2021 – ArcGIS Pro

Spatial Data Formats

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Horizontal units are in **feet and meters** (UTM 10-N, NAD-83 and SPCS Wa-S, NAD-83 HARN).

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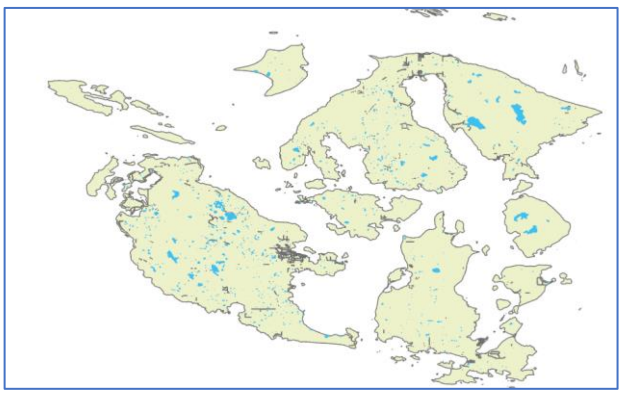
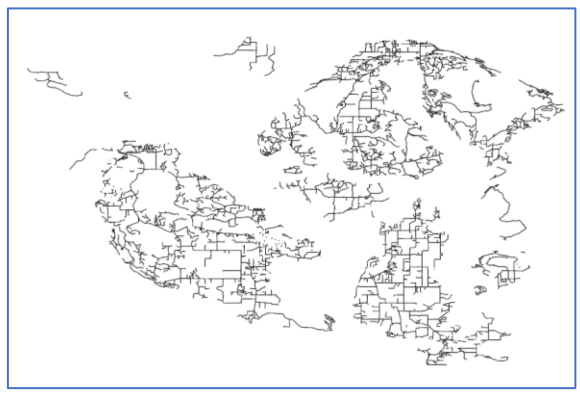
Introduction

The spatial data used in GIS comes in two basic categories: *Vector* data and *Raster* data. In addition, *TINs***,** while technically a type of vector data, are sometimes classified separately. In this exercise we'll learn about these different types of spatial data. In addition, we will look at some of the different file types used for these spatial data.

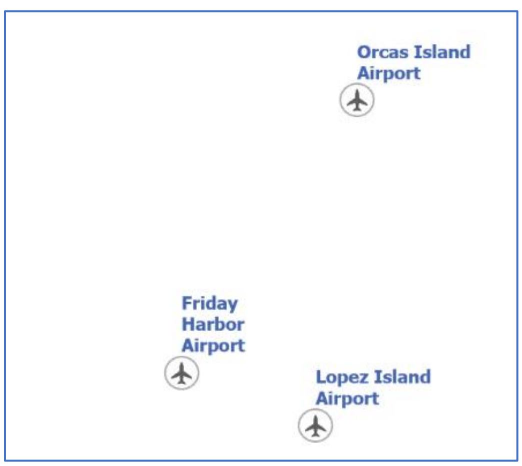
Vector data layers are made up of *points*, *lines* or *polygons* representing features. These features are typically grouped thematically (e.g., the road lines and kept in a separate file from the stream lines and zoning polygons are stored separately from census block polygons). Vector data is commonly used for discrete features such as cities, state boundaries, roads, streams, bus stops, sample sites, etc. Each individual feature in a vector data set has corresponding record or row of attributes stored in an attribute table.



Polygons: Islands and Lakes

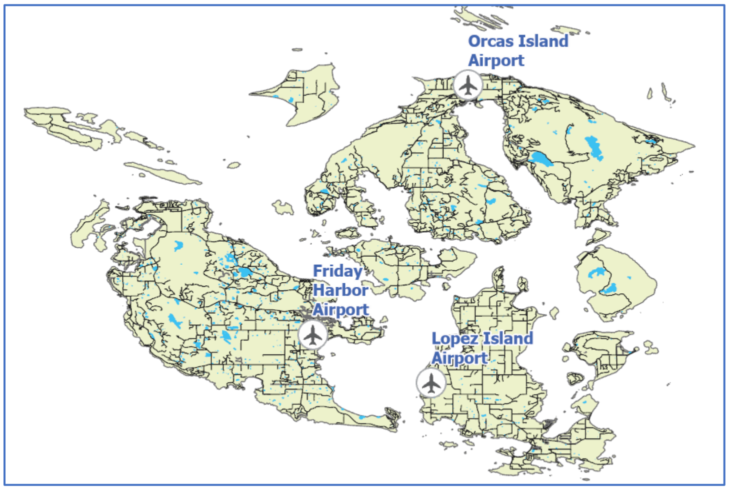


Lines: Roads



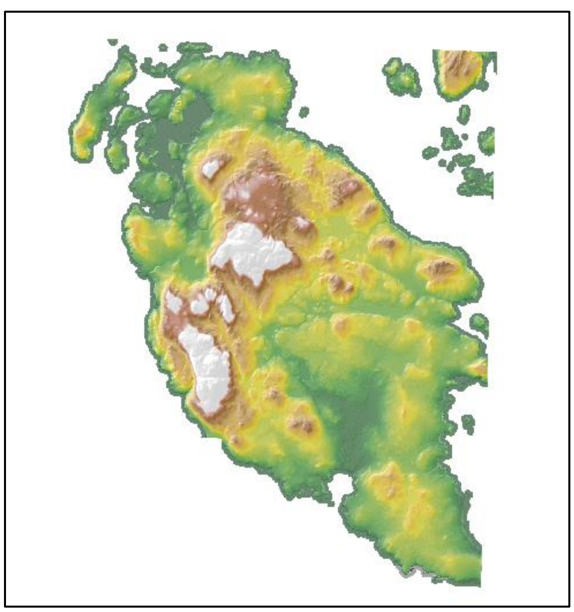
Points: Airports

GIS software allows for different layers of spatial data to overlay based on spatial reference information. Later in the training we will learn how the spatial reference system in GIS works. For now, we provide a number of examples of spatial data overlay to introduce you to spatial data functionality in GIS. Please see the vector data overlay on the following page as an example of that.



