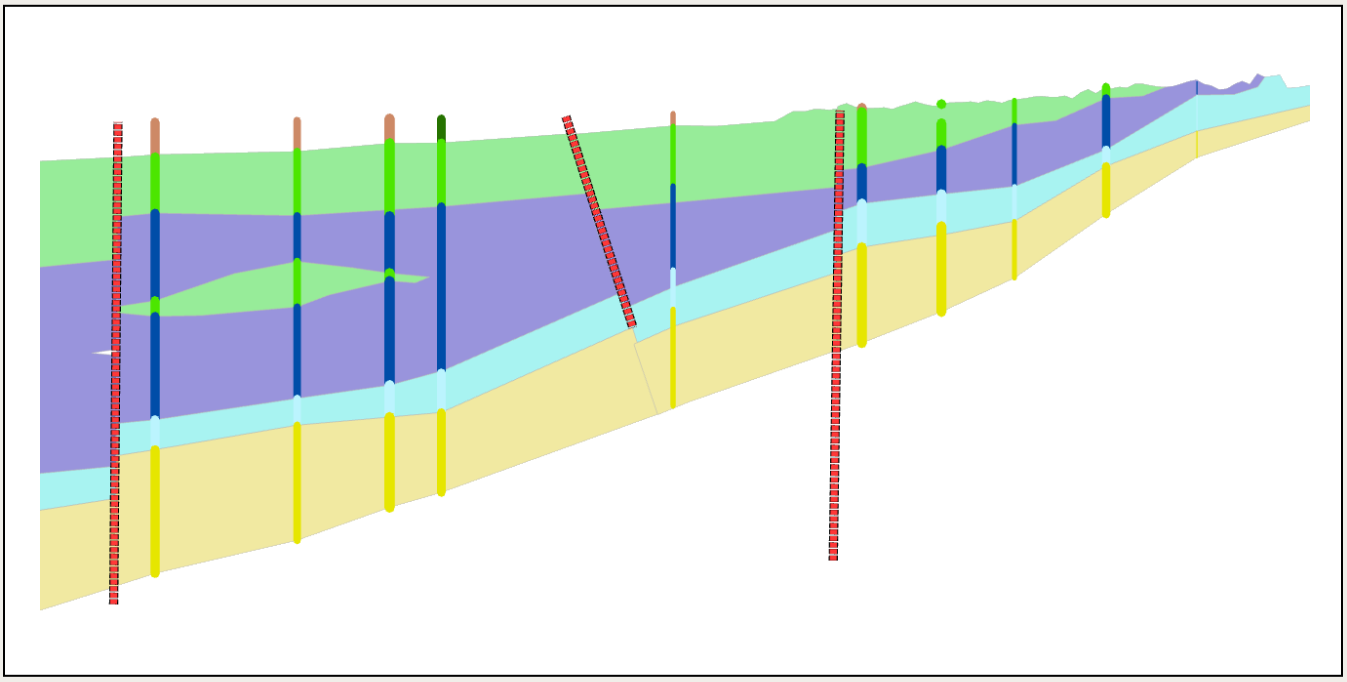
AHGW Pro 1.0 Tutorial

Subsurface Analyst – Adding Faults to Cross Sections

Add faults to 2D cross sections using Arc Hydro Groundwater in ArcGIS Pro



Objectives

Learn how to use Arc Hydro Groundwater Pro tools to add faults to cross sections.

Prerequisite Tutorials

- Subsurface Analyst – Creating 2D Cross Sections

Required Components

- ArcGIS Pro
- Subsurface Analyst

Time

- 10–25 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, and includes several components to represent different types of datasets, including representations of aquifers and 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.

Subsurface Analyst includes tools for creating 2D cross sections by adding data to a new XS2D data frame and "sketching" cross sections based on borehole stratigraphy, outcrops, faults, etc. In addition Subsurface Analyst supports the creation of 3D cross sections and volumes from a set of surfaces. The 3D features can be viewed in ArcGIS Pro. The workflow and tools for creating 2D cross sections and 3D features are described in separate tutorial.

This tutorial will demonstrate how to add faults to cross sections.

