CHAPTER 2

Map design

LEARNING GOALS

- Symbolize maps using qualitative attributes and labels.
- Use definition queries to create a subset of map features.
- Symbolize maps using quantitative attributes.
- Learn about 3D maps.
- Symbolize maps using graduated and proportional point symbols.
- Create normalized maps with custom scales.
- Create density maps.
- Create group layers and layer packages.

Introduction

In this chapter, you'll learn how to design and symbolize thematic maps. A thematic map strives to solve or investigate a problem, such as analyzing access to urgent health care facilities in a region, as you did in chapter 1. A thematic map consists of a subject layer or layers (the theme) placed in spatial context with other layers, such as streets and political boundaries.

Choosing map layers for a thematic map requires answering two questions:

1. What layer or layers are needed to represent the subject?
2. What spatial context layers are needed to orient the map reader to recognize locations and patterns of the subject features?

Quite often, the subjects of thematic maps are vector map layers (points, lines, or polygons), because such layers often have rich quantitative and qualitative attribute data that is essential for analysis. Of course, the subject can be a raster layer (in chapter 10, for example, you will create a risk-index raster map to identify poverty areas of a city, and poverty is the subject of the map). Spatial context layers can be vector, such as streets and political boundaries. These layers also can come in both raster or vector formats, including many basemap layers provided by Esri map services.

The major map design principle for thematic maps is to make the subject prominent while placing spatial context layers in the background. For example, if the subject is a map layer with points and you want to give them focus, you might give the point symbols a black boundary and a bright color. These subject features are known as "figure" and are the main composition of the map. Everything that is not figure is known as "ground." For example, if a context layer has polygons that are not the

focus of the map, you might give the polygons a gray boundary and no color, thereby placing them in the background.

Symbolization is easy for vector maps because ArcGIS Pro can use attribute values to automate drawing. For example, ArcGIS Pro could draw all food pantry facilities in a city by using unique values with a square point symbol of a certain size and color. Continuing, the software could draw all soup kitchen facilities with a circle of a certain size and different color by using an attribute with type-of-facility code values (including "food pantry" and "soup kitchen").

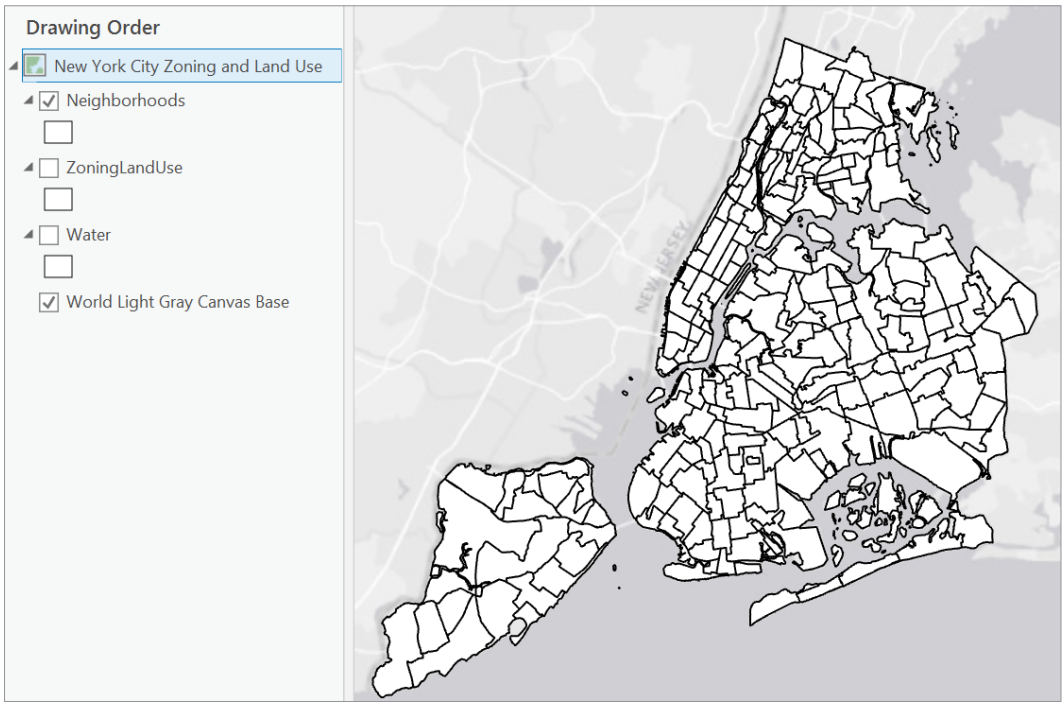
In this chapter, you will learn to use good cartographic (symbolization) principles as you build several vector-based thematic maps.