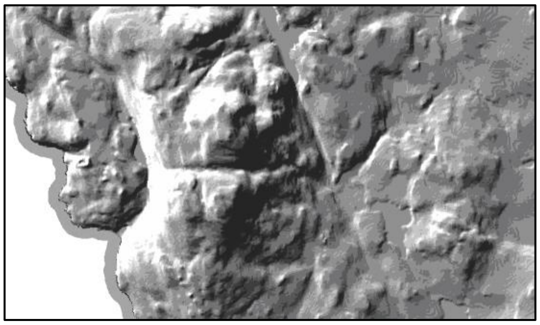
Vector Data Overlay: Polygons, Lines and Points

Raster data layers contain a series of cells (or pixels) that completely cover the spatial extent, not unlike a large checkerboard. A common raster data format is called a *Grid* (referring to the grid-like nature of the cells as laid out next to one another). Each cell in a raster dataset has a numeric value which can be used to indicate a generalized value of landscape phenomena that occurs across that cell's location on the landscape. Generally, raster data is used for phenomena that change gradually but continuously across the surface of the earth (referred to as 'continuous' data as opposed to discrete features) such as elevation, rainfall, slope, etc.

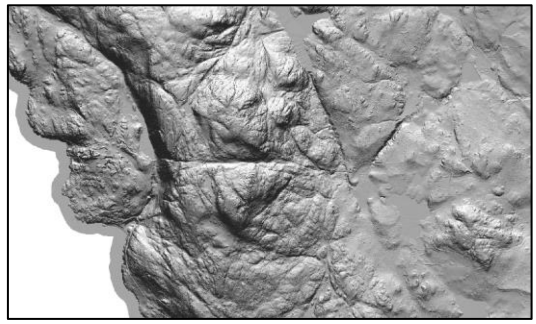


Raster data: Elevation surface overlaying hillshade.

Raster data resolution and detail are controlled by cell-size, a raster with smaller cell-size means each cell represents a smaller area on the landscape, and which results in less generalization or more detail across the landscape.



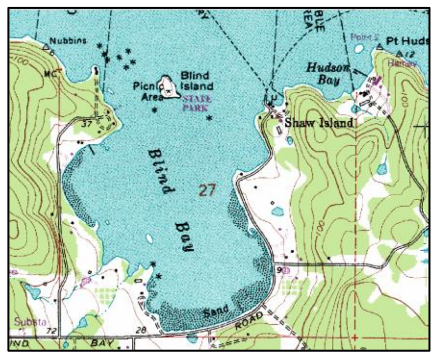
Hillshade raster (10m cell-size).



Hillshade raster (3ft cell-size).

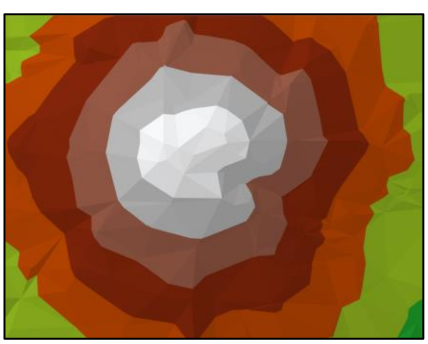
Imagery (e.g. air photos, satellite imagery and scanned maps) is also raster data. With imagery, the cell values are used to specify a particular color or shade of gray (based on a numerical list of colors). Scanned maps are another form of imagery data.

Air photo imagery

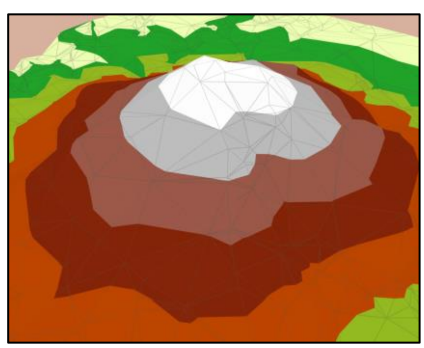


Scanned map imagery

A *TIN* (Triangulated Irregular Network) is a method of storing continuous data, typically for elevation. Technically, a TIN is a type of vector data (triangles made up of lines connecting points of elevation) but they function similar to a raster surface. TINs are often used for 3D visualization and analysis. TINs can have a higher resolution in areas where a surface is highly variable and a lower resolution in areas that are less variable.



A TIN of a mountain peak



3D perspective of a TIN

Exercise Learning Objectives

- Introduction to Vector Data
- Introduction to Raster Data
- Introduction to TIN Data

Step 1: Open the ArcGIS Pro Project

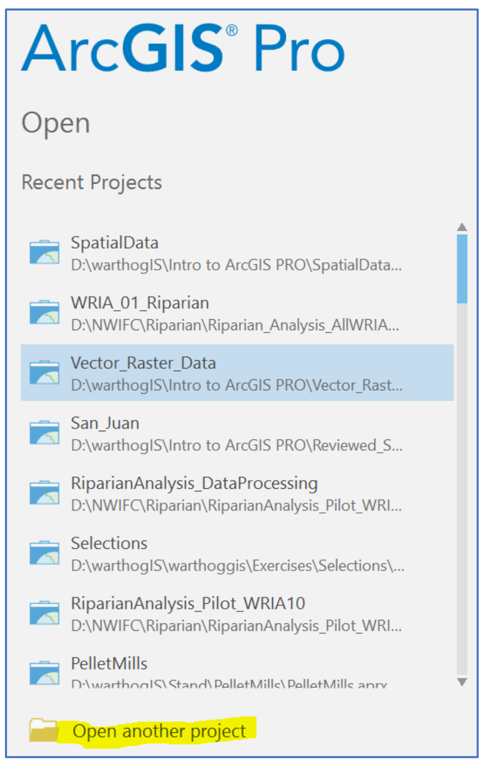
Overview

Start this exercise by opening the **SpatialData.aprx** ArcGIS PRO project file from the **SpatialData** project folder in the **Spatial_Data_Formats** folder in the **Exercises** folder .

