1

Frame the problem and explore the study area

THE VOLATILE LOS ANGELES RIVER

is the reason America's second-largest city was founded in its present southern California location by Spaniards in 1781. (The area was originally settled by the Gabrielino Native American Tribe thousands of years earlier.) Its water was tapped for drinking and irrigation, and a new city spread out from the river across the coastal plain. By the turn of the 20th century, the river was surrounded by a thriving urban center. Every few decades, raging floods would crest the banks at various points, submerging entire neighborhoods. After the historic floods of 1938 that claimed more than 100 lives and washed out bridges from Tujunga Wash to San Pedro, city leaders had seen enough. By 1941 the U.S. Army Corps of Engineers began to straighten, deepen, and reinforce the once wild waterway. Much of its length was eventually lined in concrete, and the river was more or less tamed.

Today, the City of Angels—home to nearly 4 million people—is a vibrant world center of business and culture. Running straight through the heart of the city, the Los Angeles River now serves ably as a flood-control channel. Sadly, this once-bucolic waterway that was so instrumental in the formation of the city became known as something ugly and marginal. Mile after mile of angled concrete appealed only to graffiti artists and filmmakers, and save for the occasional televised rescue of some hapless Angeleno swept away by a winter storm-fed torrent, the river remained a part of the city ignored by most. The negative perception has stuck with the neglected river for decades.

But in recent years, as the city has densified and much of southern California's wildlands have been appropriated for development, new attention has focused on the river corridor and the scattered pockets of open space that line its length. While it must always serve its important flood control function, the river and adjacent lands are increasingly recognized as under-utilized, providing opportunities for regreening and psychic restoration for human beings in an overbuilt city. Adventuresome and resourceful citizens have discovered peaceful pockets of sanctuary along the river and made these places their own. A vital and concerned activist community has raised awareness of the river and pushed for its beautification and redevelopment.

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In 2005, the city launched a major public works project focused on the human dimensions of the river. A landmark study, the Los Angeles River Revitalization Master Plan, demonstrated the significant potential to improve quality of life for citizens living near the river corridor through wise redevelopment. Mayor Antonio Villaraigosa said at the time: "We have an opportunity to create pocket parks and landscaped walkways...to create places where children can play and adults can stroll."

According to Villaraigosa, "The Plan provides a 25- to 50-year blueprint for transforming the City's 32-mile stretch of the river into an 'emerald necklace' of parks, walkways, and bike paths, as well as providing better connections to the neighboring communities, protecting wildlife, promoting the health of the river, and leveraging economic reinvestment."

While the 2005 master plan identified some of the most obvious areas for large-scale regional redevelopment along the river, it stopped short of identifying smaller (and more affordable) neighborhood projects; that work would require a more involved study. With thousands of land parcels strung out along the river, identifying the best places for park development is like looking for that proverbial needle in a haystack. Many factors come into play, among them current land use, demographics, and accessibility.

In the years since the plan's completion, the city has created a web site that encourages people to learn about (and participate in) the latest developments related to its landmark resource. The web site at www.lariver.org contains links to many resources about the river and its watershed, including scientific studies and recreational opportunities. If city leaders can find the resources and a motivated citizenry keeps up the pressure, there will be a renaissance transforming growing stretches along the river that become real versions of these artists' renderings.

All images on this page courtesy of The City of Los Angeles, LA River Revitalization Master Plan

Here's where you pick up the thread in this book. You'll use the city's real need for river redevelopment as a launching point for a park siting analysis using a geographic information system (GIS). A GIS is ideal for this type of decision-making because it allows you to analyze large amounts of data in a spatial context. In this book, you'll spend a lot of time with Esri's ArcGIS® for Desktop software, and by the end you'll have completed a project from start to finish. Along the way, you'll gain an excellent grasp of what a GIS can do.

You'll be assuming the role of a GIS analyst for the City of Los Angeles. So what exactly does a GIS analyst do and how is that job different from other jobs that also use GIS software? The table below defines some of the various roles that a typical GIS operation might establish to accomplish their work.

GIS Roles	
Editors	People who create, update, and correct spatial data and its attributes (statistical and descriptive information).
Cartographers	People who make and publish maps and solve information design problems.
Analysts	People who query and process geographic data to solve analytical problems.
Programmers	People who implement custom GIS functionality by developing scripts and applications for specific procedures.
Managers	People who oversee staffing and equipment, database design, workflow, new technology, and data acquisition.

The central work in this book is analytical. Your main focus will be on using ArcGIS tools and methods to find the most park-suitable land within a study area, but there is preparatory work to do before the analysis proper, and there are results to interpret and present afterwards. This book has two goals. One is to present a comprehensive approach to geographic problem solving. We want to help you develop skills, habits, and ways of thinking that will be useful in projects other than this one. The second goal is to teach you how to use ArcGIS 10.1 for Desktop software. These goals are mostly complementary. ArcGIS is a big system, however, and it wouldn't be realistic to try to cover all it can do in a single book. Our principle has been to teach the software in the service of the project and not otherwise. You'll delve into many aspects of ArcGIS for Desktop—editing, modeling, and cartography among them—but there are other aspects we won't use, or will only touch lightly, because they aren't strictly relevant to our needs. We might say (with apologies to Waldo Tobler) that everything in a GIS is related to everything else, but some things are more closely related to analysis than others.

Frame the problem

The first step in the geographic approach to problem-solving is to frame the problem. What that means, first of all, is coming up with a short statement of what it is you want to accomplish. We want to find a suitable site for a park near the Los Angeles River.

Once you have the statement, you can begin to tease out its ambiguities. What factors make a site "suitable"? Fortunately for us, the city council has already established a concise and fairly specific set of guidelines. They want a park to be developed:

- On a vacant parcel of land at least one acre in size
- Within the Los Angeles city limits
- As close as possible to the Los Angeles River
- Not in the vicinity of an existing park
- In a densely populated neighborhood with lots of children
- In a lower-income neighborhood
- Where as many people as possible can be served

This limits the scope of our inquiry, but it's far from a complete breakdown of the problem. Some of the guidelines are specific, but others are vague. Familiar concepts are sometimes the hardest to pin down. For example, what income level should count as "lower income"? How are the boundaries of a "neighborhood" established? We can't solve the big problem until we've solved the little problems buried inside it. Usually, however, it's not possible to address (or even foresee) all the little problems ahead of time.

Data exploration influences the framing of the problem. Do you have income data on hand? If so, is it for individuals or households? Is it average, median, or total? To the extent that the questions themselves are indefinite (what is lower income? how should it be measured?), the data you have available will help shape the answer.

Analysis also influences the framing of the problem. Given that we want a one-acre tract of vacant land, what do we do about adjacent half-acre lots? Is there a tool to combine them? If so, does it have undesired side effects, such as loss of information? Our data-processing capabilities (and our knowledge of them) may determine how we define a "one-acre parcel."
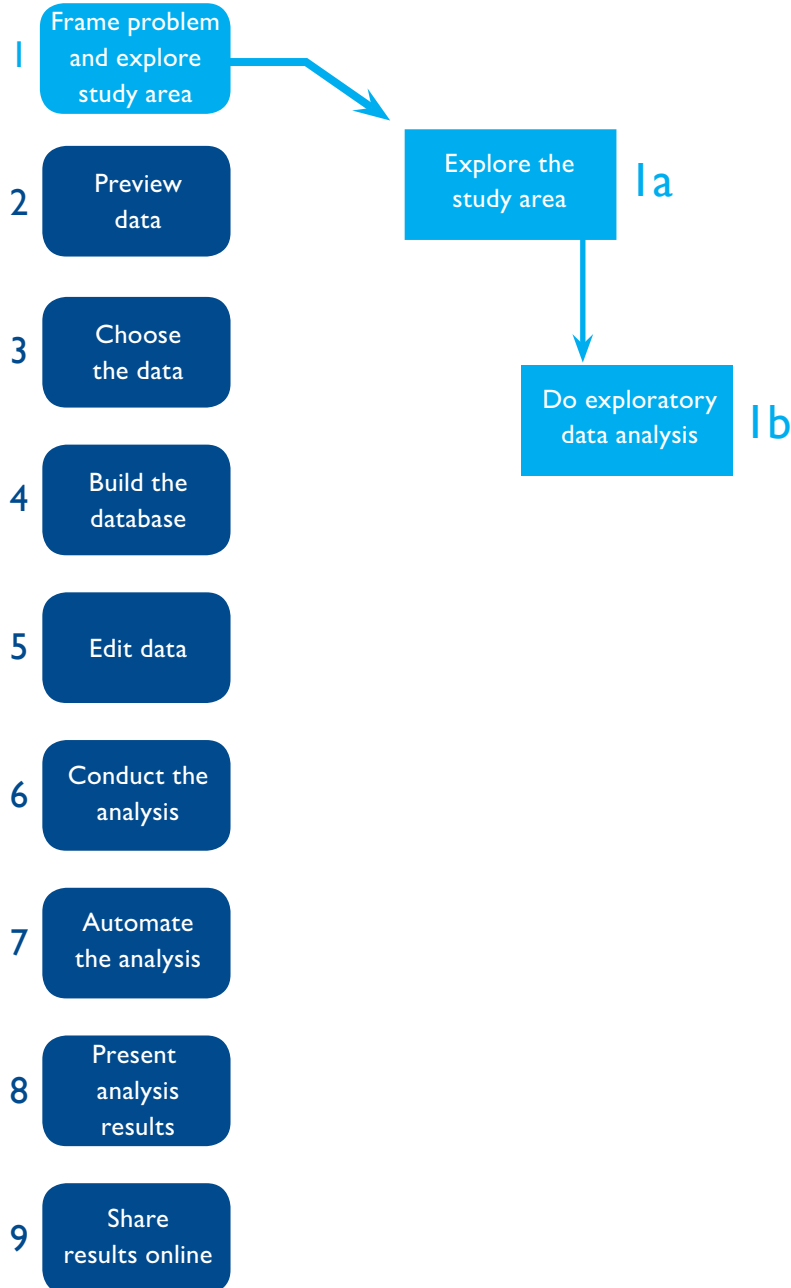
Even the results of an analysis influence the framing of the problem. Suppose, after having carefully defined the guidelines, we run the analysis and don't find any suitable sites. Do we report to the city council that there's just no room for a park anywhere? More likely, we change some of our definitions and run the analysis again.

Framing the problem, therefore, is an ongoing process, one that will occupy us through much of the book.

You are here:

What you'll do in this lesson:

1 Frame problem and explore study area

Explore the study area 1a

Do exploratory data analysis 1b

2 Preview data

3 Choose the data

4 Build the database

5 Edit data

6 Conduct the analysis

7 Automate the analysis

8 Present analysis results

9 Share results online

Exercise 1a: Explore the study area

In this exercise, we'll get to know the Los Angeles River and its surrounding area with maps and data. At the same time, we'll learn the basics of working with ArcMap: how to navigate a map, how to add and symbolize data, and how to get information about map features.

1) **Start ArcMap.** We'll open the ArcMap application.

Ⓐ Click the Windows Start button and choose All Programs ➔ ArcGIS ➔ ArcMap 10.1.

The application opens with the ArcMap - Getting Started dialog box in the foreground (Figure 1-1).

Ⓑ In the left-hand window, if necessary, click My Templates.

Other templates are listed here.

A template is a predefined layout, or design, for a map. It may include graphic elements and data. The default template is a blank map.
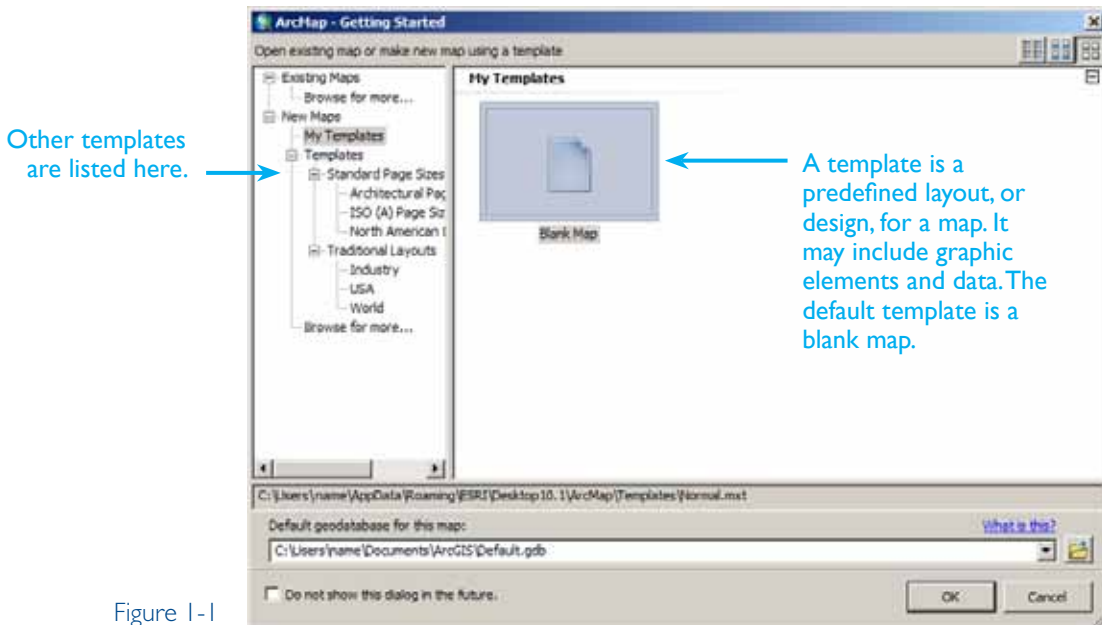
Figure 1-1

Ⓒ Click the Blank Map icon to select it and click OK.

A blank map document opens. A map document is a file that contains one or more maps, layouts, and associated layers, tables, charts, and reports.

2) **Add a basemap layer.** A basemap is a layer of reference geography that forms a backdrop to your map.

Ⓐ On the Standard toolbar at the top of the application window, locate the Add Data button ⊕▾ .

Ⓑ Click the small drop-down arrow next to the button.

▷ If you click the icon instead of the arrow, an Add Data dialog box will open. Close this dialog box and try again.

Ⓒ On the drop-down menu, choose Add Basemap.

D In the Add Basemap window, click *Streets* to select it (Figure 1-2), then click Add.
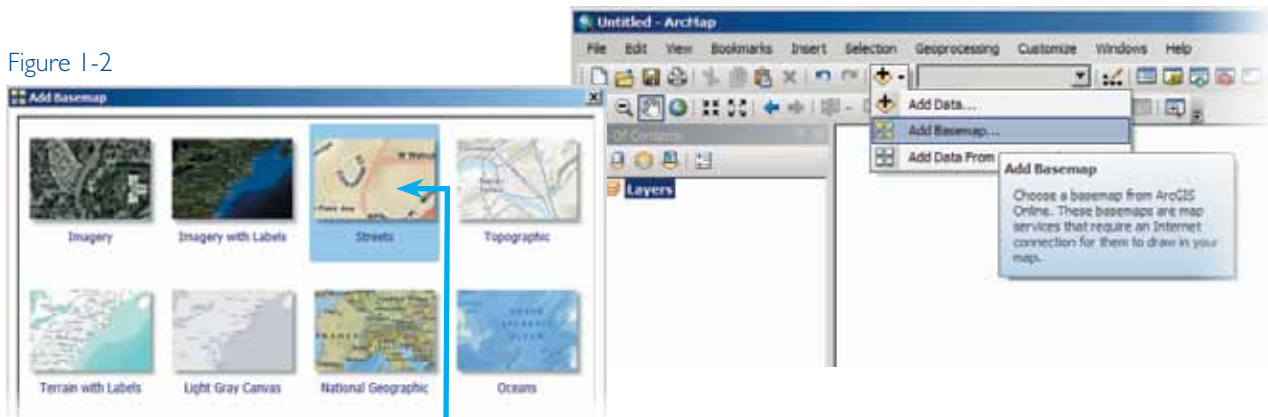
Click the *Streets* basemap.

You'll probably be prompted to enable hardware acceleration. (It depends on your computer configuration.)

E If you're prompted to enable acceleration, click Yes.

This book makes frequent use of online map services; specifically the *Streets* and *Imagery* basemaps. One side effect is that there can be complications due to servers, web and network connections, and the processing power of your computer. Therefore, operations in some cases may be slower than you anticipate. Be reasonably patient as you work, and check the Understanding GIS web site (see page xii) for updated information if performance issues persist.
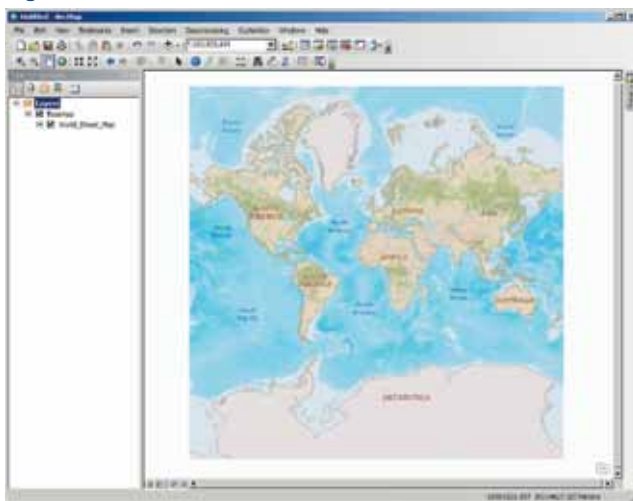
The *World_Street_Map* basemap layer is added to your map document (Figure 1-3). It has an entry in the Table of Contents

Figure 1-3

window on the left. At the top of the application is the main menu. Underneath it are two toolbars. The Standard toolbar has generic functions (such as New, Save, Print, Copy, Paste) and buttons to open other windows. The Tools toolbar has navigation tools (such as Zoom In, Zoom Out, and Pan) and other common tools for doing things with maps. There are lots of other toolbars besides these, and we'll use a couple of them in this lesson.

On the right side of the application are two tabs named Catalog and Search. These tabs are hidden windows. We'll use both windows a lot in the book, although we won't get to the Search window for a few more lessons.

Toolbars and windows can be moved around and resized. Figure 1-3 reflects the default arrangement.

3) Zoom in to Southern California. We'll zoom in to our area of interest.

Ⓐ On the Tools toolbar, click the Zoom In tool 🔍. In the map window, click and drag to draw a box around Southern California, as shown in Figure 1-4.

▷ Your box doesn't have to match exactly.

Ⓑ Use the Zoom In tool again to get closer. When you see city names and major roads, use the Pan tool 🖐 to center the view on the Los Angeles area.

Ⓒ Keep zooming in (try the Fixed Zoom In button ⌗, too) until you can easily distinguish cities, freeways, and landmarks such as airports, as in Figure 1-5.

▷ If you zoom in further than you want, use the Zoom Out 🔍 or Fixed Zoom Out ⌗ tools to go back.

You probably noticed that no streets were visible at the global scale, and that as you kept zooming in, more and more detail appeared. This is because the basemap is a multiscale map: really a set of maps which turn themselves on and off to display features and symbology that are appropriate to your map scale.

Figure 1-5 shows greater Los Angeles, an area that includes hundreds of incorporated communities and nearby cities.

Figure 1-4

Draw a box around the area you want to zoom to.