1.1 Background

In a separate tutorial a cross section were built from borehole stratigraphy, outcrops, and terrain data. In this tutorial the same cross section will be used to add faults to it. Figure 1 shows the cross section location in map view and the vertical cross section representing the hydrogeologic units along the cross section.

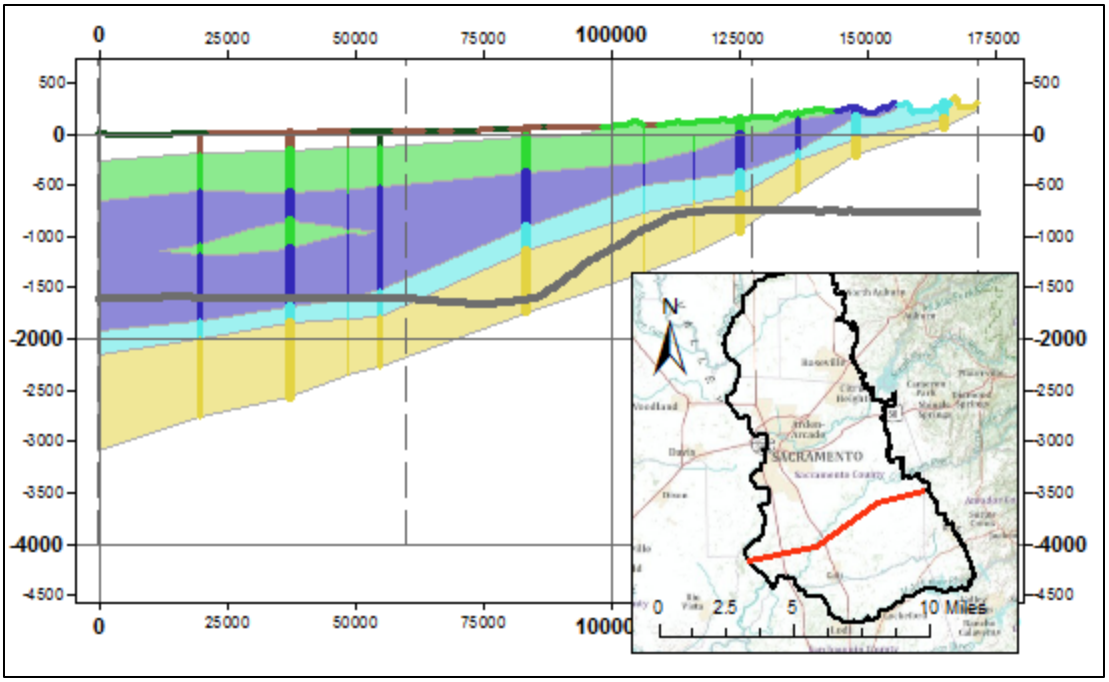


Figure 1 Cross section representing hydrogeologic units.

1.2 Outline

The objective of this tutorial is to introduce the basic workflow and tools for adding faults to 2D cross sections.

1. Get familiar with how faults are represented as point features with attributes describing the 3D setting of the fault.
2. Create a new XS2D Line feature class and transform faults onto a XS2D data frame.

1.3 Required Modules/Interfaces

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

- ArcGIS Pro License
- Arc Hydro Groundwater Pro Tools
- AHGW Pro Tutorial Files

The AHGW Pro Tools require that you have a compatible ArcGIS Pro service pack installed. Check the AHGW Pro Tools documentation to find the appropriate service pack for the version of the tools. The tutorial files should be downloaded and saved on a local drive.

2 Getting Started

Begin by opening a project containing the cross section and background data for the 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_faults.aprx" located in the *SubsurfaceAnalystPro/XS2D_Faults* folder.

Once the file has loaded, a map of the Roseville, California area will appear with a sketched cross section in a separate data frame (Figure 2).