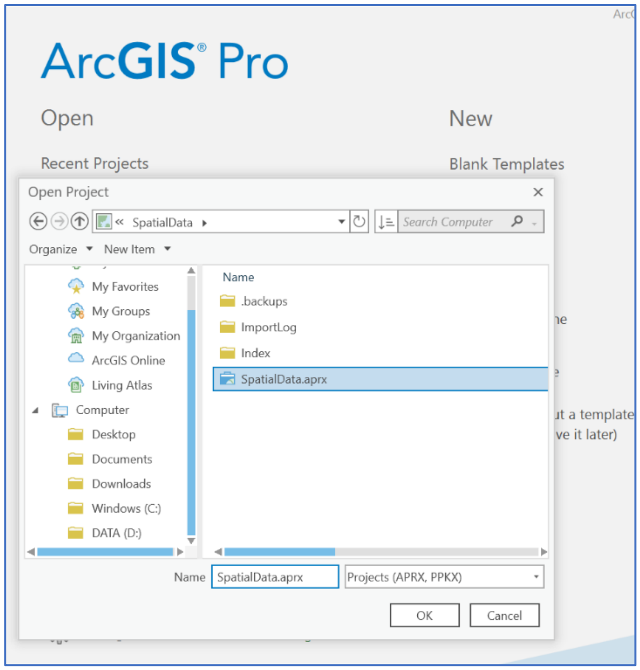
Instructions

➢ Open ArcGIS Pro on your computer (from the Start Menu/All Programs/ArcGIS, or search "ArcGIS" in the Windows search bar) - (logging in to your user account if required).

➢ From the bottom of the ArcGIS Pro opening page, select *Open another project* to browse through that project folder.



➢ Browse to the **Exercises / Spatial_Data_Formats / SpatialData** folder and double-click on **SpatialData.aprx** to open the **SpatialData** project.



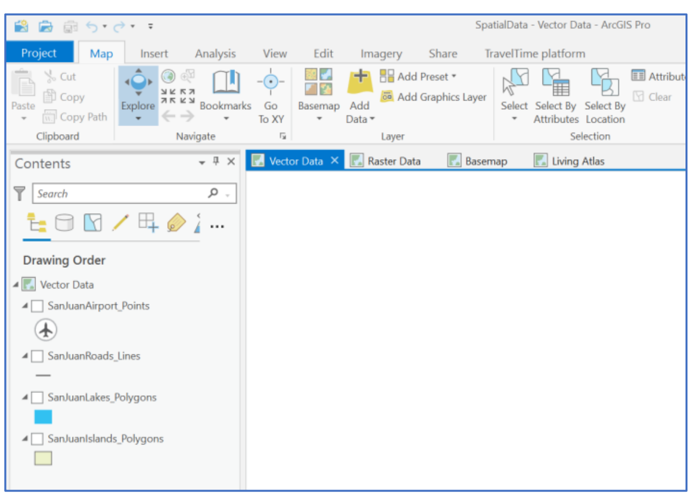
Step 2: Introduction to Vector Data Layers

Overview

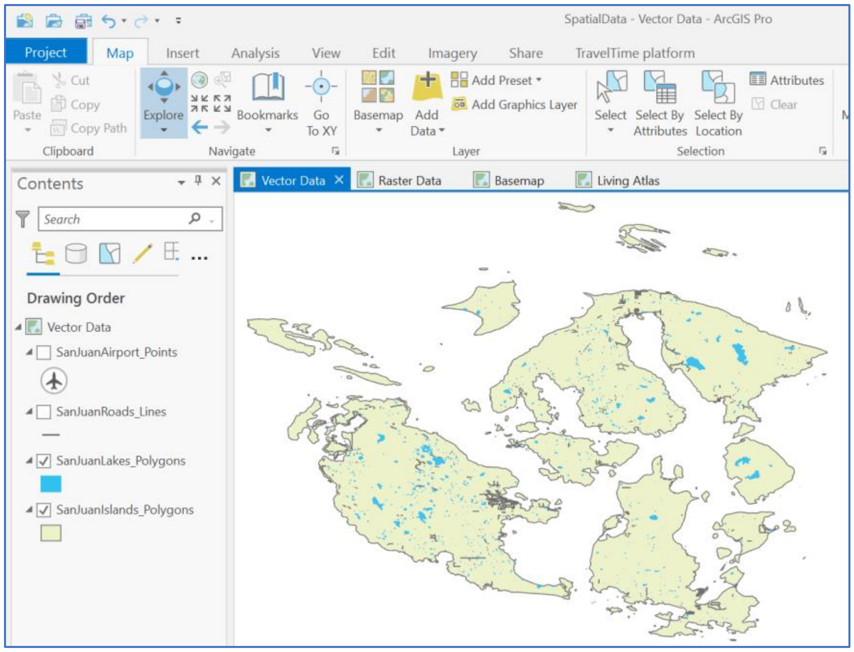
In this step of the exercise we explore vector data in the context of an ArcGIS Pro project.

Instructions

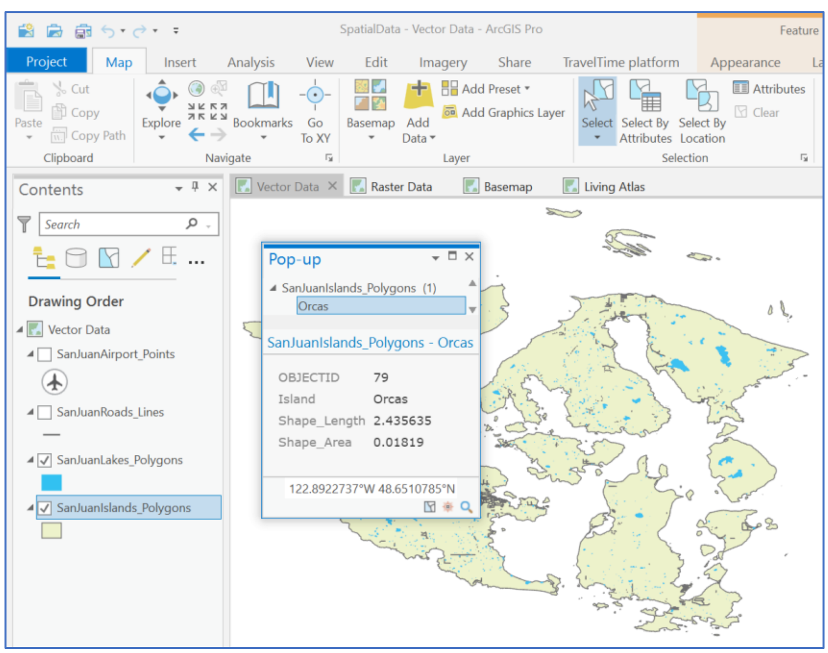
➢ Your project file opens with the *Vector Data* map view active. None of the layers are yet turned on in this active view.