Figure 1-5

Basemap layers

Basemap layers show reference geography such as street maps, imagery, topography, and physical relief. The ones available from the Add Basemap window in ArcMap® are remotely hosted map services that you can navigate, view, and use as backdrops to other data. Basemaps are stored at multiple scales, so that as you zoom in or out you see different amounts of detail. As you navigate a basemap, the various pieces of it (called *tiles*) that compose your current view are stored locally on your computer in a so-called display cache. When you zoom or pan to a new area, the map may be a little slow to draw, but any place you return to will redraw quickly because the data comes from your cache, not from the remote server.
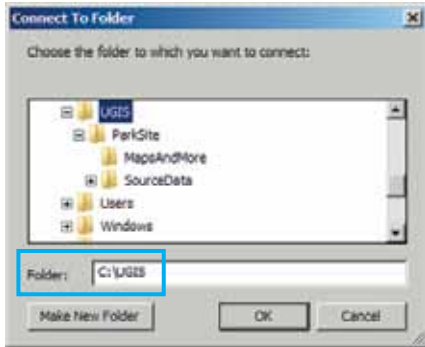
Figure 1-6

4) Add a layer of project data. On top of the basemap, we'll add a layer from the data that has been put together for this project and is stored on your computer. In Lesson 2, we'll talk more about where this data comes from and how to acquire data of your own.

Ⓐ On the Standard toolbar, click the Add Data button ✛. This time, click the icon itself, not the drop-down arrow.

The Add Data dialog box opens to a default "home" location in your Documents\ArcGIS folder. We don't have any project data here. To navigate to our data folder, we have to make a folder connection.

Ⓑ In the row of buttons at the top of the Add Data dialog box, click the Connect To Folder button 📁.

Ⓒ In the Connect To Folder dialog box, navigate to the folder where you installed the data—probably C:\UGIS— (Figure 1-6) and click OK.

Ⓓ In the Add Data dialog box, navigate as follows:
- Double-click the ParkSite folder to open it.
- Double-click the Source Data folder.
- Double-click ESRI.gdb.
- Double-click Boundary.

We'll discuss GIS data formats in the topic *Representing the real world as data* in Lesson 2. For now, we just want to dig down to our data.

Ⓔ In the Add Data dialog box, click *City_ply* to select it (Figure 1-7) and click Add.
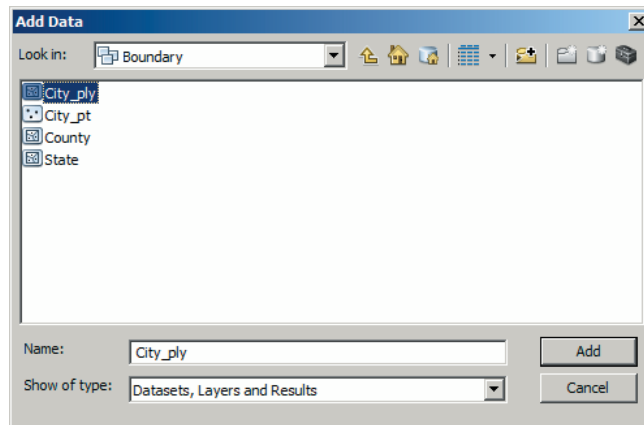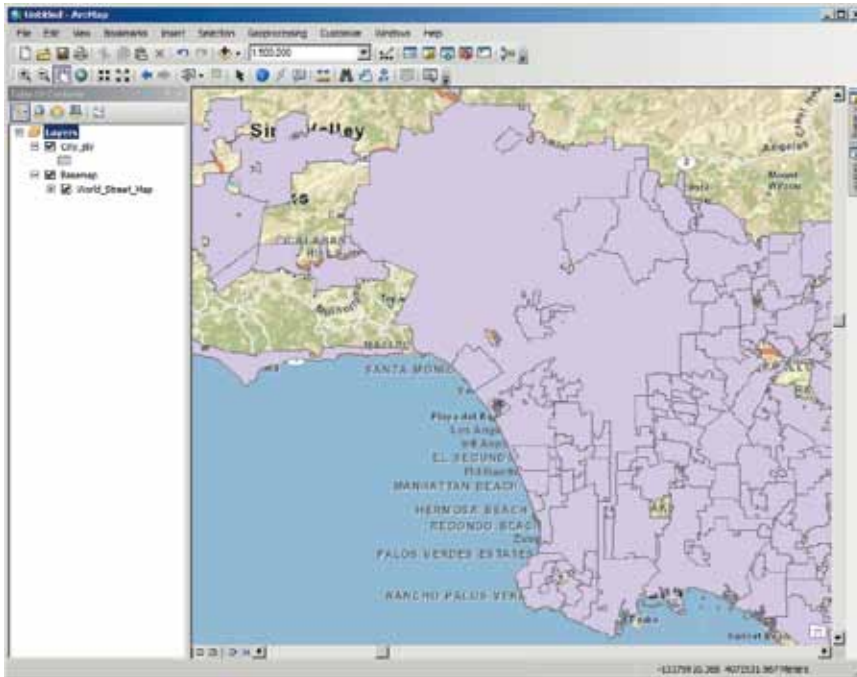   ▷ Or just double-click *City_ply* from the list.

Figure 1-7

A layer of city boundaries is added to the map (Figure 1-8). Each city in the layer is called a feature. These features are polygons, which are one of the three basic shapes with which geographic objects are represented in a GIS. (The others are lines and points.)

The color of the layer is assigned at random, so yours may be different.

Figure 1-8

In the Table of Contents, the order of entries matches the drawing order of layers in the map. *City_ply* is listed above *Basemap,* and on the map, the cities cover the basemap. You can control a layer's visibility with its check box in the Table of Contents.

F In the Table of Contents, click the check box next to *City_ply.*

The layer turns off.

G Click its check box again to turn the layer back on.

5) Set layer properties. Every layer has properties you can set and change. For example, you just changed the visibility property of the *City_ply* layer.

A In the Table of Contents, right-click the color patch underneath the *City_ply* layer name.

A color palette opens (Figure 1-9). Moving the mouse pointer over any color square shows its name as a tool tip.

B On the color palette, click any color you like to change the layer color.

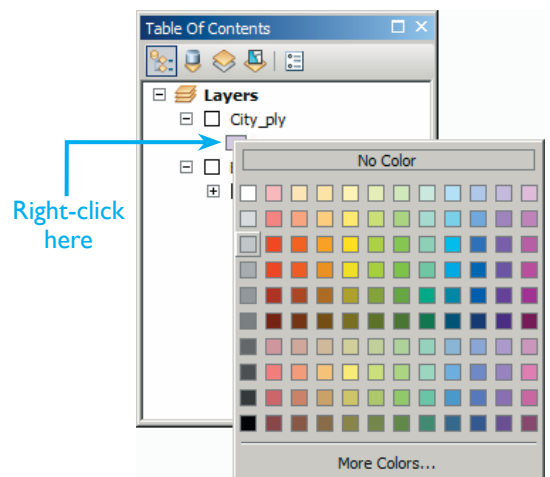On the map, the cities redraw in the color you chose.

Right-click here

Figure 1-9

In the Table of Contents, right-click the *City_ply* layer name to open its context menu. At the bottom of the menu, choose Properties.

The Layer Properties dialog box opens. This is where you access the full set of properties for a layer.

 If necessary, click the General tab (Figure 1-10).
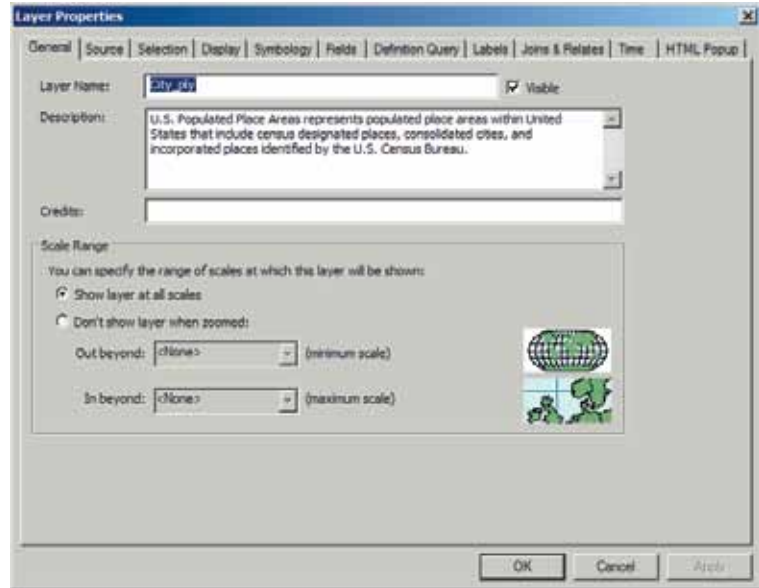
Each tab along the top has different layer properties.

Figure 1-10

The layer's name, *City_ply,* is one of its properties. This name is cryptic (it stands for "city polygons") and unattractive, so let's change it.

 In the Layer Name box, delete the name and type **Cities** instead. Click Apply.

The name is updated in the Table of Contents.

 In the Layer Properties dialog box, click the Source tab.

This tab shows technical information about the layer, including the path to the data on your computer (Figure 1-11).
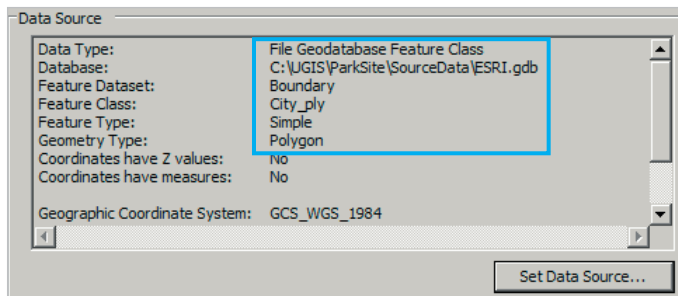
Figure 1-11

Renaming the layer in the map document doesn't change the name associated with the source data (which is still *City_ply*). A layer is a representation or rendering of the data, not the data itself. You can make any changes you want to a layer's properties without affecting the data on which the layer is based.

G Click OK on the Layer Properties dialog box to close it.

6) Get information about cities. Let's see what we can find out about the cities on the map.

A On the Tools toolbar, click the Identify tool ⓘ.

B Click any city polygon on the map.

The city flashes green and an Identify window opens (Figure 1-12). In the top window, you see the name of the city you identified. In the bottom window, you see its attributes, or the information that this layer stores about cities. Some of them aren't obviously meaningful, but others are. If POP2010 is population for the year 2010, and POP10_SQMI is population per square mile for the same year, then you know that Los Angeles (if that's the city you identified) had 3,792,621 inhabitants at the time of the 2010 census and its population density was 8,018 people per square mile.

C Move the Identify window away from the map, if necessary. Click another city on the map.

The Identify window updates with information about the new city. All the cities have the same set of attributes; it's the values of the attributes that change.

D Identify a few more cities, then click somewhere on the basemap where there isn't a city.

The Identify window is empty and a message at the bottom says, "No identified features."

E Close the Identify window.

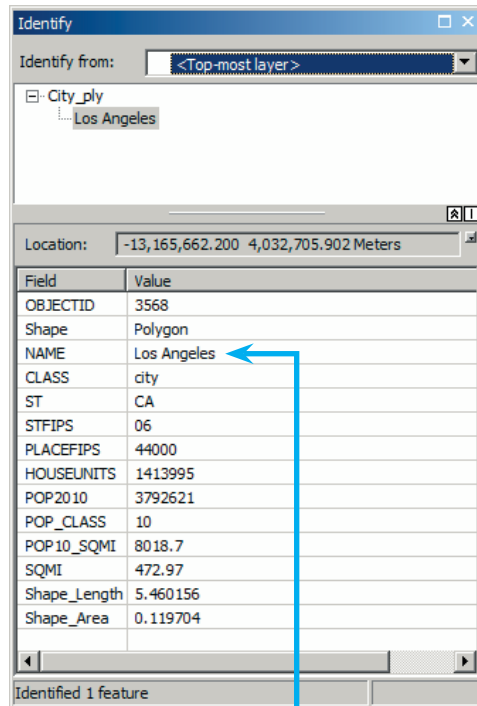**F** In the Table of Contents, right-click *Cities* and choose Open Attribute Table (Figure 1-13).

Figure 1-12

This example shows Los Angeles, but it doesn't matter which city you identify.

Figure 1-13

Ⓖ Scroll across the table and look at the field names (the gray column headings).

This is a different presentation of the same information you saw when you identified cities.

Ⓗ Scroll back to the beginning of the table, then scroll a little way down through the records (the table rows).

There are a lot of records in this table: in fact, 29,259 of them, as you can see at the bottom. Each corresponds to a unique feature—that is, a unique city—on the map. So there must be a lot of cities we're not seeing in the current view.

Ⓘ Leave the table open, but move it out of the way of the map.
  ▷ You can dock it by dropping it on any blue arrow, or you can move it outside the ArcMap application window.

Ⓙ In the Table of Contents, right-click the *Cities* layer. On the context menu, choose Zoom To Layer.

The map zooms out to the geographic extent of the layer: the entire United States. You can't distinguish individual cities at this scale.

Ⓚ On the Tools toolbar, click the Go Back To Previous Extent button ◀.

7)   **Select the record for Los Angeles.** When you select a record in an attribute table, the corresponding feature is selected on the map. (Likewise, when you select a feature on the map, its record is selected in the table.) Selections are marked with a blue highlight.

Ⓐ Scroll up to the top of the table. Make sure the table is wide enough that you can see the POP2010 field.
  ▷ If necessary, widen the table by dragging its edge.

Ⓑ Right-click the POP2010 field name. On the context menu, choose Sort Descending.

The records are sorted in the order of their populations, from largest to smallest. Los Angeles is now the second record in the table, right after New York.

Ⓒ At the left edge of the table, click the small gray box next to the Los Angeles record to select it (Figure 1-14).

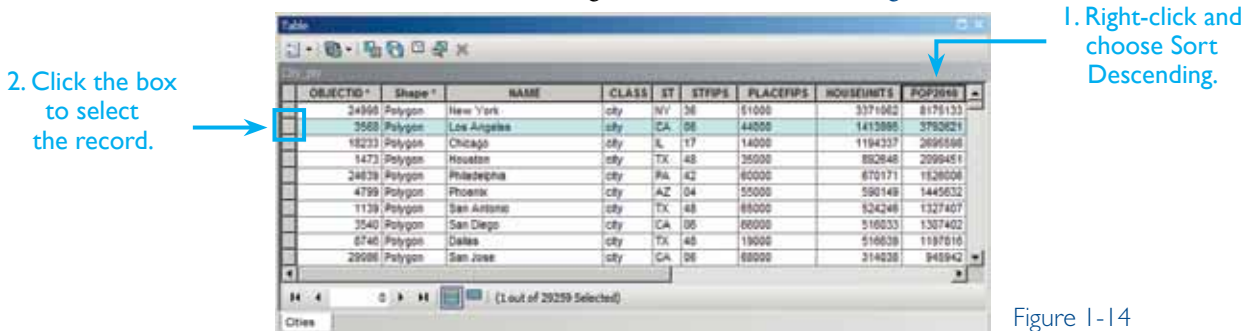

1. Right-click and choose Sort Descending.

2. Click the box to select the record.

Figure 1-14

On the map, the city of Los Angeles is highlighted in blue. You may be able to see the whole city already, but let's make sure.

D Close the attribute table.

E In the Table of Contents, right-click *Cities* and choose Selection ➔ Zoom To Selected Features.

The map zooms in close on the selected feature and centers it in the view (Figure 1-15). The city's odd shape is attributable to years of piecemeal expansion and incorporation. It has internal "holes" where it surrounds other cities, such as Beverly Hills, or unincorporated areas. It also has a long, narrow southern corridor that connects it to its harbor at the Port of Los Angeles.
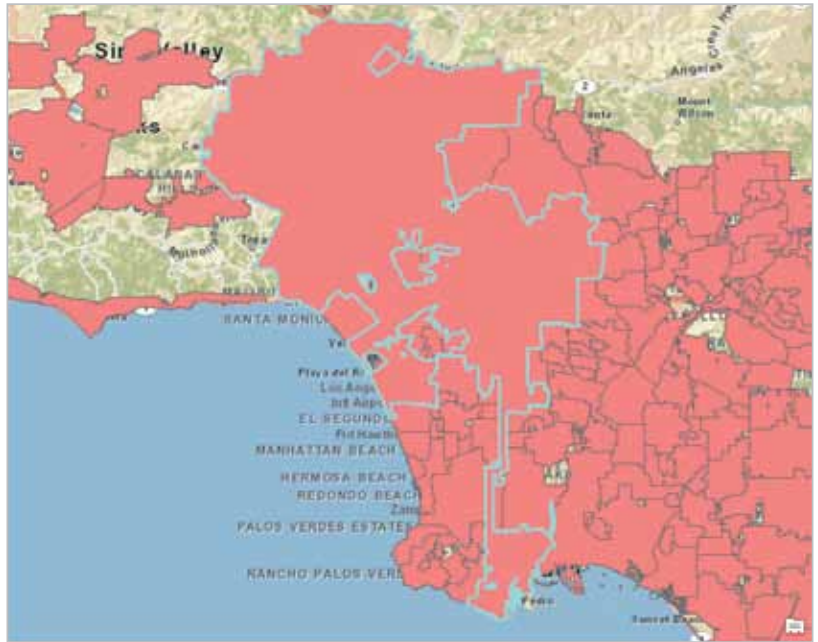
Figure 1-15

F On the Tools toolbar, click the Clear Selected Features button ⬚ to unselect the feature.

8) Filter the display of cities with a definition query. One of our project requirements is that the new park be inside the Los Angeles city limits. Therefore, we're more interested in Los Angeles than in other cities. A layer property called a definition query lets us show only those features in a layer that interest us.

A In the Table of Contents, right-click the *Cities* layer and choose Properties.

B In the Layer Properties dialog box, click the Definition Query tab.

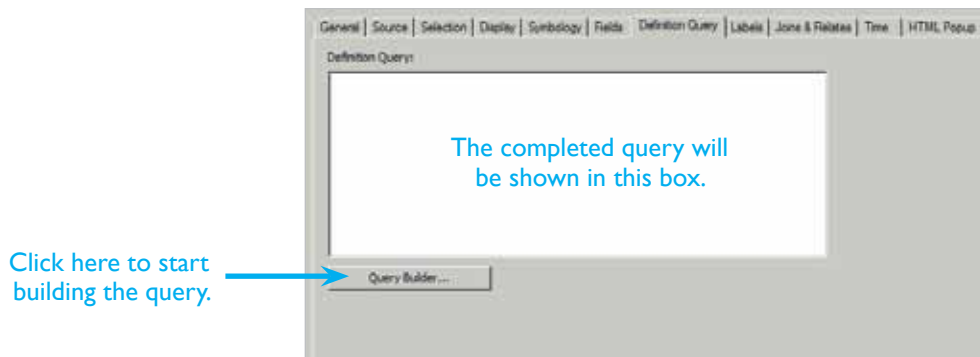**C** Click Query Builder to open the Query Builder dialog box (Figure 1-16).

Figure 1-16

You build a query on an attribute table by specifying a field and setting a logical or arithmetic condition that values in that field have to satisfy. In our case, we want to find records with the value "Los Angeles" in the NAME field.

D In the list of field names at the top of the Query Builder dialog box, double-click "NAME."

The field is added to the expression box at the bottom of the Query Builder.

E Click the Equals button [=].

F Click Get Unique Values.

The middle box in the Query Builder is populated with a list of all the city names in the NAME field. Since there are so many, it would be inconvenient to scroll to the one we want.

