BRIGHTE Workshop 2019:

Envisioning Risk of Hurricane Storm Surge and Sea Level Rise

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Exercise 1: Introduction to ArcGIS Pro

Exploring ArcGIS Pro Interface

Use Case: Hurricane Sandy's official track and impacts

ArcGIS Pro is the latest addition to ESRI's desktop GIS applications. ArcGIS Pro allows you to create multiple maps, layouts, tables and charts in a single project.

In this exercise, you will learn how to work with spatial data using ArcGIS Pro and explore the official hurricane track for Hurricane Sandy and its impacts along the eastern coast.

Sub-Sections in Exercise 1 Part 1:

1. Opening and Exploring ArcGIS Pro
2. Importing an existing map
3. Symbolizing data
4. Navigating ArcGIS Pro

Sub-Sections in Exercise 1 Part 2:

5. Create a 3D scene
6. Navigate the 3D scene

Part 1: ArcGIS Pro

Opening and Exploring ArcGIS Pro

Step 1 Creating an ArcGIS Pro project.

You will create an ArcGIS Pro project and import an existing ArcMap map document.

ArcGIS Online organizational account credentials

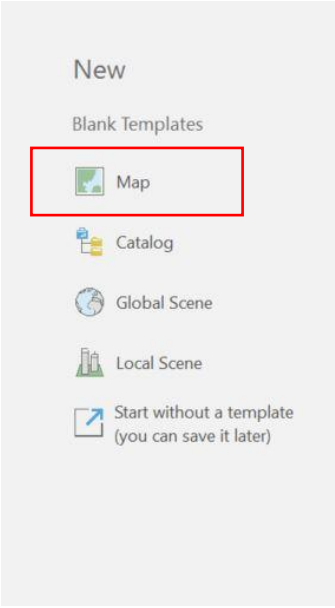
Username

Password

- Start ArcGIS Pro, and sign in using your ArcGIS Online organizational account.

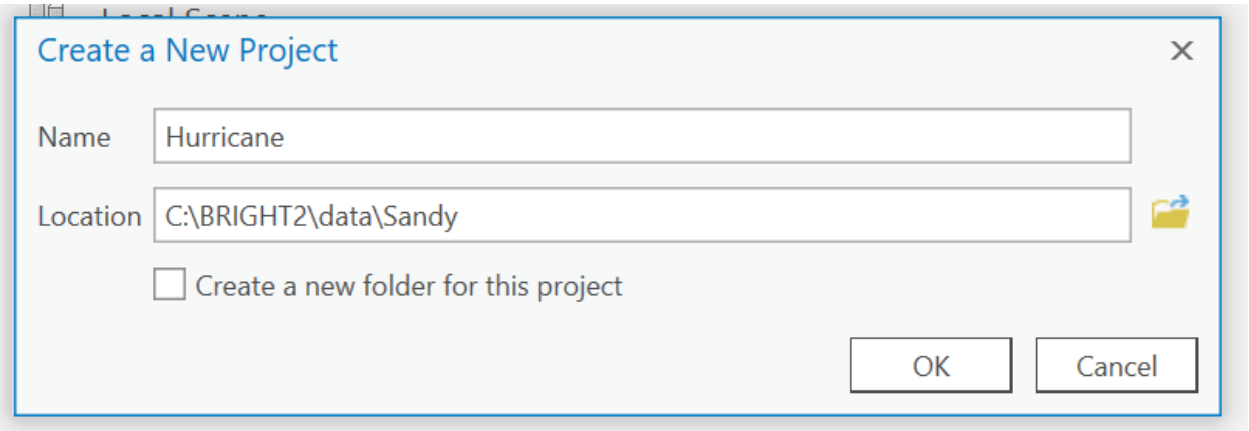
In this first step, you will create a new project in ArcGIS Pro. A project holds all the required resources and components in one place. The elements that comprise a project are: maps, layouts, tasks, toolbox, and data. We will first create a new project for this exercise.