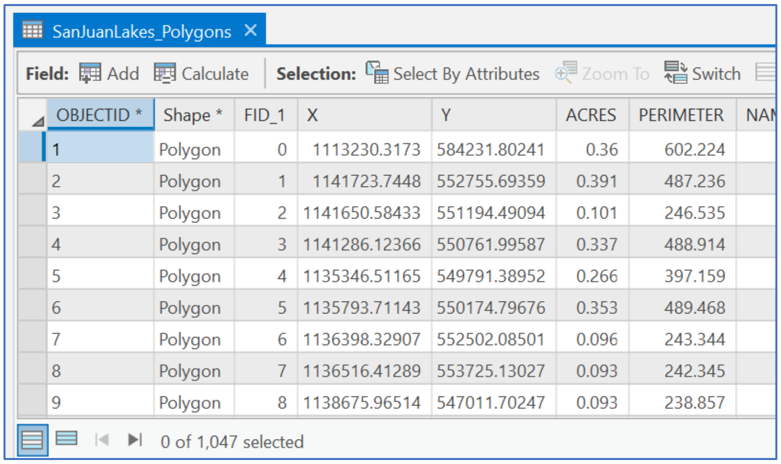
- In the map *Contents* pane on the left, check (to make visible) the **SanJuanIslands_Polygons** and the **SanJuanLakes_Polygons** vector layers. These are both polygon vector layers. The features in polygon vector layers are enclosed areas and can be used for areal measurements (i.e. acres, square miles, hectares, etc.).



- From the *Map* tab of the ribbon, click on the *Explore* tool and click on any of the polygon features visible in the map. A *pop-up* will emerge showing you the attribute details of the feature you clicked on. Each feature in a vector dataset has a record of attributes in a table. The pop-up draws from the feature layer's attribute table.

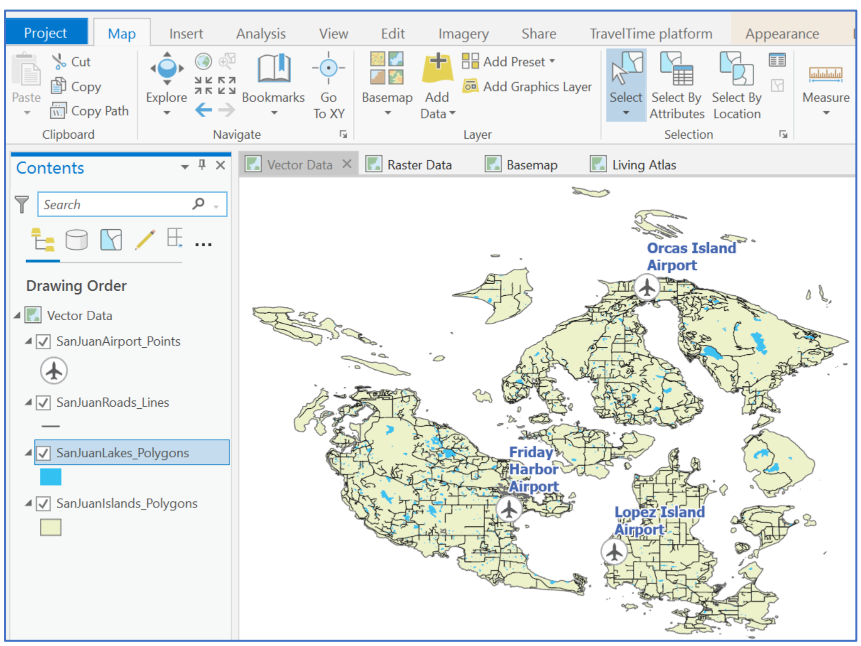


➢ In the map Contents pane right-click on the **SanJuanIslands_Polygons** layer and click on *Attribute Table*. This opens the attribute table for **SanJuanIslands_Polygons**. At the bottom left of the attribute table is the number of records in the table (1,047). This record count in a vector feature layer's attribute table is always the same as the number of vector features in the feature layer. There are 1,047 island polygons in the **SanJuanIslands_Polygons** dataset.



OBJECTID *	Shape *	FID_1	X	Y	ACRES	PERIMETER	NAI
1	Polygon	0	1113230.3173	584231.80241	0.36	602.224	
2	Polygon	1	1141723.7448	552755.69359	0.391	487.236	
3	Polygon	2	1141650.58433	551194.49094	0.101	246.535	
4	Polygon	3	1141286.12366	550761.99587	0.337	488.914	
5	Polygon	4	1135346.51165	549791.38952	0.266	397.159	
6	Polygon	5	1135793.71143	550174.79676	0.353	489.468	
7	Polygon	6	1136398.32907	552502.08501	0.096	243.344	
8	Polygon	7	1136516.41289	553725.13027	0.093	242.345	
9	Polygon	8	1138675.96514	547011.70247	0.093	238.857	

➢ There are two more vector feature layers in the Vector Data map view. One is a line feature layer (**SanJuanRoads_Lines**) and the other is a point feature layer (**SanJuanAirports_Points**). Turn them both On in the map Contents pane to make them visible in the map view.



➢ Take a couple of minutes on your own and explore these layers. Click on either a road feature or an airport feature to see a pop-up of attributes. Right-click on either layer and open their attribute table to see the data associated with the features in either layer. Use the Explore tool to pan and zoom within the Vector Data map view.

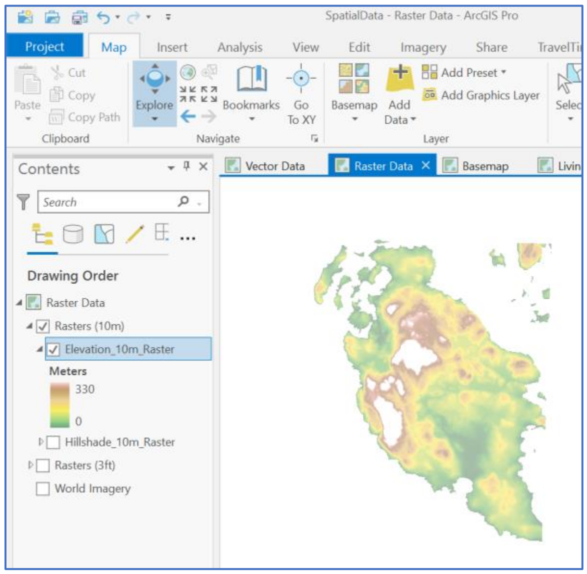
Step 2: Introduction to Raster Data Layers

