

# **Introduction to ArcGIS I**

(Final)

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# *Introduction*

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class database**

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## ***EXERCISE 1: INSTALL THE CLASS DATABASE***

In this exercise, you will install the database that you will use for certain other exercises in the course.

### ***STEP 1: INSTALL THE CLASS DATABASE***

- ☐ Ask your instructor whether the database has already been installed.
- ☐ If not, turn to the last page of the exercise book and remove the database CD-ROM from the sleeve attached to the back cover.
- ☐ Insert the CD-ROM into the CD-ROM drive.
- ☐ From the *Start* menu, start *Windows Explorer*.

Before running the setup program, you will change the view setting of Windows Explorer.

- ☐ From the *Tools* menu, click *Folder Options*.
- ☐ Click the *View* tab.
- ☐ In the *Advanced settings* area, verify that the *Hide file extensions for known file types* check box is unchecked.
- ☐ Click *OK*.

Now you will execute the Setup program on the CD-ROM to install the training data.

- ☐ Navigate through the tree structure to the CD-ROM and click on the CD-ROM drive.
- ☐ In the contents of the CD-ROM, double-click *Setup.exe*.
- ☐ On the *Welcome* panel, click *Next*.

- ☐ Ask your instructor for the destination folder for the database.

Destination Folder: \_\_\_\_\_.

---

If the destination folder is C:\Student:

---

☐ Click *Typical*.

☐ Click *Next*.

☐ Click *Finish*.

---

---

If the destination folder is *not* C:\Student:

---

☐ Click *Custom*.

☐ Click *Browse*.

☐ Enter the path to the destination folder.

☐ Click *OK*.

Now you are ready to install the class database.

☐ Click *Next*.

☐ Click *Finish*.

---

The database is installed in the destination folder. From now on, the destination folder for the installation will be referred to as your working folder.

- ☐ Remove the CD from the CD-ROM drive and keep it with this book.

## ***EXERCISE END***



# *Exploring GIS concepts*

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## EXERCISE 2: EXPLORE A SAMPLING OF GIS CONCEPTS

This exercise will show you how spatial data is organized based on the theme it represents. You will also see how geographic data relates to its descriptive components by exploring tables pertaining to the features. You will explore concepts of topology (i.e., how spatial features relate to one another), and you will become familiar with how data is displayed and queried and how meaningful output is created.

### STEP 1: START ARCMAP

First, launch the ArcMap™ application.

- ☐ If you have a shortcut for *ArcMap*  on your desktop, double-click it to start *ArcMap*. Otherwise, click *Start > Programs > ArcGIS > ArcMap*.
- ☐ If you see the ArcMap startup dialog, confirm or click *A new empty map*; then click *OK*.

You are now looking at the interface of the ArcMap application. ArcMap allows you to view maps in Data View or Layout View. Data View lets you examine, query, edit, symbolize, and otherwise prepare your data for map output. Layout View provides tools for creating a presentation-quality map.

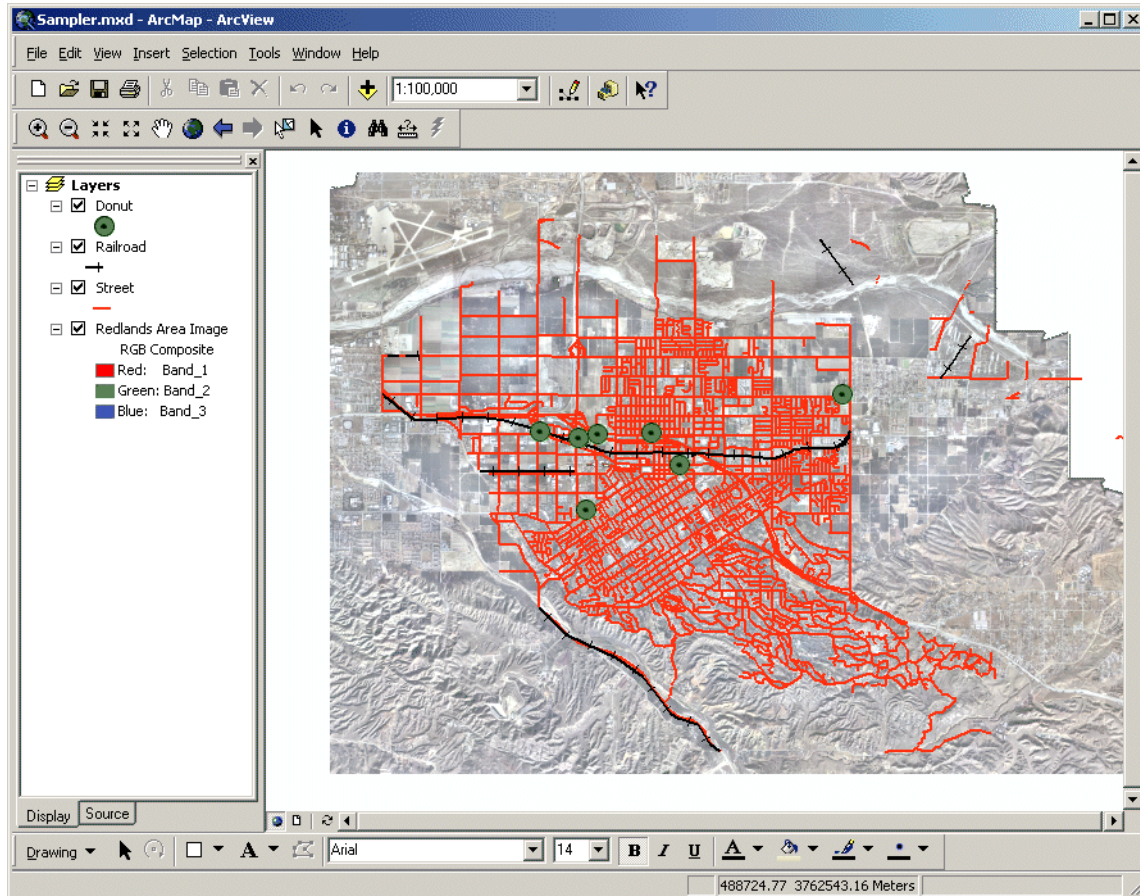
Whenever you work in ArcMap, you are working with a map document. This document can contain various data frames, which in turn are populated by spatial datasets. A map document has an *.mxd* file extension.

### STEP 2: EXAMINE SOME FEATURE LAYERS AND THEIR ORGANIZATION

A map document was created for this exercise. You will use this file to examine the spatial data contained in the Redlands data folder.

- ☐ Click *File > Open*.
- ☐ Navigate to the *C:\Student\igis1\Map\_documents* folder and locate *sampler.mxd*.
- ☐ Double-click *sampler.mxd* to open and display the map.

When sampler.mxd opens, you will see an image depicting the general Redlands vicinity overlaid by streets, railroads, and donut shops.



**NOTE:** The image is displayed at 40 percent transparency to balance with the symbols of the other three layers.

Notice how the various geographic features (streets, railroads, donut shops) are organized into layers in the Table of Contents according to the theme of information they convey. For instance, all donut shops are grouped into a Donut layer. Each donut shop is represented by a point feature.

Now examine the ArcMap Table of Contents and answer the following questions:

Question 1: How many layers are present in the Table of Contents?

---

Question 2: Of the layers listed in the Table of Contents, how many are visible in the display area? \_\_\_\_\_

Question 3: The Street layer represents roads as \_\_\_\_\_ features.

