borelines and outcrops.

The sketch should be similar to the one shown in Step 2 of Figure 15.

8. Make sure to reach the right side panel divider as shown in Step 3 of Figure 15.
9. Double-click on the starting point to close the panel.

The sketch should be similar to the one shown in Step 4 of Figure 15.

Tip: To better visualize the borelines on top of the panels, set a transparency of 70% on the panel features (select the layer, right-click, and select Display tab to set the transparency for the layer).

Next, assign some basic attributes to the panel.

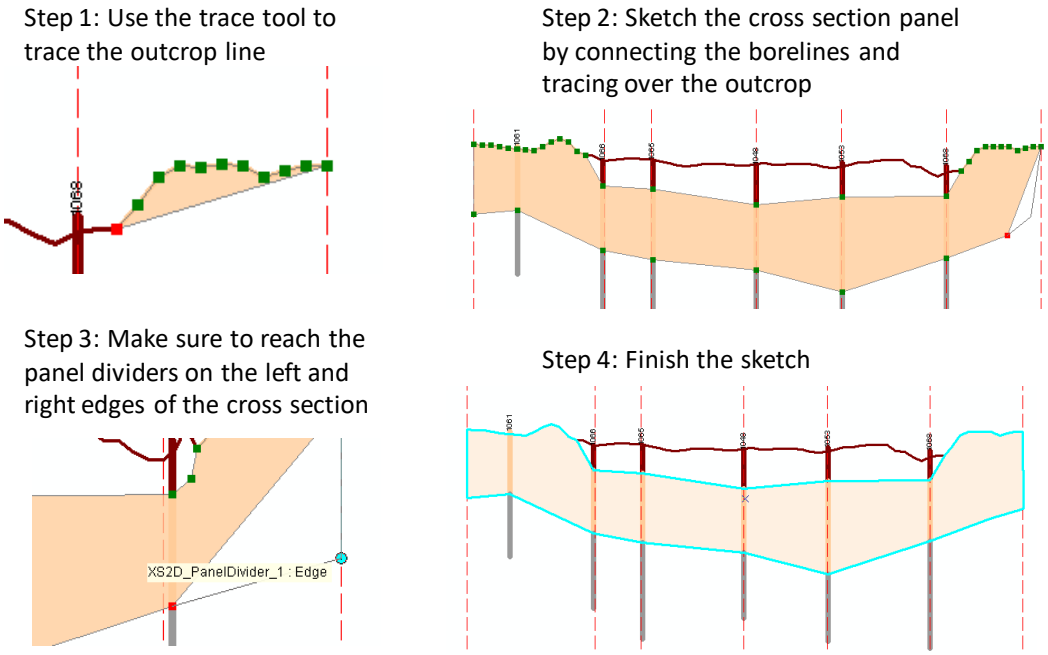


*Figure 15 Steps in sketching a cross section panel*

10. Using the **Select** tool, select the feature which was just created.
11. Right-click and select **Attributes** to open the *Attributes* pane.

In the *Attributes* pane make sure a value of "2" is in the *HGUID* field so it matches the HGUID of the borelines and outcrops used in the sketching process. This value should be created automatically.

12. In the *Edit* tab of the ribbon, select **Save Edits**.

Next, digitize the panel for the peat layer represented by HGUID = 1:

13. Zoom in to the outcrop line representing HGUID = 1.
14. In the *Create Features* pane, under "XS2D_Panel_1", select the feature symbology for HGUID = 1.
15. Select the **Autocomplete Polygon** tool.

16. Using the **Trace** tool, sketch a line following the outcrop representing HGUID = 1.
17. Make sure that the line snaps to the end of the panel representing unit 2, as shown in Figure 16.

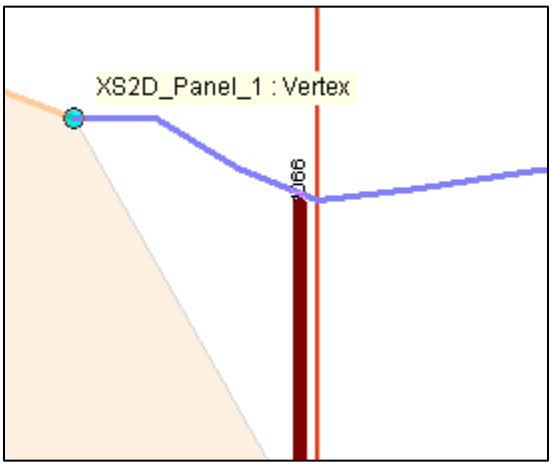


*Figure 16 The new polygon should snap to the vertex located at the intersection of the cross section panel and outcrop*

18. Double-click on the starting point to close the panel.

A new polygon representing HGUID = 1 should be created. The polygon's boundary should match the boundary of the polygon representing HGUID = 2.