Tutorial 2-1: Choropleth maps for qualitative attributes

Placing objects of all kinds into meaningful classes or categories is a major goal of science. Classification in tabular data is accomplished using attributes with codes that have mutually exclusive and exhaustive qualitative values. For example, a code for size could have the values "low," "medium," and "high." Any instance of the features with this code is displayed in only one of the classes (the values are mutually exclusive). Moreover, there are no more size classes (the values are exhaustive). In this tutorial, you learn how to symbolize mapped features—points, lines, and polygons—by class membership as available in code attributes.

Open the Tutorial 2-1 project

1. **Open Tutorial2-1.aprx from Chapter2\Tutorials, and save the project as** Tutorial2-1YourName.aprx.
   A New York City Zoning and Land Use map opens showing Neighborhoods and a light-gray raster basemap. Two other layers, ZoningLandUse and Water, are available but not visible yet. None of the vector layers are properly symbolized yet.



2. **Use the Lower Manhattan bookmark.** The subject of this map, zoning and land use, is best viewed and studied at approximately this zoomed scale or even closer, because the geographic zones are relatively small in area. You must get close enough to distinguish them from one another.

Display polygons using a single symbol

The Neighborhoods and Water polygon layers provide spatial context. Such layers should be displayed using outlines with no color fill, with water features being an exception and generally given a blue color and no outline. Context layers are easy to symbolize. You can start with Neighborhoods.

1. **In the Contents pane, under Neighborhoods, click the white color box to modify the symbol.**

2. **In the Format Polygon Symbol pane, under Properties, change Color to No Color.**

3. **Change the Outline color to Gray (60 percent), and click Apply.**

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Turn on the Water layer, and symbolize the layer with a blue polygon symbol. Hint: On the Gallery tab, search for Water, and click one of the Water (area) symbols.

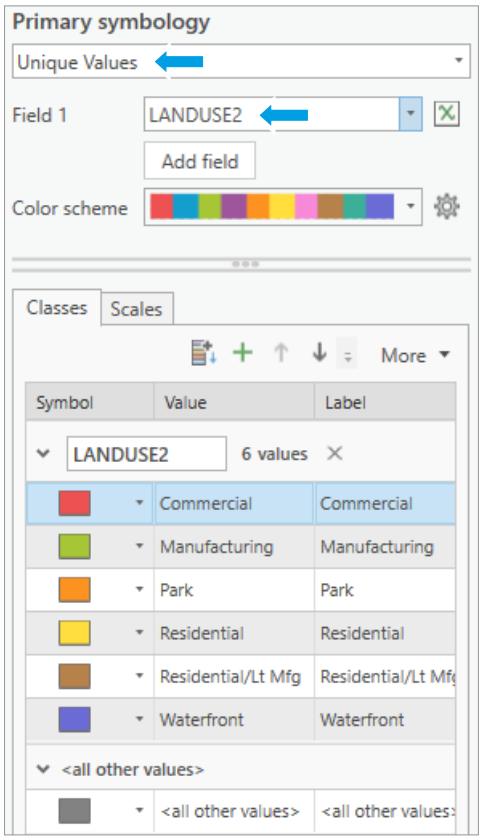
Display polygons using unique value symbols

The last layer to symbolize, Zoning Land Use, is the subject of the map, displayed by Unique Values on primary land-use code. Land-use maps use muted colors, which you'll create next.

