Design and publish basemaps

Use basic principles of cartography to create a custom basemap.

Duration	Difficulty
1hr(s) 30mins	Intermediate

As the GIS Specialist for the city of Cambridge, Minnesota, you make a lot of maps for city projects and presentations. You want to create a basemap in a local projection that is more tailored to your data. Using ArcGIS Pro, you will add your data to a new basemap and symbolize roads, water bodies, cities, and other features and edit the symbology so it looks good at several scales, and publish it to ArcGIS Online so others in your community can use it.

This lesson was last tested on May 18, 2022, using ArcGIS Pro 3.0. If you're using a different version of ArcGIS Pro, you may encounter different functionality and results.

VIEW FINAL RESULT

Requirements

- ArcGIS Pro (get a free trial)
- Publisher or Administrator role in an ArcGIS organization

Lesson Plan

Symbolize features — 40 minutes

Change symbols to emphasize important map features.

Label features — 30 minutes

Place labels on key features.

Publish a multiscale basemap — 20 minutes

Edit the map for vector basemap creation using scalable symbols and limited visibility extents.

Symbolize features

Most of the maps you create as the GIS specialist for Cambridge, Minnesota, include a basemap. By designing a custom basemap, you will have more control over the appearance of your maps. In this lesson, you will add raw county data into a new basemap, change the coordinate system, and symbolize the features. When symbolizing, you will consider both the guidelines for visual variables and the visual hierarchy of important features.

Start a new basemap

First, you will create a new basemap in ArcGIS Pro.

1. Download the Isanti_Data compressed folder.
2. Locate the downloaded file on your computer.

   Note:

   Depending on your web browser, you may have been prompted to choose this file's location before you began the download. Most browsers download to your computer's Downloads folder by default.

3. Right-click the file and extract it to a location you can easily find, such as your Documents folder.

   Next, you will start a new project in ArcGIS Pro.

4. Start ArcGIS Pro and sign in to your ArcGIS organization account or into your ArcGIS Enterprise using a named user account.

   Note:

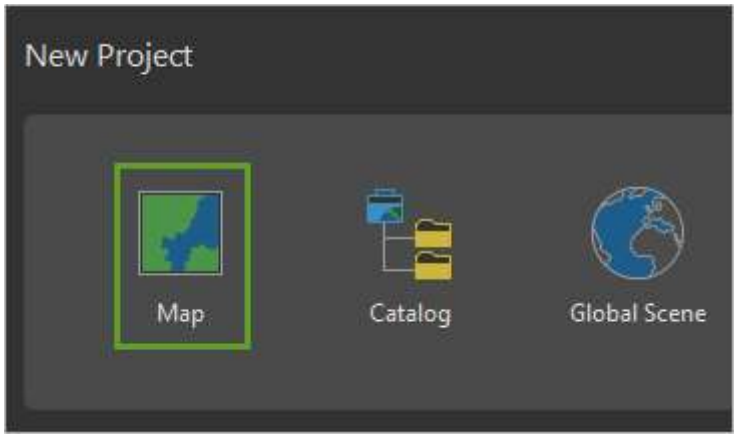
   If you do not have an organizational account, you can sign up for an ArcGIS free trial.

   When you open ArcGIS Pro, you are given the option to create a new project or open an existing one. If you have created a project before, you will see a list of recent projects.

5. Under **New Project**, choose **Map**.

   Note:

   The example images in these lessons use the ArcGIS Pro dark theme instead of the default light theme. To change the theme, click **About ArcGIS Pro** and click **Options**. On the **General** tab, change **Theme** to **Dark**.

6. In the **Create a New Project** window, name the map Isanti Basemap. Save it to a folder of your choice, such as your Documents folder and click **OK**.

   A new project opens.

7. On the ribbon, click the **Insert** tab. In the **Project** group, click the arrow on the **New Map** button and choose **New Basemap**.

A blank basemap pane is added to the project. It is named **Basemap**. You will rename it something meaningful.

8. In the **Contents** pane, click **Basemap** once to select it and a second time to edit the name. Change the name to Isanti Basemap.

Change the coordinate system

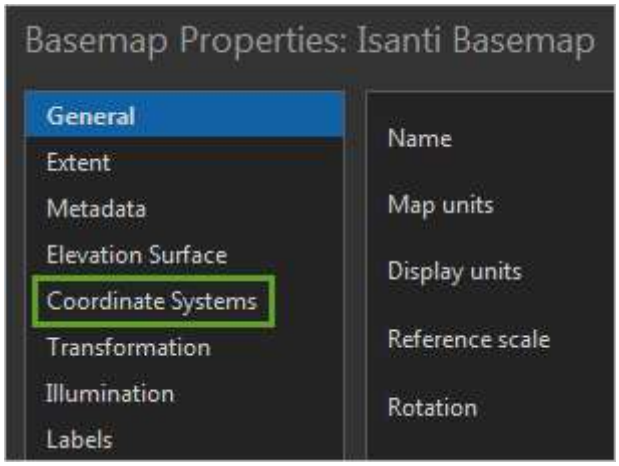
Next, you will change the coordinate system to something more appropriate for Minnesota. The default coordinate system is WGS 1984 Web Mercator, which is widely used for data at small scales, such as the United States or the world. But the Web Mercator projection is most accurate along the equator and distorts data towards the poles. Since Minnesota is far north of the equator and your map is large scale, you will use a State Plane coordinate system instead.

There are 124 State Plane coordinate systems, each tailored to a specific area in the United States. These zones are popular with local governments because they are accurate at specific scales. You will choose a State Plane coordinate system designed for central Minnesota, where Cambridge is located.

1. In the **Contents** pane, double-click **Isanti Basemap**.

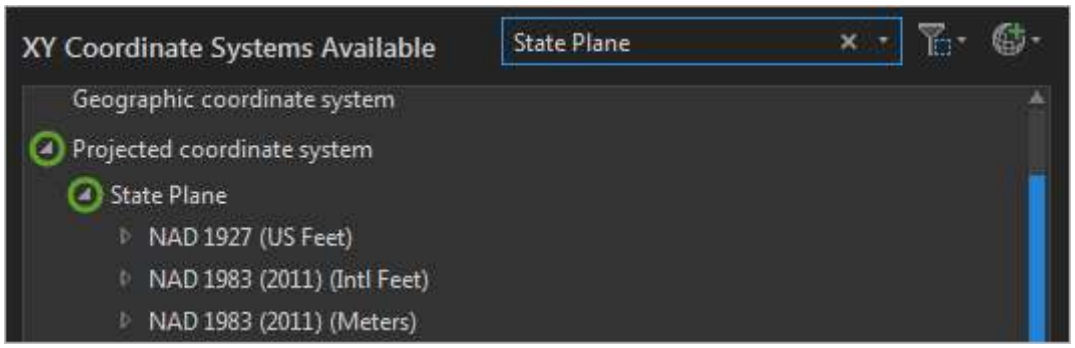
   The **Basemap Properties** window opens.

2. Click **Coordinate Systems**.



A list of available coordinate systems and other coordinate systems options becomes available.

3. In the search bar, type State Plane and press Enter. In the list of results, expand **Projected coordinate system** and **State Plane**.

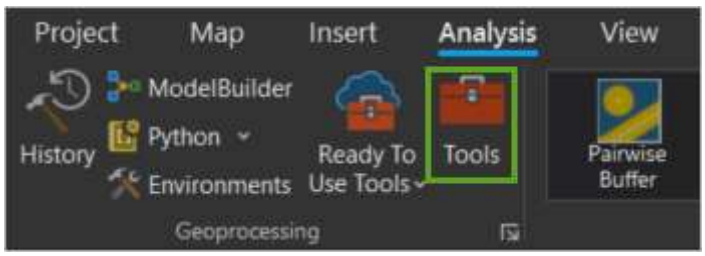


4. Expand **NAD 1983 (Meters)** and click **NAD 1983 StatePlane Minnesota Central FIPS 2202 (Meters)**. Then, click **OK**.