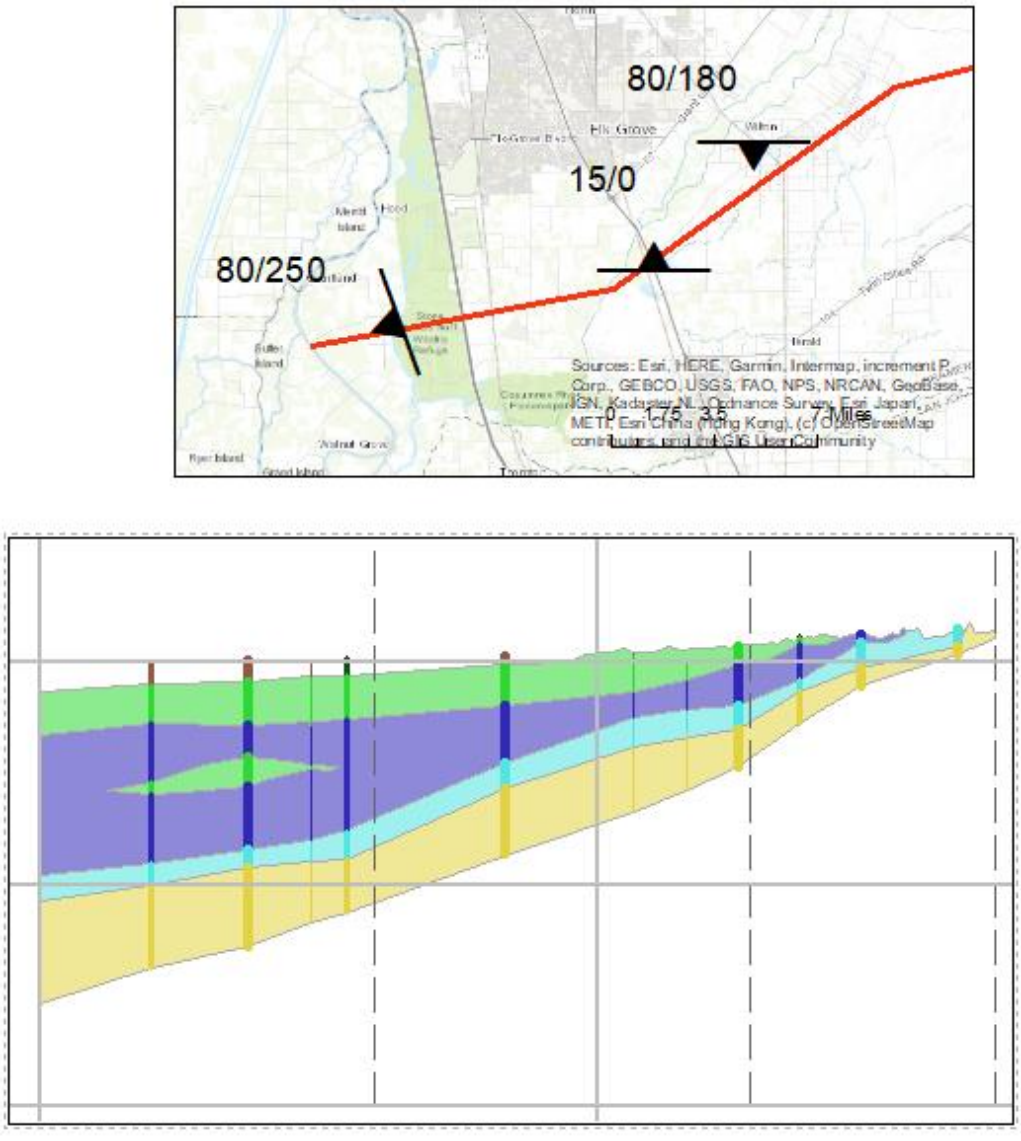


Figure 2 Map of Roseville, California along with sketched cross section

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".
6. Expand "Groundwater Analyst".

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:

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

3 Adding Faults to a Cross Section

The project includes a layer that represents faults as point features as shown in Figure 3.