1. **Turn on ZoningLandUse, right-click the layer, and click Symbology.**

2. **In the Symbology pane, for Primary symbology, choose Unique Values.**

3. **In the Value field for Field 1, choose LANDUSE2.** This step adds random colors for six land uses (your colors may be different from those shown in the figure).



Next, you'll assign colors used by the New York City Planning Department. You'll start by changing the outlines of all polygons from black to light gray. When you view land-use polygons, their black outlines often take up too much of your map and attention, and also distract from the symbolized color. A gray color will soften this interference and still show boundaries.

4. **In the Symbology pane, click More > Format All Symbols.**

5. **In the Format Polygon Symbols pane, click Properties, and change Outline Color to Gray 20 percent.**

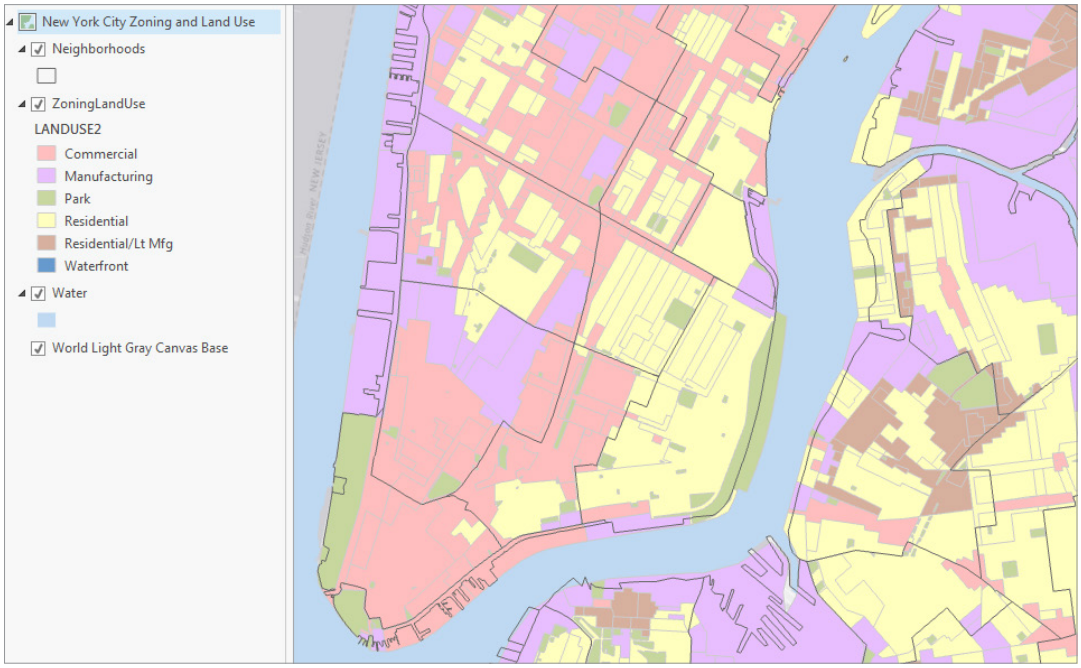
6. **Click Apply, and click the back button ← to go back to the Symbology pane.**

7. **For Landuse2, click the symbol for Commercial, and change the color to Rose Quartz (first row, second column).**

8. **Click Apply, click the back button, and apply the following colors for the remaining land uses:**
   - **Manufacturing: Lepidolite Lilac (first row, 11th column)**
   - **Park: Apple Dust (seventh row, sixth column)**
   - **Residential: Yucca Yellow (first row, fifth column)**
   - **Residential/Lt Mfg.: Soapstone Dust (seventh row, third column)**
   - **Waterfront: Atlantic Blue (ninth row, ninth column)**

9. **In the ZoningLandUse pane, click More, and clear Show All Other Values.** All polygons have land-use code values, so this option is not needed. If left on, other values would be entered in the legend in the Contents pane and perhaps confuse the map reader.

10. **Close the Symbology pane, and save your project.** You can see all boundaries of primary land uses with their gray outlines.



Part 1

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Tutorial 2

Tutorial 2-2: Labels

Labels created from attributes, such as neighborhood names, are an important part of cartography and an integral and informative component of a map. You must specify the elements of font, size, color, placement, and visibility ranges to make labels easy to read.