> **Tip:**
>
> You can enter more keywords of the coordinate system's name to reduce the choices and find it more easily, for instance StatePlane Minnesota Central.

The map's coordinate system is now set and the window closes. You will also change the projections of all the data you'll use in the project, that is, the data stored in the **Isanti_Data** folder you extracted. If the basemap and the data have different coordinate systems, you may encounter visual errors or incorrect geometry. You will use a tool called **Batch Project** to change the coordinate system of all your data at once.

5. On the ribbon, click the **Analysis** tab. In the **Geoprocessing** group, click **Tools**.

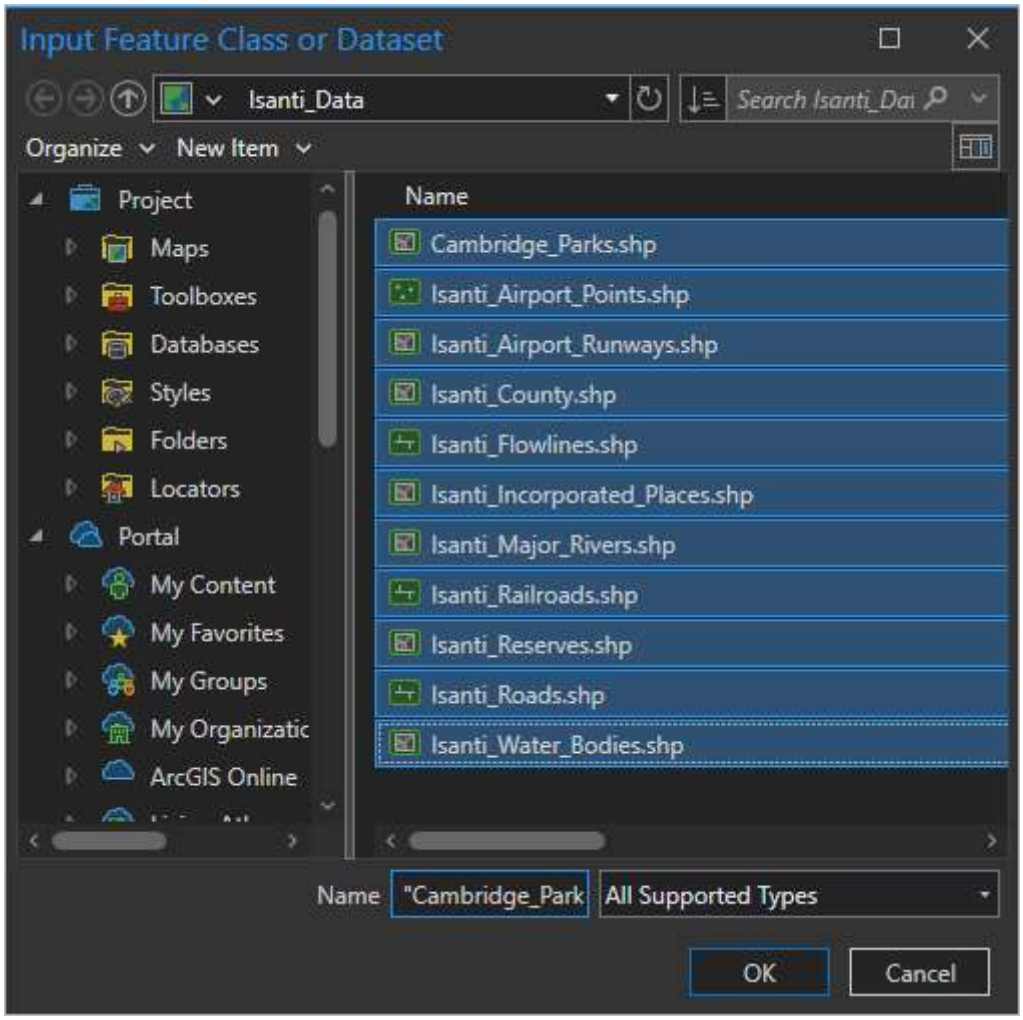


The **Geoprocessing** pane appears.

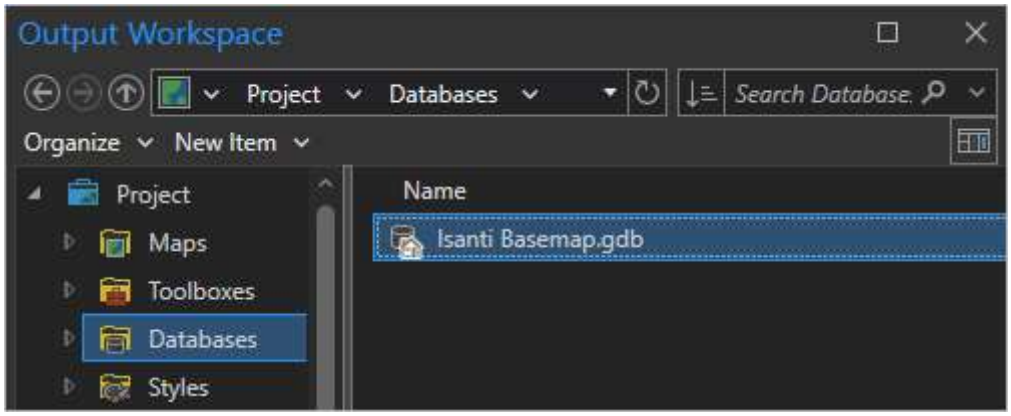
6. In the search bar, type Batch Project. In the list of results, click **Batch Project (Data Management Tools)**.
7. For **Input Feature Class or Dataset**, click the browse button and browse to the **Isanti_Data** folder you extracted.

   The folder contains a list of 11 shapefiles.

8. While pressing Shift, click the first layer in the list and the last layer to select all 11 layers. Click **OK**.



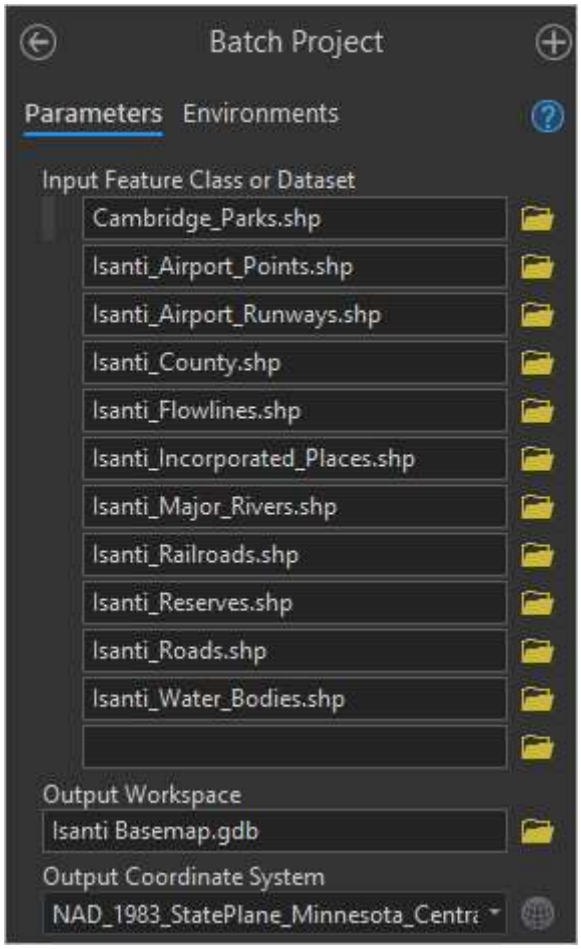
9. For **Output Workspace**, click the browse button. In the **Output Workspace** window, under **Project**, click **Databases** and choose the **Isanti Basemap** geodatabase. Click **OK**.



The output layers will be added to the project's default geodatabase.