### STEP 3: IDENTIFY RELATIONSHIPS BETWEEN GEOGRAPHIC FEATURES

Maps represent the location of geographic features in relation to one another. Just glancing at a map, you are able to distinguish features that are north of, south of, or beside other features. These types of relationships are understood by the software through topology. *Topology* is a mathematical procedure used to establish the spatial properties of connectivity, adjacency, and coincidence. ArcGIS® uses these and other planimetric relationships like area, length, and direction to analyze spatial patterns.

In this step, you will examine the spatial relationships between features by observing a map. Later, you will select features based on spatial relationships, such as selecting all donut shops that fall within one kilometer of Interstate 10. In future lessons, you will see how the software determines topology and enables you to recognize spatial relationships between features.

Before proceeding with this step, you will zoom in on the area around an ESRI building. You will access a previously created bookmark of a geographic extent that encompasses ESRI and neighboring streets.

□ On the menu bar, click *View > Bookmarks > ESRI*.

The display zooms in on an area that represents ESRI and its general vicinity. The streets are now labeled with street names. The creator of the map document chose to only display labels at a scale where the text could be read easily. The large building near the center of the display is the post office. The irregularly shaped building bordering New York Street is ESRI's Building M. Now, using this information and assuming that north is at the top of your display, answer the questions below by visually inspecting the display.

Question 4: Which street intersects New York Street to the south? \_\_\_\_\_

Question 5: Can you drive from ESRI to the intersection of Redlands Boulevard and Texas Street? \_\_\_\_\_

Question 6: According to your visual observation, which building appears to occupy a larger area, the post office or ESRI's Building M? Include the parking lot to the west of the post office and the parking lot to the south of Building M in your comparison. \_\_\_\_\_

You just answered some questions that involved determining spatial relationships. Later you will see how the software makes the same determinations.

**STEP 4: ASSOCIATE DESCRIPTIVE INFORMATION WITH A LAYER**

In this step, you will learn how descriptive, or attribute, information is associated with spatial data. Before you explore the attributes of some of the layers listed in the Table of Contents, you will return to the ArcMap document's original geographic extent (stored as a bookmark). Then you will manipulate the layers to display only those of current interest to you. This prevents the display from becoming cluttered and allows you to focus only on those layers you want to learn more about.

- ☐ On the menu bar, click *View > Bookmarks > Original*.

The displayed layers should be: Donut, Railroad, Street, and Redlands Area Image. Now you will examine the attribute information regarding all zoning parcels and donut shops.

- ☐ In the *Table of Contents*, right-click *Street* to bring up the layer's context menu; then click *Open Attribute Table*.

The attribute table associated with the Street layer appears. Each record represents an individual feature in the Street layer. The bottom portion of the table provides information on the number of records comprising the table. The attribute table of the Street layer contains a few thousand records.

- ☐ Scroll down the table to observe the number of records. If necessary, scroll to the right of the table to view all of the attributes describing this layer.
- ☐ Close the attribute table.

Repeat the same procedure for the Donut layer.

- ☐ In the *Table of Contents*, right-click *Donut*; then click *Open Attribute Table*.

The attribute table associated with the donut shops appears. Notice the number of records in the table.

Question 7: How many records are present in the Donut layer attribute table?

---


Hint: Examine the information at the bottom center of the attribute table window.

- ☐ Close the *Attributes of Donut* window.



### STEP 5: IDENTIFY SPECIFIC FEATURES

The previous step showed you how to list attribute information for all features in a layer. This step will teach you how to identify individual features (i.e., list attributes pertaining to only a single feature).

- ☐ Click the *Identify Features* button  on the *Tools* toolbar.
- ☐ Position the pointer over the center of the easternmost donut shop (the one on the right-hand side of the map); then click it.

Hint: If you position the pointer slightly away from the center of the symbol, this might exceed the default search tolerance (distance) and could result in the selection of features from the *Street* layer instead. If this occurs, just keep trying the *Identify* operation until you click on the donut shop.

The feature flashes when clicked, and the *Identify Results* dialog appears.

Question 8: What is the name of the donut shop? \_\_\_\_\_

- ☐ Identify other donut shops within your display area.
- ☐ Close the *Identify Results* dialog.

Now you will learn to set map tips for a layer. If you simply hold the pointer over a feature, map tips display a single feature attribute.

- ☐ Right-click the *Railroad* layer and click *Properties*.
- ☐ Click the *Display* tab.
- ☐ Check the *Show Map Tips* check box. Do not close the *Layer Properties* dialog yet.

The primary display field will be the attribute displayed as a map tip. You can designate a primary display field by clicking the *Fields* tab in the layer properties.

- ☐ Click the *Fields* tab.
- ☐ Click the *Primary Display Field* dropdown list and observe all the attribute choices. The default application choice is the first string (character) field: *NAME*. This is the most useful for this exercise, so do not change it.
- ☐ Click *OK* in the *Layer Properties* dialog.
- ☐ Hold your pointer over any railroad feature.

The name should appear in a map tip.

In the next step, you will learn how to use a layer's attributes to locate specific features.

#### **STEP 6: SELECT GEOGRAPHIC FEATURES BASED ON CERTAIN CONDITIONS**

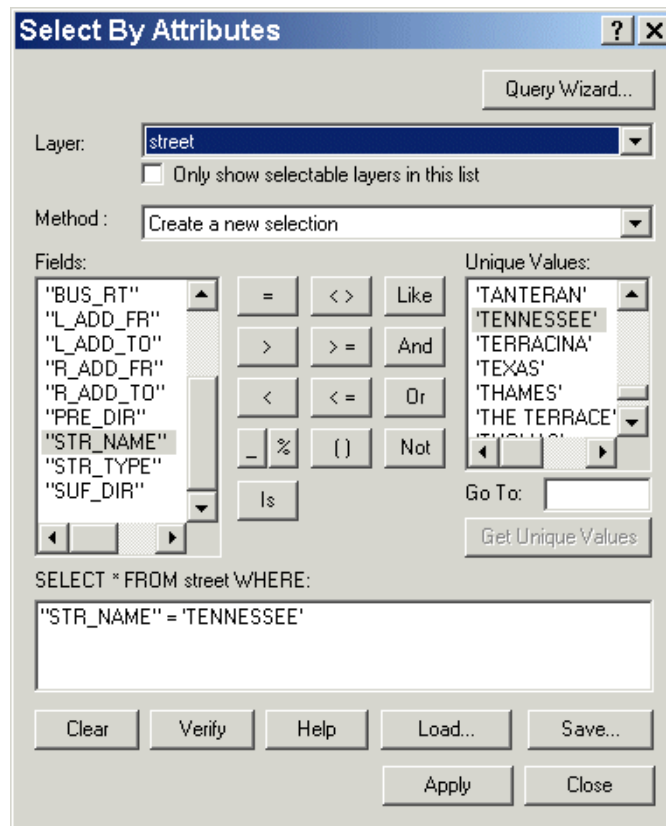
You may encounter a situation where you want to display a feature (or features) that meets specific criteria. In this step, you will select and locate those street segments named Tennessee. Before you proceed with this step, turn off the Redlands Area Image layer in the Table of Contents. Turning off this large image will speed up your display when you make your selections.

- ☐ In the *Table of Contents*, uncheck the *Redlands Area Image* check box to turn it off.
- ☐ On the menu bar, click *Selection > Select By Attributes*.

The Select By Attributes dialog allows you to construct queries for the layers in your map. You will choose the Street layer and formulate an expression using the attribute STR\_NAME (for street name) to be equal to TENNESSEE. This will select from all roads only those street segments that meet this criterion. The selected streets will then be highlighted in the display area.

- ☐ For *Layer*, click *Street*.
- ☐ For *Fields*, double-click *STR\_NAME*.
- ☐ Click the equal button (=) from the list of operators.
- ☐ Click the *Get Unique Values* button to get the list of all the street names.
- ☐ In the list of unique values, double-click *TENNESSEE*.