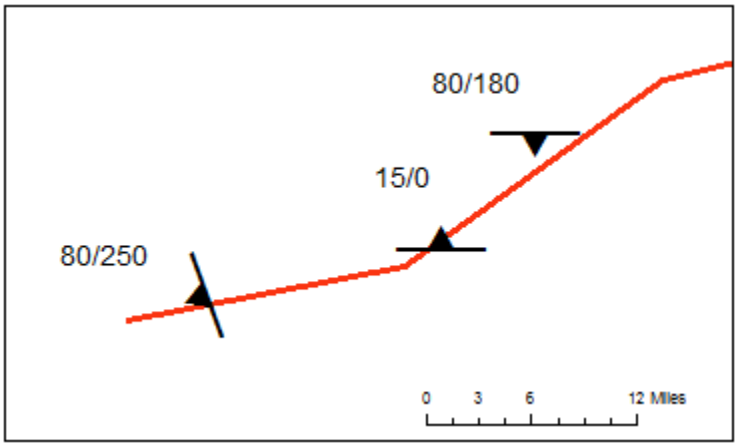
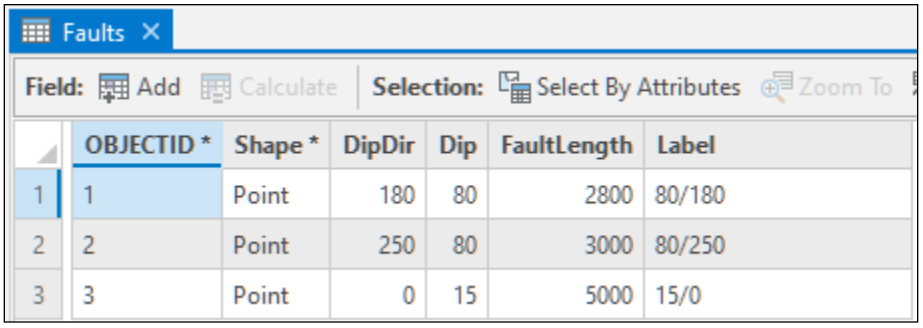


Figure 3 Faults represented as point features.

Additional attributes (see Figure 4) describing the dip direction, dip angle, and fault length describe the 3D orientation of the fault. The *DipDir* attribute describes the direction of the fault and is measured clockwise from the north (values range from 0 to 360). The *Dip* attribute represent the dip angle from a horizontal plane (values range from 0 to 90). The *FaultLength* attribute represents the length of the fault from the land surface. For example

the first row represents a fault dipping to the south (DipDir = 180) and the angle of the dip is 80°.



	OBJECTID *	Shape *	DipDir	Dip	FaultLength	Label
1	1	Point	180	80	2800	80/180
2	2	Point	250	80	3000	80/250
3	3	Point	0	15	5000	15/0

Figure 4 Attributes of Fault features.

Before adding the faults to the cross section, create a new XS2D Line feature class to hold the transformed faults. The faults will be projected onto the cross section surface and appear as line features on the cross section.

1. Switch to the "Map" view.
2. In the *Catalog* pane, expand the "Subsurface Analyst" and "XS2D Editor" toolsets under the "ArcHydroGroundwater.pyt" toolset.
3. Double-click on the "Create XS2D Line Feature Class" tool to open the *Create XS2D Line Feature Class* pane.
4. For *Input Section Line Features* select "SectionLine".
5. For *Input XS2D_Catalog Table* select "XS2S_Catalog".
6. For *XS2DType value of the XS2D line features* enter "Fault".
7. For *Feature class name prefix* enter "Fault".
8. Click **Run** to execute the *Create XS2D Line Feature Class* tool.

The tool creates a new feature class named *Fault_6475*; also the XS2D_Catalog is updated to include a new record referring to the new feature class. Next, transform the fault features to create lines in the XS2D data frame.

To display faults on a cross section the 3D fault, defined by the dip, dip direction, and fault depth, is projected onto the cross section plane. Faults will then appear as lines on the cross section. We use the *Transform Faults to XS2D Lines* to transform the faults and create the line features.

9. In the "XS2D Editor" toolset, double-click on "Transform Faults to XS2D Lines" tool to open the *Transform Faults to XS2D Lines* pane.
10. Specify the parameters as follows:
    - *Input SectionLine Features* select "SectionLine".
    - *Input XS2D_Catalog Table* select "XS2D_Catalog".
    - *XS2DType* select "Fault".
    - *Input Fault Features* select "Faults".
    - *Fault Dip Direction Field* select "DipDir".
    - *Fault Dip Field* select "Dip".
    - *Fault Length Field* select "FaultLength".