10. For **Output Coordinate System**,click the pull-down arrow and choose **Current Map**.

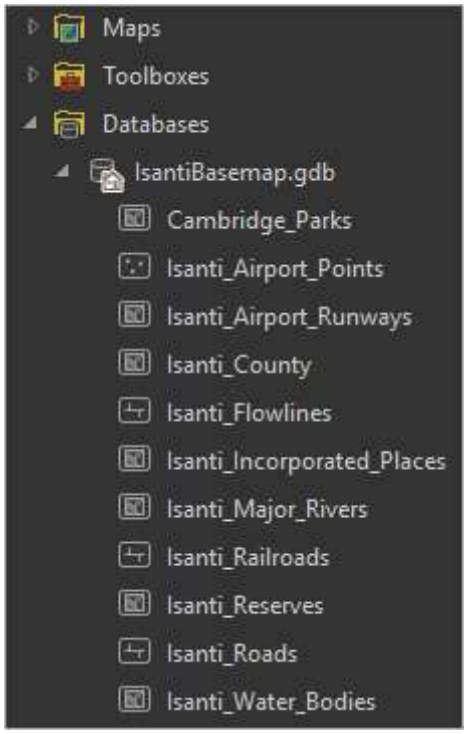
    The coordinate system changes to match the one of the map (NAD 1983 StatePlane Minnesota Central FIPS 2202).



11. Click **Run**.

    The tool runs and the reprojected data layers are added to the project's default geodatabase.

12. Close the **Geoprocessing** pane. In the **Catalog** pane, expand **Databases** then click and expand **Isanti Basemap.gdb**.



Note:

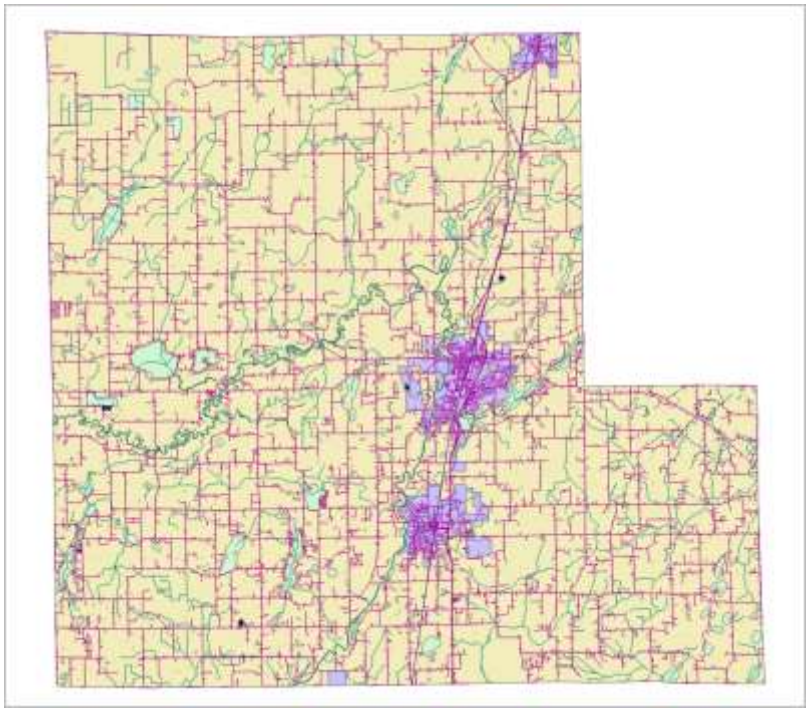
If no layers appear, right-click the geodatabase and choose **Refresh**.

13. Add all 11 of the projected layers to the map.

Tip:

To quickly add all layers, select them all using Shift+Click. Then, right-click any selected layer and choose **Add to Current Map**.

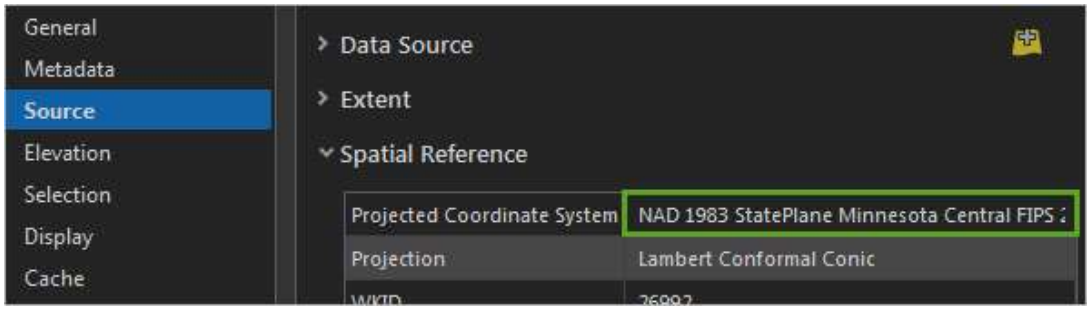
The layers appear on the map.



Note:

The default symbology for each layer is random and may differ from the example images.

14. In the **Contents** pane, double-click any layer to open its **Layer Properties** window. On the **Source** tab, click **Spatial Reference** and confirm the coordinate system is the Central Minnesota State Plane coordinate system.



15. Close the **Layer Properties** window.

Group the data

Your map has a large number of data layers. To keep these layers organized, you will group them based on the kind of data they contain. Grouping layers will also make it easier to manage the order in which layers appear on the map.

1. In the **Contents** pane, click the arrow next to each layer to hide the symbols.

   The layers now take up less space in the pane.

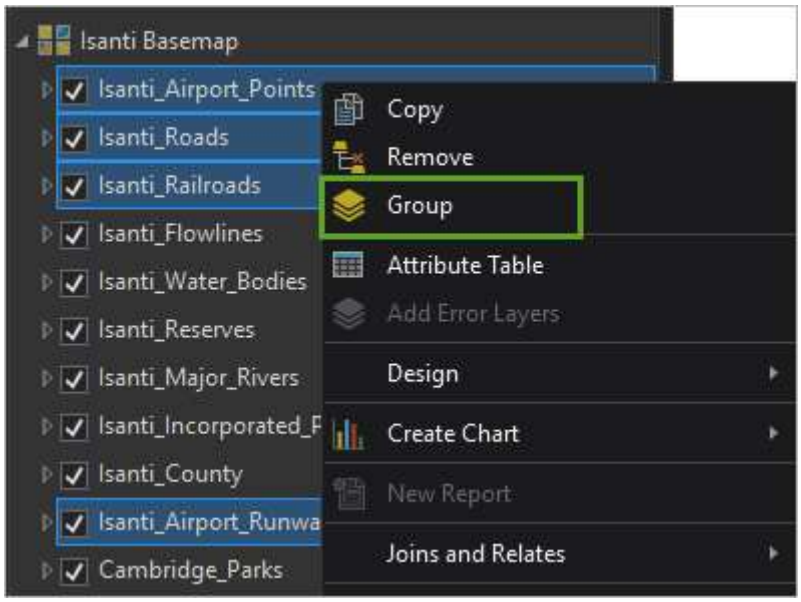
2. Press the Ctrl key while clicking all the following layers:

   - **Isanti_Airport_Points**

- **Isanti_Roads**
- **Isanti_Railroads**
- **Isanti_Airport_Runways**

These layers involve transport, so it makes sense to group them.

3. Right-click the selected layers and choose **Group**.



The selected layers are added to a new group layer. Each layer is still functional on its own, but they can also be turned on and off as a group, along with other capabilities.