Overview

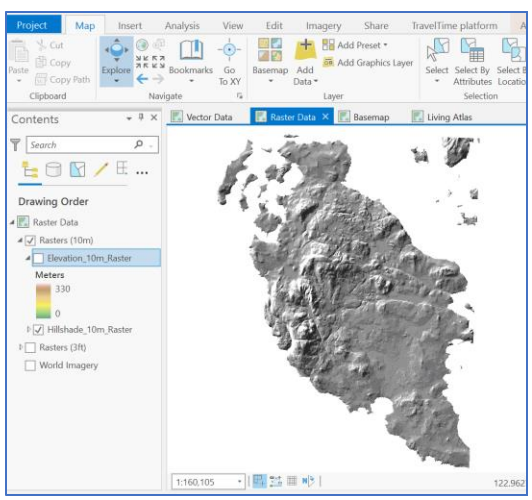
In this step of the exercise we explore raster data in the context of an ArcGIS Pro project.

Instructions

- Click the *Raster Data* tab (above the map display) to activate the Raster Data map view.
- The Raster Data map view opens with **Elevation_10m_Raster** turned on. This raster is a 10-meter cell size elevation raster of San Juan Island. Each cell in this raster has an elevation value in meters. Each cell's elevation value is generalized across 100 square meters of area.

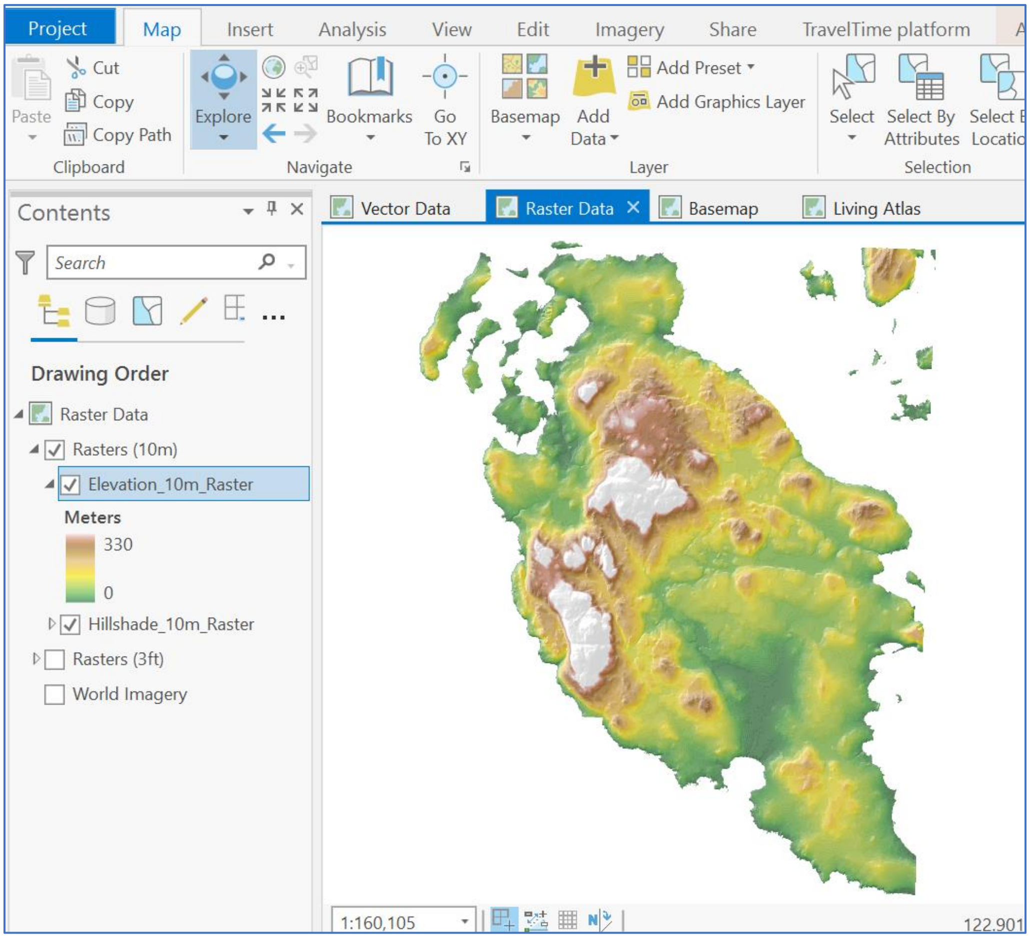


- In the Contents pane to the left of the map view, uncheck the elevation raster to make it non-visible, and check the **Hillshade_10m_Raster** to make it visible in your Raster Data map view.