Click **Map** for the New Template you want to start.



- Name your project **Hurricane**. For **Location**, browse to ***C:\BRIGHTE\data\Sandy***

- Make sure the ***Create a new folder for this project*** is unchecked.
- Click **OK**



TIP: All components for the project are stored in a project directory.

Step 2 Create a folder connection

For this project, you will use data that is not contained in the ArcGIS Pro project structure.

- **On the Project tab expand *Folders > Sandy > data*.**

Take a look at the contents of this folder, it contains all the data we will use in this exercise.

Add data

Step 3 Add data

On October 29th, 2012, Hurricane Sandy made landfall near Atlantic City, NJ as a Category 1 hurricane. Sandy made landfall in the most densely populated state in the middle of the most densely populated region. It was the deadliest and most destructive hurricane of the 2012 Atlantic hurricane season.

- In the **Catalog** (right pane), in the **Project** tab, expand the **Folders** folder.
- Click on **Sandy > data**.

- Open the **Hurricane.gdb** geodatabase and drag **HurricaneSandyTracks** and **stormSurge** in the map.

The data is added to the map and the Contents pane. You will now rename the map from Map to something more meaningful

- In the **Contents** pane (left pane), click ***Map***, and then click it again to make the text editable.
- Rename the map to ***Sandy Impacts*** and press **Enter**.

The name is automatically updated in the table of Contents as well as in the Project tab.

- **Save** your work by clicking the save project button.

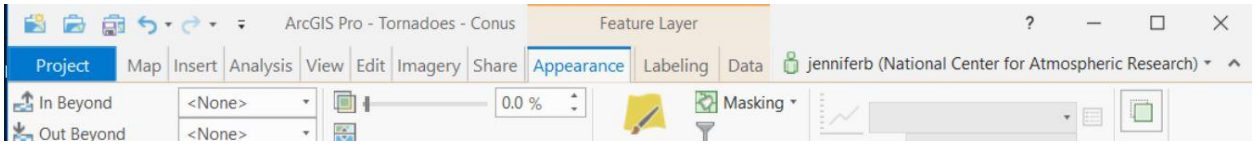
Symbolizing data in ArcGIS Pro

Step 4 Symbolize the data

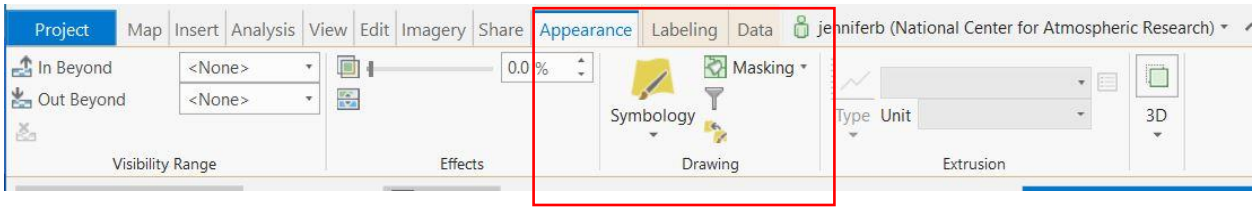
- Make sure ***HurricaneSandyTrack*** is highlighted in the **Contents** pane.

This is the official track for Hurricane Sandy, downloaded from the National Hurricane Center.

In the top ribbon, notice that 3 new contextual tabs have appeared: Appearance, Labeling, and Data.