The Select By Attributes dialog should look like the figure below.



□ Click *Apply*.

In the display area, observe that Tennessee Street is highlighted with the default cyan blue color, indicating the selected segments making up Tennessee Street (you may need to move the Select by Attribute dialog to see the selected features). Also, the status bar at the bottom of ArcMap shows the number of features selected by this operation. This message will disappear as soon as you move the mouse to another toolbar or menu.

□ On the *Select by Attributes* dialog, click *Close*.

□ On the menu bar, click *Selection > Clear Selected Features*.

Now you will identify all donut shops that are within 1,000 meters (0.62 miles) of Interstate 10 for all these hungry commuters driving between Palm Springs to Los Angeles.

First, you need to select all the street segments named I 10. As with the previous step (selecting Tennessee street), you need to formulate an expression that satisfies a condition.

☐ On the menu bar, click *Selection > Select By Attributes*.

You will choose the Street layer and formulate an expression making the attribute STR\_NAME equal to I 10. As before, this will select only those streets that meet the criterion. The selected streets will then be highlighted in the display area.

☐ For *Layer*, confirm or click *Street*.

☐ Click *Clear* to erase the previous expression.

☐ For *Fields*, double-click *STR\_NAME*.

☐ Click the equal button (=) from the list of operators.

☐ If necessary, click the *Get Unique Values* button under the list of unique values.

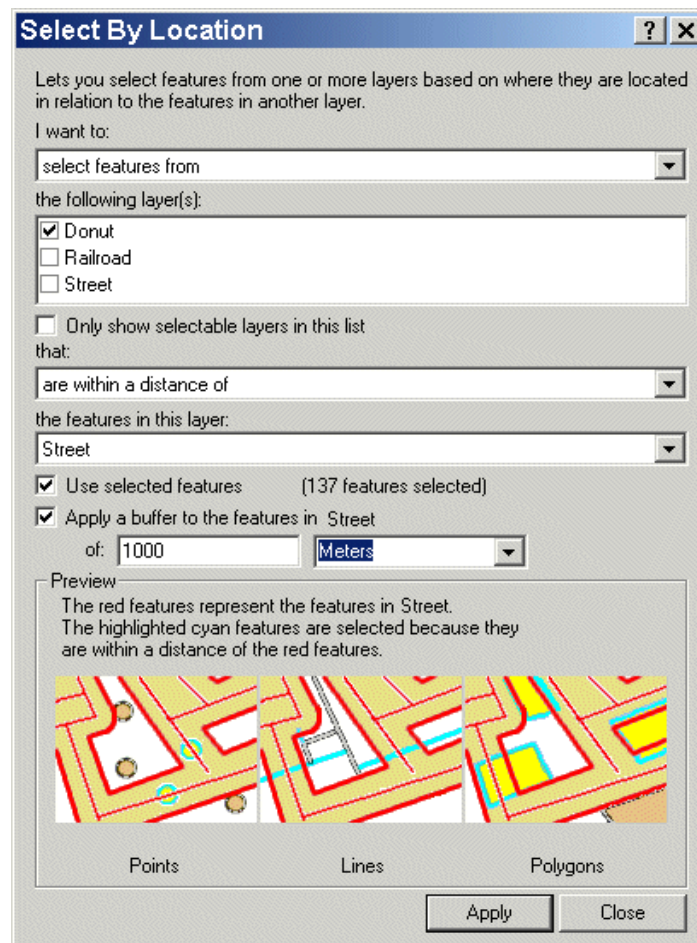
☐ In the list of unique values, double-click *I 10*.

☐ Click *Apply*, then click *Close*.

In the display area, observe that I 10 is highlighted, indicating the selected segments making up Interstate 10. Now you will find the donut shops that are within 1,000 meters of the selected features.


☐ On the menu bar, click *Selection > Select By Location*.

- In the *Select By Location* dialog, ensure your settings match those shown below.



- Click *Apply*.
- Click *Close* to close the *Select By Location* dialog.

Notice that within the 1000-meter buffer zone around I 10, five donut shops are selected and highlighted in the display.

- If necessary, refresh the display by clicking the *Refresh* button  at the bottom left corner of the ArcMap display area.

You have just performed a spatial analysis operation. In upcoming exercises, you will learn how to perform similar operations and further expand your results in combination with other criteria.

- Exit *ArcMap* without saving, or you can choose to go on to the challenge step.

*CHALLENGE: WORK WITH QUERIES*

In the last step of this exercise, you performed two different types of queries—an attribute selection and a spatial selection—to locate donut shops within one kilometer of Interstate 10. Using the same tools, see if you can locate local streets that are within 100 meters of the SP Railroad. Here are some hints for completing the query:

- The entire task should require only three separate queries. The first query will select the railroads with a *NAME* value of *SP RAILROAD*. The second query will select all of the streets within 100 meters of the selected railroads. The final query will select only those that have a *CLASS\_DESC* value of *Local Street* from the currently selected set of streets.
- Pay special attention to the select method on the final query. Think about what you are trying to find.
- Exit *ArcMap* without saving.

*EXERCISE END*

## ***ANSWERS TO EXERCISE 2 QUESTIONS***

Question 1: How many layers are present in the Table of Contents?

**Answer: four**

Question 2: Of the layers listed in the Table of Contents, how many are visible in the display area?

**Answer: four**

Question 3: The Street layer represents roads as \_\_\_\_\_ features.

**Answer: line**

Question 4: Which street intersects New York Street to the south?

**Answer: State Street**

Question 5: Can you drive from ESRI to the intersection of Redlands Boulevard and Texas Street?

**Answer: Yes—the streets are connected.**

Question 6: According to your visual observation, which building appears to occupy a larger area, the post office or ESRI's Building M? Include the parking lot to the west of the post office and the parking lot to the south of Building M in your comparison.

**Answer: Building M occupies a larger area, especially when you include the parking lot and additional undeveloped land.**

Question 7: How many records are present in the Donut layer attribute table?

**Answer: Seven**

Question 8: What is the name of the donut shop?

**Answer: Mo Do Nuts**

## CHALLENGE SOLUTION

You should have found 72 local streets within 100 meters of the SP Railroad.

**NOTE:** The status bar reports the total number of features selected for all layers. Open the streets attribute table to check the number of selected street features.





# *Displaying data*

## **Exercise 3: Display data**

Start your applications and add a polygon layer  
Add an image to ArcMap  
Add a layer for a polygon shapefile  
Change a layer name  
Use the Definition Query  
Classify and symbolize spatial data  
Label features  
Add a halo to the labels  
Create a layer file  
Create a map layout using Layout View  
Set map scale  
Save your map document  
Exit ArcMap

**3-1**

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Challenge: Save labels as annotation

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*contents*



## ***EXERCISE 3: DISPLAY DATA***

In this exercise, you will learn how to display spatial and attribute data by creating a map for a local insurance agency. The agency needs to formulate insurance premium guidelines for buildings that fall within the flood zone in Maplewood. Your objective is to create a map showing the buildings in the flood zone.

This exercise will give you a brief introduction to a number of ArcGIS features and functions, many of which you will examine in greater detail later in the course.

### ***STEP 1: START YOUR APPLICATIONS AND ADD A POLYGON LAYER***

First, start the ArcCatalog™ application.

- ☐ Click *Start > Programs > ArcGIS > ArcCatalog*.
- ☐ In the *ArcCatalog* tree, the left panel of *ArcCatalog*, double-click on the *C:\* drive to expand its contents.
- ☐ In the *ArcCatalog* tree, navigate to *C:\Student\igis1\Maplewood*.