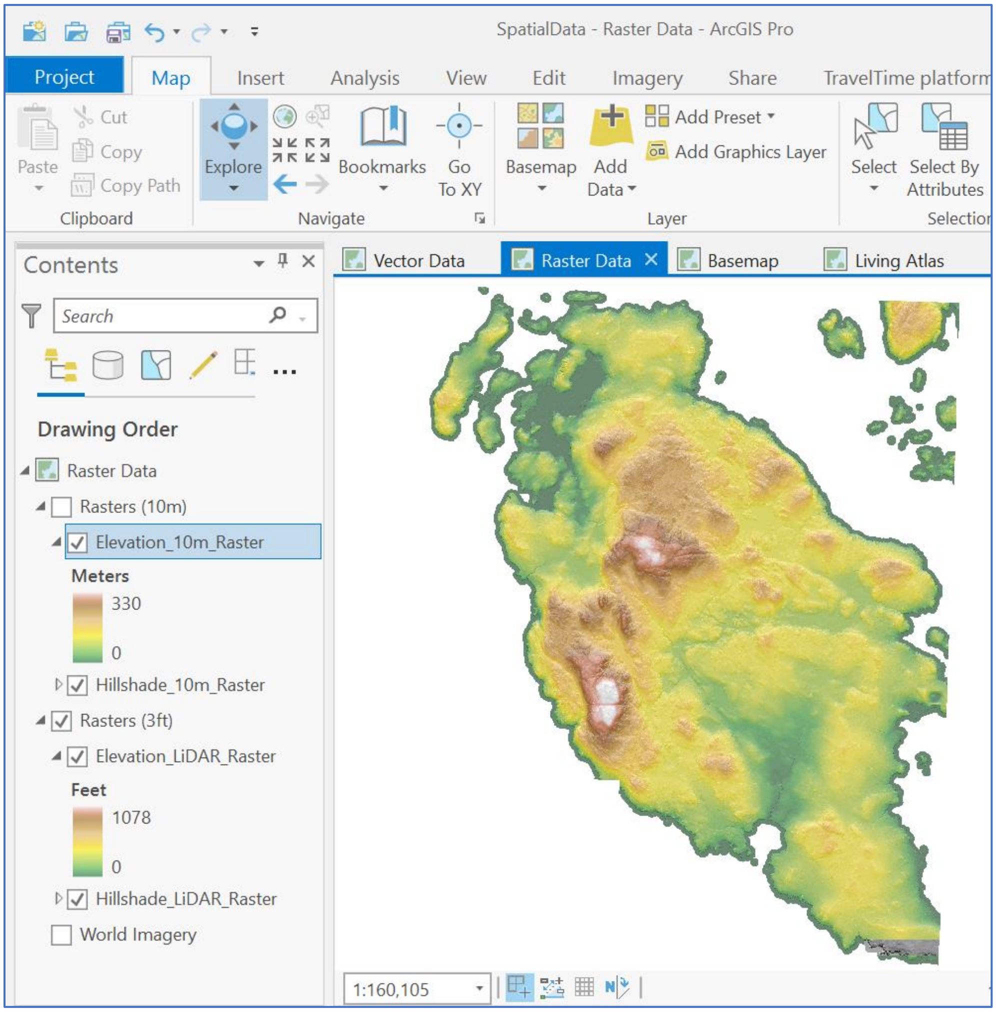


- This hillshade raster was generated from the elevation raster. It is also a 10-meter cell size raster, but the values stored with each cell are not elevation values, they are grey scale values (more like imagery) that are generated to show topographic relief.

➢ Return to your Contents pane and check on the **Elevation_10m_Raster**, while leaving the **Hillshade_10m_Raster** checked on. We set a slight transparency on the elevation data to see elevation and topographic relief together in the map view. This is a common technique in shaded relief mapping, and it provides topographic context for elevation data values.



- Return to your Contents pane and uncheck the **Rasters (10m)** group layer to turn off all of the 10-meter raster data, and check the **Rasters (3ft)** group layer to turn on the 3-ft cell size raster data.

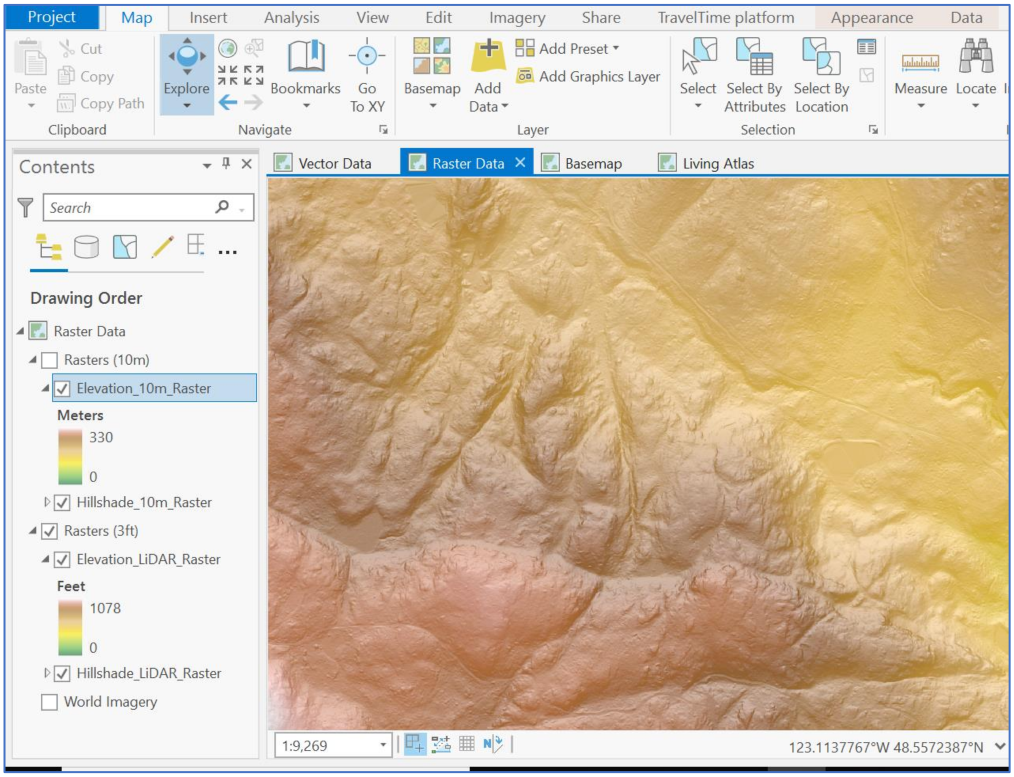


- Raster data spatial resolution is controlled by cell-size, because each grid cell in a raster only gets one value for the entire area of that cell. Take elevation as an example: a 10-meter raster has one value for a 100 square meter area (one cell); a 3-foot raster would have over 100 cells, each with its own elevation value for the same area.

  Note: Often (but not always), elevation raster datasets use the same units of measure for elevation data as they do for their (horizontal) spatial reference system. The 10-meter elevation dataset we have provided originated with USGS, and they use NAD 1983 UTM for their spatial reference system, which is in meters. The elevation units for the 10-meter DEM are also in meters.

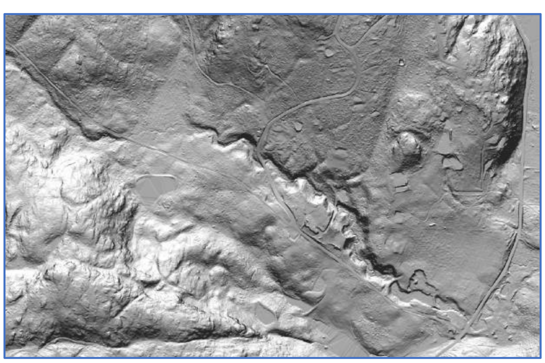
  The 3-foot elevation dataset we have provided originated with the Washington State Department of Natural Resources and they use NAD 1983 HARN WA State Plane for their reference system, which is in feet. The elevation units for the 3-foot DEM are also in feet.