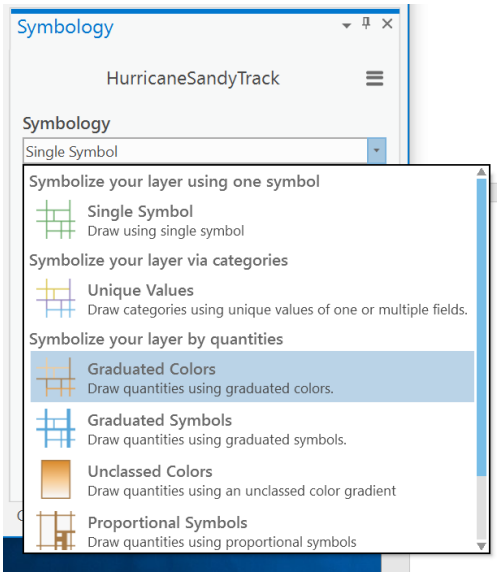
- Click the **Appearance** tab.
- On the **Appearance** tab, in the **Drawing** group, click **Symbology** (not the downward arrow).



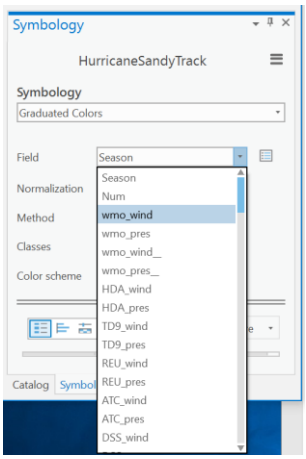
The Symbology pane opens to the right of the map. The data layer is currently mapped using Single Symbol you will change it to map the data based on the wind speed.

TIP: The Symbology and Catalog panes are stacked with other panes on the right. You can toggle between them by clicking on the tabs at the bottom of the panes.

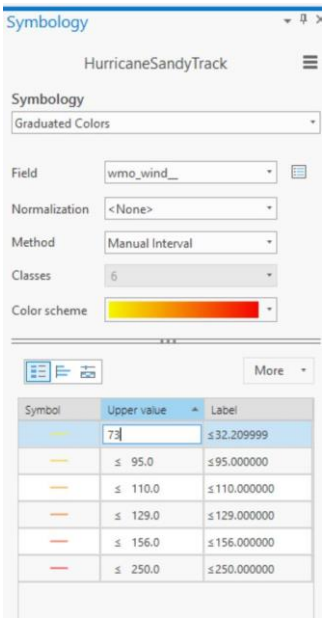
- In the **Symbology** pane, change the Symbology from Single Symbol to **Graduated Colors.**



- Change the **Field** value to ***wmo_wind***. This field is the highest 1-minute average wind speed (MPH) associated with a tropical cyclone at a particular point in time.

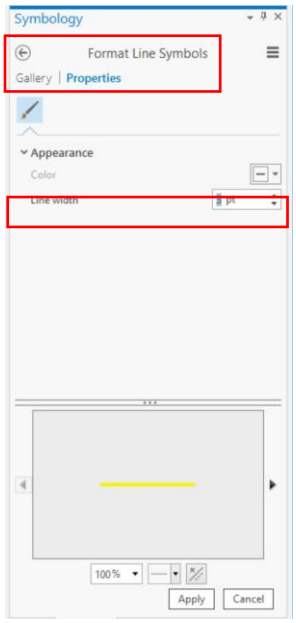


- Change the number of Classes to 6.
- Set the Method of Classification from Natural Breaks (Jenks) to **Manual Interval**.
- Change the break values in the table on the Symbology pane to match the table below for the hurricane categories. To change the value, (start at the bottom with the highest break value) click twice in the cell in the **Upper value** column to make it editable.
- The break points would be **73, 95, 110, 129, 156, and 250**. Start changing at the bottom (highest value first).
- Then change the **Labels** to match the labels in the table below.

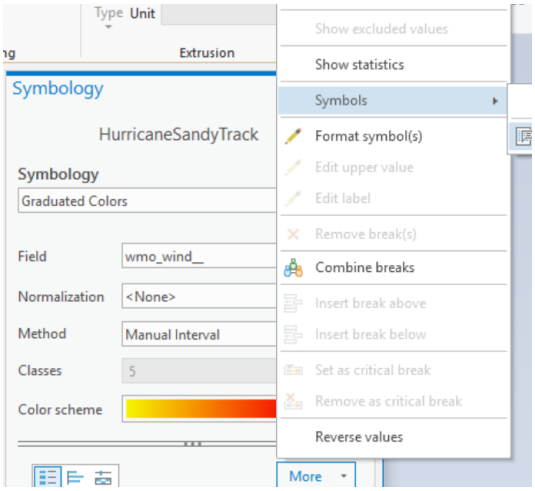


In the table below, are the wind speeds for the hurricane categories.