Open the Tutorial 2-2 project

In this exercise, you will label all three layers of the map. Each layer will have its own label properties and label placements.

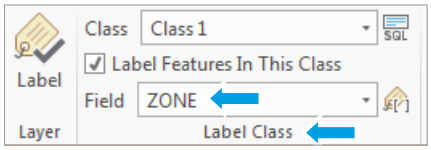
1. **Open Tutorial2-2.aprx from Chapter2\Tutorials, and save the project as** Tutorial2-2YourName.aprx**.**

2. **Use the West Village bookmark.** To maintain visual clarity, labels for a detailed layer such as ZoningLandUse are most useful when zoomed in to the neighborhood level or similar larger scale because of the number of small polygons.

Change label properties

1. **In the Contents pane, click Zoning Land Use.** The Feature Layer contextual tab appears on the ribbon with the tabs Appearance, Labeling, and Data highlighted.

2. **On the Labeling tab, in the Label Class group, click the field named Zone.**

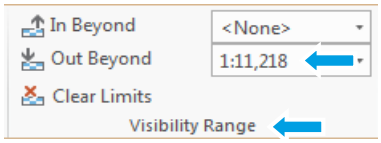


The field in this map has detailed zoning codes known by developers, planners, and other members of the user community.

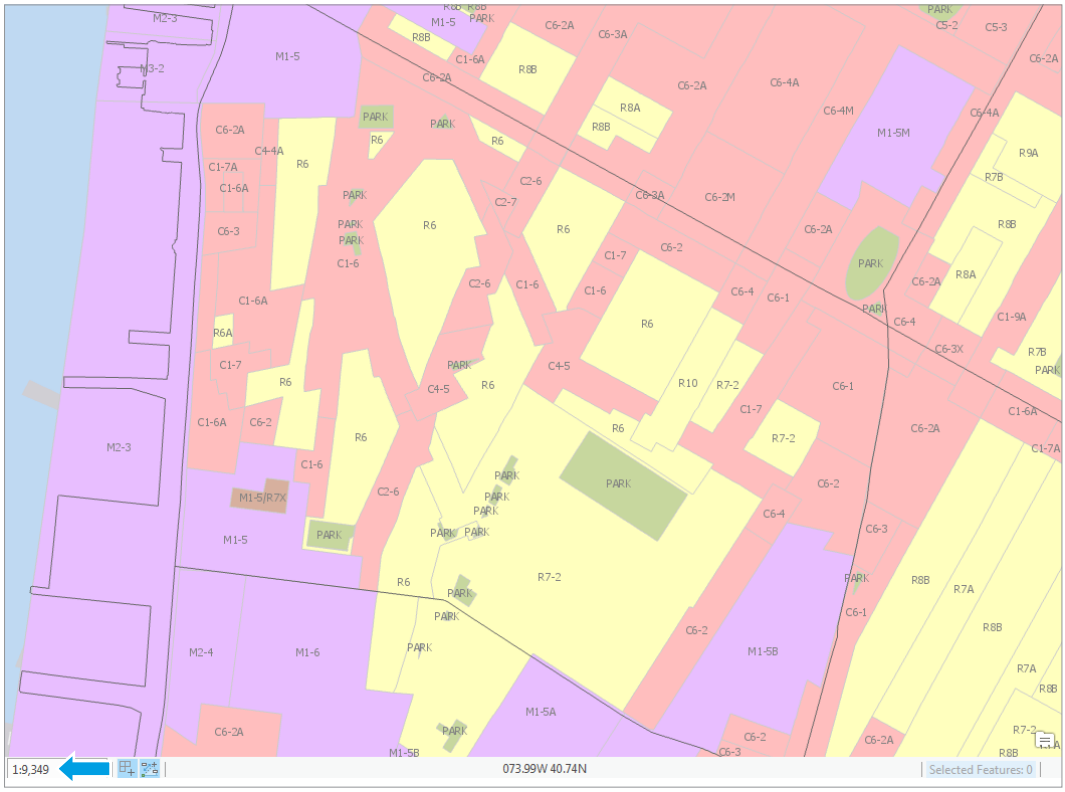
3. **In the Layer group, click Label** . Wait for the labels to appear; when they appear, the labels will get defaults and should be customized to better suit the purpose of the map.