G Click in the Go To box and start typing **Los Angeles**.

By the time you get to "Los An" the value "Los Angeles" will be highlighted in gray.

H Double-click Los Angeles.

I Compare your expression to Figure 1-17. If it doesn't match, click Clear and rebuild it.
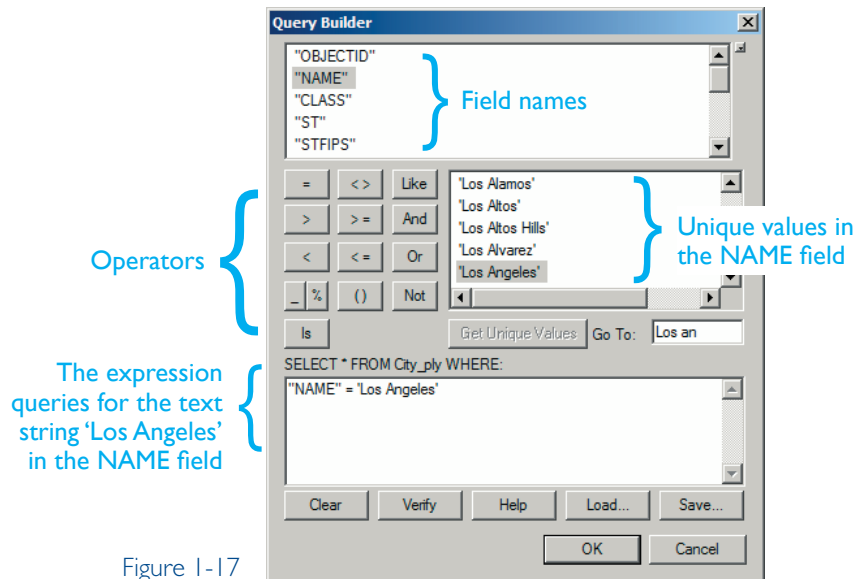
Figure 1-17

J Click Verify and click OK on the Verifying Expression message box.

▷ If you get an error message, click OK. Clear and rebuild the expression.

K Click OK on the Query Builder dialog box.

The expression appears on the Definition Query tab (Figure 1-18).

L Click OK on the Layer Properties dialog box.

On the map, only the city of Los Angeles is shown. The other cities are hidden by the definition query (Figure 1-19).
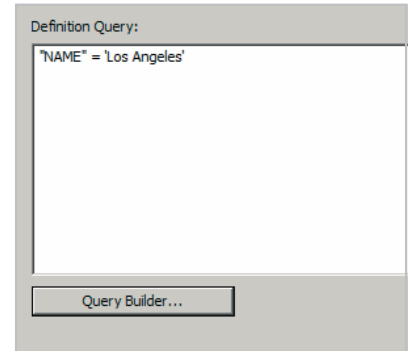

Figure 1-19

Figure 1-18

M In the Table of Contents, right-click the *Cities* layer and choose Open Attribute Table.

The table shows just the record for Los Angeles.

N Close the attribute table.

The other city features haven't been deleted. Clearing the definition query would display them again. Layer properties affect the display of data in a map, not the essential properties of the data itself: the number of features, their shapes, locations, and attributes.

Layers and datasets

A layer points or refers to a dataset stored somewhere on disk (as specified on the Source tab of the Layer Properties dialog box). A layer is *not* a physical copy of the data. A layer is a representation or rendering of the data. The dataset stores the shapes, locations, and attributes of features; the layer stores display properties, including what the layer is named, which of its features are shown or selected, how those features are symbolized, and whether they are labeled. Changes to layer properties do not affect the dataset that the layer refers to. You can make as many layers as you want from the same dataset and give them different properties. These layers can coexist in the same map document or in many different map documents.
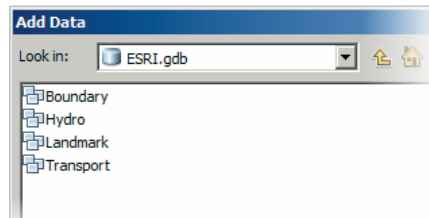
9) Add a layer of rivers. Let's add a layer of local rivers to the map and see where the Los Angeles River fits into the picture.

Ⓐ On the Standard toolbar, click the Add Data button ✚. (Click the icon itself, not the drop-down arrow.)

The Add Data dialog box opens to your last location. There's no river data here.

Ⓑ In the row of buttons at the top of the Add Data dialog box, click the Up One Level button 🔼 (Figure 1-20).

Figure 1-20

Ⓒ Double-click Hydro.

Ⓓ Click *River* to select it and click Add.

A layer of rivers is added to the map and placed at the top of the Table of Contents.

Ⓔ On the Tools toolbar, click the Identify tool 🛈, if necessary.

Ⓕ Click on any river to identify it.
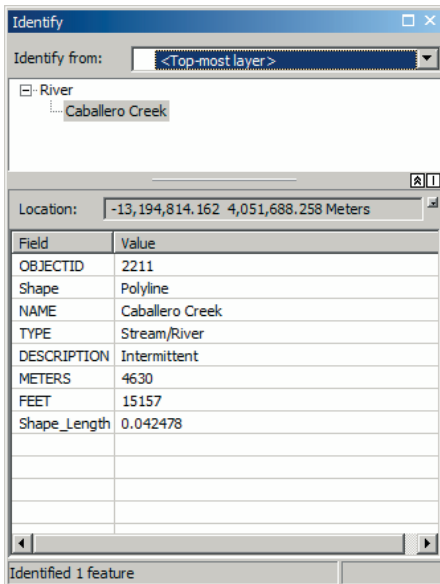
You see the name of the river (many of them don't have names) and its other attributes (Figure 1-21).

By default, the Identify tool identifies features from the topmost layer in the Table of Contents. If you miss a river, you'll either identify the City of Los Angeles or nothing. That's fine—leave the Identify window open and click again on a river.

Ⓖ Click on a few more rivers to identify them. Try to identify a segment of the Los Angeles River.

The river runs west to east across the city, turns south near the city's eastern edge, and follows a freeway to San Pedro Bay.

Ⓗ Close the Identify window.

10) Make a definition query on the LA River. Just as we're mainly interested in one city, we're mainly interested in one river. We'll make another definition query to show just the Los Angeles River.

Ⓐ In the Table of Contents, right-click the *River* layer and choose Properties.

▷ A shortcut is to double-click the layer name in the Table of Contents.

Figure 1-21

ⓑ Click the Definition Query tab, if necessary.

ⓒ Click Query Builder to open the Query Builder dialog box.

ⓓ In the list of field names at the top of the Query Builder dialog box, double-click "NAME."

ⓔ Click the Equals button $\boxed{=}$.

ⓕ Click Get Unique Values.

ⓖ Click in the Go To box and start typing **Los Angeles River**.

The value will be highlighted in gray before you finish typing.

ⓗ Double-click Los Angeles River.

ⓘ Compare your expression to Figure 1-22. If it doesn't match, click Clear and rebuild it.

ⓙ Optionally, verify the expression.

ⓚ Click OK on the Query Builder dialog box.

ⓛ On the Layer Properties dialog box, click the Symbology tab.

ⓜ On the Symbology tab, click the button displaying the blue line symbol to open the Symbol Selector.

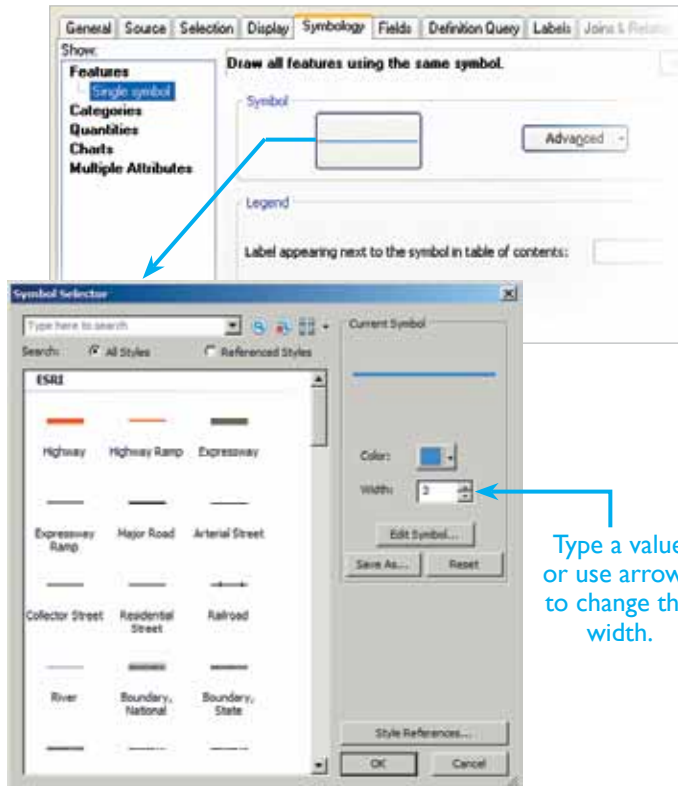**ⓝ** Change the line width to 3 (Figure 1-23) and click OK on the Symbol Selector.
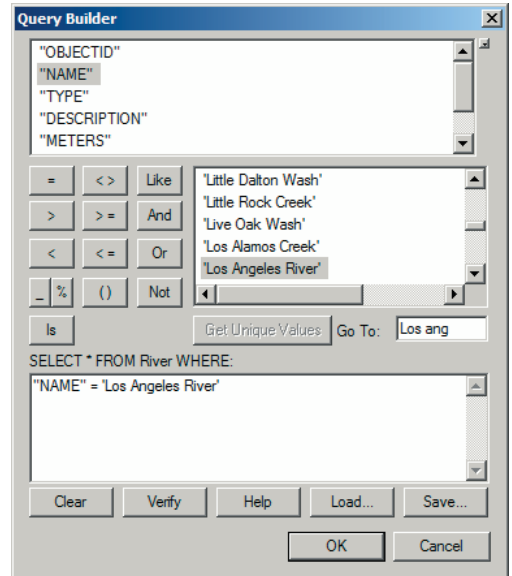
Figure 1-22

Figure 1-23

Type a value or use arrows to change the width.

O On the Layer Properties dialog box, click the General tab.

P In the Layer Name box, delete the layer name *River* and type **Los Angeles River** (Figure 1-24).

▷ You can also rename a layer directly in the Table of Contents by clicking the name once to highlight it and clicking it again. (Be careful not to double-click or you'll open the layer properties.)

Figure 1-24
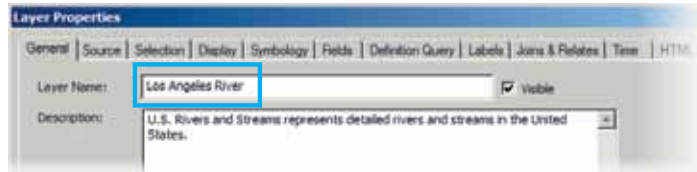
Q Click OK on the Layer Properties dialog box.

On the map, the river is displayed with its new symbology (Figure 1-25). The Table of Contents reflects the new layer name.

11) Select Los Angeles River features with a query. On the map, the river looks like a single feature (just like the city), but it's not.

A In the Table of Contents, right-click the *Los Angeles River* layer and choose Open Attribute Table.

At the bottom of the table, you see that 0 of 17 records are selected. That means that, in this particular layer, the Los Angeles River is composed of 17 features. Why would that be?

B Scroll down through the table.

All the records have the same NAME value. Most have the same TYPE, but one is an artificial path. There are a few DESCRIPTION values. The need to maintain different attribute values for different parts of a geographic object is a common reason that data—especially data representing linear features such as streets and rivers—is constructed this way (Figure 1-26). We'll come back to this point in the next lesson.

Figure 1-25

Figure 1-26

OBJECTID *	Shape *	NAME	TYPE	DESCRIPTION	METERS	FEET	Shape_Length
2191	Polyline	Los Angeles River	Stream/River	Perennial	11473	37558	0.12056
2192	Polyline	Los Angeles River	Stream/River	Perennial	1278	4184	0.013569
2200	Polyline	Los Angeles River	Stream/River	Intermittent	1911	6256	0.020894
2203	Polyline	Los Angeles River	Stream/River	Intermittent	1362	4459	0.014402
2205	Polyline	Los Angeles River	Stream/River	Intermittent	1631	5339	0.017653
2217	Polyline	Los Angeles River	Stream/River	Perennial	4077	13346	0.043274
2218	Polyline	Los Angeles River	Stream/River	Perennial	2303	7539	0.024279
2226	Polyline	Los Angeles River	Stream/River	Intermittent	3961	12967	0.042332
2345	Polyline	Los Angeles River	Stream/River	Perennial	10147	33217	0.0974
2410	Polyline	Los Angeles River	Stream/River	Perennial	2452	8027	0.026548

I◀ ◀ 17 ▶ ▶I (0 out of 17 Selected)

Los Angeles River

C In the row of tools at the top of the table window, click the Select By Attributes button ![icon].

Having noticed "perennial" and "intermittent" values in the DESCRIPTION field, we might want to know which parts of the river are which. We can find out with an attribute query. An attribute query is like a definition query in that both single out features in a layer on the basis of attribute values. The difference is that an attribute query highlights (selects) features that satisfy the expression rather than hiding features that don't.

D At the top of the dialog box, make sure the Method drop-down list is set to "Create a New Selection."

E In the list of field names, double-click "DESCRIPTION" to add it to the expression box.

F Click the Equals button ![=].

G Click Get Unique Values.

H In the list of unique values, double-click 'Perennial.'

I Confirm that your expression matches the one in Figure 1-27 and click Apply.
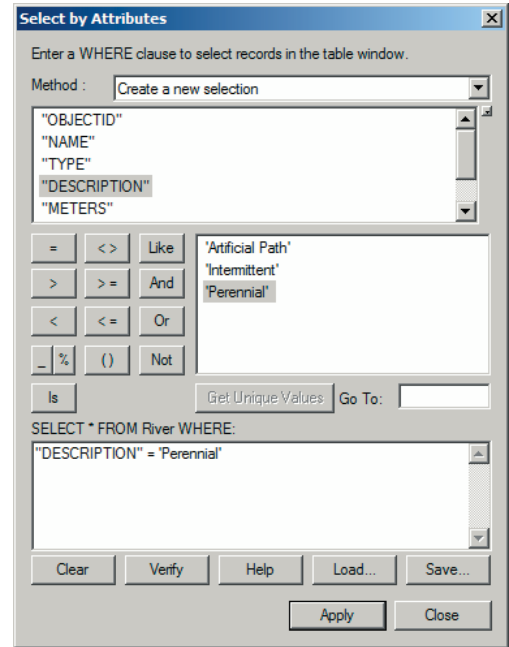
Figure 1-27

Twelve records are selected in the table. The corresponding features are selected on the map, showing you that the river is perennial for most of its length (Figure 1-28).

It's not among our guidelines to locate the new park along the river's perennial stretch, but it's interesting that fairly simple data exploration may introduce new ways of thinking about your problem.

J Close the Select By Attributes dialog box.

K At the top of the table window, click the Clear Selection button ![icon].

Clearing the record selection clears the feature selection on the map. (The reverse is true as well.)

L Close the attribute table.

Figure 1-28

Selecting features

You make selections in order to work with a subset of features in a layer. You can use a selection to zoom the map in to a specific area, to make a new layer from the selected subset, to get statistical information about the subset, or for many other things.

Selections are also used in queries. Whether you do an attribute query (to find records with a certain attribute value) or a spatial query (to find features with a certain spatial relationship to other features), the records and features that satisfy the query are returned as a selection on the layer.

12) Save the map document. This is a good time to save the map document. Save your maps often as you do these exercises—don't wait to be reminded.

Ⓐ On the Standard toolbar click the Save button 🖫 .

In the Save As dialog box, ArcMap should default to your My Documents\ArcGIS folder. In this book, we'll save most of our maps to the ParkSite\MapsAndMore folder.

Ⓑ In the panel of icons on the left side of the dialog box, click Computer.

Ⓒ Navigate to C:\UGIS\ParkSite\MapsAndMore.

Ⓓ When you're inside the MapsAndMore folder, replace the default file name with **Lesson1** (Figure 1-29) and click Save.

Click here
to navigate
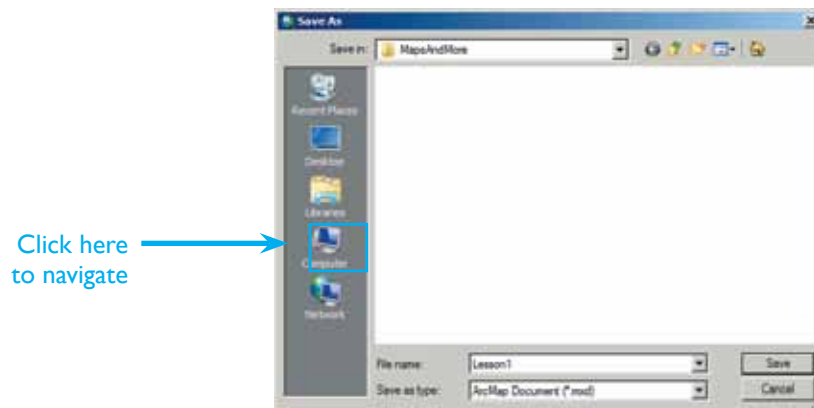
Figure 1-29

13) Add a basemap of imagery. Imagery provides a detailed, photorealistic view of the ground, and we'll rely on it to explore the LA River in more detail. Imagery also has other important uses, such as providing a background against which to edit features (Lesson 5), and "ground-truthing" analysis results (Lesson 6).

Ⓐ On the Standard toolbar, click the drop-down arrow next to the Add Data button and choose Add Basemap.

Ⓑ In the Add Basemap window, click *Imagery with Labels* to select it (Figure 1-30) and click Add.

The selection and arrangement of
basemaps is subject to change, so
your screen may look different.
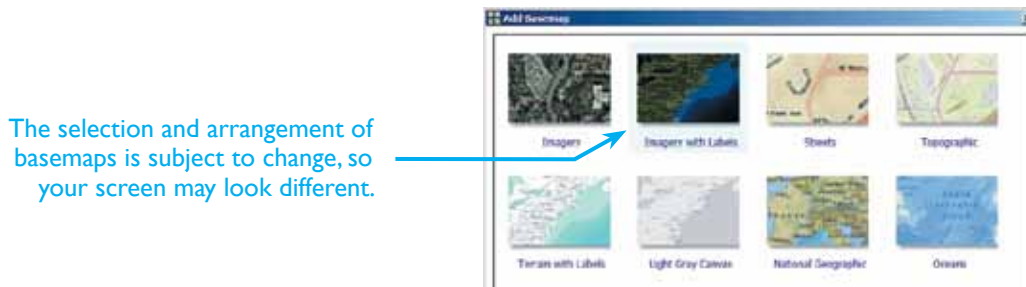
Figure 1-30

The *World_Imagery* basemap layer is added to the bottom of the Table of Contents. You don't see it on the map because it's covered by the basemap of streets. A layer called *Reference* has simultaneously been added to the top of the Table of Contents. This layer consists of locations, boundaries, and labels and should be visible on the map. (You should see yellow place-names covering the city of Los Angeles feature, for instance.).

> ▷ If you don't see these labels, click the Refresh button ⟳ in the lower left corner of the map window.

We don't need two basemaps in the map, so we'll remove the basemap of streets.

Ⓒ In the Table of Contents, right-click the name *Basemap* above *World_Street_Map* (Figure 1-31) and choose Remove.