The sketch should be similar to the one shown in Figure 17.

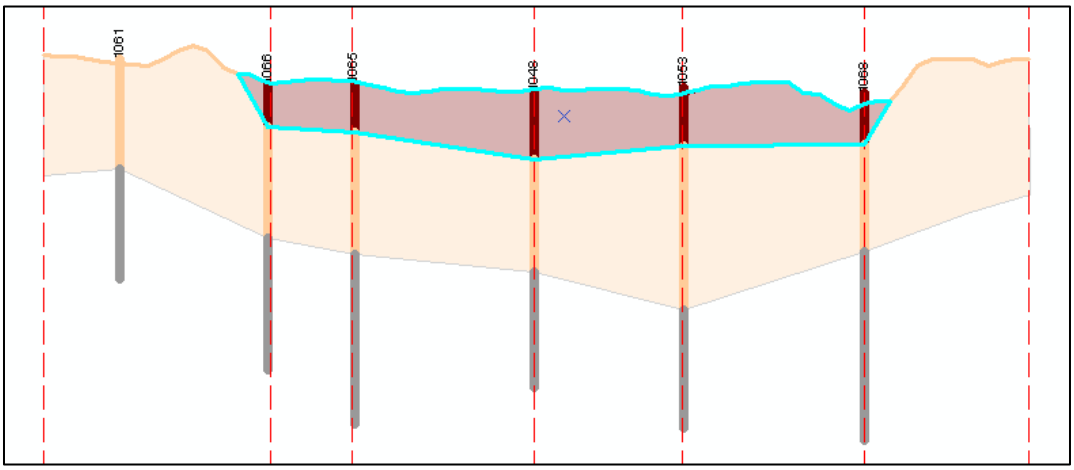


*Figure 17 Cross section panel created using the Autocomplete Polygon task*

19. Using the **Select** tool, select the feature which was just created.
20. Right-click and select **Attributes** to open the *Attributes* pane.

In the *Attributes* pane edit make sure HGUID is set to "1", so it matches the HGUID of the borelines and outcrops used in the sketching process.

21. In the *Edit* tab of the ribbon, select **Save Edits**.

Next, sketch the panel for the gravel unit HGUID = 3.

22. In the *Create Features* pane, under "XS2D_Panel_1 template", select the feature symbology for HGUID = 3.
23. Select the **Autocomplete Polygon** tool.
24. Using the **Trace** tool, start sketching from the upper left or right corner of the unit and make sure to snap to the panel representing unit 2, as shown in Figure 18.
25. Using the **Line** tool, sketch downward along the panel divider, and then across following the borelines representing the bottom of unit 3. At the edge of the cross section, snap to the panel dividers and sketch upwards. Make sure to snap to the panel representing unit 2, as shown in Figure 18.
26. Double-click on the starting point to close the panel.

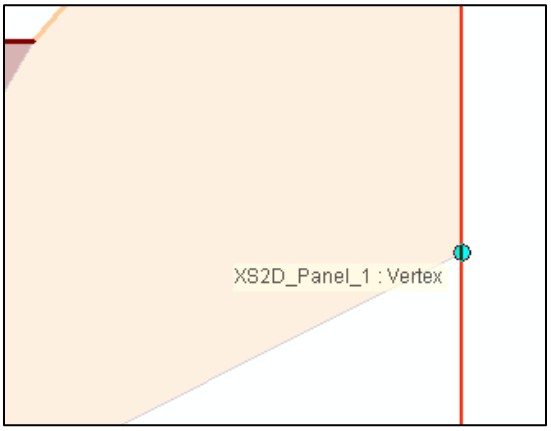


*Figure 18 Sketching cross section panel for HGUID = 3*

After finishing the sketch of the gravel unit the cross section should be similar to the one shown in Figure 19.