The Contents tab, displayed to the right, will show the datasets underneath the Maplewood folder. If those datasets are not shown, double-click Maplewood in the catalog tree.

Now start ArcMap.

- ☐ Click *Start > Programs > ArcGIS > ArcMap*.
- ☐ Confirm selection of *A new empty map*.
- ☐ Click *OK*.
- ☐ Position your *ArcMap* and *ArcCatalog* window so you can see both on your screen simultaneously.

The ArcMap interface appears on the screen with an untitled map document and a default data frame named Layers.

Now you will add spatial data as layers to your map. Layers can be added for a variety of data formats including: geodatabase feature classes, ArcInfo® coverages, ArcView® GIS shapefiles, CAD, and several supported raster formats (e.g., ERDAS and MrSID images or ArcInfo GRIDs). In this exercise, you will add coverage polygon features, shapefile polygon features, and an aerial photo from a TIFF image. These data formats will be discussed in more detail later in the course.

ArcCatalog allows you to explore different data sources. ArcMap allows you to display, edit, and analyze them. Using your mouse, you can drag and drop data from ArcCatalog into ArcMap.

First, you will add a layer, consisting of a coverage's polygon features, to the Data View in ArcMap.


- ☐ In *ArcCatalog*, navigate to the *Maplewood* folder.
- ☐ Double-click the *floodcov* coverage to show the features in the coverage.
- ☐ Drag and drop the *floodcov polygon* features from *ArcCatalog* into *ArcMap*. (You may need to arrange your windows so you can see both *ArcMap* and *ArcCatalog*.)

The polygon features are added to the ArcMap display area and shaded with a random shade symbol. You will change the shade symbol later.

- ☐ Minimize the *ArcCatalog* application and ensure that *ArcMap* is open on your screen.

## **STEP 2: ADD AN IMAGE TO ARCMAP**


Next, you will add an aerial photograph as an image in TIFF format to your map. You will add this layer differently than you did in Step 1.

- ☐ In the *ArcMap* toolbar, click the *Add Data* button .
- ☐ In the *Add Data* dialog, navigate to the *Maplewood* folder.
- ☐ Click *photoclip.tif* to select it.
- ☐ Click *Add*.

The TIFF image is added as a layer in the Table of Contents and displayed in the top right corner of the display area.

**NOTE:** ArcMap automatically adds the raster image to the bottom of the Table of Contents so it does not obscure the display of the other layers.

Next, you will pan to the area of interest for your map (the area encompassed by the aerial photograph).

☐ Use the *Pan* tool  to center the image within the display area.

Several properties need to be modified for the floodcov polygon layer. First, change its name.

☐ In the *Table of Contents*, right-click the *floodcov polygon* layer and click *Properties*.

☐ In the *Layer Properties* dialog, click the *General* tab or confirm that it is active.

☐ For *Layer Name*, replace the displayed name by highlighting it and typing `Flood`

☐ Click *Apply*.

The name of the layer changes in the Table of Contents.

Notice that the Flood layer's random fill shade may obscure the details of the image and may not suggest water or inundation. First, you will change the Flood layer's transparent property so that the image underneath will be visible.

☐ In the *Layer Properties* dialog, click the *Display* tab.

☐ For *% Transparent*, type `40`

☐ Click *Apply*.

The layer is redisplayed with a transparent shade.

**NOTE:** If nothing shows up for your transparency, you need to change the settings on your monitor to true color.

Next, you will add a red outline to the flooded area and change its shade to blue.

☐ In the *Layer Properties* dialog, click the *Symbology* tab.

☐ For *Symbol*, click the shaded symbol button to open the *Symbol Selector*.

☐ In the *Symbol Selector*, for *Options > Fill Color*, click the shaded symbol button.

☐ On the color palette, click a blue color.

- ☐ For *Outline Width*, click the up arrow to choose 2.
- ☐ For *Outline Color*, click the shaded symbol button.
- ☐ On the color palette, choose a red color.

Notice the changes in the Preview area of the Symbol Selector.

- ☐ Click *OK* to close the *Symbol Selector*.
- ☐ Click *OK* to close the *Layer Properties* dialog.

The Flood layer is displayed with a transparent blue fill and a red outline.

Question 1: What is the difference between the transparency setting on the Display tab and the transparency setting on the Symbology tab (Advanced button)? \_\_\_\_\_


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If the photoclip.tif image appears too dark, you can choose to display it with a transparent property. This is especially practical if you are going to place the final map layout in a report. You do not want the background image to be too conspicuous.

### **STEP 3: ADD A LAYER FOR A POLYGON SHAPEFILE**

Now you will add polygon features from a shapefile using a third method.

- ☐ In the *Table of Contents*, right-click the *Layers* data frame, then click the *Add Data* button .
- ☐ Use the *Add Data* dialog to add the *Maplewood/homeshp* shapefile.

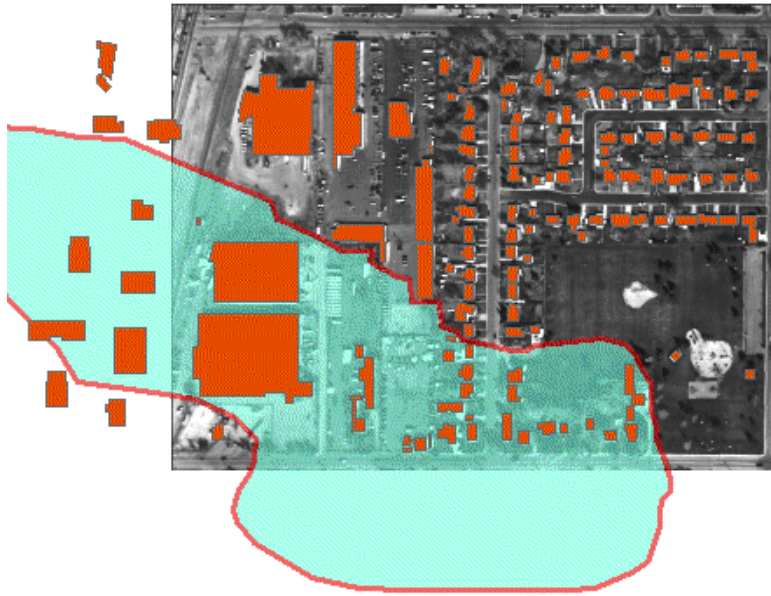
If the default shade symbol for the buildings is not suitable, follow the steps below to change it.

- ☐ In the *Table of Contents*, right-click the *homeshp* shade symbol.
- ☐ Choose an appropriate color from the color palette (one of the orange or brown shades would create a good contrast).
- ☐ Spend a moment experimenting with symbol properties like the ones you used with the flooded areas.

## Display data

You just learned how to add layers using different methods and various data sources (coverages, images, and shapefiles). Remember that other data sources such as grids or geodatabase feature classes can also be added as layers.

Your map should look like this:



The current scale of this Data View appears in a top-middle toolbar in the ArcMap application window.

Question 2: What is the current scale? 1: \_\_\_\_\_

This is the scale that ArcMap used to fit your data on its display area. Your scale will vary depending upon the size of the rectangle defined when you zoom in or out, the size of your ArcMap application window, or the size of your monitor. This is not the final map scale. You can set the final map scale when you compose your map layout.

### **STEP 4: CHANGE A LAYER NAME**

When a new layer is added, ArcMap assigns it a layer name. Sometimes this name is not very descriptive because it inherits the dataset or the feature class name. You can rename the layer any time.

Now you will change the names of the remaining two layers.