- *Input Surface Elevation Raster* select “dem30m”.
- Make sure *Overwrite Existing XS2D Line Features* is turned on.

11. Click **Run** to execute the *Transform Faults to XS2D Lines* tool.

The tool should create three new features in the “Fault_6475” feature class.

12. Switch to the “ Section A-A’” view.
13. In the *Catalog* pane, expand the “ Folders”, “ XS2D_Faults”, “ Roseville_faults.gdb”, and “ Data” folders.
14. Drag the “ Fault_6475” layer to the “ Section A-A’” data frame.

The three faults should appear on top of the cross section panels.

15. If desired, adjust the display of the faults in the cross section.

At this point the cross section should be similar to the one shown in Figure 5.

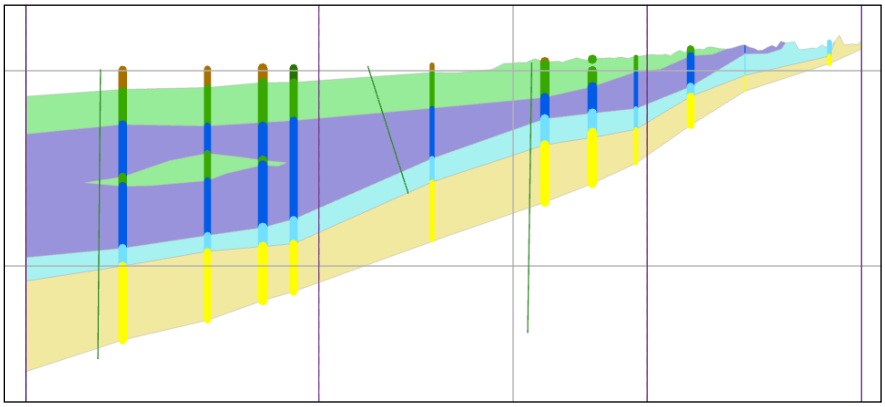


Figure 5 Lines representing the faults.

Notice that the cross section panels shown in Figure 5 do not really match the faults as they were sketched before adding the faults to the cross section. In practice, the faults to the cross sections can be added before sketching the cross section panels then use the fault lines on the cross section as guides for sketching cross section panels. Figure 6 shows an alternative set of cross section panels that better match the faults. Turn on layer “ XS2D_Panel_6475_with_faults” to view the solution panels in the cross section data frame.

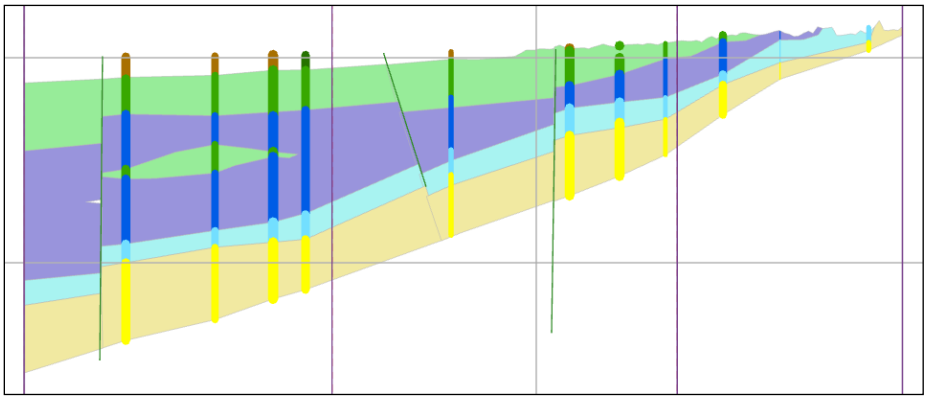


Figure 6 Cross section panels sketched based on faults.

4 Conclusion

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

- Faults can be represented by point features with attributes describing the direction, dip angle, and length.
- Faults can be added to cross sections as line features by transforming fault features and projecting them into a XS2D data frame.