The basemap is removed and the imagery is now visible. Your Table of Contents and map should look like Figure 1-32.

Figure 1-31
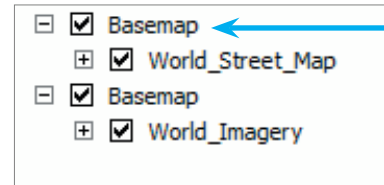
Right-click here.
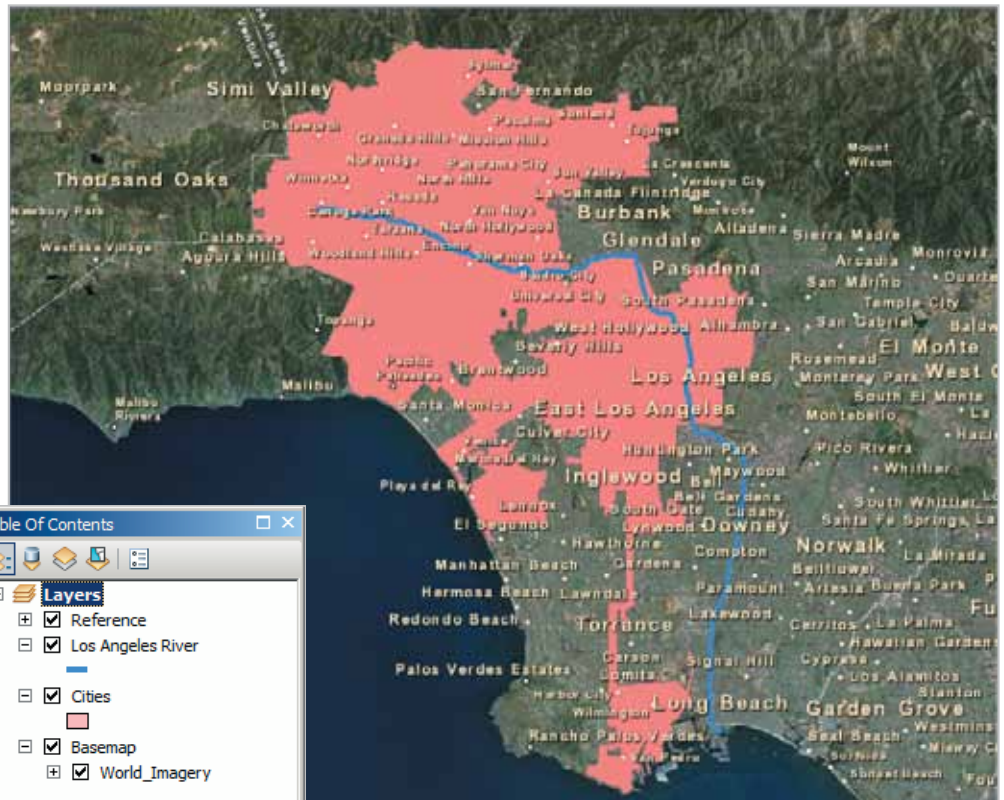
Here the Table of Contents is shown floating free. By default it's docked in the ArcMap application window, which is probably where it is on your screen.
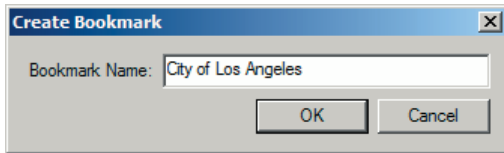
Figure 1-32

Figure 1-33

14) Create a bookmark. Certain views in a map are useful for orientation or reference. You can bookmark a view to make it easy to return to.

Ⓐ From the main menu, choose Bookmarks ➤ Create Bookmark.

Ⓑ In the Create Bookmark dialog box, replace the default name with **City of Los Angeles** (Figure 1-33). Click OK.

Ⓒ Use the Zoom In tool 🔍 to zoom in on the river's mouth in the harbor at Long Beach.

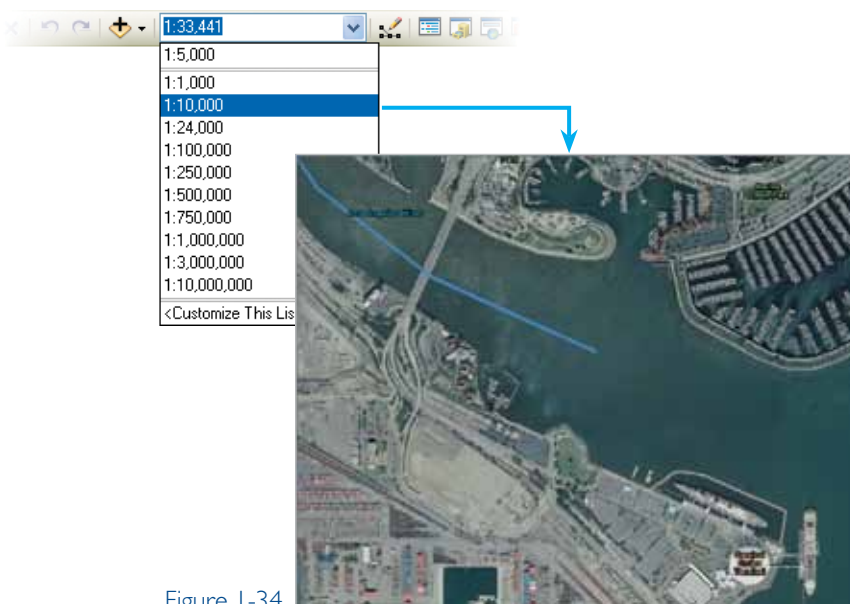Ⓓ On the Standard toolbar, click the Map Scale drop-down arrow and choose 1:10,000 (Figure 1-34).

At this scale, one unit of measure on the map is equivalent to ten thousand of the same units on the ground. Loosely, a thing on the map is ten thousand times smaller than its actual size.

Figure 1-34

Ⓔ Use the zoom and pan tools to explore the harbor.

The imagery is very high resolution and you'll see more detail as you keep zooming in. Eventually, you'll reach a limit.

Ⓕ When you're ready, from the main menu, choose Bookmarks ➤ City of Los Angeles.

The map view returns to the bookmarked extent.

15) Change the symbology for Los Angeles. The boundary of Los Angeles is filled in with a solid color, so the imagery underneath is still covered up. Pretty soon we're going to zoom in and follow the river's course through the city. It will serve that purpose to resymbolize the city so that we just see its outline.

Ⓐ Open the layer properties for the *Cities* layer. Click the Symbology tab, if necessary.

Ⓑ On the Symbology tab, click the button displaying the current color symbol to open the Symbol Selector.

Ⓒ In the Symbol Selector, click the Fill Color button to open the color palette.

▷ You can click either the color square itself or the drop-down arrow.

Ⓓ At the top of the color palette, click No Color.

This will make the symbol transparent.

Ⓔ Change the Outline Width value to 2.

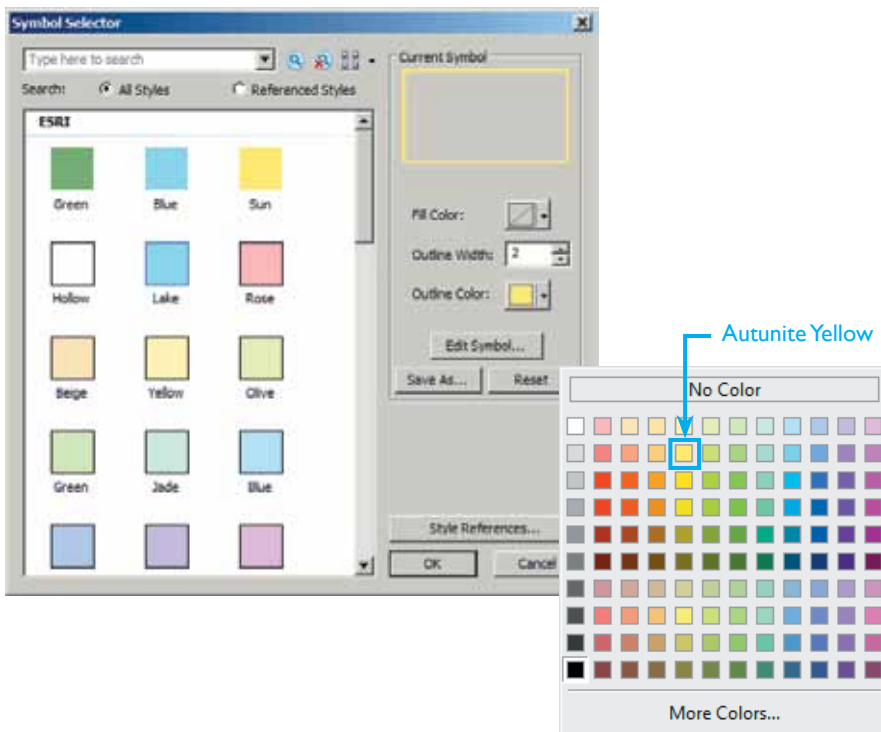Ⓕ Click the Outline Color button. On the color palette, click Autunite Yellow (Figure 1-35).

Figure 1-35

Figure 1-36

G Click OK on the Symbol Selector. Click Apply on the Layer Properties dialog box and leave it open.

The new symbology is displayed on the map (Figure 1-36).

H Click the General tab and rename the layer **Los Angeles**.

I Click OK on the Layer Properties dialog box.

16) Save the layer as a layer file. It wasn't hard to make this particular symbol, but often it does take time and effort to create good symbology. Having done so, you may want to reuse that symbology. In this book, for instance, we'll draw the outline of Los Angeles in other map documents in coming lessons.

You can save layer properties to a file called a layer file, which has the file extension *.lyr*. A layer file is not a copy of the data, but you add it to a map document in the same way that you add data. The layer file stores all the properties of a layer—name, symbology, definition query, and so on—including the path to the layer's source dataset. When you add a layer file to ArcMap, the layer draws with its properties already set.

A In the Table of Contents, right-click *Los Angeles* and choose Save As Layer File (near the bottom of the context menu).

The Save Layer dialog box opens to the ParkSite\MapsAndMore folder (Figure 1-37).

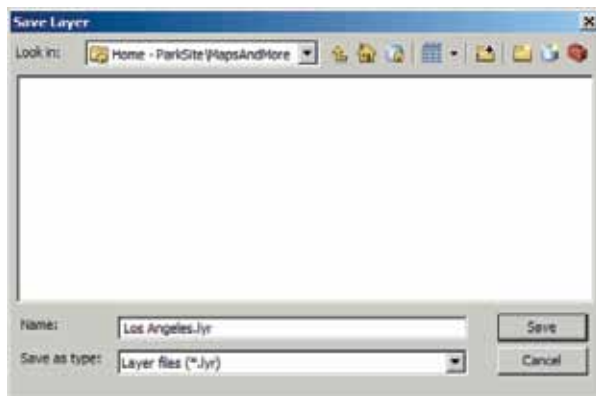**B** Accept the default name *Los Angeles.lyr* and click Save.

When you saved the map document in the MapsAndMore folder, this became the map's "home" folder. Now other files associated with the map, such as layer files, will be saved to this location by default.

Figure 1-37

We'll remove the *Los Angeles* layer that's currently in the map, then add the layer file to see how it works.

C In the Table of Contents, right-click *Los Angeles* and choose Remove.

The layer disappears from the map and the Table of Contents.

D On the Standard toolbar, click the Add Data button.

E In the Add Data dialog box, click the Look in: drop-down arrow and click the ParkSite folder (Figure 1-38).

F In the dialog box, double-click the MapsAndMore folder.

G Click *Los Angeles.lyr* to select it (Figure 1-39) and click Add.
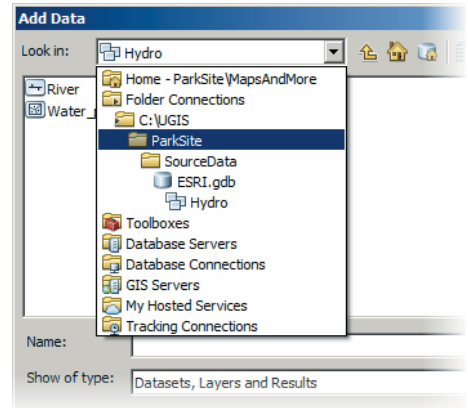
Figure 1-38
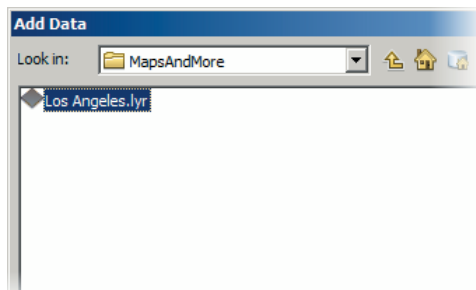
Figure 1-39

The layer is added to the map with its properties set.

H Open the layer properties for *Los Angeles*. In the Layer Properties dialog box, click the Source tab.

As before, the layer points to the *City_ply* feature class.

I Close the Layer Properties dialog box.

Anytime you add the *Los Angeles.lyr* file to a map document, the layer will draw as a yellow outline with a definition query on the city of Los Angeles. Once the layer has been added to the map, however, it's just the same as any other layer, and you can change its properties however you want. (Not that you want to change them.)

17) Follow the river. Let's start developing a sense of the study area by following the river's course through the city.

A Maximize the ArcMap window if you haven't done so already.

B Use the Zoom In tool to zoom in on the river's source in the community of Canoga Park in northwest Los Angeles.

The river officially starts where Bell Creek and the Arroyo Calabasas converge at Canoga Park High School.

C On the Standard toolbar, click the Map Scale drop-down arrow and choose 1:24,000.

Figure 1-40

Sepulveda Dam Recreation Area

D Click the Pan tool and slowly pan eastward along the river.

Densely populated residential neighborhoods line both sides of the river until you get to the Sepulveda Dam Recreation Area (Figure 1-40), a large recreational area with golf courses and a lake. The river bottom is natural here, becoming concrete again at the Sepulveda Dam in the southeastern corner of the basin.

East of the Sepulveda Basin, the river follows a freeway for a while, and is again surrounded by fairly dense residential and commercial areas.

E On the keyboard, press and hold the Q key.

Now you roam continuously across the display in whichever direction you point the mouse. To control your speed, make small brushing movements with the mouse either with or against the direction of movement. As you roam, the imagery should draw smoothly and continuously, although your experience may vary. Other layers, such as the *Los Angeles River* layer, suspend drawing and catch up when you stop.

F Release the Q key to stop roaming.

▷ You can also use the four arrow keys on the keyboard to roam.

G Continue to pan (or roam) along the river.

The river flows generally southeast for a while, then follows the northern edge of unincorporated Universal Studios (Figure 1-41). It continues east, then bends sharply south as it curves around Griffith Park (at 4,218 acres, one of the largest city parks in the United States). To the north of Griffith Park lies the city of Burbank; to the east is Glendale.

As it flows south, the river runs parallel to another major freeway. You'll see the Silver Lake Reservoir and then Elysian Park, where the Los Angeles Dodgers play major league baseball.

Figure 1-41

Universal Studios

H **Save bookmarks as place files.** Dodger Stadium is a landmark that we may want to return to.

I Center your view on Dodger Stadium, more or less as shown in Figure 1-42.

J From the main menu, choose Bookmarks ➤ Create Bookmark.

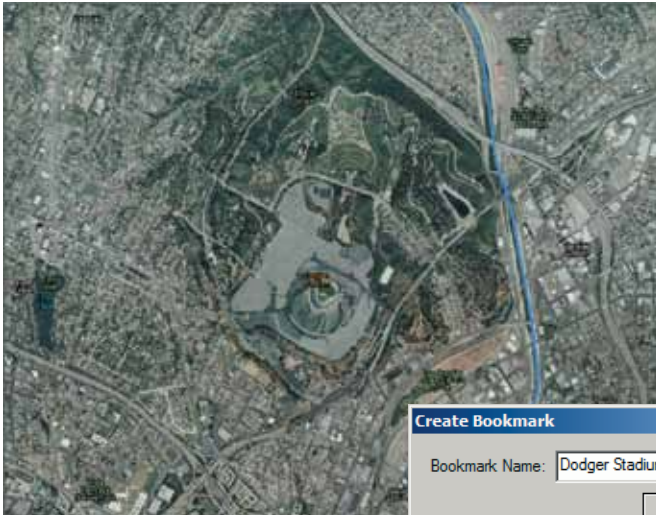**K** In the Create Bookmark dialog box, name the bookmark **Dodger Stadium** (Figure 1-43) and click OK.
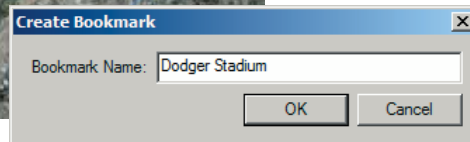

Figure 1-42

Create Bookmark

Bookmark Name: Dodger Stadium

OK   Cancel

Figure 1-43

Bookmarks are meant for use within a particular map document. The two we've created so far, however, might be useful in other maps. There's a tool for managing saved places so that any map document can access them: it's called My Places and we'll use it in Lesson 3. For now, we'll save our bookmarks as external files. When the time comes, we'll be able to load them into My Places.

L From the main menu, choose Bookmarks ➤ Manage Bookmarks.

You should see two bookmarks in the Bookmarks Manager, with City of Los Angeles highlighted on top (Figure 1-44).

M Near the bottom of the Bookmarks Manager dialog box, click Save ➤ Save All.

Figure 1-44

Bookmarks Manager

Name
City of Los Angeles
Dodger Stadium

Zoom To
Pan To
Create...
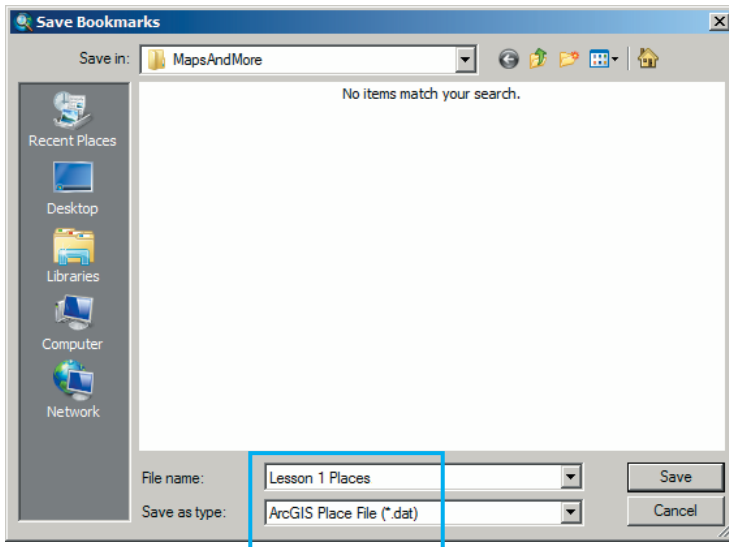Remove
Remove All
Load...
Save

Save Selected...
Save All...

Figure 1-45

The Save Bookmarks dialog box opens to the MapsAndMore folder.

Ⓝ In the File name box, type **Lesson 1 Places** (Figure 1-45) and click Save.

Ⓞ Close the Bookmarks Manager.

18) Pan to the city limits. We'll follow the river until it crosses the LA city limits, which marks the boundary of our study area.

Ⓐ Pan along the river as it runs south.

This last section of river passes through an industrial landscape and leaves the city at the Redondo Junction train yards.

Ⓑ Save the map.

Ⓒ If you're going on to the next exercise now, leave ArcMap and Lesson1.mxd open; otherwise, from the main menu, choose File ➤ Exit.