- ☐ In the *Table of Contents*, right-click the *homeshp* layer (on the text) and click *Properties* to display the *Layer Properties* dialog.

- ☐ Click the *General* tab at the top of the *Layer Properties* dialog.
- ☐ For *Layer Name*, type **Buildings**
- ☐ Click *OK*.

The name changes in the Table of Contents.

- ☐ Repeat what you just did, but this time, change the name of the *photoclip.tif* layer to  
**Photo image of area**

### STEP 5: USE THE DEFINITION QUERY


There may be occasions where you will choose not to display features contained within the feature class that are not of interest. However, you may want to keep these records in order to maintain data integrity and not lose information, which may become useful in the future. You can use the *Definition Query* in the *Layer Properties* to define those features you want to exclude from display and analysis.

In this step, you will use a Definition Query to reduce some of the clutter in your building layer display by removing structures with an area of less than 750 square feet. However, before you do this, first record how many buildings are currently displayed on your map.

- ☐ Right-click the *Buildings* layer and select *Open Attribute Table*.

Question 3: How many buildings are currently displayed? \_\_\_\_\_

Hint: Look at the bottom of the attribute table window.

- ☐ Click the  button at the top right corner of the table window to close the attribute table.
- ☐ Right-click the *Buildings* layer and click *Properties*.
- ☐ Click the *Definition Query* tab in the *Layer Properties* dialog.
- ☐ Click the *Query Builder* button.


The *Query Builder* dialog helps you build a SQL query statement, which you use to define which features you want to display. Through the use of different mathematical operators (e.g., ‘greater than’, ‘less than’, and so on), you can include or exclude features of interest. In this example, you will display only buildings *greater than* 750 square feet.

- ☐ In the *Fields* window, double-click “*AREA*”.



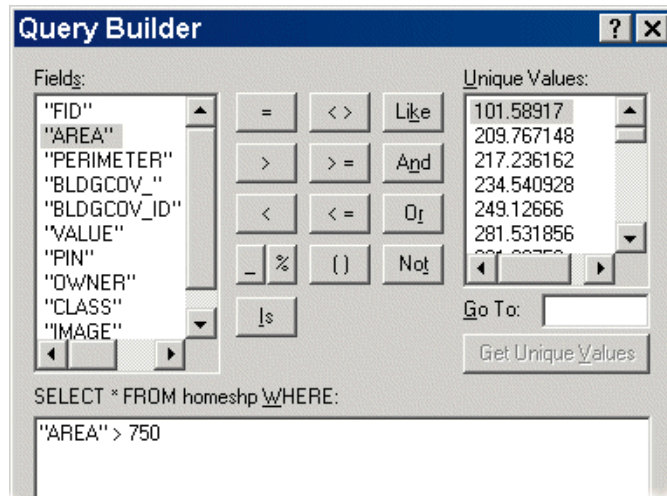
## Display data

The text will be automatically entered in the SQL statement window.

☐ Next, click the button with the '*greater than*' symbol. 

☐ Inside the SQL statement window, type 750

☐ Your *Query Builder* dialog should look like this:



☐ Click *OK* to perform the operation and close the *Query Builder* dialog.

☐ Click *OK* to close the *Layer Properties* dialog.

☐ Right-click the *Buildings* layer and select *Open Attribute Table*.

Question 4: How many buildings are now displayed?\_\_\_\_\_

The buildings smaller than 750 square feet have not been deleted from the feature class, just removed from display and analysis. If you wanted to restore the full, original dataset, you would remove the query from the *Definition Query* tab in the *Layer Properties*.

☐ Close the attribute table window.

Your current map extent may not show all of the buildings. Before moving on to the next step, you will ensure that all of the buildings are visible in your display.

☐ Right-click the *Buildings* layer and select *Zoom To Layer*

Question 5: What is another tool you could use to display all of the features in all of the layers in your map?\_\_\_\_\_

### STEP 6: CLASSIFY AND SYMBOLIZE SPATIAL DATA

The Buildings layer appears in a single color by default. You may want to display the buildings with symbols based on their value or age.

Next, you will change the display of the Buildings layer to reflect classes based on the value of these buildings.

- ☐ In the *Table of Contents*, double-click the *Buildings* layer to open its *Layer Properties* dialog.

Notice that this is a second technique for accessing layer properties.

- ☐ Click the *Symbolology* tab.
- ☐ In the left panel, for *Show*, click *Quantities*.

Note that the *Graduated Colors* option is highlighted as the default type.

- ☐ For *Fields Value*, click *VALUE*.
- ☐ For *Color Ramp*, click a yellow to dark brown ramp.

By default, you will get five classes that were calculated using Jenks' Natural Breaks method. You can verify this by looking just above the *Classify* button.

- ☐ Click *Apply*.
- ☐ Move the *Layer Properties* dialog aside to see the change on the map.

The buildings are now shown divided into five classes based on their values. Each class is listed in the Table of Contents and is shaded with a different color. You can see that some of the more expensive buildings are within the flood zone.

You can change the classification scheme for the data at any time. Now you will change the number of classes to four and the classification method to Manual, and you will explicitly define the classes.

- ☐ In the *Layer Properties*' *Symbolology* panel, under *Classification*, change the number of classes to 4
- ☐ Click the *Classify* button.
- ☐ For *Classification Method*, select *Manual* from the dropdown list.

## Display data

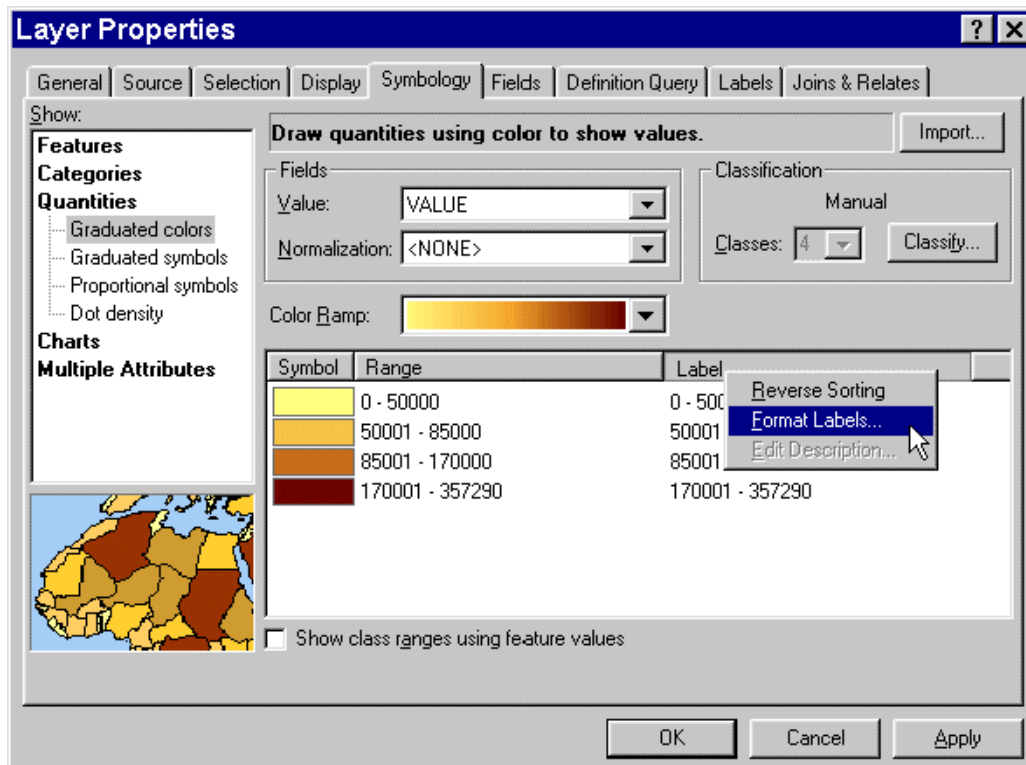
- ☐ For *Break Values* (on the right-hand side of the dialog), click on the first value.
- ☐ Change the value by typing a new value of 50,000 over the current value.
- ☐ Press **Enter**.
- ☐ Change the second break value to 85,000 and the third to 170,000

The bars on the histogram update their positions.