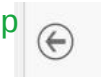
Label	Wind Speeds	Upper Value
Tropical Storm	< 74	<= 73
Category 1	64-82 kt 74-95 mph	<= 95
Category 2	83-95 kt 96-110 mph	<= 110
Category 3	96-112 kt 111-129 mph	<= 129
Category 4	113- 136 kt 130-156 mph	<= 156
Category 5	>137 kt > 157 mph	<= 250



- Click the **More** down arrow.
- Then click **Format All Symbols**.



- In the Format Line Symbols pane (at the top), click on **Properties**.
- Change the Line Width to **3 pt**.
- Click **Apply (at the bottom of the pane).**
- Go back to the Symbology pane by clicking the back arrow in the top left corner.



By default, the color scheme is a yellow to red color scheme.

- Click the down arrow beside the color scale and select a Color scheme that you would like to use for wind speed.

NOAA uses the following color scheme for wind speed in their graphics. You can choose something similar or a color scheme of your choice.

In ArcMap, we called Color Schemes Color Ramps.

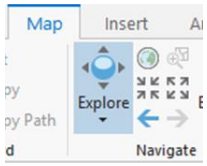
- Close the Symbology pane by clicking the **X** in the top right corner.
- **Save** your project.

From this map, we can see that Hurricane Sandy made landfall in New Jersey as a Category 1 hurricane and then weakened. The storm strengthened at sea and then weakened as it approaches land. The greater danger came from the huge storm surge the hurricane caused along the coast. Now you will add a layer which shows the storm surge.

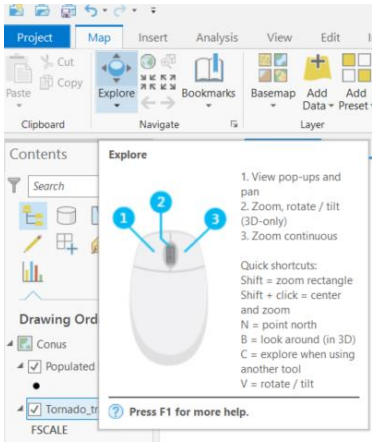
Step 5 Navigate the map

We will now take a look at the storm surge that was caused by Hurricane Sandy.

There are several ways to navigate the map.



- Click the **Map** tab.
- Make sure the **Explore** tool is selected.
- Hover your mouse over the down arrow on the **Explore** tool (do not click).



You will see a list of mouse buttons and quick shortcuts for navigating.

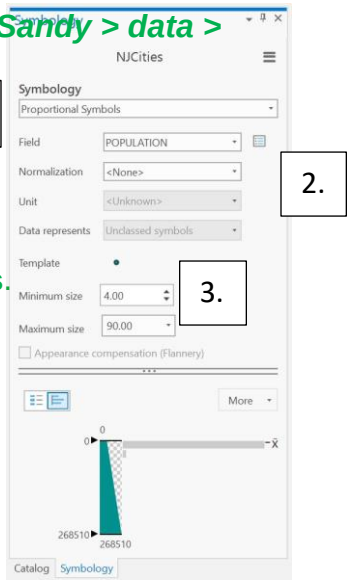
- Click an area on the southeast of your map and drag the map to the left.
- Click the **Previous Extent** button in the Navigate group.

- On the map, roll your mouse wheel forward. This will zoom in on the location of your pointer.

- Click the **Full Extent** button.
- Using the scroll wheel, zoom into New Jersey.