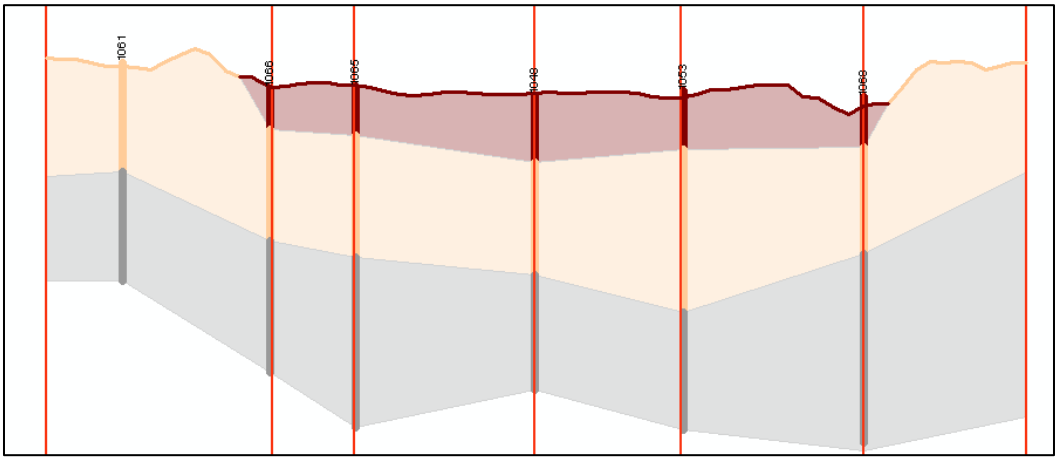


*Figure 19 Cross section after sketching the panel representing the gravel unit*

Next, assign some basic attributes to the panel.

27. Using the **Select** tool, select the feature which was just created.
28. Right-click and select **Attributes** to open the *Attributes* pane.

In the *Attributes* pane make sure HGUID is set to "3" so it matches the HGUID of the borelines and outcrops used in the sketching process.

29. When done editing the attributes, close the *Attributes* window
30. In the *Edit* tab of the ribbon, select **Save Edits** .
31. Select **Disable Editing** .
32. Repeat steps 1–31 to sketch cross section panels for cross section B-B' (make sure to activate the B-B' data frame before you start a new edit session).

At the end of this process there should be two completed cross sections, similar to the ones shown in Figure 20.

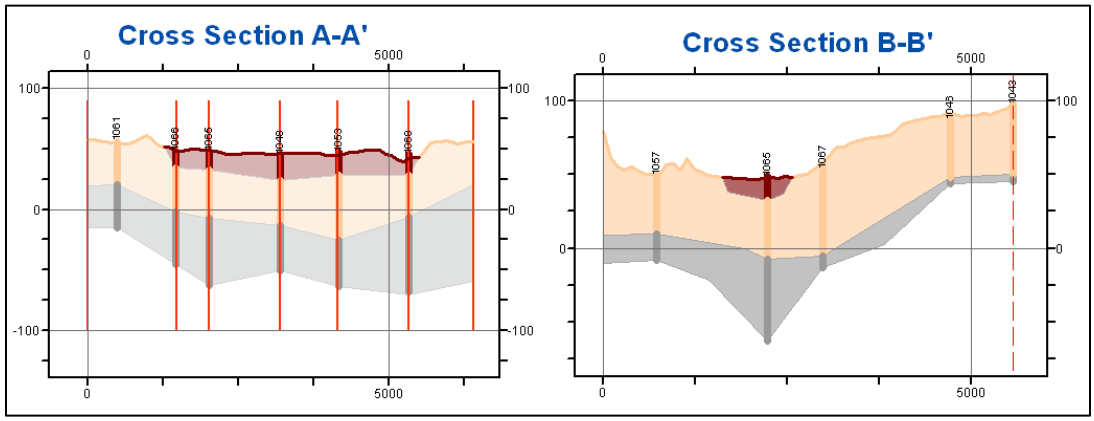


*Figure 20 Completed cross sections with borelines, outcrops, and panels*

Next, add data from a water level raster into the cross section.

# 8 Adding Raster Data to the Cross Section

In this section, add a line representing a water table to the cross section. The line is derived from a raster representing the water table surface, values from the raster are transformed into the XS2D coordinate system and a new line is created in the cross section.

1. Switch to the " Map" view.
2. Click the **Clear** icon to unselect all features in the data frame.
3. In the *Catalog* pane, expand the " Subsurface Analyst/XS2D Editor" toolset under the " ArcHydroGroundwater.pyt" toolset.
4. Double-click on the " Create XS2D Line Feature Class" tool to open the *Create XS2D Line Feature Class* pane.
5. For *Input Section Line Features* select "SectionLine".
6. For *Input XS2D_Catalog Table* select "XS2D_Catalog".
7. For *XS2DType Value* enter "Water Table".
8. For *Feature Class Name Prefix* enter "WaterTable".
9. Select **Run** to execute the tool.

Two new feature classes WaterTable_1 and WaterTable_2 should be created and added to the map. Now create new line features representing the water table along the section line.