4. Click **New Group Layer** and click it a second time to change its name. Rename the group layer Transport.
5. Group the following layers:

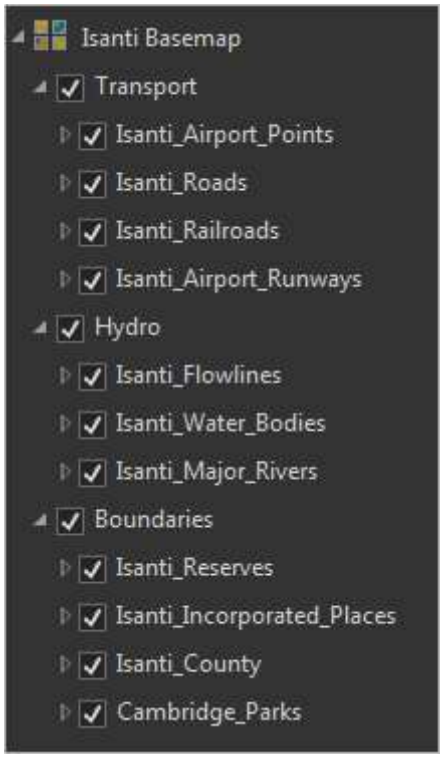
- **Isanti_Flowlines**
- **Isanti_Water_Bodies**
- **Isanti_Major_Rivers**

These layers all involve hydrological features.

6. Rename the group Hydro.

All the remaining four layers involve political boundaries, such as nature reserves or incorporated cities.

7. Group the remaining layers and rename the group Boundaries.

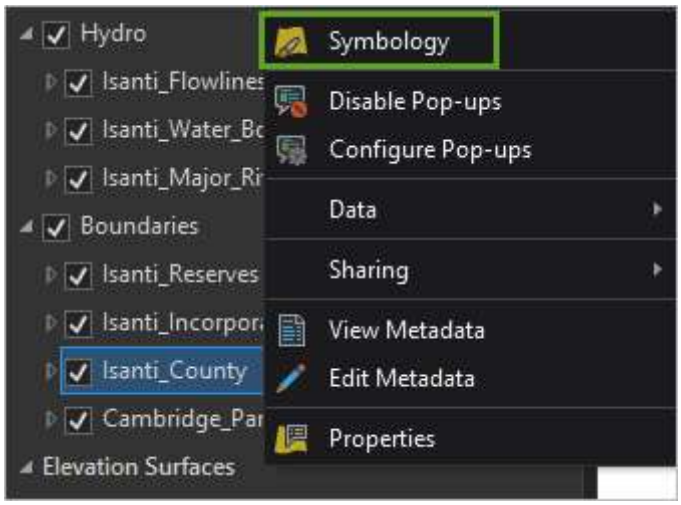


Your data is now grouped into three types of data. It will be easier to find specific layers as you proceed through the workflow.

Change the background

Now that all the data is on the map, you will start to symbolize it. First, you will change the background. Currently, the county boundary layer has a fill color that serves as the background, but only for the parts of the map inside Isanti County. You will change the county boundary's symbol to an outline with no fill, and then change the basemap's background to a light gray color that will not stand out too much or obscure the other layers.

1. In the **Contents** pane, right-click **Isanti_County** and choose **Symbology**.

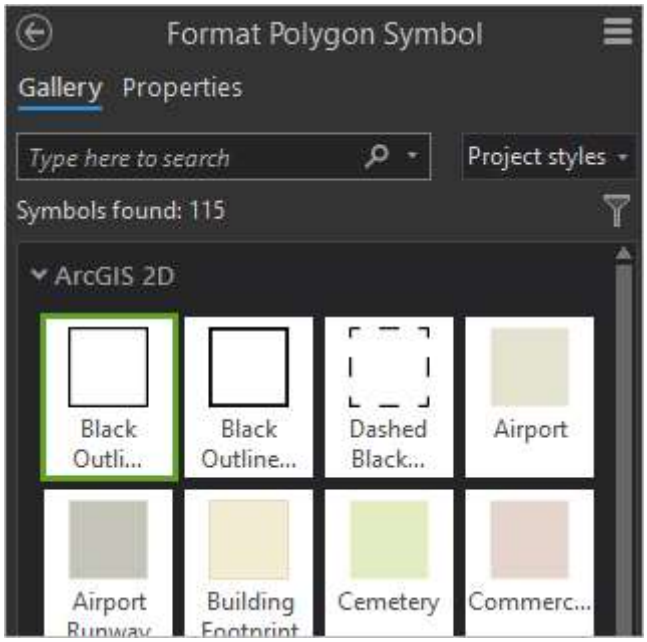


The **Symbology** pane opens and displays the layer's symbol. Isanti County is displayed as a single symbol.

2. Next to **Symbol**, click the symbol swatch.

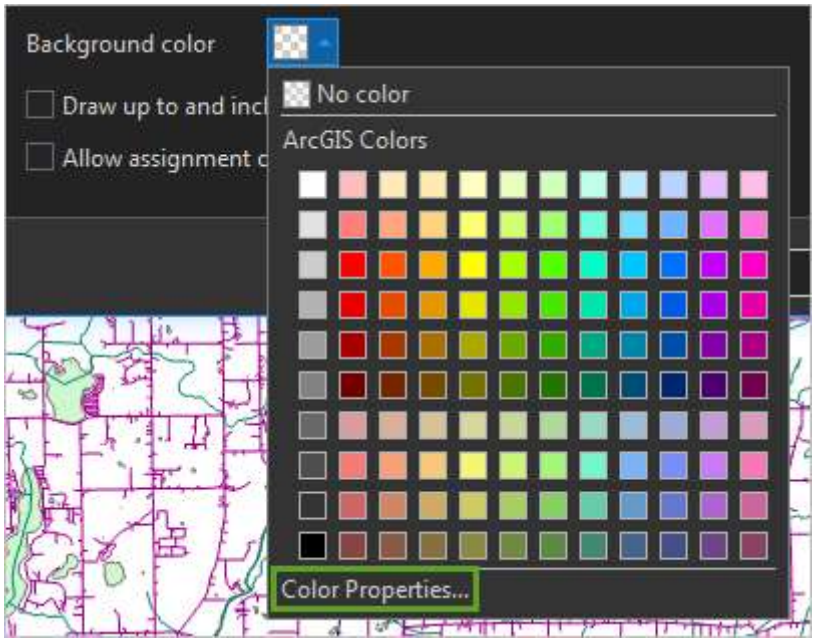
The **Format Polygon Symbol** window opens to the gallery. Esri provides a list of default symbols for both 2D and 3D maps. For this layer, you will use one of these symbols.

3. In the gallery, scroll down and choose **Black Outline (1 pt)**.



The county layer redraws with the new outline and no fill color. Next, you will add a light gray background color to the entire basemap.

4. In the **Contents** pane, double-click **Isanti Basemap**. In the **Basemap Properties** window, click the **General** tab.
5. For **Background color**, click the color box and choose **Color Properties**.



The **Color Editor** window opens. It contains advanced color options.

6. In the **HEX** box, type FCFBFA. If necessary, change **Transparency** to 0 percent.

7. Click **OK**. In the **Basemap Properties** window, click **OK**.

   The new light gray background color is added to the map.

8. In the upper left corner of ArcGIS Pro, click the **Save** button.

Symbolize transportation layers

Next, you will symbolize your layers. You will start with the transport layer group. Of the layers in this group, the roads layer has the most prominence—roads fan out all over the country, with dense clusters in cities. Most of the roads are minor streets, but some are major highways. You will symbolize the layer to emphasize more important streets and prevent the clustered side streets from becoming unclear.