Exercise 1b: Do exploratory data analysis

In this exercise, we'll add park data and census data (containing demographic and socioeconomic information) to our map. Our goal is to pay attention to patterns in the data and thereby build an intuitive sense of likely and unlikely locations for the park. This intuition should give us confidence that the analysis results we get in Lesson 6 are plausible. Conversely, if the results contradict our gut feeling, we may be alerted to possible mistakes in the analysis.

1) Start ArcMap. We'll start ArcMap, if necessary, and continue working with our map document from the last exercise.

Ⓐ If ArcMap is open from the last exercise, go to Step 2.

Ⓑ Otherwise, start ArcMap.

▷ You may want to pin ArcMap to your Start menu or create a desktop shortcut to it.

In the ArcMap - Getting Started dialog box, you should see Lesson1 under the heading "Recent."

Ⓒ Click Lesson1 to highlight it (Figure 1-46) and click Open.
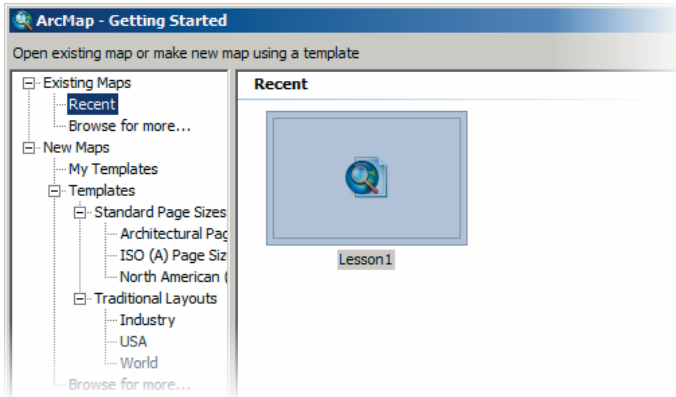

Figure 1-46

The map opens to a view of where the LA River leaves Los Angeles and enters the industrial city of Vernon.

2) Add a layer of parks. One of our geographic constraints is that the new park not be located too close to existing parks. We know there are a couple of big parks along the river, but let's look at the whole situation.

Ⓐ On the right side of the ArcMap application window, click the Catalog tab to open the Catalog window (Figure 1-47).

▷ If you don't have this tab, on the Standard toolbar, click the Catalog button 📅.

The Catalog window lets you view and manage geographic files on disk. The top entry in the window is your home folder, which presently contains your map document, the layer file you saved in the last exercise, and some graphs that are part of the starting data and which you'll use in Lesson 8. By default, the catalog recognizes only a limited number of file types to help you focus on geographic data.

The Catalog window has two states. When the pin icon in the upper right corner points sideways, the window closes if not in focus. When the pin icon points down, the window stays open. In this state, you can move and resize it. Leave the window in whichever state you prefer.

Ⓑ In the Catalog window, click the plus sign next to Folder Connections to expand it.

Ⓒ Expand C:\UGIS.

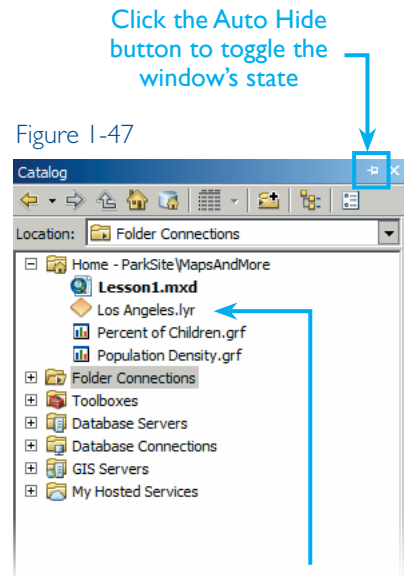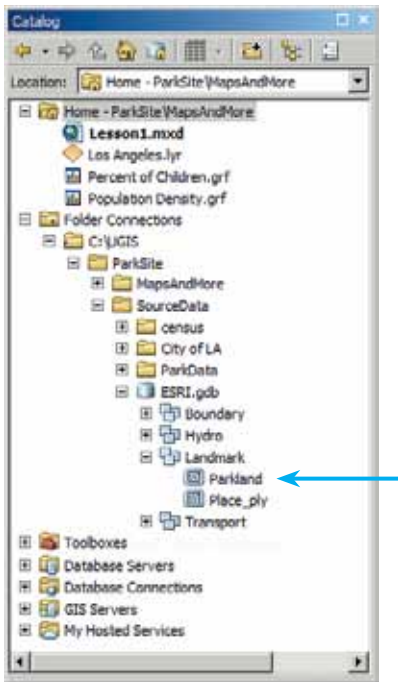Click the Auto Hide button to toggle the window's state

Figure 1-47

If you don't see Los Angeles.lyr, right-click the Home folder and choose Refresh.

Figure 1-48

In figures, the Catalog window is usually shown floating free from ArcMap (as here).

This is the folder connection you created in the last exercise from the Add Data dialog box.

D Expand the following items:

- ParkSite
- SourceData
- ESRI.gdb
- Landmark

The Catalog window should look like Figure 1-48.

E In the Catalog window, click *Parkland* to select it.

F Drag and drop *Parkland* anywhere over the ArcMap window.

The layer is added to the Table of Contents and the map. Dragging and dropping data from the Catalog window is the same as adding it with the Add Data button—it's just faster.

3) Symbolize the layer. A shade of green is usually the right cartographic choice for parks. ArcMap may have chosen one by a stroke of luck, but probably not. We'll symbolize the layer after taking a look at its extent.

A In the Table of Contents, right-click the *Parkland* layer and choose Zoom To Layer (Figure 1-49).

Figure 1-49

B In the Table of Contents, turn *Parkland* off and on a few times by clicking its check box. Leave it checked on.

The data extends well beyond Los Angeles, and the basemap shows that those big polygons to the north correspond to mountains. They're probably national forests. Notice that the *Parkland* layer is also obscuring some of the labels on the map.

C In the Table of Contents, click the *Reference* layer to highlight it. Drag it to the top of the Table of Contents (its position is marked by a horizontal black line) and drop it above the *Parkland* layer.

The labels now draw on top of the park features.

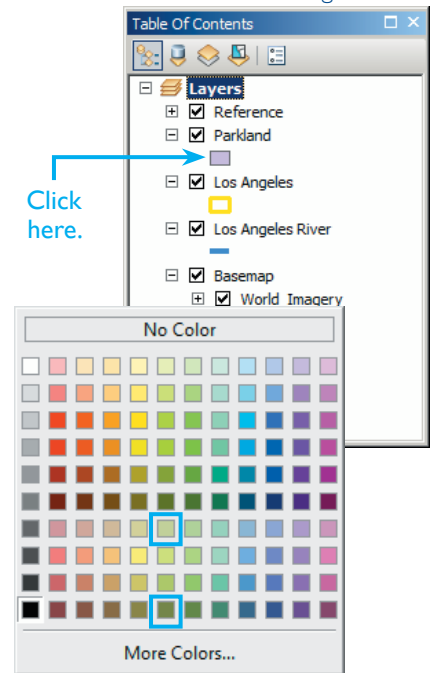**D** In the Table of Contents, click the color patch under the *Parkland* layer name to open the Symbol Selector (Figure 1-50).

▷ This is a shortcut to opening the Symbol Selector from the layer properties.

E In the Symbol Selector, click the Fill Color button to open the color palette. Click Apple Dust (Figure 1-51).

F Click the Outline Color button to open the color palette again. Click Moss Green (Figure 1-51).

G Click OK on the Symbol Selector.

The layer symbology is updated on the map.

4) Identify features. Let's find out what attributes this layer has.

A On the Tools toolbar, click the Identify tool ⓘ.

B Click on one of the big park features in the mountains to identify it.

Among the attributes are the park's name, its type, and its acreage (Figure 1-52).
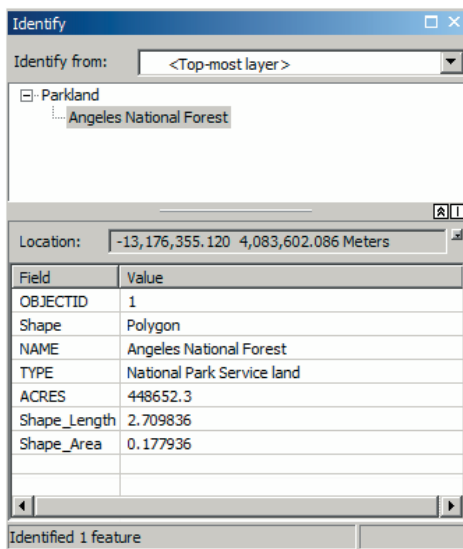
Figure 1-50

Click here.

Figure 1-51

Figure 1-52

C Leave the Identify window open. From the main menu, choose Bookmarks ➤ City of Los Angeles.

At this scale, you can make out the larger parks within the city.

D Try to locate the parks mentioned on page 28: the Sepulveda Dam Recreation Area, Griffith Park, and Elysian Park. Click on each with the Identify tool ⓘ to see their attributes.

E When you're done, leave the Identify window open and zoom to the Dodger Stadium bookmark.

Figure 1-53

ArcMap places labels dynamically. The position of labels in a view depends on the map scale, the extent, the presence of other features, and more. The label placement in your map may be different from what's shown here.

F Identify some of the neighborhood-sized parks in the view.

G Close the Identify window.

Our list of park requirements doesn't have an upper size limit, but we can expect our candidates to be under ten acres. Our trip down the river in the last exercise didn't reveal any great big tracts of open land that weren't already parks.

5) Label parks. Some of the larger parks are already labeled in the *Reference* layer, but many of the smaller ones are not.

A In the Table of Contents, right-click *Parkland* and choose Label Features.

The parks are labeled with their names in simple black text (Figure 1-53). The information is being taken from the NAME attribute in the *Parkland* attribute table.

The default labels aren't ideal for this map. The black text disappears into the imagery wherever the label doesn't fit inside the park. In addition, the labels appear on one line no matter how long they are.

B Open the layer properties for the *Parkland* layer and click the Labels tab (Figure 1-54).

Figure 1-54

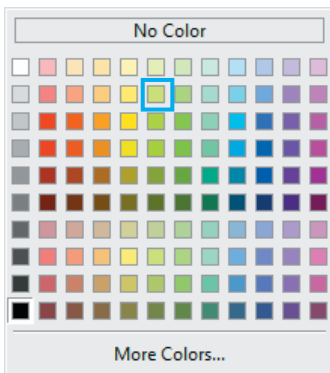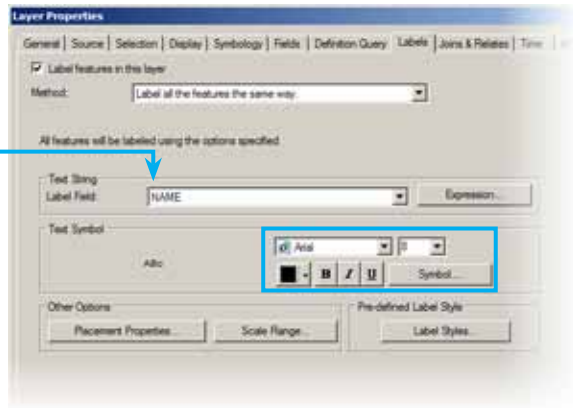If the layer attribute table has a NAME field, ArcMap uses it by default.

Figure 1-55

C In the Text Symbol area, click the font size drop-down arrow and change the size from 8 to 9 (points).

D Click the color button. On the color palette, change the text color to Lemongrass (Figure 1-55).

Light green text will show up better than black, but to be legible it will still need an outline, or halo.

- **E** Click the Symbol button to open the Symbol Selector.
- **F** On the Symbol Selector, underneath the properties of the current symbol, click Edit Symbol.
- **G** In the Editor dialog box, click the Mask tab.
- **H** Click the Halo option and change the size to 1.

The default halo color is white, but we're going to use something darker.

- **I** Click Symbol.

The Symbol Selector opens again.

- **J** Click the Fill Color button and change the fill color (the halo color) to Moss Green (Figure 1-56).
- **K** Click OK on the Symbol Selector.

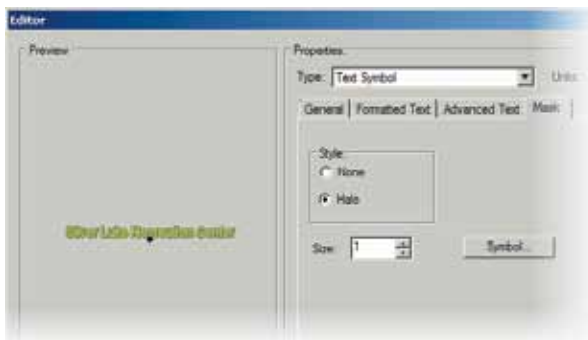Your Editor dialog box should look like Figure 1-57.
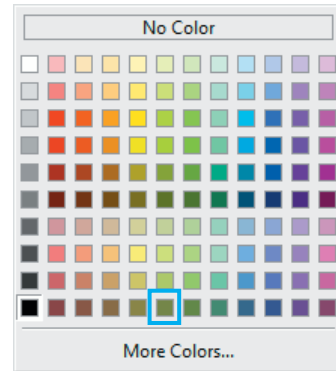
Figure 1-56

Figure 1-57

- **L** Click OK on all open dialog boxes.

On the map, the park labels are visible against the basemap (Figure 1-58).

Figure 1-58

Figure 1-59

The new symbology is a big improvement, but the labels would look better still if the text were stacked instead of strung out in a line. To make this change, we'll switch from ArcMap's default labeling system to its advanced system.

M From the main menu, choose View → Data Frame Properties.

N In the Data Frame Properties dialog box, if necessary, click the General tab.

The "data frame" refers generally to the map view. Data frame properties apply to the map view as a whole or to all the layers within it equally. You'll work more with data frame properties in Lessons 3 and 8.

O At the bottom of the dialog box, click the Label Engine drop-down arrow and choose Maplex Label Engine (Figure 1-59).

ArcMap has two labeling "engines." Both place labels on the map automatically according to a set of preferences that you can adjust. (For example, you might want labels placed to the left of features rather than to the right.) The Maplex Label Engine has a more robust set of preferences than the Standard Label Engine. We won't explore label functionality very deeply in this book, but the Maplex Label Engine offers one immediate advantage: it stacks label text automatically.

P Click OK on the Data Frame Properties dialog box.

On the map, the park labels are stacked, keeping them closer to their features (Figure 1-60).

Figure 1-60

6) Set a scale range for the labels. The park labels look good at this fairly large scale, where there's room to accommodate them. Let's see what happens when we zoom out.

Ⓐ Zoom to the City of Los Angeles bookmark.

At this smaller (zoomed-out) scale, the labels overwhelm the map (Figure 1-61). We could just turn them off, of course, whenever they seem to be too crowded. A nicer solution is to make their visibility dependent on the map scale.
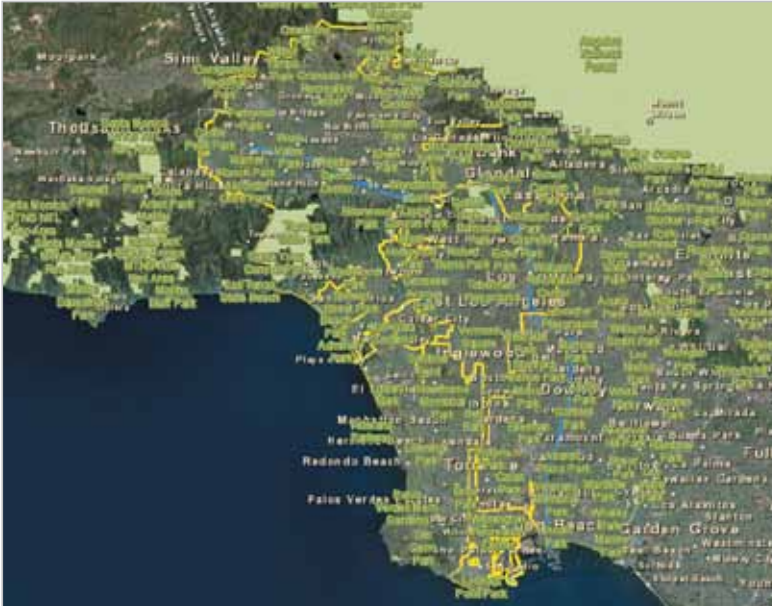

Figure 1-61

Ⓑ Open the layer properties for the *Parkland* layer. Click the Labels tab if necessary.

Ⓒ Near the bottom of the Labels tab, click Scale Range.

Ⓓ In the Scale Range dialog box, click the "Don't show labels when zoomed" option.

Ⓔ Click in the "Out beyond" box and type **40,000**.

Figure 1-62

Whenever the map scale crosses the 1:40,000 threshold, the park labels will turn off automatically.

Ⓕ Compare your Scale Range dialog box to Figure 1-62 and click OK. Click OK again on the Layer Properties dialog box.

The park labels (that is, the ones that you set) disappear from the map.

Ⓖ Zoom to the Dodger Stadium bookmark.

As long as the map scale is larger than 1:40,000 (which it should be), the labels show up again.
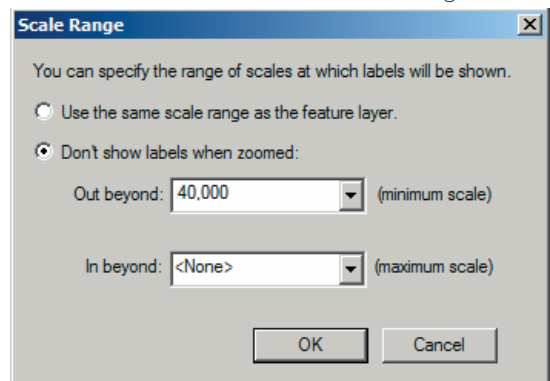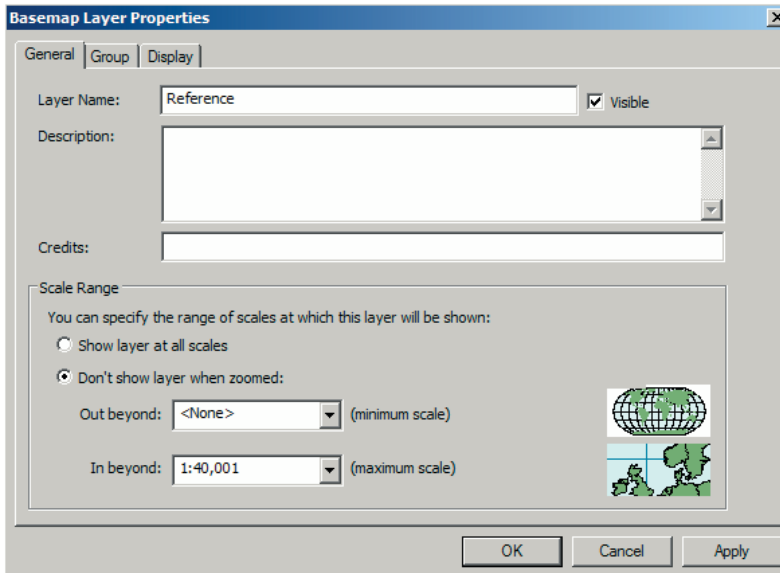
You've probably noticed that some parks, such as Elysian Park and Echo Park, are labeled in both the *Reference* and *Parkland* layers. We can set the scale range of the *Reference* layer reciprocally to the *Parkland* labels.