- In the left side of the Map tab of the ribbon, in the *Navigate* group find *Bookmarks.*
- Click on the drop-down arrow for *Bookmarks* and select the **Raster Resolution** bookmark.

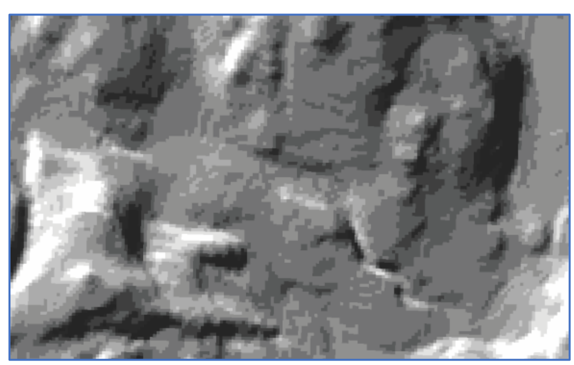


- This is a zoomed in map view with the **Raster (3ft)** group layer On. This is high-resolution elevation data overlaying a hillshade generated from the high-resolution elevation data.

- To compare resolution, uncheck to turn Off the **Elevation_10m_Raster** in the **Raster (10m)** group layer and uncheck to turn Off the **Elevation_3ft_Raster** in the **Raster (3ft)** group layer. Both of the hillshade rasters remain visible. Now, toggle **Raster (10m)** group layer On and Off and you can see clearly how much more topographic relief is visible at the 3-foot cell size.

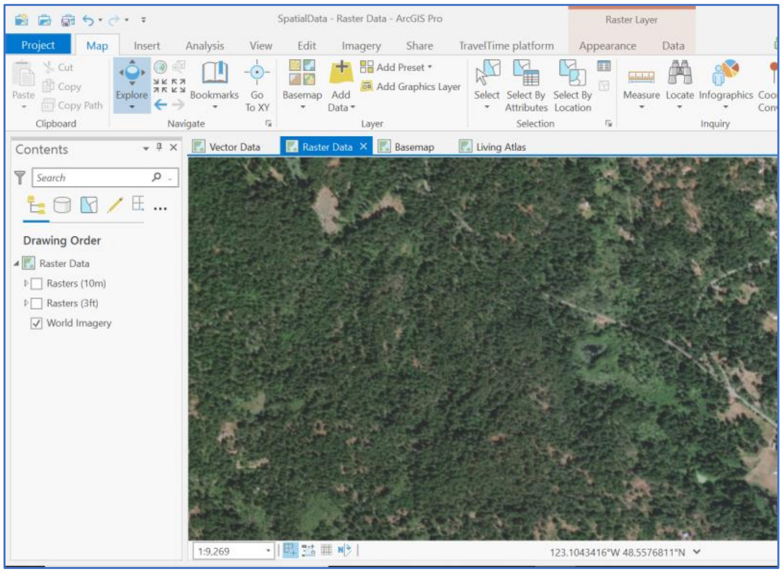


Raster (3ft) Hillshade



Raster (10m) hillshade

- In the map Contents pane, uncheck both the **Raster (10m)** and the **Raster (3ft)** group layers to turn them off. The **World Imagery (1m)** raster layer should now be visible in your map view.



This is also a raster cell-based layer, the values for this raster represent colors and not landscape data values. The resolution of this imagery is a 1-meter or better cell size.

- From the Map tab of the ribbon, in the Navigate group open the Bookmarks drop-down menu.
- Select the **Lake Imagery** bookmark to get a better sense of the resolution of the imagery.

Note: The dock to the west of the pond is a good indicator of the resolution of the data.

- Explore rasters on you own for a few minutes inside the Raster Data map view. Feel free to use the Explore tool to pan and zoom in and out, and to check individual cell values in the pop-up window. Toggle layers On and Off to see differences at different zoom levels.