Proportional symbol is a symbology that represents features based on a field value as a series of proportionally sized symbols. Values are not classified, but are drawn based on field magnitude relative to other values.

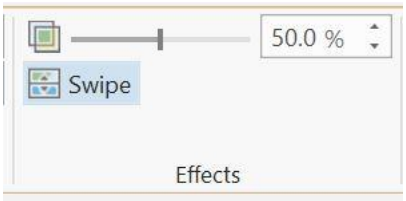
- In the **Project** tab, in the **Catalog** pane, expand ***Folders > Sandy > data > baseData.gdb*** and drag the layer ***NJCities*** into your map.
- Make sure ***NJCities*** is selected in the Contents pane.
- Click Appearance and **Symbology** on the top pane.



1. Change the Symbology to **Proportional Symbols**.
2. For the Field select ***Population***.
3. Click the point symbol for Template.

- Change the color to **Dark Amethyst**. (hover mouse over the colors and the names will appear
- Click **Apply** to apply your changes.

- Click the back arrow on the Symbology pane to return the previous pane.
- Close the Symbology pane.
- In the Appearance tab at the top in the Effects section, change the transparency to 50%. You can use the up down arrows or the slider.



Proportional symbols represent the data as a series of proportionally sized symbols. The dataset is not classified, but sized according to its value based on the range of the rest of the data.

Notice how many cities and towns are within regions of storm surge.

Your map symbolizes New Jersey cities and towns based on their population size, and displays them in relation to the hurricane track, and storm surge. Notice the large yellow area along the New Jersey / New York border. This indicates this area has a high population. This region also had a strong storm surge.

- **Zoom** into the region along the New Jersey / New York border.

The proportional point symbols (cities and towns) rescale along with the zoom factor.

In the next step, you will look at the storm impacts at the county level for New Jersey.

- Click the **Map** tab, and click **Bookmarks** > **New Bookmark.**
- Name your Bookmark **New Jersey** and click **OK.**
- **Click on the layer *stormSurge* in the Contents pane.**
- **Click Appearances and Symbology.**
- **Change the symbol color to Cretan Blue.**
- **Change the transparency to 50%.**
- **Save** your project.

You can now see the areas affected by storm surge.

Step 6 Importing symbology using a layer file

So far, you have mapped the cities in New Jersey and the official track and storm surge for Hurricane Sandy. The storm-surge data you added to ArcGIS Pro show the extent of the storm surge. In this step, you will take a look at impacts from the storm surge according to FEMA's assessment.

You are about to add a feature class to your map that was developed by FEMA. It represents a composite of surge, wind, precipitation, and snow impacts used to assess impacts for each County.

- In the Content pane, drag the layer ***Impacts*** from the ***Hurricanes.gdb*** file geodatabase.

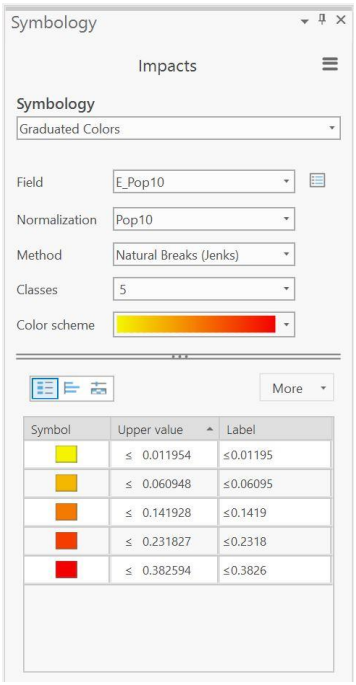
The feature class displays the counties for the region.

- Right click on the ***Impacts*** layer in the Table of Contents and select Attribute Table.
- Take a minute to examine the table. Each field contains an attribute for the feature class.