H Open the layer properties for the *Reference* layer. Click the General tab, if necessary.

Figure 1-63

This layer, being a remotely hosted map service, has fewer properties you can set than a layer whose source data is on your computer.

I In the Scale Range area, click the "Don't show layer when zoomed" option.

J Click in the "In beyond" box and type **40,001**.

K Compare your dialog box to Figure 1-63 and click OK.

The labels from the *Reference* layer should disappear from your map. (Most of these labels are actually for places other than parks, but we'll accept their loss at large scales.)

L Zoom back and forth across the 1:40,000 scale threshold to test your settings.

At scales of 1:40,000 or larger, the *Reference* layer appears with a gray check box in the Table of Contents (Figure 1-64). This tells you that the layer is turned on, but is set not to show at the current map scale.
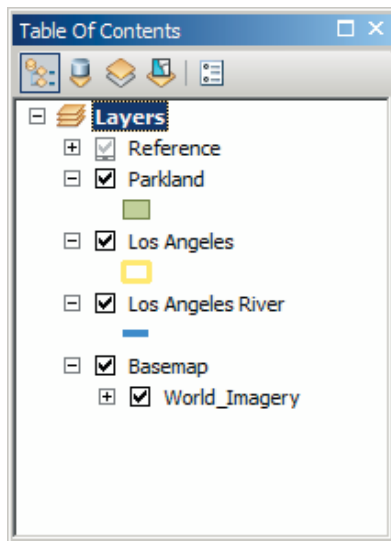

Figure 1-64

Scale ranges

As you've just seen, scale ranges can be set both for a layer's labels and for the layer itself. In this case, the distinction was blurred because the *Reference* layer is composed of labels. But layers that are composed of features, such as parks or rivers, can have their scale ranges set in exactly the same way. When you design maps to be viewed at multiple scales, you normally want layers representing detailed data, such as buildings or utility lines, to be visible only at large (close-up) scales. You may want your map to include multiple copies of a layer, each with a different scale range and unique symbology. For example, one layer might represent trees with a generic point symbol at medium scales. A second layer might represent the same trees with a more detailed and realistic symbol at large scales.

7) Dim the basemap. Without doing anything further to the labels, we can emphasize them a little more by dimming the imagery basemap. To do that, we'll add a toolbar to the interface.

Ⓐ From the main menu, choose Customize ➤ Toolbars ➤ Effects.

The Effects toolbar is added (Figure 1-65). ArcMap has a lot of special-purpose toolbars, and we'll use several of them in this book.

Figure 1-65

Ⓑ Drag the toolbar to a position you like.

▷ You can dock it on the top, bottom, or either side of the ArcMap window, or leave it undocked anywhere on your screen.

Ⓒ On the Effects toolbar, click the drop-down arrow and choose the *Basemap* layer.

Ⓓ Click the Adjust Dim Level button ◇ to open a slider bar.

Ⓔ Set the Dim Level to 10% (Figure 1-66).

On the map, the imagery fades slightly.

8) Add a layer of census tracts. The U.S. Census Bureau gathers socioeconomic data about households and aggregates it by various geographic units. One of these units is a census tract, which is a relatively small subdivision of a county.

Figure 1-66

Ⓐ Open the Catalog window.

Ⓑ Under the SourceData folder, expand the census folder.

Ⓒ Drag and drop *tracts.shp* onto the map.

The *tracts* layer is added to the top of the Table of Contents. The tracts cover everything except the *Parkland* labels.

Ⓓ In the Table of Contents, right-click the *tracts* layer and choose Zoom To Layer.

The census tract data covers Los Angeles County, including the islands of Catalina and San Clemente.

Ⓔ Zoom to the City of Los Angeles bookmark.

Ⓕ Drag the *Reference* layer to the top of the Table of Contents.

The *tracts* layer is made up of contiguous polygons that are reminiscent of a jigsaw puzzle (Figure 1-67). Since each piece of the puzzle represents a different set of living, breathing human beings, it's natural that each tract's attribute values for population, income, age, and so on, are different.

Figure 1-67
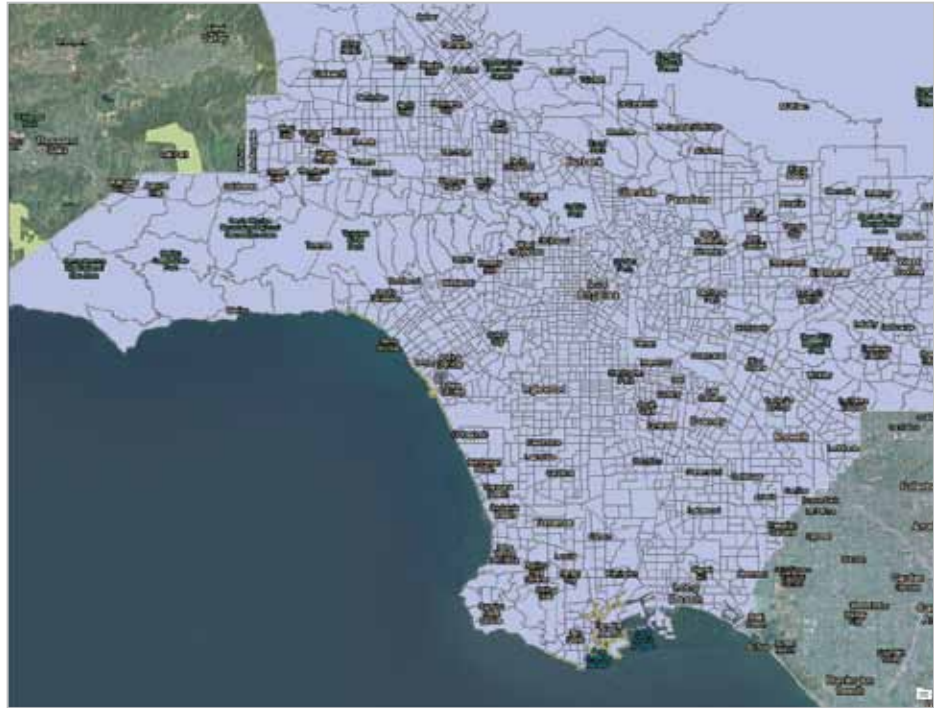
You may see a different set of labels, depending on your map scale. Map scale is affected by things like the size of your ArcMap window and the resolution of your monitor.

9) **Open the attribute table.** Let's see what attributes the table has.

Ⓐ In the Table of Contents, right-click the *tracts* layer and choose Open Attribute Table.

Ⓑ Scroll across the table and look at the field names.

The table has some identification codes, followed by population attributes and breakdowns of ethnicity, sex, age, household status, and housing. Some of the field names are fairly easy to interpret, others less so. In Lesson 2, we'll see how to get more information about our information by accessing metadata.

Ⓒ Locate the POP10_SQMI field (Figure 1-68).

Figure 1-68

FIPS	POP2000	POP00_SQMI	POP2010	POP10_SQMI
06037101110	4500	10227.3	4731	10752.3
06037101122	3176	3113.7	3665	3592.2
06037101210	6066	24264	5996	23960
06037101220	3028	11214.8	3363	12455.6
06037101300	3974	4096.9	4198	4328.9
06037101400	3760	1579.8	3903	1639.9
06037102103	1706	3652.1	1748	3625
06037102104	2974	4248.6	3648	5211.4

(0 out of 2343 Selected)

tracts

This attribute stores population density (people per square mile) for the year 2010. Since one of our criteria is to locate the park in a densely populated area, this is relevant information. The attribute doesn't tell us what value should be a threshold for "high density," but it does give us a way to start making patterns on a map.

D Right-click the POP10_SQMI field name and choose Statistics (Figure 1-69).
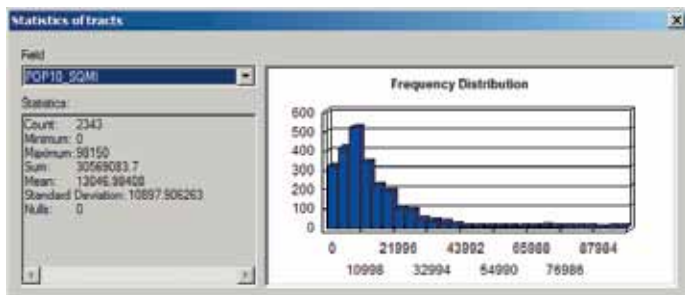

Figure 1-69

The Statistics of tracts window displays summary statistics for the field. The lowest value is 0 (at least one tract must be unpopulated) and the highest is 98,150. The frequency distribution chart, or histogram, on the right shows you that most of the values are between 0 and about 25,000. The remaining values spread out in a long tail.

E Close the Statistics of tracts window.

F Close the table.

10) Symbolize census tracts by population density. Symbolizing a layer by an attribute, also called thematic mapping, allows us to see how values are spatially distributed.

A Open the layer properties for the *tracts* layer and click the Symbology tab.

By default, all features in a layer have a single symbol (Figure 1-70). That's why all your census tracts are purple, or whatever color they happen to be.

B In the Show box, click Quantities.
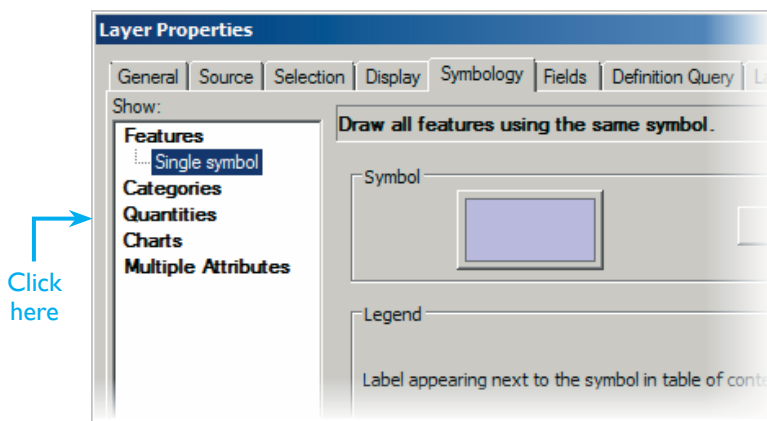
Figure 1-70

Under Quantities, four methods for symbolizing numeric attributes are listed. The default Graduated colors method will give each feature in the *tracts* layer a color that reflects its numeric value for a chosen attribute.

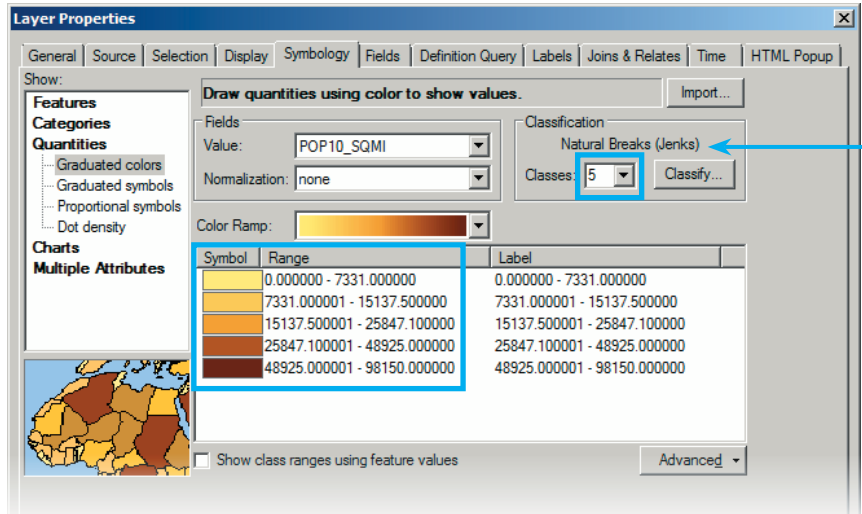**C** In the Fields area, click the Value drop-down list and choose POP10_SQMI (Figure 1-71).

Figure 1-71

A lot is going on here. The values for the POP10_SQMI attribute, which range from 0 to 98,150, are divided into five classes. The starting and ending values for each class are calculated by a "natural breaks" algorithm that separates clumps in the data. That's why the range of values is different from class to class and why classes break at seemingly arbitrary numbers. Each class is associated with a symbol in a color ramp (probably yellow to dark red, but yours may be different if you happened to change it).

Figure 1-72

D Click Apply. Move the Layer Properties dialog box out of the way.

On the map, the tracts are symbolized by population density (Figure 1-72).

11) Change the classification. Quantitative symbology is flexible, and you can present data in many ways. Because all we want right now is a general sense of viable areas for our project, and because we're going to look at a couple of variables together, we should keep our presentation simple.

A In the Layer Properties dialog box, click the Classes drop-down arrow and choose 3.

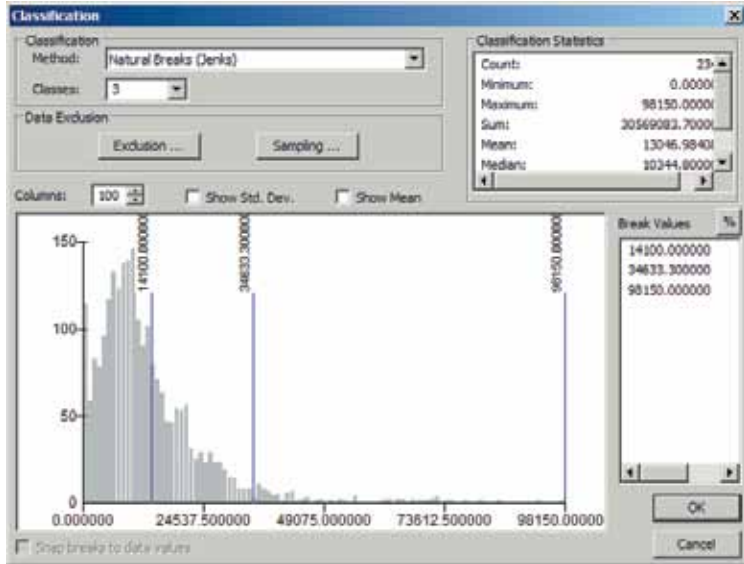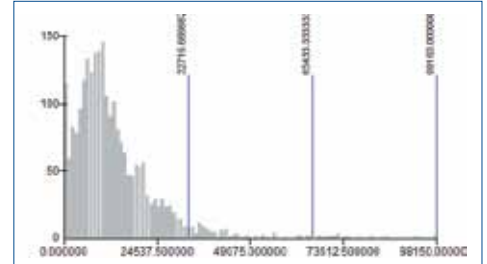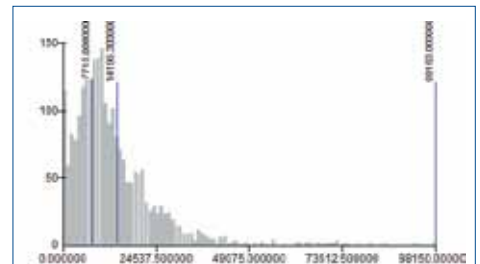**B** Click Classify to open the Classification dialog box (Figure 1-73).

Figure 1-73

Equal Interval Figure 1-74

Classes are evenly spaced. In this case, almost all the records fall in the first class.

The histogram shows you the distribution of values in relation to the current class breaks. We can change the algorithm used to set class breaks, or make manual adjustments as desired.

C Click the Method drop-down arrow and choose Equal Interval (Figure 1-74).

D Now set the Classification Method to Quantile.

With three classes, we'll easily be able to see high, medium, and low values. The Quantile method guarantees that an equal number of tracts will fall into each class. It should be noted that there are no inherently good or bad ways to classify data—different classifications may be more or less appropriate to the purpose of your map and the background knowledge of your audience.

E In the Break Values box to the right of the histogram, click the first class break point (7715).

The value becomes editable. At the bottom of the dialog box, a message tells you that there are 772 elements (in this case, census tracts) in this class.

F Replace the highlighted value with **8,000** and press Enter.

The second class break point is selected and editable.

G Replace the highlighted value (14196) with **16,000**.

H Click in some white space in the Histogram window to stop editing class breaks (Figure 1-75).

Quantile

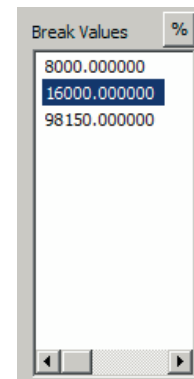Each class has an equal number of records. Class spacing is very different.

Figure 1-75

At the top of the dialog box, the classification method has been reset to Manual because we've changed the class breaks. The histogram is updated, too. We no longer have a pure quantile classification, but having our classes break at round numbers makes intuitive sense.

🔵 Click OK on the Classification dialog box.

12) Change the symbology. We'll make some changes to the symbology as well.

🅐 On the Layer Properties dialog box, click the Color Ramp drop-down arrow (or click on the ramp itself).

🅑 Scroll up and down to see the choices, then click the ramp again to close the list.

🅒 Right-click the color ramp. On the context menu, click Graphic View to uncheck it (Figure 1-76).

Toggle Graphic View to see ramps by color or name
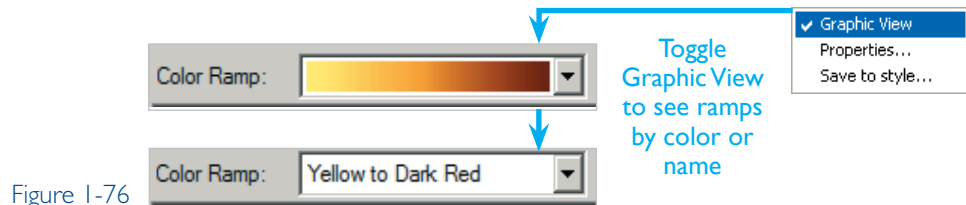
Figure 1-76

🅓 Click the ramp's name. In the drop-down list, click the Red Light to Dark ramp to select it (Figure 1-77).

🅔 Right-click the ramp name and choose Graphic View to show the ramps by color again.

Underneath the color ramp is a box with three columns:

- The Symbol column shows the symbol for each class.
- The Range column shows the range of values for each class.
- The Label column shows how each symbol will be described in the Table of Contents. (By default, the label matches the range.)

🅕 Click the Symbol column heading and choose Properties for All Symbols.

🅖 In the Symbol Selector, click the Outline Color button. On the color palette, choose No Color.

🅗 Click OK on the Symbol Selector.

Figure 1-77

We're taking away the outlines because we don't need to see the tract boundaries on the map. For now, we're interested in them as areas, not specifically as tracts.

🅘 In the Label column, click on the first label (0.000000 - 8000.000000) to make it editable. Type **Low** and press Enter.
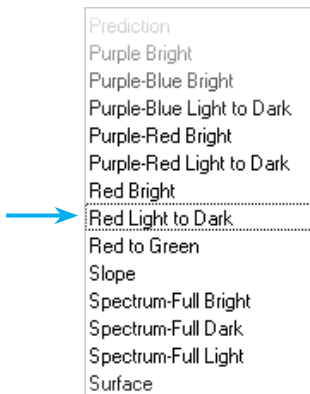
🅙 Replace the second label with **Medium**. Press Enter.

K Change the third label to `High`. Click outside the edit box to commit the edit.