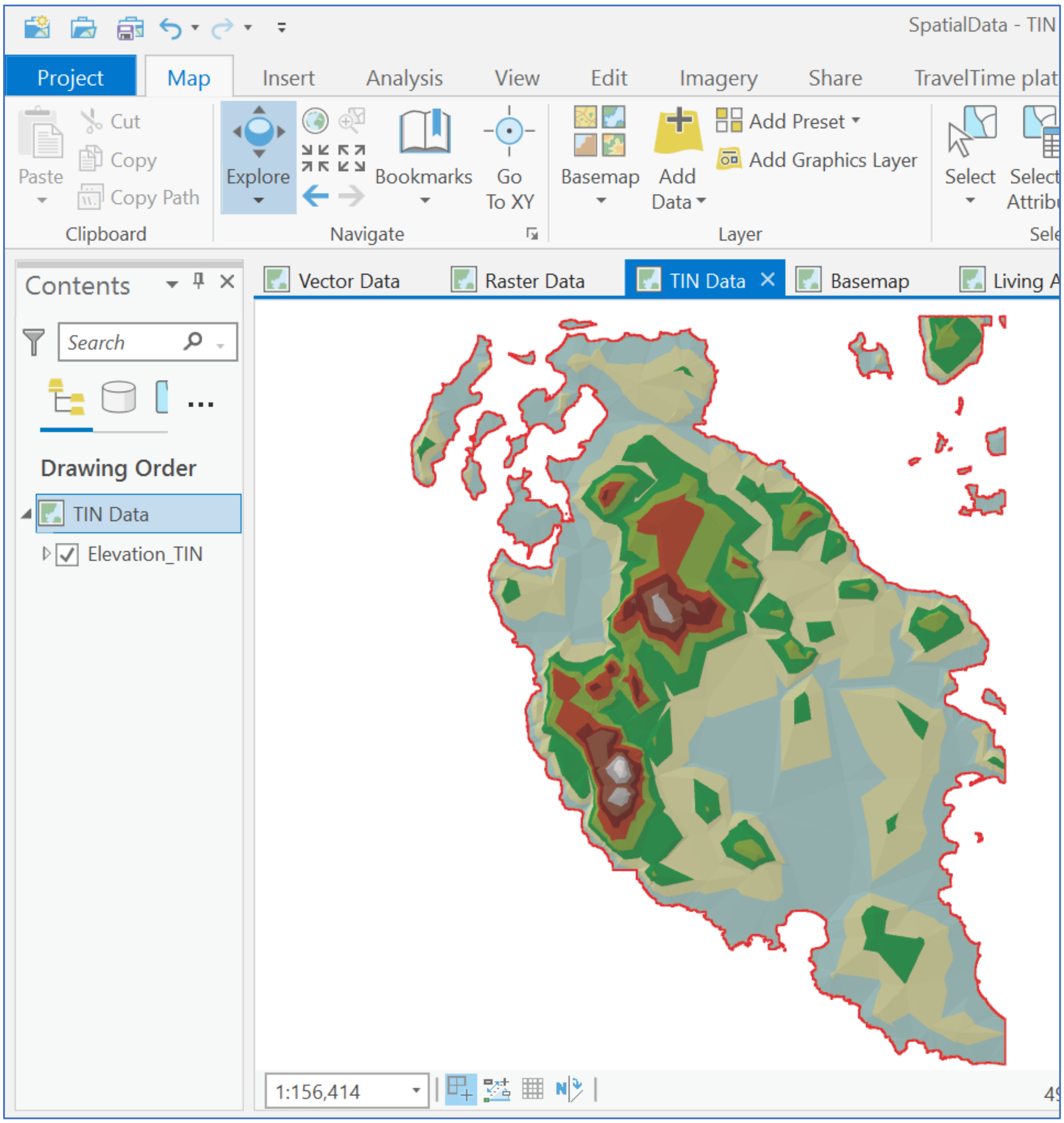
Step 4: Introduction to TIN data

Overview

In this step of the exercise we will explore TIN data.

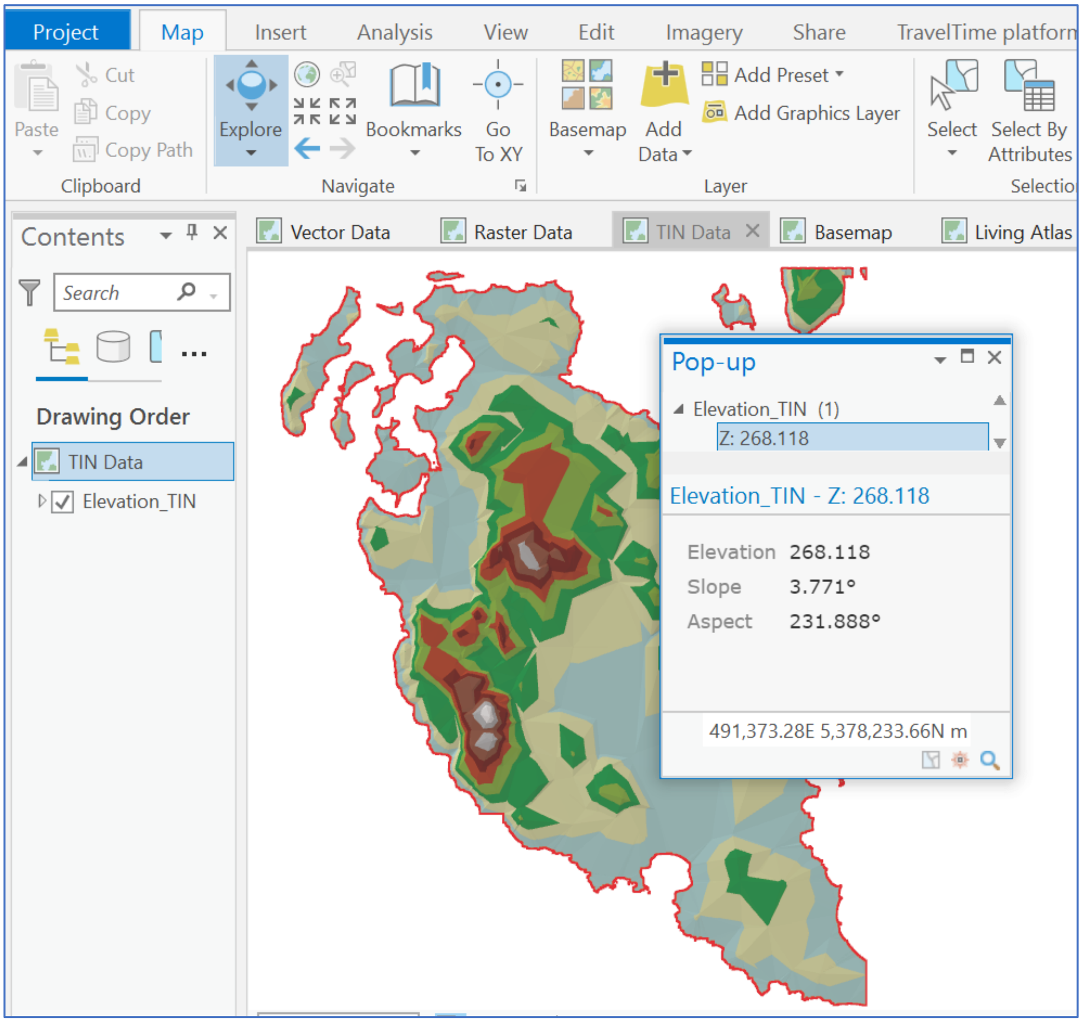
Instructions

- Click the *TIN Data* map view tab.
- The TIN Data map view opens with a TIN elevation surface of San Juan Island visible. Note the units of **Elevation_TIN** are in meters.



A TIN is made up a 'network' of irregularly sized triangles.

- On the Map ribbon, click on the Explore tool move to your map view and click on the **Elevation_TIN** in the map. A pop-up will emerge showing you the surface details for the location where you clicked.
- The elevation value in the pop-up is interpolated from the elevations of the points of the triangles. This interpolation means that you can get an elevation estimate for any location on the map. A TIN does not have cells and is not limited by cell size / resolution.



- The elevation, slope and aspect of each triangulated polygon area are generated automatically in ArcGIS PRO as part of the TIN.

- Explore the TIN data on you own for a few minutes from the TIN Data map view. Feel free to use the Explore tool to pan and zoom in and out, and to check individual triangulated area values in the pop-up window.

End of Exercise

Spatial Data

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