More information about this layer can be found at:

https://www.arcgis.com/home/item.html?id=307dd522499d4a44a33d7296a5da5ea0

- Close the Table.
- Make sure the ***Impacts*** layer is highlighted in the Contents pane.
- Click the **Appearance** tab and **Symbology** button.
- Change the Symbology Method to **Graduated colors**.
- Change the field you are symbolizing to **E_Pop10** (population affected by storm).
- Change the **Normalization** field to **Pop10** (total population in 2010).
- Keep the Method **Natural Breaks (Jenks)**
- Choose any color scheme you wish.
- Close the Symbology pane.
- Change the name of the layer to "**Percent of Population Affected**."
- Drag the ***Percent of Population Affected*** layer underneath the ***stormSurge*** layer.
- Turn off the layer ***NJCities***.

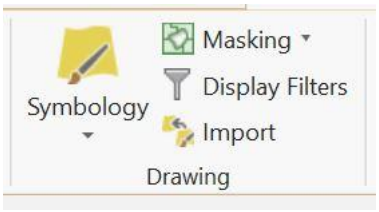


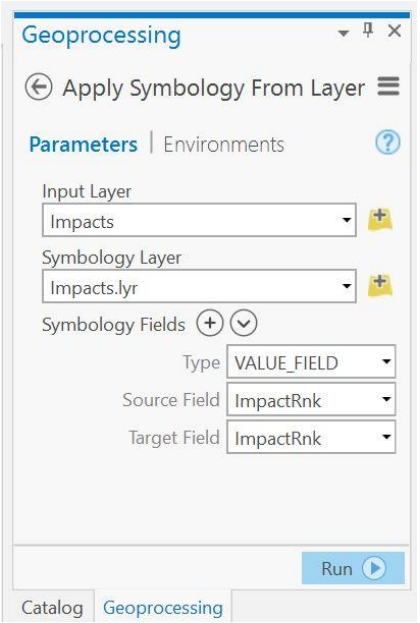
Explore the counties in New Jersey and New York that have large percentages of their population affected by the hurricane. Notice how this corresponds to the areas that experienced storm surge.

The field **ImpactRnk,** also in this layer, is the relative impact based on surge, wind, precipitation, and snow. You will now use this field to symbolize the data.

One way to apply symbology to data is by importing that symbology from a layer file (.lyr). A layer file includes all feature class display properties for symbology and labeling.

- Make sure ***Percent of Population Affected*** is highlighted in the Contents pane.
- Right click and select **Copy**.
- Right click on the map name Sandy Impacts in the Contents pane and select **Paste**.
- Rename the newly pasted layer ***Impacts***.
- Click the **Appearance** tab, In the **Drawing** group, click the **Import** button.





- For Input Layer select Impacts.
- For Symbology Layer click the **Browse** button and navigate to ***C:\BRIGHTE\Sandy\data*** and select ***Impacts.lyr***.
- Click **Ok**.
- For the Symbology Fields select the following values
    1. Type = VALUE_FIELD
    2. Source Field = ImpactRnk
    3. Target Field = ImpactRnk
- Click **Run**.

You just added a new layer to your map using the symbology saved in a layer file.

- Move ***Impacts*** layer below ***stormSurge*** in the Contents pane.

Surge is the primary driver of the severe impacts as a result of Hurricane Sandy, and the relative impact assessment is summarized as follows:

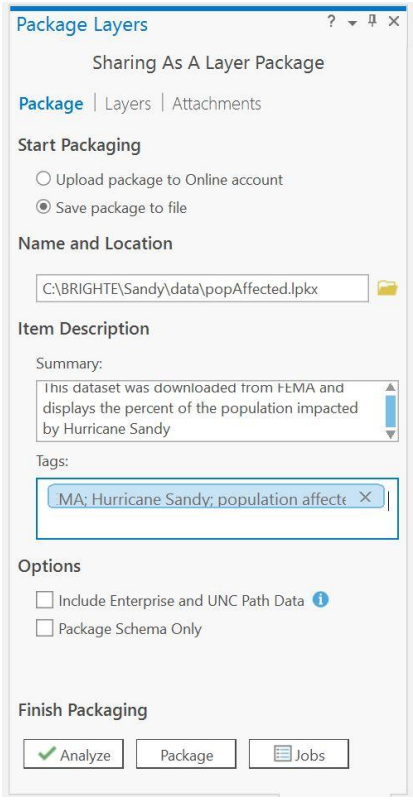
- Very High (Purple): Greater Than 10,000 of County Population Exposed to Surge
- High (Red): 500 - 10,000 of County Population Exposed to Surge, or Modeled Wind Damages > $100M, or High Precipitation (>8")
- Moderate (Yellow): 100 - 500 of County Population Exposed to Surge, or Modeled Wind Damages $10 - $100M, or Medium Precipitation (4" to 8")
- Low (Green): No Surge Impacts, or Modeled Wind Damages < $10M, or Low Precipitation (<4")

Step 7 Creating a Layer Package in ArcGIS Pro

A Layer package is a nice way to share information with others.

You are now going to save the Percent of Population Affected as a ***Layer Package***.

- Right-click on the Layer ***Percent of Population Affected*** and select **Sharing > Share as Layer Package.**
- In the **Package Layers** pane, select the option to ***Save package to file***.
- Click the **Browse** button and navigate to ***C:\BRIGHTE\Sandy\data***.
- Name the package, **popAffected** in the Share As window.
- Click **Save**.
- Enter the following for the *Summary*: "This dataset was downloaded from FEMA and displays the percent of the population impacted by Hurricane Sandy."
- Enter the following for the *Tags*: "FEMA; Hurricane Sandy; population affected"
- Click **Analyze**.
- If you return zero errors, click **Package**.
- Once the process is complete close the Package Layers pane.
- In the Catalog pane, go to ***Folders > Sandy > data.***
- Right click the data directory and select **Refresh.**



The file ***Percent of Populations Affected.lpkx*** can be emailed or shared with others. It contains the data as well as the layer file information such as how the data are symbolized.

- **Save** your project.

You have just completed Part 1.

Part 2 : Working with 3D Scene

Step 8 Convert the map to a scene

ArcGIS Pro has the ability to tilt your map and view the spatial relationships between objects in a 3D scene. In the next few steps you will create a 3D scene of Savannah.

- On the **Insert** tab, click **New Map.**
- In the **Catalog** (right pane), on the **Project** tab, right click on the ***Folders***.
- Select **Add Folder Connection**.
- Navigate to ***C:\BRIGHTE\Savannah*** and click ***OK***.
- Expand ***Folders > Savannah > data > SavannahData.gdb***.
- Drag the ***structures*** feature classes into the map.
- Right click on the ***structures*** layer in the Content pane and select ***Zoom to Layer*** (if you are not zoomed in automatically).

- On the **Map** tab, in the **Layer** group, click the **Add Data** drop-down arrow and select Elevation Sources.
- Navigate to ***Folders > Savannah > SavannahData.gdb*** and click on ***elevation.***
- Click **OK**.

The elevation sources define height values across the extent of your map or scene. A scene is a map that displays data in 3 dimensions. In ArcGIS Pro, you can convert your 2D map to a 3D scene, which shows the data on a spherical globe.

The default elevation being used is a world elevation terrain from ArcGIS Online. You have changed the elevation source to use the elevation dataset you added to map from the geodatabase. It is a higher resolution dataset than the default elevation.

- On the **View** tab, in the **View** group, click **Convert > To Local Scene**.

A global scene displays data on a spherical globe; a local scene displays data on a projected planar surface rather than on a sphere.

A new scene call Map_3D is created. In Scene, layers can be either 2D or 3D. The current layers are all still 2D which is why they are still flat.

Step 9 Navigate the 3D scene

Navigation controls in 3D scenes are slightly different from navigation controls in 2D maps. Some of the actions are the same, but others have been changed to make navigation in 3D easier.