4. **Make the following changes in the Text Symbol group:**
   - **Text Symbol Font Size: choose** 8.
   - **Text Symbol Color: choose Gray 50 percent.**

5. **In the Visibility Range group, for Out Beyond, choose <Current>.** This step sets the visibility range for zoning labels so that they do not display when zoomed beyond the current scale. Your scale will not necessarily match the scale of the next figure, because scale varies with monitor resolution and how the application is arranged.



6. **Zoom in and out to see that the labels are on only when zoomed in closer than the West Village bookmark.** Note the map scale when the labels turn on or off.



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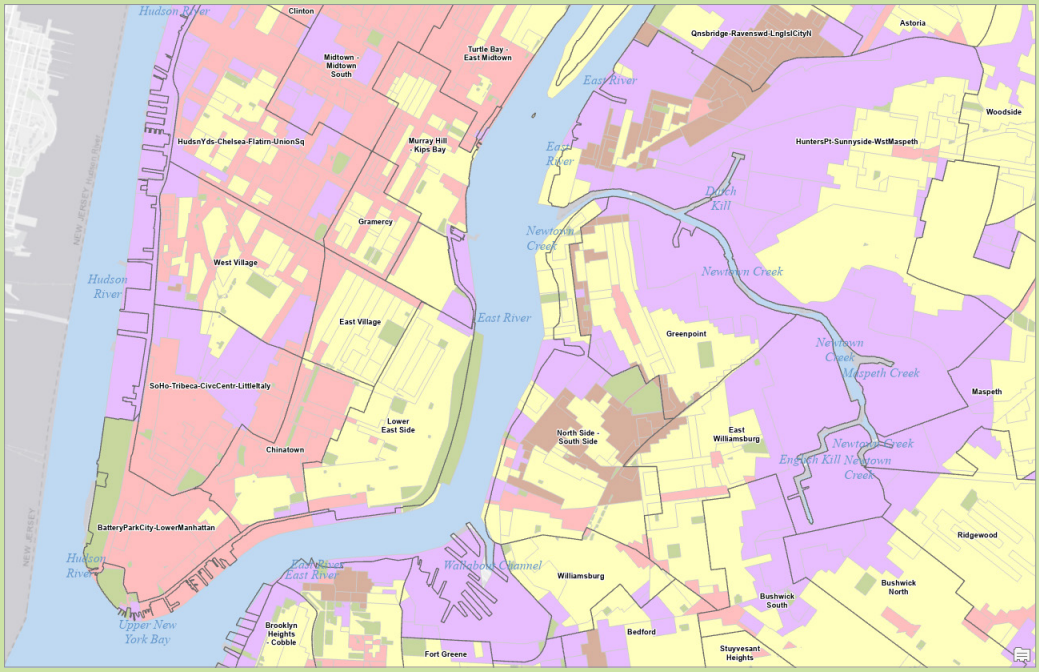
YOUR TURN

Use the Lower Manhattan bookmark. Label the Neighborhoods layer using name, Arial font, bold, size **7**, and a white halo. Finally, on the ribbon, on the Labeling tab in the Label Placement group, choose Land Parcel.

Label the Water layer using Landname. Use font Times New Roman, italic, size **12**, and the color Atlantic Blue.

Set the Neighborhoods and Water labels to turn off when zoomed out beyond the Lower Manhattan bookmark. Try out the labels by zooming in and out and using bookmarks.



Remove duplicate labels

Labels for some water polygons may overlap with redundant and unnecessary labels. Removing duplicate labels will unclutter the map. You will do so using another menu option to set label properties.

1. **In the Contents pane, right-click Water > Labeling Properties.**

2. **In the Label Class pane, click Position (near the top of the pane), and click the Conflict Resolution button** .

3. **Expand Remove Duplicate Labels, and click Remove All.**

4. **Close the Label Class pane.** The map will now show just one label for each water feature.