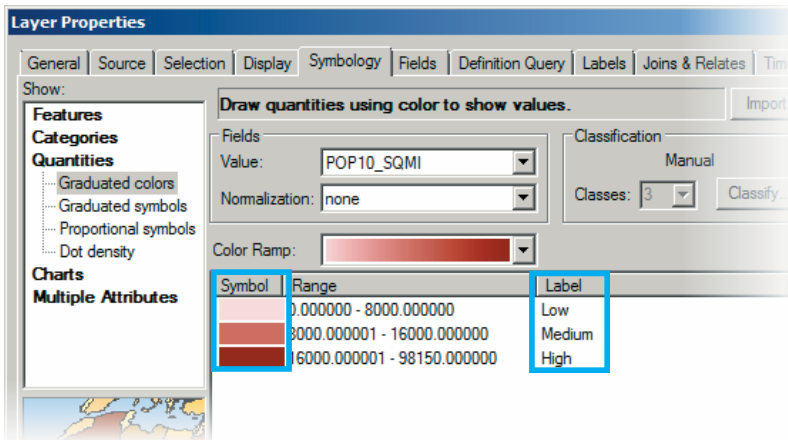**L** Compare your settings to Figure 1-78 and click Apply.

M In the Layer Properties dialog box, click the Display tab. In the Transparent box at the top, replace the value 0 with `50` (Figure 1-79).

N Click OK on the Layer Properties dialog box.

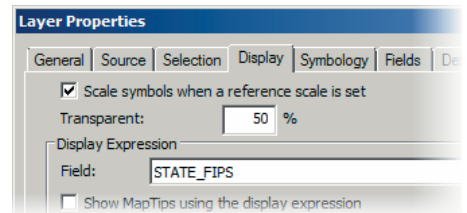**O** In the Table of Contents, drag and drop the *tracts* layer underneath the *Los Angeles* layer.

On the map, we can now see where population is concentrated along the river, and we can see it in relation to existing parks (Figure 1-80).
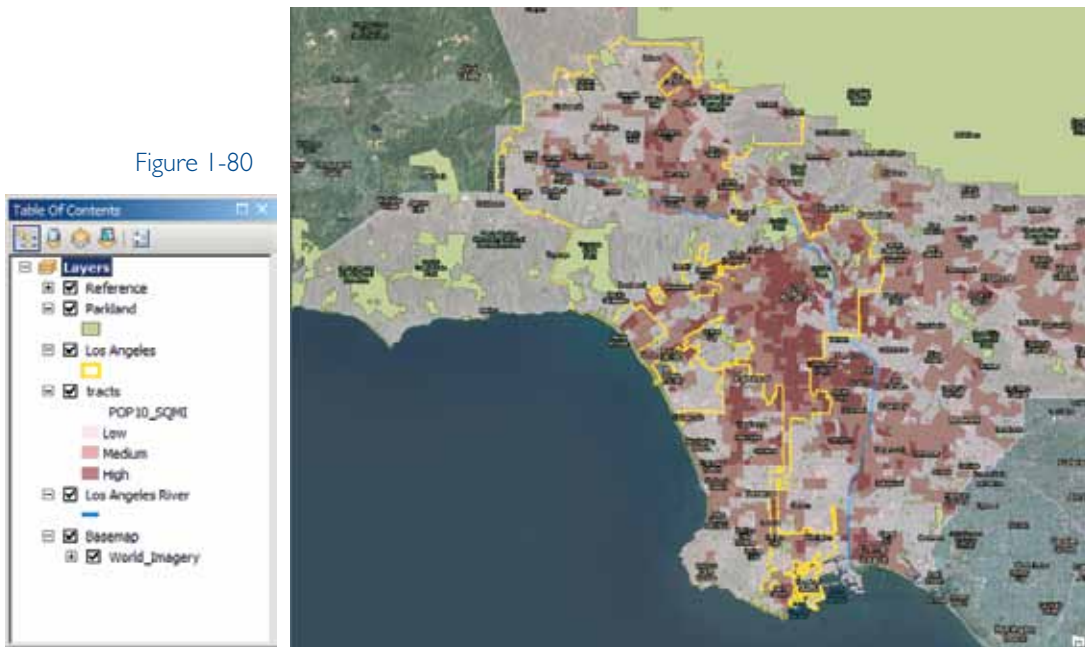
13) Measure distance from the river to parks. Making a few measurements will improve our ability to estimate distance on the map and will give us a better intuitive sense of how close to the river the new park should be.

Ⓐ Zoom to the Dodger Stadium bookmark.

Ⓑ Pan the map so that a number of parks are in the view. Feel free to zoom in or out.

Ⓒ On the Tools toolbar, click the Measure tool 🔧 to open the Measure dialog box.

Ⓓ In the row of tools at the top of the Measure dialog box, make sure the Measure Line tool is selected (Figure 1-81).

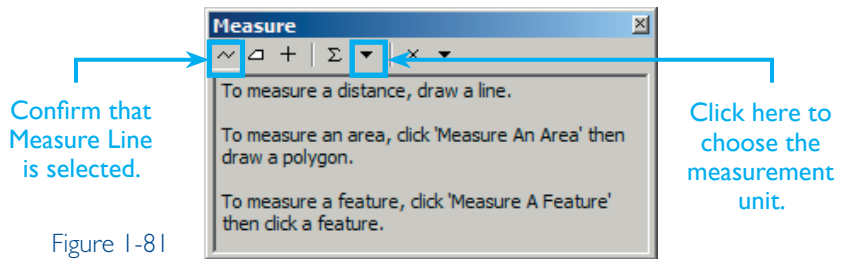Ⓔ Click the Choose Units button and choose Distance ➤ Miles.

Confirm that Measure Line is selected.

Click here to choose the measurement unit.

Figure 1-81

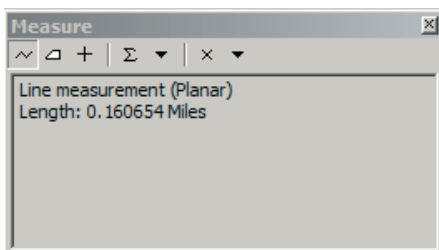On the map, the mouse pointer changes to a ruler with inscribed crosshairs.

Ⓕ Move the mouse pointer over a park, such as Cypress Park (northeast of Dodger Stadium on the east side of the river).

The mouse pointer "snaps" to the park boundary. You can probably feel the effect in the mouse movement. It's confirmed on-screen by a light gray square near the mouse pointer and a message such as "Parkland: Vertex" or "Parkland: Edge" (Figure 1-82).

Ⓖ Click to start a measurement.

Ⓗ Move the mouse pointer (you don't have to drag) to the river.

The mouse pointer snaps to the river feature. The measurement result is displayed in the Measure dialog box (Figure 1-83).

Ⓘ Double-click to end the measurement.

Ⓙ Click on another park and measure its distance to the river.

The new result replaces the previous one in the Measure dialog box.

Ⓚ Measure the distances from a few more parks.

Figure 1-82

Figure 1-83

Your result will depend on where you start and end your measurement.

Cypress Park, Elysian Valley Rec Center Park, and Downey Playground are close to the river. Elyria Canyon Park, a little over three quarters of a mile away (at its nearest edge), stretches the notion of proximity. Bear in mind that these measurements are straight-line distances, not distances along streets.

Ⓛ Close the Measure dialog box.

Although the dialog box is closed, the tool stays active until another tool is selected.

Ⓜ Zoom to the City of Los Angeles bookmark.

14) Add a layer of census block groups. Another requirement for the new park is that it be located in a lower-income neighborhood. To symbolize an income attribute, we have to add another layer to the map. (It's not that income data isn't reported at the census tract level, it's just that our particular *tracts* layer doesn't happen to include it.)

Ⓐ Open the Catalog window.

The same census folder that contains *tracts.shp* also has a dataset called *block_groups.shp*.

Ⓑ Drag and drop *block_groups.shp* on the map.

In the Table of Contents, the new layer is added above the other layers. Like the *tracts* layer, the *block_groups* layer covers Los Angeles County. And like the census tracts, the block group polygons resemble a jigsaw puzzle. Block groups are another Census Bureau statistical unit: they're smaller than tracts and nest inside them. We'll talk more about census geography in Lesson 2.

Ⓒ Open the attribute table for the *block_groups* layer and scroll across the attributes.

Most of these attribute names are cryptic. One of the last fields in the table is called MEDHINC_CY (Figure 1-84). For now, take it on faith that this stands for median household income.

RENTER_CY	VACANT_CY	POP18UP_CY	MEDAGE_CY	MEDHINC_CY	AVGHINC_CY	AGGHINC_CY	PCI_CY
266	17	761	42.1	29782	49196	19924561	21788
70	5	1400	33	60122	78449	27849561	16534
32	5	647	34.4	56282	69003	14421723	17568
672	62	1501	29.8	38276	55837	38416014	19314
64	23	1708	43.1	94370	119792	75109361	36720
126	16	710	34.1	74676	117093	39191826	39086
746	56	2659	37.6	42003	58348	61499122	19699

Figure 1-84

Ⓓ Right-click the MEDHINC_CY field name and choose Statistics.

The Statistics of block_groups window tells you that the lowest value in the field is 0 and the highest is 200,001. Median value is a midpoint. For each block group, half the households earn more than the median income and half earn less.

E Close the Statistics of block_groups window.

F Close the attribute table.

G Drag the *Reference* layer to the top of the Table of Contents.

15) Symbolize census block groups by median household income. If we symbolize the *block_groups* layer with graduated colors, we won't be able to evaluate income and population density at the same time. Instead, we'll represent each block group's median household income as a point drawn inside the block group polygon. The point sizes will be graduated according to the income value.

A Open the layer properties for the *block_groups* layer and click the Symbology tab.

B In the Show box, click Quantities. Under Quantities, click Graduated Symbols (Figure 1-85).

C In the Fields area, click the Value drop-down list and choose MEDHINC_CY.

D Click the Classes drop-down arrow and choose 3.

E Click Classify to open the Classification dialog box.

By coincidence, the first break point is already a nice round number (50,000), so we don't have to alter it.

F In the Break Values box to the right of the histogram, click the second class break point (94370) to make it editable.

G Replace the highlighted value with **100,000** and press Enter.

H Click in some white space in the Histogram window to stop editing class breaks (Figure 1-86). Click OK on the Classification dialog box.
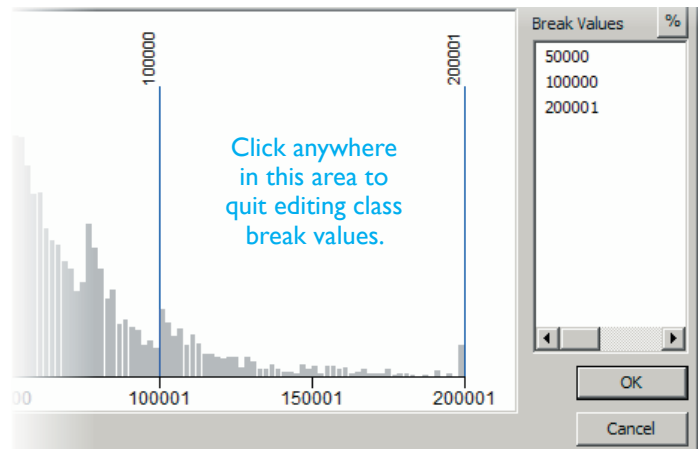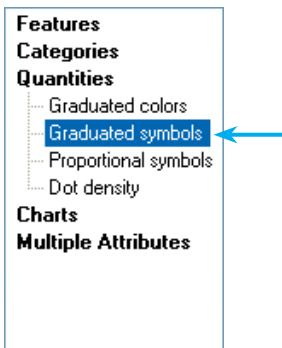
Figure 1-85

Figure 1-86

I In the Layer Properties dialog box, click Template (underneath the Classify button) to open the Symbol Selector.

J In the scrolling box of symbols, click Circle 2 to select it.

K Click the Color button and change its color to Tourmaline Green (Figure 1-87).

L Click OK on the Symbol Selector.

This sets the color and shape of the symbols that will be used to represent income values.

M Click Background (underneath Template) to open the Symbol Selector again.

N Change the fill color to No Color, then change the outline color to No Color. Click OK.

Figure 1-87

This makes the block group polygons themselves invisible. All we'll see are the income dots spread around the map.

O In the Symbol Size boxes, replace the "from" value with **8** and the "to" value with **24**.

P In the Label column, click on the first label (0 - 50000) to make it editable. Type **Low** and press Enter.

Q Replace the second label with **Medium**. Press Enter.

R Change the third label to **High**. Click outside the edit box to commit the edit.

S Compare your settings to Figure 1-88. Click Apply and move the Layer Properties dialog box out of the way.

At the present scale, the symbols overwhelm the map (Figure 1-89).
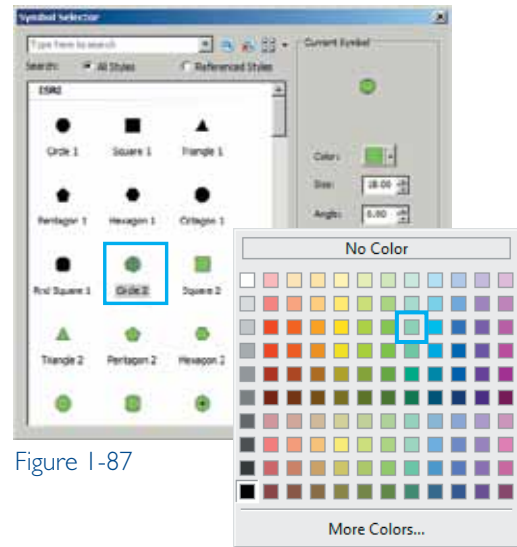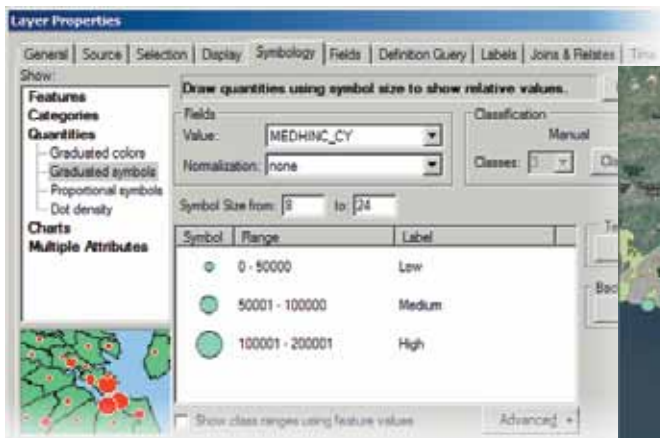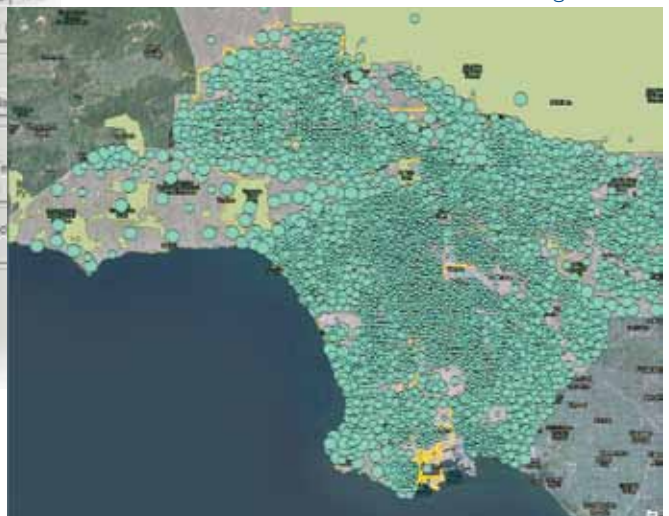
Figure 1-88

Figure 1-89

Your view may look different depending on the size of your computer screen and ArcMap window, but the effect should be similar.

16) Set a scale range for the *block_groups* layer. Earlier, we set a maximum scale value for the *Reference* layer. Here, we'll set a minimum value for the *block_groups* layer.

- Ⓐ On the Layer Properties dialog box, click the General tab.
- Ⓑ In the Scale Range area, click the "Don't show layer when zoomed" option.
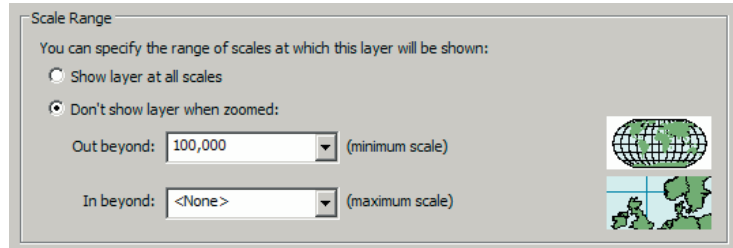- Ⓒ Click in the "Out beyond" box and type **100,000** (Figure 1-90) and click OK.
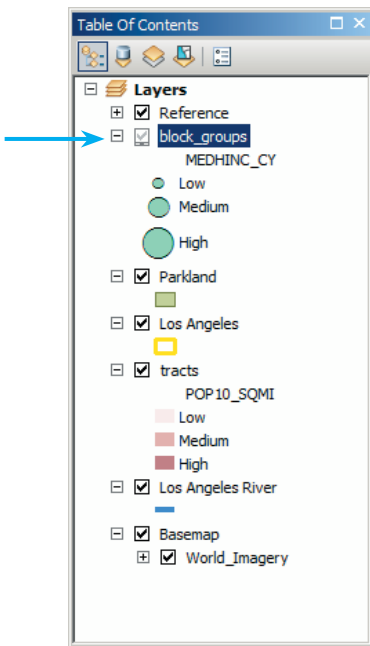
Figure 1-90

The symbols disappear from the map. In the Table of Contents, the layer's check box indicates that the layer is turned on but is not visible at the current map scale (Figure 1-91).

- Ⓓ Zoom to the Dodger Stadium bookmark.
- Ⓔ Click the Fixed Zoom Out button several times until some of the Medium and High symbols begin to appear.

Now we can start to get a general sense of household income and population density along the river, and look at these variables in relation to park locations (Figure 1-92).

Figure 1-91

Figure 1-92
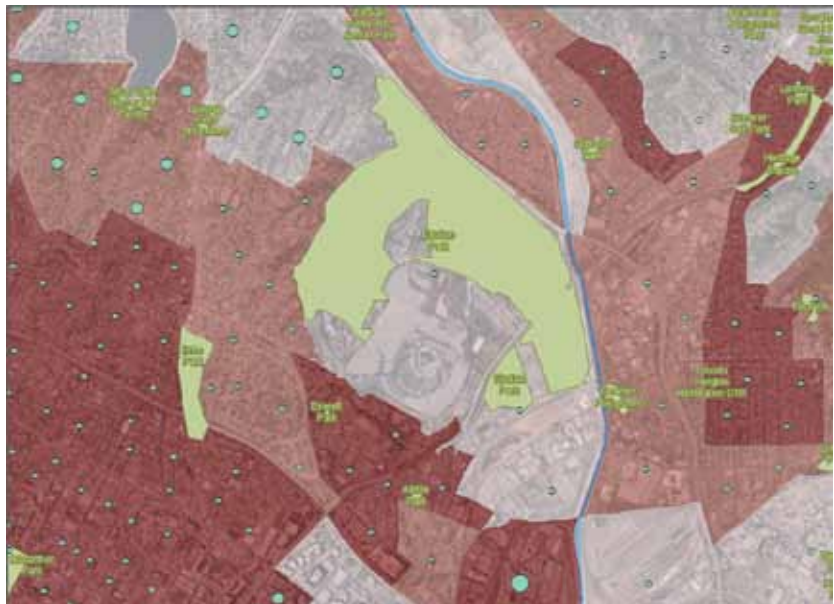
17) Search for likely park areas. Clearly, we're taking an incomplete initial look at a complex problem. We haven't considered all the requirements (for example, the presence of children). We're not making any exact measurements of distance. Our data classifications are casual: we don't yet have a good reason to say what values should count as high population density or low median household income in the context of our project. Nevertheless, we can form some meaningful impressions. We won't be able to say of an area that a park should *definitely* go there, but we might be able to identify likely and unlikely areas. Later, it will be interesting to see how well these impressions are borne out by analysis.