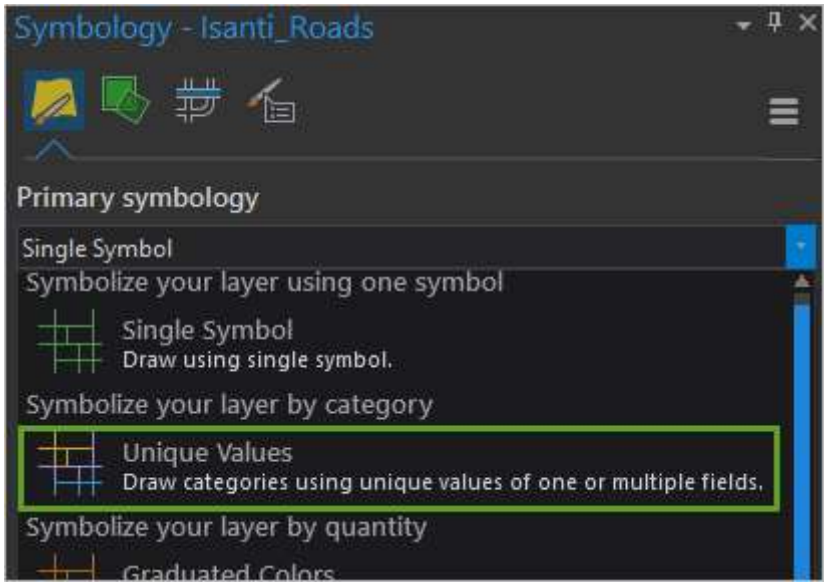
1. In the **Contents** pane, click **Isanti_Roads**.

   If the **Symbology** pane is active, the roads layer will be added to it. The layer is currently drawn with a single symbol, but you want to use different symbols for different types of roads.

   > **Note:**
   > If the **Symbology** pane is not active, in the **Contents** pane, right-click the layer and choose **Symbology**.

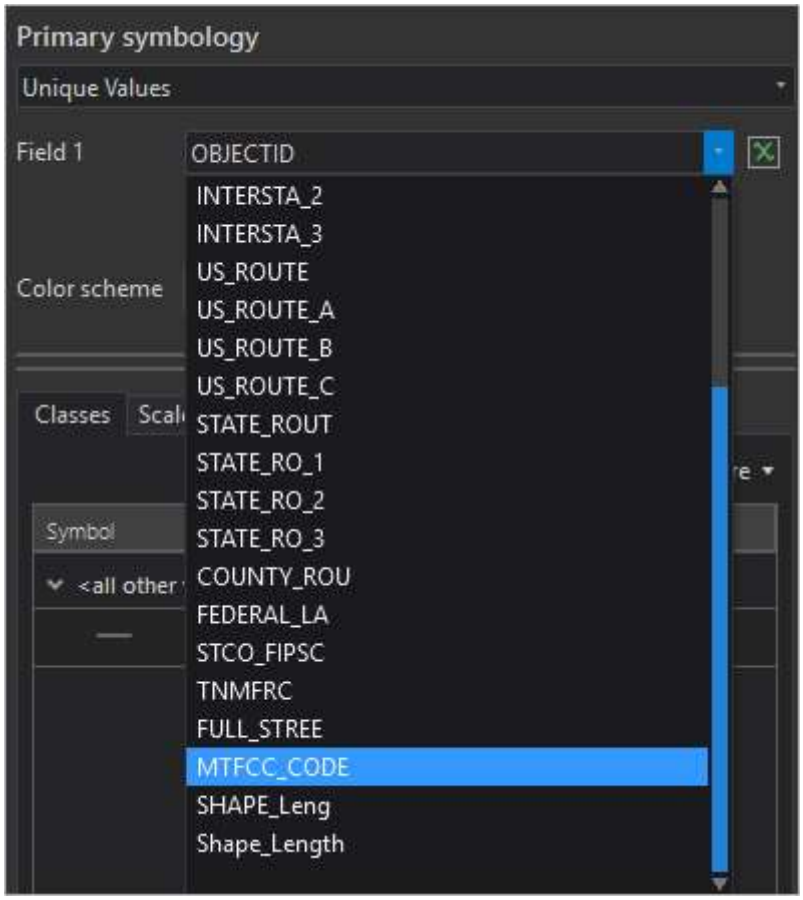
   The layer is currently drawn with a single symbol, but there are different classes of roads that you must show.

2. Under **Symbology** for **Primary Symbology**, choose **Unique Values**.



The pane changes with options to choose the value field you want to symbolize. All of your layers have several value fields that contain more information about the features displayed on the map. Often, these fields only contain the name of the feature, but the roads layer contains a field called MTFCC_CODE. MTFCC_CODE stands for MAF/TIGER Feature Class Code, which the United States Census Bureau uses to classify road types.

3. Under **Unique Values**, for **Field 1**, choose **MTFCC_CODE**.

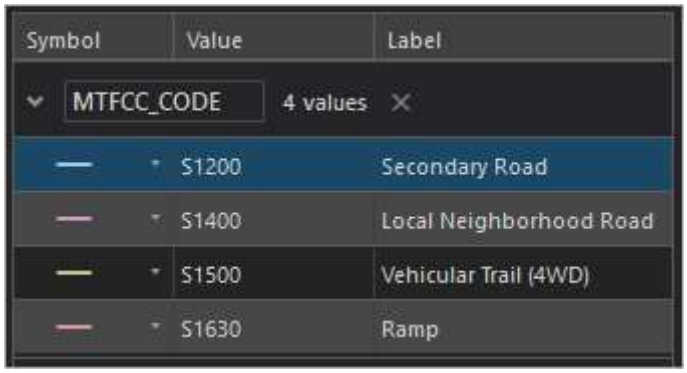


The layer has four **MTFCC Code** classes. Each code is a series of letters and numbers without much meaning. You will change the label of each code with a more meaningful description of the type of road. (The definitions

for each code can be found in the link provided in step 2 above.)

4. Under **Label**, double-click each value and change it to the following text:

   - **S1200**: Secondary Road
   - **S1400**: Local Neighborhood Road
   - **S1500**: Vehicular Trail (4WD)
   - **S1630**: Ramp

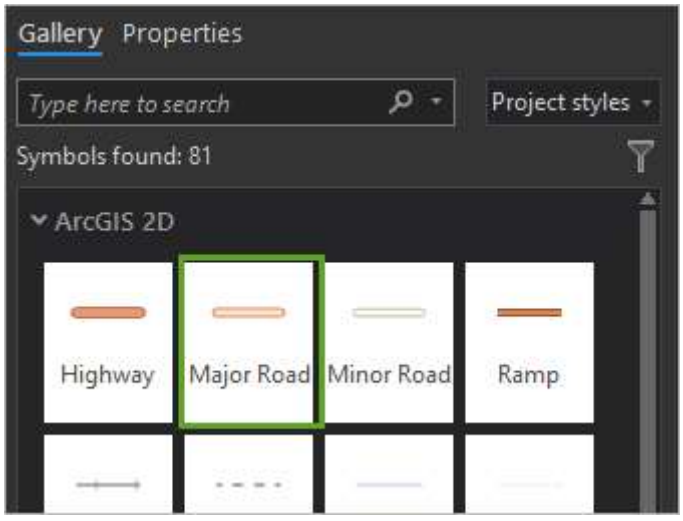


Secondary roads are the most important roads in Isanti County. You will give this road type a symbol to indicate its importance.

5. On the **Secondary Road** row, click **Format Symbol** (that is, the line symbol).

   The **Format Line Symbol** pane opens to the gallery. It is similar to the polygon symbol gallery, but has specific options for line symbols.

6. Click the second line symbol, **Major Road**.



Three major roads travel through Isanti County. Two are aligned vertically and one is aligned horizontally. The city of Cambridge is at the intersection of the horizontal highway and the right vertical highway.