- ☐ Click *OK* to close the *Classification* dialog.
- ☐ Click *Apply* on the *Layer Properties* dialog. Confirm that the *ArcMap* display reflects your changes.

Next you will change the format of the labels next to the symbols in the ArcMap Table of Contents.

- ☐ In the *Layer Properties* dialog on the lower panel, click the gray *Label* heading, and click *Format Labels* from the menu that appears.



- ☐ In the *Number Format* dialog, from the *Category* listing, choose *Currency*.

☐ Click *OK*.

☐ Click *Apply* and confirm that the labels in the *Table of Contents* were updated.

Do not close the Layer Properties dialog; you will use it to add labels in the next step.

### **STEP 7: LABEL FEATURES**

A map is incomplete without some labeled features. Placing names on your map is an important communication task; map readers should be able to find names quickly or they will not use your map.

Now you will place owner names on specific polygons in the Buildings layer.

☐ In the *Layer Properties* dialog, click the *Labels* tab.

☐ Check the *Label Features in this layer* check box.

☐ For *Label Field*, click or confirm *OWNER*.

☐ For *Text Symbol*, click the *Symbol* button.

☐ In the *Symbol Selector*, for *Options: Color*, choose a bright green color for the text.

Green contrasts nicely with the grayscale image in the background and the color ramp used for the homes.

☐ For *Options: Size*, type 14

☐ Click the *B* button for a bold font style.

Notice that the selected text characteristics display in the Preview area.

☐ Click *OK* to close the *Symbol Selector*.

Notice that the Text Symbol area in the Properties dialog shows a sample of the text.

☐ Click *Apply* to view the owner names.

☐ Move the *Layer Properties* dialog aside to see the change on the map.

If you want to reduce the amount of text placed automatically on your map, use the conflict detection rules. Among these rules is a label buffer ratio, which uses the text size to determine buffer width. For example, if you choose a label buffer ratio of 3, and the size of the letters is 0.2 inches, no label will appear around any displayed label within a distance of 0.6 inches.

Using the conflict detection rules may considerably reduce the amount of text on your map, but will have the benefit of making the remaining labels much easier to read.

Now you will use the label buffer ratio.

- ☐ In the *Layer Properties* dialog, click *Placement Properties* (at the bottom left corner).
- ☐ In the *Placement Properties* dialog, click the *Conflict Detection* tab.
- ☐ Accept the defaults for *Label Weight* and *Feature Weight*.
- ☐ For *Buffer*, type 3 to reduce the amount of displayed text.
- ☐ Ensure the *Place overlapping labels* check box is unchecked.
- ☐ Click the *Placement* tab, and ensure the *Remove duplicate labels* option button is selected.
- ☐ Click *OK* to close the *Placement Properties* dialog.
- ☐ In the *Layer Properties* dialog, click *Apply*.

Do not close the Layer Properties dialog; you will use it in the next step.

Notice that the number of labels has decreased.

### **STEP 8: ADD A HALO TO THE LABELS**

Another technique you can use to make your labels more visible is to add a halo. This method is very useful if your background data is complex or dense or if the labels need to be drawn across a wide range of colors or feature symbols.

- ☐ Click the *Symbol* button in the text symbol section.
- ☐ Click the *Properties* button in the *Symbol Selector* dialog.
- ☐ Examine the four tabs available in the Editor dialog: *General*, *Formatted Text*, *Advanced Text*, and *Mask*.

Notice that there are a large number of choices you can make about how you want your labels to appear. You are only going to investigate one option, and add a halo to your labels.

- ☐ Select the *Mask* tab.
- ☐ Under *Style:*, choose *Halo*.
- ☐ Reduce the size of the halo outline to *1.5*.
- ☐ Click *OK* to close all the dialogs.

Notice that your labels now stand out more clearly against the photo image and the building features.

### **STEP 9: CREATE A LAYER FILE**

Layers point to the location where the source data is stored and store properties for how the data is displayed. Independent layer files (.LYR) may be used to share data display properties, so your colleagues will not have to repeat the process of classifying and symbolizing data. You can distribute the display scheme you have defined by e-mailing them your layer file or saving it to a common shared network drive. As long as your colleagues have access to the same underlying source data, the layer will appear as you have specified.

In this step, you will create a layer file that stores the symbology for the Buildings layer.

- ☐ Right-click the *Buildings* layer and select *Save As Layer File*.
- ☐ Name the layer file `Buildings.lyr` and save it in the *Maplewood* folder.

You will use this layer file for displaying the buildings later in the exercise.

### **STEP 10: CREATE A MAP LAYOUT USING LAYOUT VIEW**

In previous steps, you worked with the ArcMap Data View. In this step, you will create the layout for a map using Layout View. Layout View helps you organize the map elements on the page as on a virtual piece of paper, so that the printed map will look exactly like the Layout View.

Now you will switch to Layout View.

- ☐ Click *View > Layout View*.

The map appears at a certain reduction to fit inside your ArcMap application. Notice the percent reduction (shown here set to 33 percent; yours may be different) in the separate layout toolbar. This toolbar automatically appeared when you moved from Data View to Layout View.



- ☐ If the toolbar's default placement is within the Layout View, drag and drop it to dock somewhere on your main *ArcMap* application.

The Layout View appears with portrait orientation by default. In this step, you will create a map with landscape orientation.

- ☐ Click *File > Page and Print Setup*.
- ☐ Under *Paper*, for *Orientation*, click *Landscape*.

**NOTE:** If you are trying to set the Map Size parameters and the Page Orientation appears to be disabled, uncheck the Use Printer Paper Settings check box. Now you can also specify custom map dimensions.

Notice the default check boxes. The *Scale map elements proportionally to changes in page size* check box will be important when you design your map layout. This creates a dynamic link to your map elements, scaling them with changes in page size.

- ☐ Click *OK* to close the *Page and Print Setup* window.

So far, you only moved your data frame from Data View to the map layout (Layout View). You will learn how to add other map elements in Exercise 9.

### STEP 11: SET MAP SCALE

Maps can be large scale or small scale. For example, a 1:10,000-scale map is a larger-scale map than a 1:100,000-scale map. Maps can be displayed at any appropriate scale set by the map designer for a specific objective and audience.

The current scale of this Layout View appears in a top-middle toolbar in the ArcMap application window.

Question 6: What is the current scale? 1: \_\_\_\_\_

ArcMap calculated a scale for your map that fit the Data View extent within the layout. This scale may not be appropriate (either too small or too large) for your map. Next, you will change the map scale.

- ☐ Type 3000 in the *Map Scale* box and press **Enter**.

The map display zooms in to 1:3,000.

**NOTE:** If necessary, resize the data frame to fit the page or use the Pan tool on the Tools toolbar to adjust the location of the mapped area for better visual balance within the map layout.

Notice that the Layout toolbar has options for pan and zoom operations on the layout page.

- ☐ Practice using different zoom buttons on this toolbar.

While exploring the zoom buttons, notice that the percent reduction changes with every zoom step, and the 1:3,000 scale remains unchanged. This means that your layout zoom operations are helping you look at the map on your screen at different reduction or enlargement ratios, but you are not changing the scale at which your data is displayed. Your final map will print at the specified 1:3,000 scale.