Ⓐ On the Standard toolbar, in the Map Scale box, highlight the current value. Type **40,000** and press Enter.

Ⓑ Pan south to where the river crosses the city boundary.

Ⓒ In the Table of Contents, drag the *Los Angeles River* layer to the position just below the *Reference* layer (Figure 1-93).

We'll follow the river to its source, marking good areas along the way. A really good area would have these properties:

- High population density (dark red)
- Low median household income (small green dot)
- No existing park nearby
- Close to the river

Ⓓ Pan slowly north.

Less than a mile north of the city limits, on the east side of the river, are a couple of tracts—one dark red and one medium red—with small green dots (Figure 1-94). They're pretty close to the river, and even though there are some parks in the general vicinity, it's probably worth marking the area.
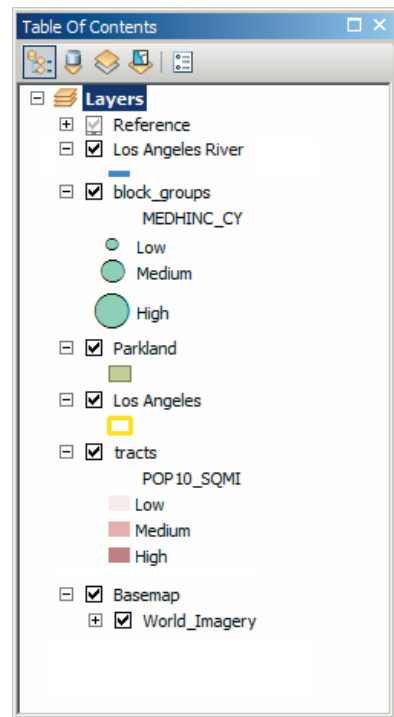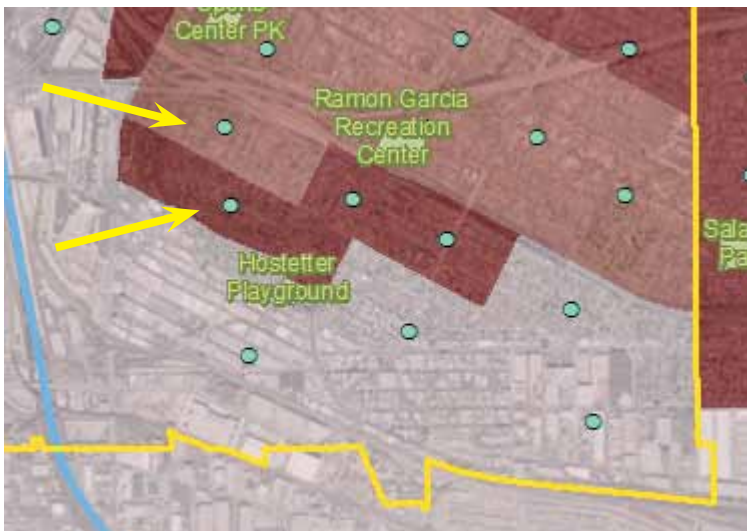
Figure 1-93

Figure 1-94

E From the main menu, choose Customize ➤ Toolbars ➤ Draw.

The Draw toolbar is added.

F Dock the toolbar or float it, whatever you like best.

G On the Draw toolbar, click the Drawing drop-down menu and choose Default Symbol Properties at the bottom.

H On the Default Symbol Properties dialog box, click the Fill button to open the Symbol Selector.

I Set properties in the Symbol Selector as follows:
- Set the fill color to No Color.
- Set the outline width to 3.
- Set the outline color to Black.

J Click OK on the Symbol Selector.

K Compare your Default Symbol Properties dialog box to Figure 1-95 and click OK.
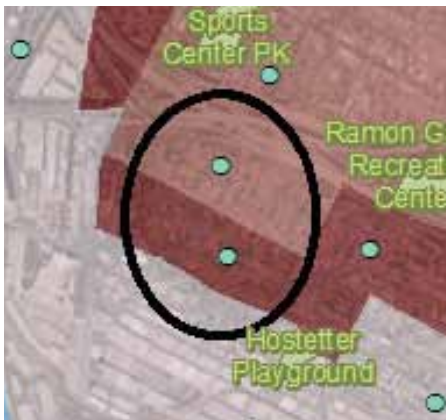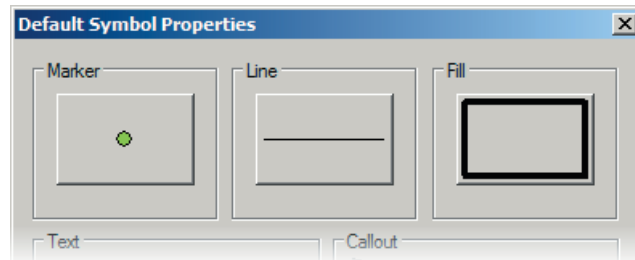
Figure 1-95

L On the Draw toolbar, click the drop-down arrow next to the Rectangle tool. From the list of tools, choose the Ellipse tool.

M On the map, click and drag a box over the area of interest. Release the mouse button to draw the ellipse (Figure 1-96).

You can reshape the ellipse by dragging its selection handles. You can move it by clicking and dragging it. The exact size and position of the shape doesn't matter as long as you mark the general area.

N Click off the graphic to unselect it.

Figure 1-96

Graphics

Map graphics, such as these created with tools on the Draw toolbar, are different from features. Conceptually, features represent geographic objects while graphics tend to be visual aids. Technically, graphics are usually stored in map documents as annotation, not in feature classes on disk. (You'll learn more about this in Lesson 8.) They aren't maintained as layers in ArcMap, nor do they have attribute tables, but they can be managed from the Data Frame Properties dialog box (Annotation Groups tab). It is possible to convert features to graphics and graphics to features.

18) Continue searching for park areas. We'll keep following the river and looking for likely places for a park.

Ⓐ Pan north.

A little farther north, again on the east side of the river, is a medium-density, lower-income area with just one park (Pecan Playground) in the general vicinity. We'd prefer a high-density neighborhood, but since we don't yet have specific criteria for our analysis, we want to be inclusive rather than exclusive in our assessments. It's up to you whether to mark this area or not—all that really matters is that you start to gain a sense of the study area.

Figure 1-97

Ⓑ On the Drawing menu, click the Ellipse tool and draw an ellipse around the area (Figure 1-97).

Ⓒ Unselect the graphic and keep panning along the river.

The area opposite Dodger Stadium, on the east side of the river, is medium-density, lower-income, and park poor.

Ⓓ Draw an ellipse around this area (Figure 1-98).

You may find that the shape of the ellipse doesn't fit the area just the way you want.

Ⓔ On the Draw toolbar, click the Rotate button 🔄.

Ⓕ Place the mouse pointer over the graphic, then click and drag to rotate the graphic. Orient the ellipse to fit the area better.

Ⓖ On the Draw toolbar, click the Select Elements tool 🔺.

Ⓗ Resize and reshape the ellipse by dragging selection handles.

You may need to switch back and forth between the Rotate and Select Elements tool to make the ellipse look the way you want (Figure 1-99). It's not art, so don't spend too much time on it.

Figure 1-98
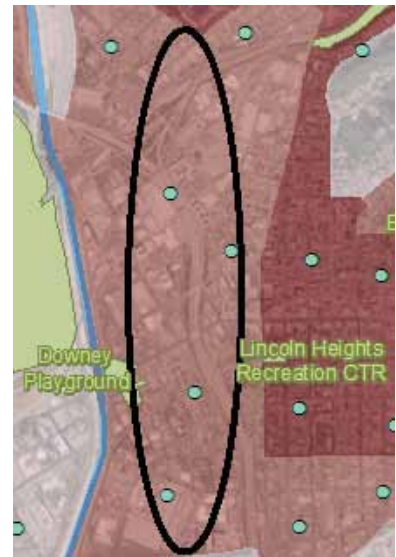

Figure 1-99

I Unselect the graphic and continue panning along the river. Mark areas that seem promising to you and reshape the ellipses as needed.

As you navigate around Griffith Park, remember that the yellow line marks the city limits. The areas north and east of the park aren't part of Los Angeles and shouldn't be considered. Once you get around this park, you may find fewer likely areas. But remember, there's no right or wrong answer for this exercise.

J After adding the last ellipse, from the main menu, choose Edit → Select All Elements.

K Again from the main menu, choose Edit → Zoom To Selected Elements.

L Click anywhere on the map to unselect the graphic elements (Figure 1-100).
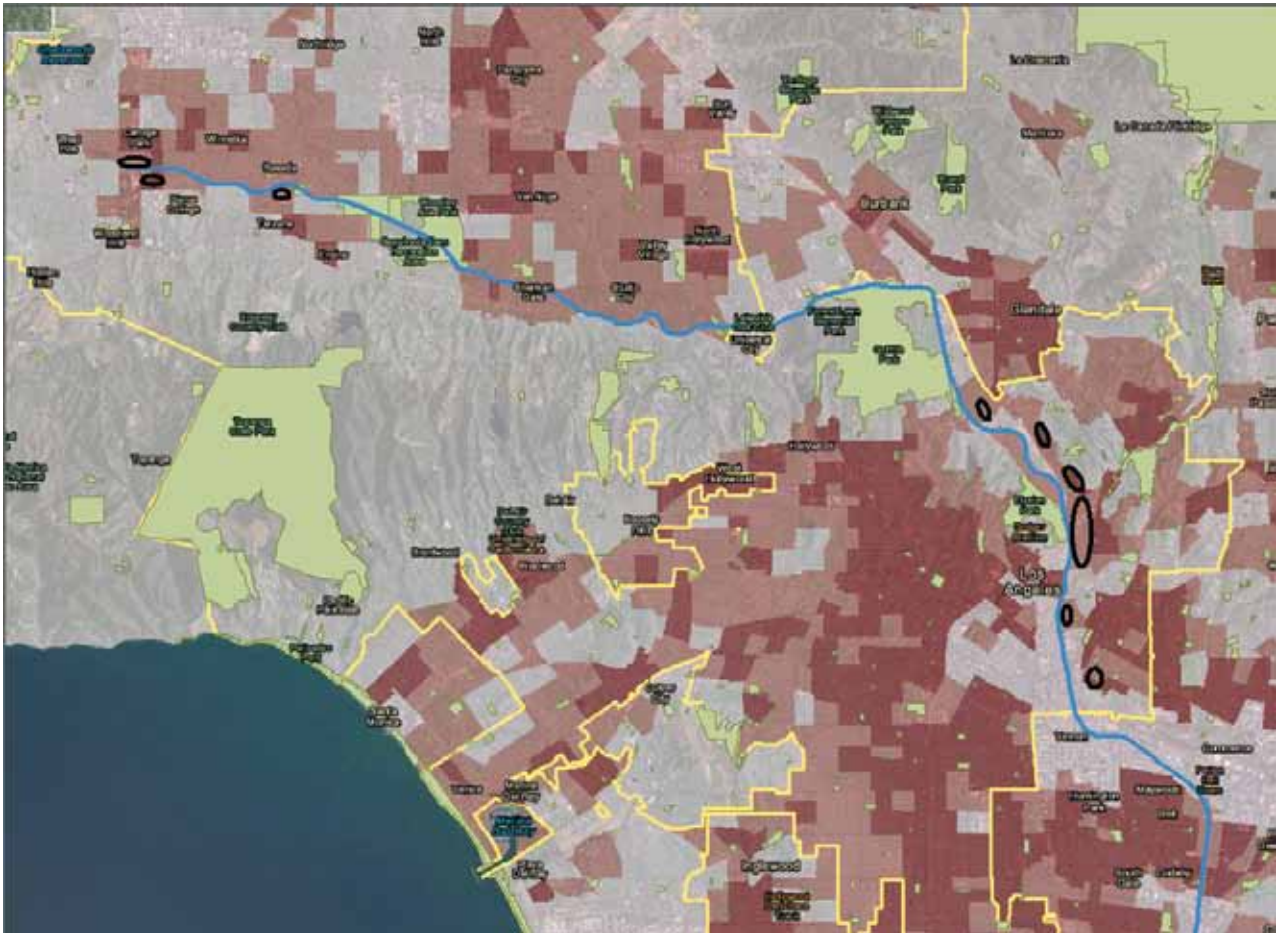
M Save the map document.

Figure 1-100

19) Export the map. We'll export this view of the map to an image in TIFF format. When we finish the analysis in Lesson 6, we'll add the image and compare our guesses to the actual results.

Ⓐ From the main menu, choose File ➤ Export Map.

Ⓑ At the top of the Export Map dialog box, click the Home 🏠 button to navigate to the MapsAndMore folder.

Ⓒ In the Save as type box, click the drop-down arrow and choose TIFF (*.tif).

Ⓓ Replace the file name with **Lesson1Predictions**.

Ⓔ Under Options, click the Format tab. At the bottom, check the box to write GeoTIFF tags.

GeoTIFF tags embed coordinate system information into the image file. The output will be an image that can be used in documents such as presentations or reports, but that will also align spatially with layers in ArcMap.

Ⓕ Compare your Export Map dialog box to Figure 1-101 and click Save.

The Export Map dialog box closes by itself.

20) Exit ArcMap. Toolbars that you leave on the interface will remain there in subsequent sessions. There's nothing wrong with that, but too many toolbars can become a distraction.

Ⓐ From the main menu, choose Customize ➤ Toolbars ➤ Draw.

The Draw toolbar is removed.

Ⓑ Remove the Effects toolbar in the same way.

Ⓒ From the main menu, choose File ➤ Exit.

At this point, you already have a basic working knowledge of ArcMap. You know the problem to be solved and you have a sense of the study area. You've worked with some of the available data for the project, but you haven't taken a careful, systematic look at it. That will be the focus of the next lesson.
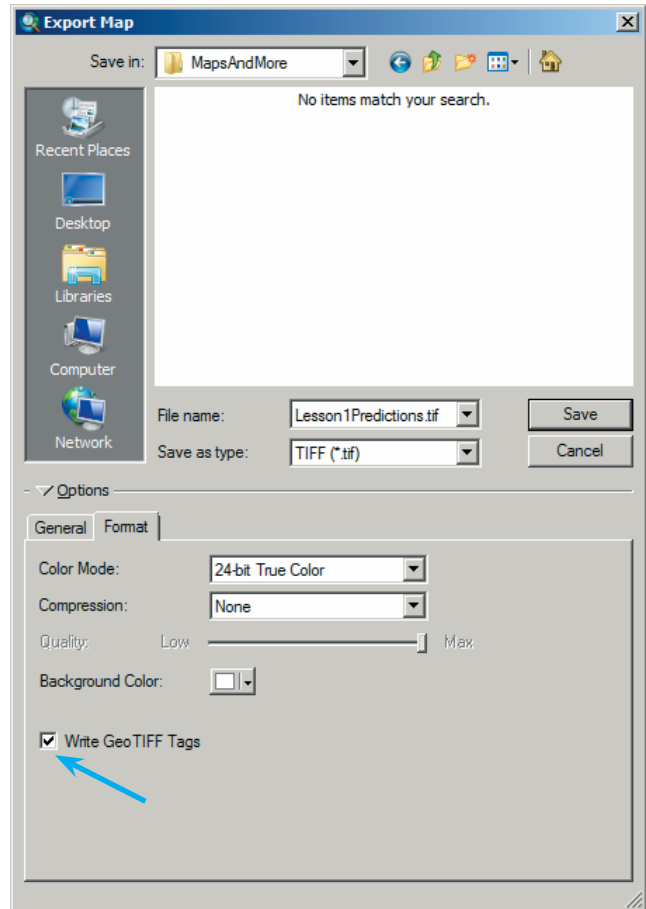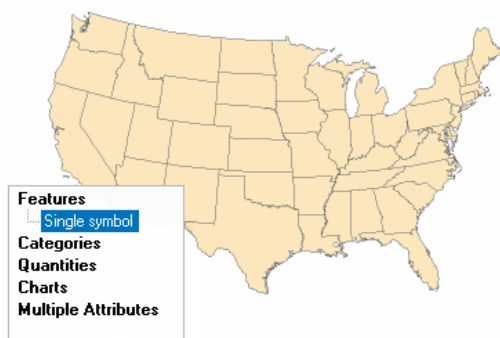
Figure 1-101

Symbology methods

The default **Single Symbol** method (under Features) assigns the same symbol to all features in a layer. No attribute is symbolized.


Under the **Categories** heading are methods for symbolizing descriptive attributes. Here, the Unique Values method assigns different line widths to a roads layer according to whether the roads are freeways, highways, or streets.
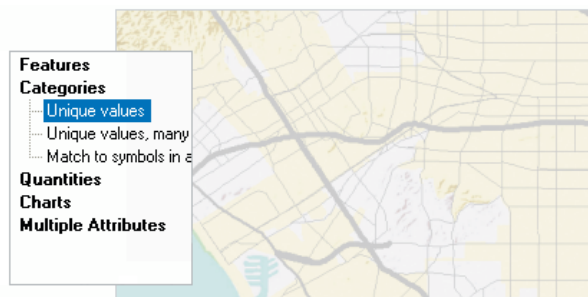
Under the **Quantities** heading are methods for symbolizing numeric data. In this example, census tracts are symbolized by population density. Low-density tracts are yellow, medium-density are orange, and high-density are brown.
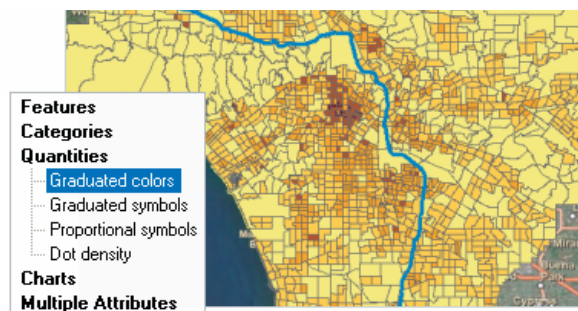
The **Charts** heading has methods to compare numeric attributes by chart symbols. These pie charts compare percentages of owner-occupied homes (red), renter-occupied homes (blue), and unoccupied homes (yellow) for Southern California cities.
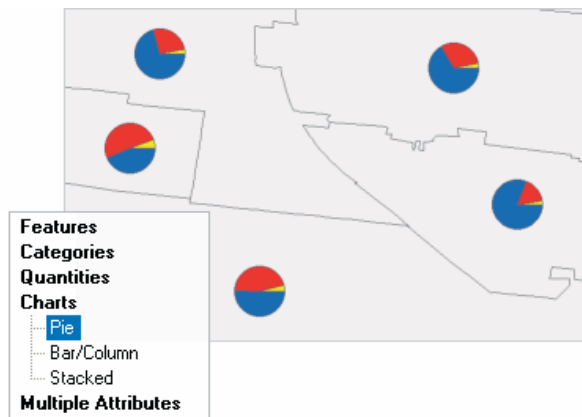
The **Multiple Attributes** heading lets you symbolize descriptive and numeric attributes together. Here, the descriptive attribute is vacancy. Vacant lots are orange; developed lots are pink. The numeric attribute is land value. A small dot in a vacant lot means the value is low; a large dot means the value is high.