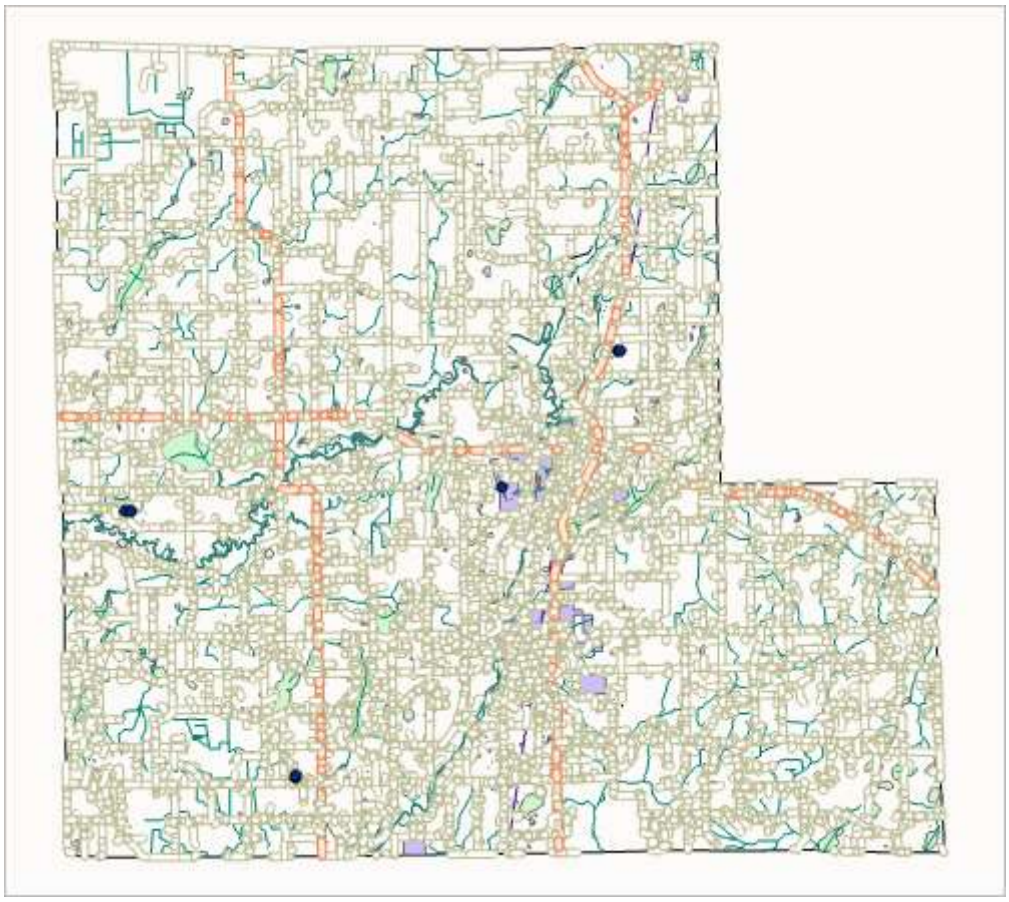
7. In the upper left corner of the pane, click the back arrow to return to the list of values. On the **Local Neighborhood Road** row, click **Format Symbol**.

8. In the gallery, click **Minor Road**. Then, return to the list of values.
9. Similarly, change **Vehicular Trail (4WD)** to the **0.5 Point** symbol, and change **Ramp** to the first ramp symbol.

> **Tip:**
>
> If you have trouble finding a symbol in the gallery, you can search for its name in the search bar.

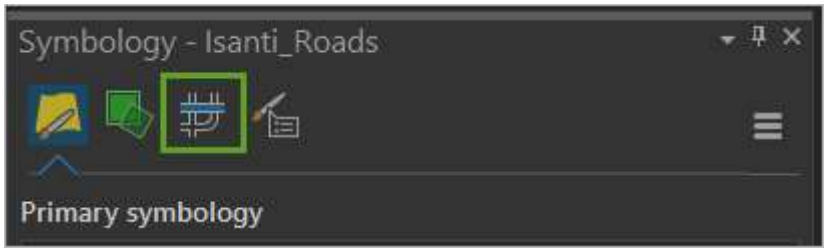
You have updated all four road types.

One of the benefits of using the default gallery symbols is that there is a clear visual hierarchy between different symbols. The symbol you chose for the secondary roads is brighter and slightly larger than the local roads symbol. This difference correctly indicates that the state routes are more important to the landscape.



The roads now have the correct symbology, but they are drawn as separate segments. Although it is easier to save roads as segments, they should be drawn as continuous features. Doing so will also reduce the bunching up of symbols, which causes the local roads symbol to sometimes obscure the more important highways.

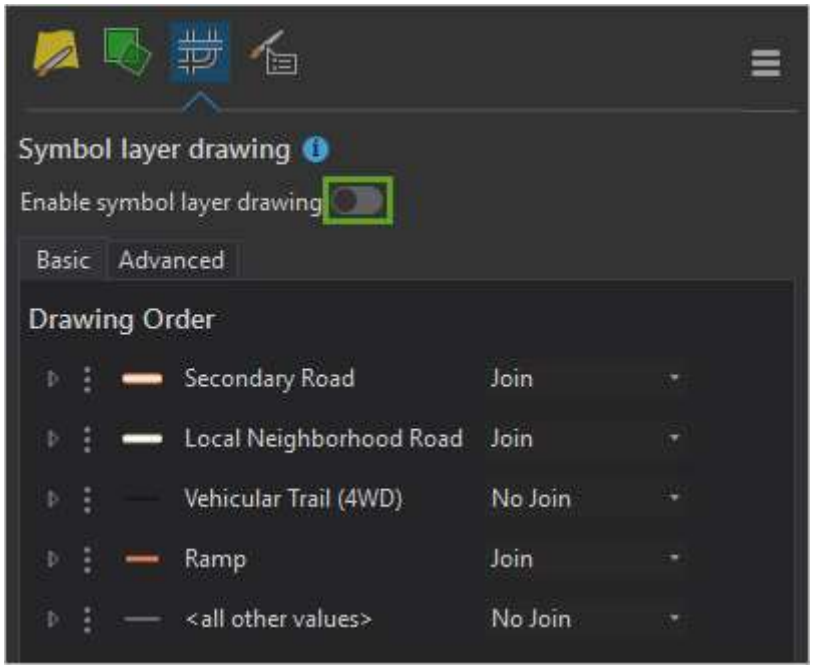
10. At the top of the **Symbology** pane, click the **Symbol Layer Drawing** button.



All the feature types in the **Isanti_Roads** layer are displayed by drawing order, which is the order in which the symbols appear on the map. You will enable symbol layer drawing for all of these layers.

Symbol layer drawing overrides the default drawing method of displaying all features in a layer as individual symbols. Instead, it draws symbols based on whether **Join** or **No Join** is chosen in the drawing order list. For features where **Join** is chosen (such as your road layers), adjacent individual symbols are displayed as a single continuous symbol.

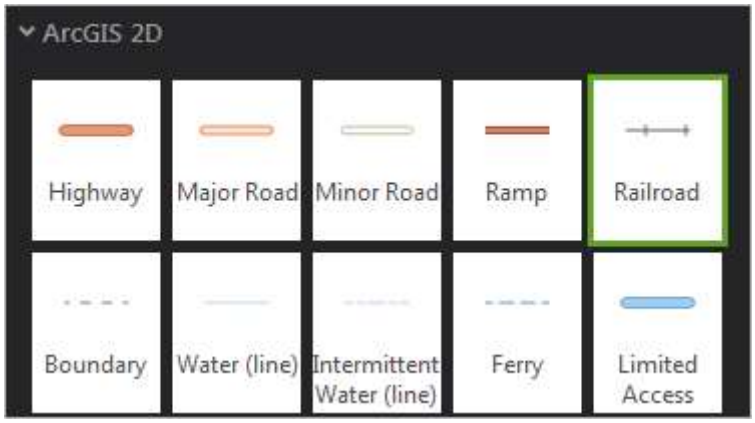
11. At the top of the pane, click **Enable symbol layer drawing**.