10. In the *Catalog* pane, expand the "Subsurface Analyst/XS2D Editor" toolset, double-click on " Transform Raster to XS2D Lines" tool to open the *Transform Raster to XS2D Lines* pane.
11. For *Input Section Line Features* select "SectionLine".
12. For *Input Raster* select "watertable".
13. For *Input XS2D_Catalog Table* select "XS2D_Catalog".
14. For *XS2DType value* select "Water Table".
15. The *Discretization Spacing* should be automatically updated to "50".
16. For *FType* enter "water table".
17. The *Append to Existing XS2D_Line Features* option should be enabled to append the new feature to existing features.
18. Select **Run** to execute the tool.
19. To view the water table lines on the cross sections, drag the WaterTable_1 and WaterTable_2 layers from the Contents and and drop them into the appropriate data frames (A-A' and B-B').
20. If desired, adjust the symbol properties of the water table layers in the A-A' and B-B' cross section data frames.

At the end of this process a line representing the water table should be added to the cross sections, similar to the blue lines shown in Figure 21.

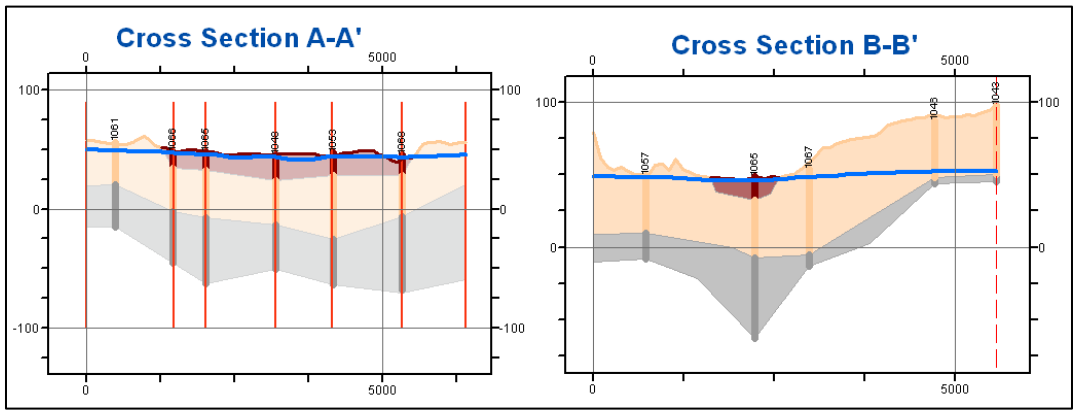


*Figure 21 Water table lines added to the cross sections*

# 9 Transforming 2D Cross Section to 3D GeoSections

Once the2D cross sections are created, it is possible to transform them to 3D features (GeoSections) and visualize them in *Scene* view. This part of the tutorial requires 3D Analyst.

First, create the GeoSection feature class:

1. Switch to the " Map" view.
2. In the *Catalog* pane, expand the "Subsurface Analyst/Features" toolset, double-click on " Create GeoSection Feature Class" tool to open the *Create GeoSection Feature Class* pane.

 

3. In the *Output GeoSection Features* field, click the browse button to open the *Output GeoSection Features* dialog.
4. Browse to the *woburn.gdb\Data* directory and enter "GeoSection" as the feature class name.
5. Click **Save** to close the *Output GeoSection Features* dialog.
6. Select **Run** to execute the tool.

Next, create the GeoSection features by transforming 2D cross section panel polygons to 3D GeoSections:

1. In the *Catalog* pane, expand the "Subsurface Analyst/XS2D Editor" toolset then double-click on " Transform XS2D Panel to GeoSection" tool to open the *Transform XS2D Panel to GeoSection* pane.
2. For *Input SectionLine Features,* select "SectionLine".
3. For *Input XS2D_Catalog Table* select "XS2D_Catalog".
4. For *Input GeoSection Features,* select "GeoSection".
5. Select **Run** to execute the tool.

Now to visualize the 3D GeoSections just created.

6. Switch to the " Scene" map view.

A 3D scene that includes the DEM and water table rasters rendered as 3D surfaces should appear.

7. Select **Add Data** to open the *Add Data* dialog.
8. Browse to and open the "Woburn.gdb" geodatabase and open the "Data" directory.
9. Select the "GeoSection" file and click **OK** to import the table and close the *Add Data* dialog.
10. If desired, symbolize the GeoSection layer using the HGU Color Manager.

# 10 Conclusion

This concludes the tutorial. Here are some of the key concepts in this tutorial:

- The Arc Hydro Groundwater data model includes XS2D feature classes that provide the framework for working with 2D cross sections in ArcGIS Pro.
- Sketch cross section lines and use the XS2D Wizard to set up a new data frame and create the basic XS2D feature classes.
- Data from geologic maps in combination with digital elevation models can be transformed to the XS2D data frame, and are used as guides for "sketching" cross sections.
- ArcGIS Pro editing tools are used to help digitize cross sections based on guiding features (e.g. borelines, outcrop lines).
- Additional data can be transformed to the XS2D data frame and added to the cross section.
- 2D cross sections can be transformed to 3D features and visualized in ArcGIS Pro.