### **STEP 12: SAVE YOUR MAP DOCUMENT**

Notice that your map has only the main map body with no marginalia (e.g., the north arrow, the legend, the scale bar, the date of the data, the date of the map, other disclosures or acknowledgements, the author, and so on). You will add all these map elements in a subsequent exercise.

You will save your map document twice to be used for two future exercises. First, save it for this exercise.

- ☐ Click *File > Save As*.
- ☐ For *Save in*, navigate to your *Maplewood* folder.
- ☐ For *File name*, type **ex\_display**
- ☐ For *Save as type*, confirm *ArcMap Documents (\*.mxd)*.
- ☐ Click *Save*.
- ☐ Now save it again, in the same location, for the layout exercise. Name it **ex\_layout**



### STEP 13: EXIT ARCMAP

Exit ArcMap, or continue to the challenge step.

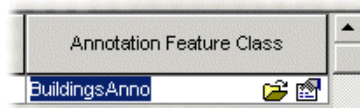
- ☐ Click *File > Exit*.

### CHALLENGE: SAVE LABELS AS ANNOTATION

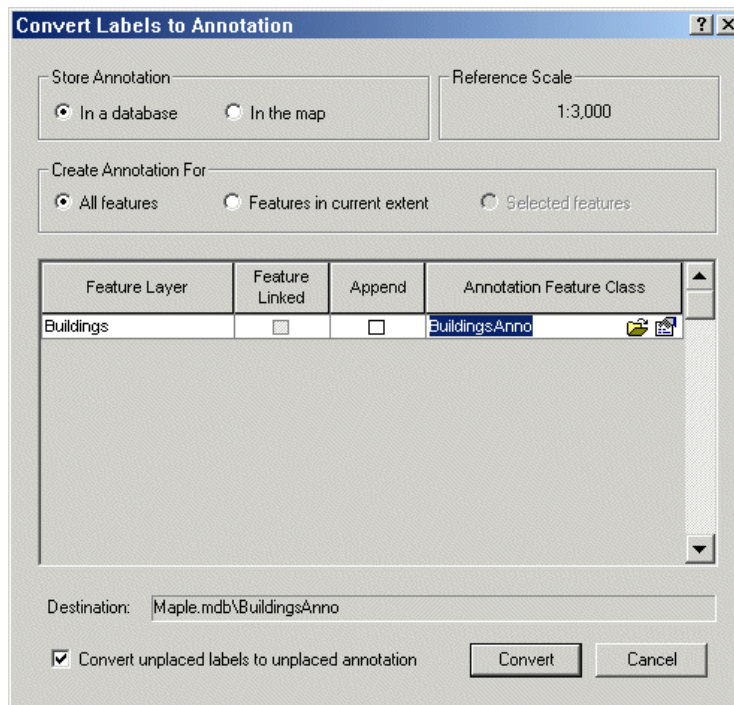
After you use the automated label placement feature in ArcMap, some labels may not appear as you, a keen cartographer, would like them to. You may need to change or move only a label or two.

In order to change individual labels, you need to convert your labels to annotation. Annotation allows you to select and move a certain text element to a better position. ArcMap gives you three ways to store annotation: as a layer contained within the map document (nothing is written to the geodatabase) or as one of two types of annotation feature class within your geodatabase. You will convert your labels to annotation using a method of your choice.

- ☐ Right-click the *Buildings* layer and click *Convert Labels to Annotation*.
- ☐ Click the *Browse* button to the right of the *BuildingsAnno* name.
- ☐ Navigate to *C:\Student\igis1\Maplewood\Maple.mdb* and open it.
- ☐ Click *Save*.



Your *Convert Labels to Annotation* window should look like this:



□ Click *Convert*.

**NOTE:** As soon as you convert labels to annotation, your normal labels are turned off. The text that appears on the display is your newly created annotation.

Not all of the converted annotation will fit onto the display; remember that you set a buffer for the labels. You may choose to add, remove, or reposition individual annotation elements to provide more information to your map.

□ Right-click the *BuildingsAnno* layer and click *Properties*.

□ In the *Layer Properties* window, click the *Symbolology* tab.

□ Click *Draw Unplaced Annotation* and accept the default symbol.

□ Click *OK*.

Obviously, cleaning up these annotation features will take a lot of work. If you were to proceed with editing the annotation features, you would treat them as any other geographic feature. You will learn editing skills in Lesson 7 of this course. More information about creating and editing labels and annotation is contained in *Introduction to ArcGIS II*.

- ☐ Right-click on *BuildingsAnno* and click *Remove*.
- ☐ Right-click on *Buildings* and turn on the labels.
- ☐ Save your *ex\_layout.mxd*.
- ☐ Exit *ArcMap*.

In this exercise, you experimented with displaying data in ArcMap. Your display of a coverage, a shapefile, and an image will help an insurance agency visualize at-risk properties. In the process, you learned how to add data to a geographic view, manage the Table of Contents, classify and symbolize ArcMap layers, and label features. You created two preliminary maps which you will use in future exercises. In the challenge steps, you learned to convert labels to annotation, and how to add a new file type to ArcCatalog.

## ***EXERCISE END***

## ***ANSWERS TO EXERCISE 3 QUESTIONS***

Question 1: What is the difference between the transparency setting on the Display tab and the transparency setting on the Symbology tab (Advanced button)?

**Answer: In the Display tab, ArcMap uses a fixed percentage value for the entire layer, while in the Symbology tab, it uses values from an attribute field, which means you could have various degrees of transparencies across the layer.**

Question 2: What is the current scale? 1:

**Answer: The answer to this question will vary depending on student settings.**

Question 3: How many buildings are currently displayed? \_\_\_\_\_

**Answer: 146**

Question 4: How many buildings are now displayed? \_\_\_\_\_

**Answer: 115**

Question 5: What is another tool you could use to display all of the features in all of the layers in your map? \_\_\_\_\_

**Answer: Click the *Full Extent* button.** 

Question 6: What is the current scale? 1:

**Answer: The answer to this question will vary depending on student settings.**



# *Querying your database*

## **Exercise 4: Query your GIS database**

Start ArcMap and open an existing map document  
Add MapTips  
Identify a feature  
Find a specific feature  
Take measurements  
Make a spatial query  
Examine your selection in the tables  
Calculate statistics for your selection  
Create a selection layer  
Explore other spatial selections  
Explore attribute selections  
Save your layer in

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another format

Save your document and exit ArcMap

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*contents*



## **EXERCISE 4: QUERY YOUR GIS DATABASE**

Last night, a heavy storm caused flooding in some low-lying areas. You are a planner in the state governor's office, and the governor has requested that you appear with her on the five o'clock news in a live interview. You will display a map of the area and must be prepared to answer questions.

In this exercise, you will learn techniques for querying in the ArcMap application in order to determine which buildings are in the flood area. You will then create a report of the affected buildings and their owners.

### **STEP 1: START ARCMAP AND OPEN AN EXISTING MAP DOCUMENT**

☐ Click *Start > Programs > ArcGIS > ArcMap*.

A dialog appears.

☐ Click *An existing map*.

☐ Click *OK*.

☐ In the *Open* dialog, navigate to *C:\Student\igis1\Maplewood*.

☐ Double-click *ex\_display.mxd*.

The ArcMap interface shows the *ex\_display.mxd* file, which was saved in Exercise 3.

**NOTE:** If you did not successfully complete Exercise 3 or if you forgot to save that exercise's map document as instructed, you can open an existing map document called *ex\_display.mxd* from the *...\Results\Ex03* folder that comes on the CD-ROM for this course. You will need to copy the document from the CD, paste it into your *\Student\IGIS\MapDocuments* folder, and change the read/write permissions on the file.