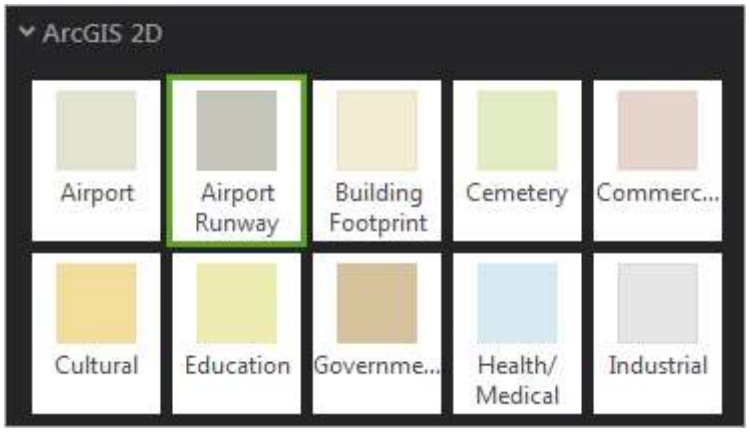
The road symbols are displayed as continuous symbols rather than individual segments.

The minor roads no longer overlap the major roads, and all roads are drawn as continuous symbols. At this zoom extent, the minor roads still cluster densely in cities. Later in the lesson, you will change the symbols to draw differently at various scales in order to avoid this clustering, but for now you will change the symbols for the other transportation layers.

12. In the **Contents** pane, click the **Isanti_Railroads** feature. In the **Symbology** pane, change its symbol to the gallery's first **Railroad** symbol.



13. Change the **Isanti_Airport_Runways** symbol to the gallery's first **Airport Runway** symbol.



The final transportation layer is **Isanti_Airport_Points**. This layer shows the location of airports as a point symbol, instead of the polygonal runways. You will use this layer when labeling features, so you will not worry about it for now.

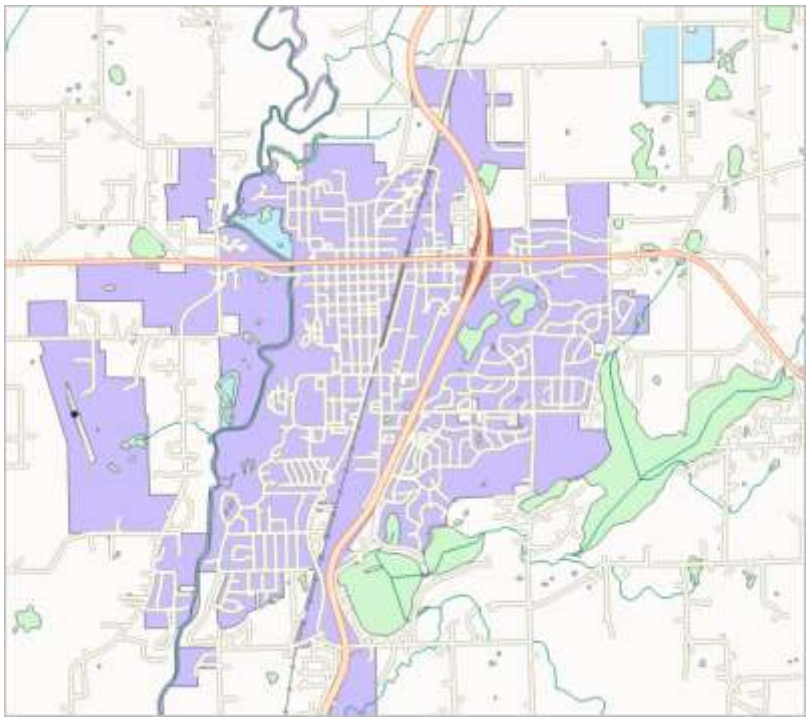
14. Press Ctrl+S to save the project.

Symbolize hydrography layers

Next, you will symbolize the hydrography layers. There is one river and several creeks flowing through Cambridge, and many lakes throughout the county. At this extent, most of the hydrography layers are difficult to see, so you will zoom in.

1. Zoom to the city of Cambridge, located at the intersection of the horizontal highway and the rightmost vertical highway.

When you zoom in, the roads become less densely clustered. It also becomes easier to see rivers and lakes in the area (in the example image, lakes have a default green symbology).



2. Open the **Symbology** pane for **Isanti_Water_Bodies**.

   This layer only contains one type of feature, so you will give it a single symbol. The size and shape of the water bodies will be enough to indicate their importance in the region.

3. In the **Symbology** pane, click the symbol swatch. In the gallery, choose the second **Water (area)** symbol.

   Tip:

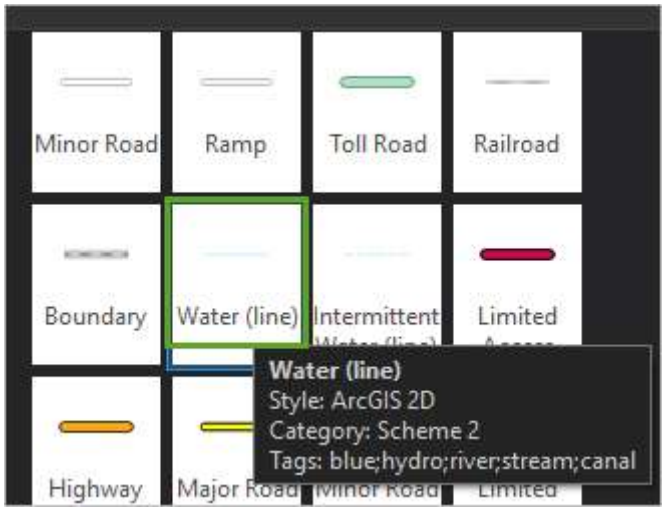
   To make sure you have picked the second symbol, point to the symbol until hover text appears. The second water symbol has the text **Category: Scheme 2**.

4. Open the **Symbology** pane for **Isanti_Flowlines**.

   The flowlines layer includes streams, canals, and ditches. Some of the flowlines represent major rivers and overlap with the **Isanti_Major_Rivers** layer. The major rivers layer provides the polygonal extent of streams,

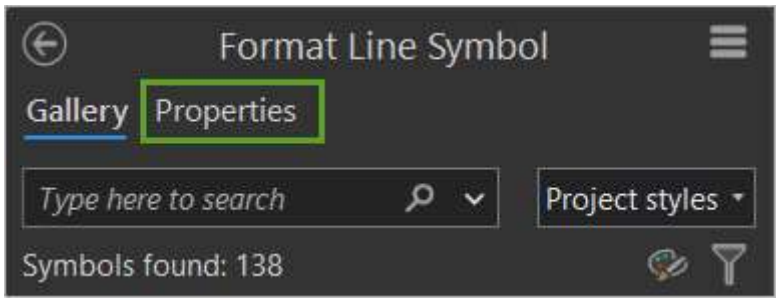
rivers, and other channels, while the flowlines layer only includes lines. The flowlines layer also contains attribute data such as flow direction and name, which will be important when labeling features. Like the water bodies, you will give the flowlines a single symbol.

5. In the **Symbology** pane, click the symbol swatch.
6. In the gallery, choose the second **Water (line)** symbol.



This symbol matches the water bodies layer. However, the line width is a little too small to see distinctly on the map.