- On the **Map** tab, ensure that the **Explore** tool is active. Left click, and drag the scene in any direction.
- On the Map tab, click the Basemap drop-down and select Imagery.

Left click will pan the scene.

- Right click, and drag the scene.
- Roll the center wheel on your mouse.

Right click, and the wheel will zoom the scene.

- Press the center mouse wheel, and then move the mouse forward and back.

Pressing the mouse wheel and dragging the mouse forward and back rotates the scene up and down.

- Press the center wheel again; and this time, move the mouse left and right.

Pressing the wheel and dragging the mouse left and right will rotate the scene around the point that you originally clicked.

- Hold down the scroll wheel on your mouse, and drag the pointer to tilt and rotate the scene.
- Explore your scene.

Step 10 Extrude the structures

In this step, you will extrude the structures based on a height attribute in the feature class' attribute table. Extruding is a process of stretching a flat 2D shape vertically to create a 3D object in a scene.

- In the **Contents** pane, drag ***structures*** from 2D Layers group to the 3D Layers group. (if it did not move automatically)
- In the **Contents** pane, right click on ***structures*** and select **Attribute Table.**

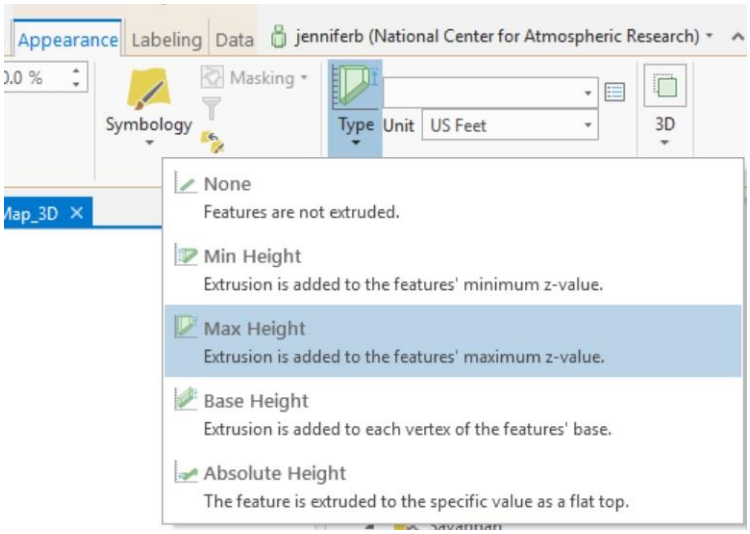
This table has a number of fields. BLDGHEIGHT is the field you will use to extrude the structures. All heights are in feet.

- Close the attribute table.

Different options to extrude shapes are listed in the table below.

None	Features are not extruded.
Min. Height	Add extrusion to each feature's minimum height. A z-value is calculated by adding the extrusion height to the minimum z-value of each feature.
Max. Height	Add extrusion to each feature's maximum height. A z-value is calculated by adding the extrusion height to the maximum z-value of each feature.
Base Height	Add extrusion to each feature's base height. A z-value is calculated by adding the extrusion height to the base z-value of each feature.
Absolute Height	Each feature is extruded to the specified z-value as a flat top, regardless of the z-value of each feature.

- Make sure ***structures*** is highlighted in the **Contents** pane.
- Click the **Appearance** tab on the **Feature Layer** contextual tab. In the **Extrusion** group, click the **Type** button and select **Max Height.**



- Select the field [***BLDGHEIGHT***] for the extrusion expression.
- Make sure the Units at ***US Feet***.

You can set the extrusion units. If the layer has a vertical coordinate system defined, then the extrusion units will get the units from the data source, otherwise it will use Meters.

The buildings should now appear in 3D on your map.

- Click the symbol for ***structures*** in the **Contents** pane to open the Symbology pane.
- Select the color **Buildings Footprints**.
- Take a few minutes and explore the map and the 3D navigation.
- Save your project and close ArcGIS Pro when finished.