7. At the top of the pane, click **Properties**.

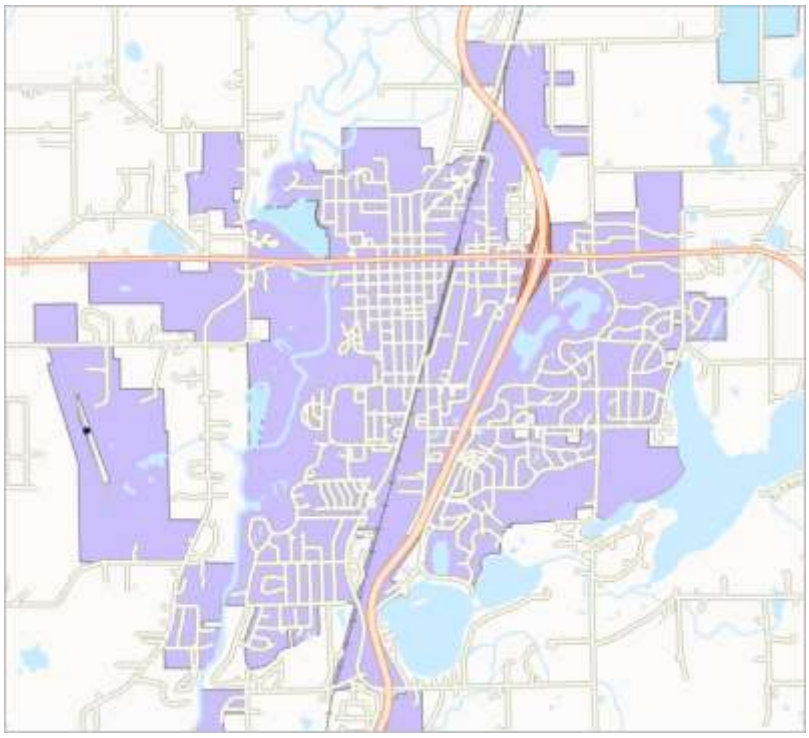


In the **Properties** tab, you can customize individual elements of your symbology, such as color and size. This is where you can create custom symbology. The symbol you have set for the flowlines layer has a width of 1 pt.

8. Change **Line width** to 1.5 pt and click **Apply**.

   The flowlines appear more clearly on the map.

9. Change the **Isanti_Major_Rivers** layer to the same **Water (area)** symbol as the **Isanti_Water_Bodies** layer.



All of the hydrology layers are symbolized.

10. Press Ctrl+S to save the project.

Symbolize boundary layers

Lastly, you will change the symbology for the boundary features. You have already symbolized the county boundary, but there are three more layers. The parks and nature reserves layers can use gallery symbols, but you will create a custom symbol for the incorporated place layer.

1. Change the **Cambridge_Parks** layer to the gallery's first **Park** symbol.
2. Change the **Isanti_Reserves** layer to the gallery's third **Recreation** symbol.

   Next, you will change the incorporated places layer. This layer represents cities in Isanti County. The gallery does not have a specific symbol for cities, so you will create your own symbol.

3. Open the **Symbology** pane for **Isanti_Incorporated_Places**.
4. Click the symbol swatch to go to the gallery. At the top of the pane, click **Properties**.
5. Under **Appearance**, change **Color** to **Tecate Dust**.

Tip:

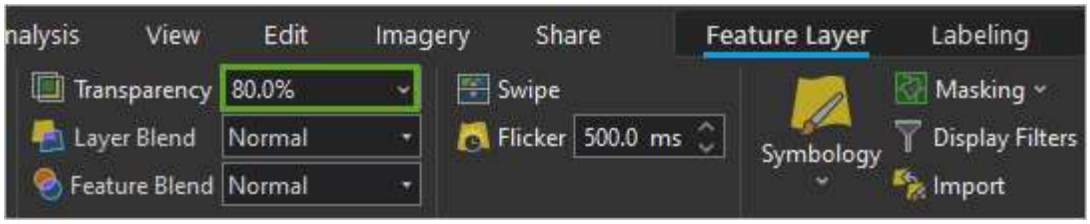
To see the name of any color in the list of colors, point to it until its hover text appears.

You will also change the outline color. It is a good idea to choose an outline that is similar to the fill color, but darker.

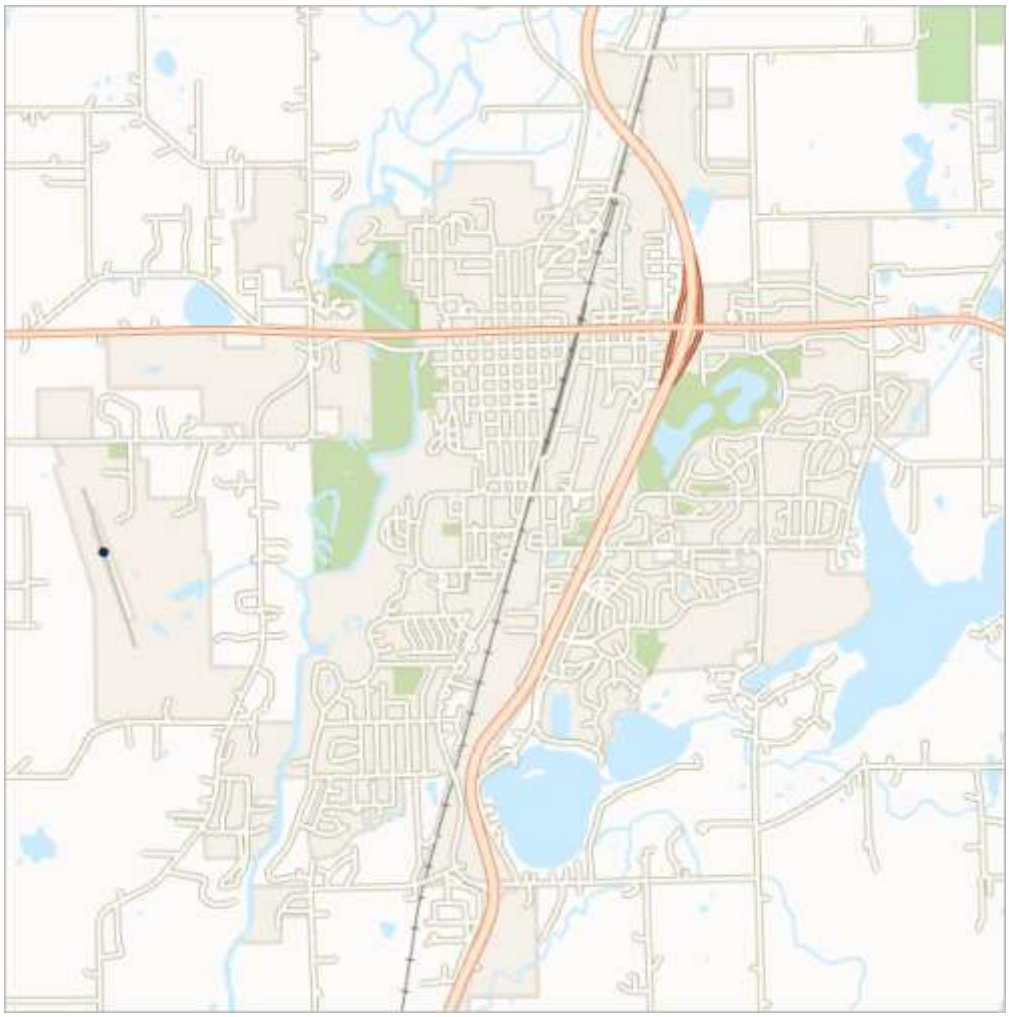
6. Change **Outline** to **Leather Brown** (fourth column, bottom row). Change the **Outline** width to 2 pt and click **Apply**.

   The symbol coloring matches the background better, but it stands out too much. You will adjust the transparency to make the symbol subtler.

7. On the ribbon, click the **Feature Layer** tab. In the **Effects** group, change the **Transparency** to 80 percent.



The incorporated place layer is still visible, but it blends into the background.



This looks much more like a typical basemap now.

8. Save the project.

In this part of the lesson, you started a new basemap, added data to it, and symbolized most of the data, while keeping cartographic principles in mind. In the next lesson, you will add labels to your features so that important places are named on the map.

Label features

Previously, you added and symbolized data to better show the transportation and hydrography features of Isanti County and Cambridge, Minnesota. You will now add context to those features with labels. You want your labels to highlight key features without being overwhelming or cluttering the map. To accomplish this, you will use font families, sizing, and other effects that make labels more legible. Then, you will set visibility limits to determine what extents the labels are drawn at.

Label major roads

Some layers, like the roads layer, have multiple categories of features. Just as you symbolized these categories differently, you will also label them differently. To do so, you will create some simple Structured Query Language (SQL)