Ensure you are in Data View.

☐ Click *View > Data View*.

**STEP 2: ADD MAPTIPS**

Data View can be useful for verifying that the labels you placed on the map are correct. MapTips allow you to move your mouse pointer over a geographic feature and see an automatic popup of the associated attribute information. You will now turn on the MapTips for the Buildings layer, but first turn off the labels for the buildings so they are not distracting.

- ☐ Right-click the *Buildings* layer and click *Label Features* to turn the labels off.
- ☐ Double-click the *Buildings* layer to open its *Layer Properties* dialog.
- ☐ In the *Layer Properties* dialog, click the *Display* tab.
- ☐ Check the *Show Map Tips* check box.
- ☐ In the *Layer Properties* dialog, click the *Fields* tab.
- ☐ For *Primary display field*, verify that *OWNER* is the chosen field.
- ☐ Click *OK*.
- ☐ Now move the pointer over a building on the map.

The MapTip appears with the owner information.

- ☐ Move the pointer across the map as needed to display more MapTips.

Question 1: Who owns the largest building? \_\_\_\_\_

Next, you will change the Label Field. The text for each label comes from the layer's attribute table.

- ☐ Double-click on the *Buildings* layer to open its *Layer Properties* dialog.
- ☐ In the *Layer Properties* dialog, click the *Labels* tab.
- ☐ Check the *Label Features in this layer* check box.
- ☐ For *Label Field*, click *VALUE*.
- ☐ Click *OK*.

The labels are displayed again, but this time, the text is coming from the *VALUE* field.



- ☐ Use the MapTips again, noticing that MapTips continue to come from the primary display field and not the *Label* field.

MapTips work independently of labels.

This should be very useful when assisting the governor during her live interview.

Question 2: Who owns the building valued at \$239,400? \_\_\_\_\_

Map labels can be toggled on or off. Now you will turn the labels off.

- ☐ Double-click the *Buildings* layer to open its *Layer Properties* dialog.
- ☐ In the *Layer Properties* dialog, click the *Labels* tab, and uncheck the *Label Features in this layer* check box.
- ☐ Click *OK*.

There are two methods you can use to toggle labels on and off: the one you just used and the other you access through the layer context menu.

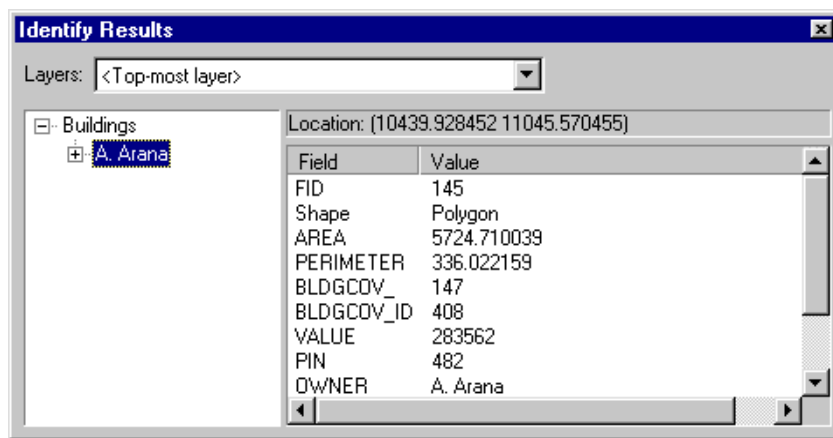
### **STEP 3: IDENTIFY A FEATURE**

You will use the Identify tool to determine the owner's name and the building value for features in the Buildings layer.

**NOTE:** The Tools toolbar may appear floating on your ArcMap display. You should drag and drop this toolbar to dock it on your ArcMap application, so that it does not get in the way of your viewing the data.

- ☐ On the *Tools* toolbar, click the *Identify* tool.

- Using the pointer, click on some buildings inside and outside the flood area and examine the *Identify Results* window for the building value and owner name.



Question 3: What is the value of the building that crosses the flooded boundary?

---

Question 4: Who owns the building that crosses the flooded boundary? \_\_\_\_\_

---

Next, you will flash the feature that you just identified to see it in the map display.

- In the left panel of the *Identify Results* window, click on the owner's name while looking at the map display to see the associated building in the *Buildings* layer flash on the display.

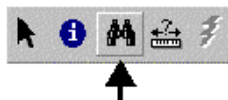
If the building is small and you forgot where you originally clicked to identify, you may need to repeat this operation several times.

- Close the *Identify Results* window.

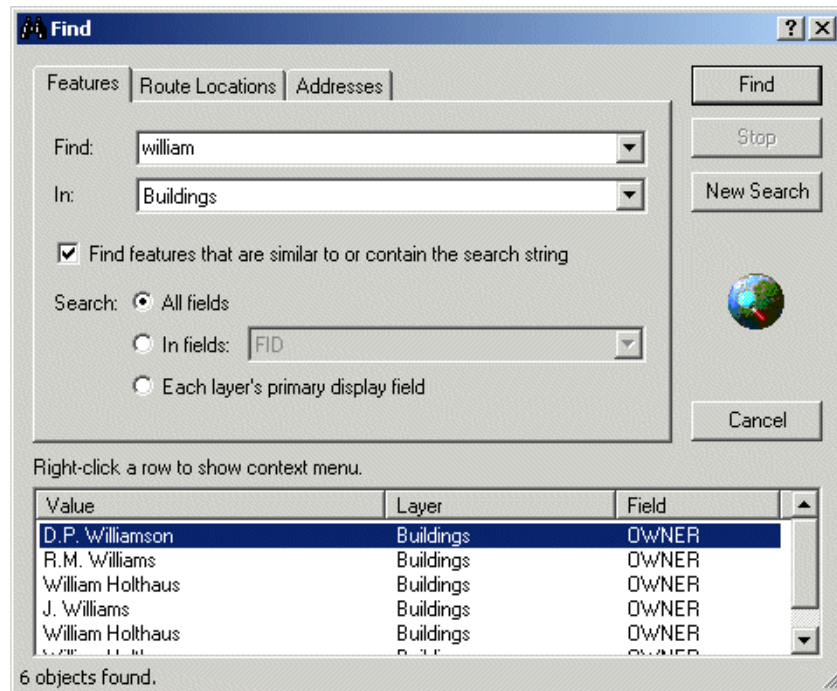
#### STEP 4: FIND A SPECIFIC FEATURE

Now you will use the *Find* tool to locate features using an attribute value. This tool helps you search one or many layers to locate a feature. You can use any part of a character string or value in your search.

- Click the *Find* tool.



- ❑ In the *Find* dialog, click the *Features* tab.
- ❑ For *Find*, type `william`
- ❑ For *In:*, click *Buildings* from the dropdown list.
- ❑ Click *Find*.



Notice that all the displayed values contain the `william` string and that the search string was not case sensitive.

- ❑ Experiment by right-clicking one of the owner names in the *Value* column and selecting the *Flash feature* on the context menu. You may need to move the *Find* window to the right so you can see the layer's flashing features.
- ❑ Flash several features until you locate the large building in the lower-left portion of the display. Keep the *Find* dialog open; you will need it for the next step.

Flash feature  
Zoom to feature(s)  
Identify feature(s)  
Set Bookmark  
Select feature(s)  
Unselect feature(s)

Next, you will experiment with the remaining options on the context menu. Your objective is to easily find the value corresponding to the largest lower-left building inside the flood area.

- From the *Find* dialog, choose the largest lower-left building using the *Select feature(s)* command on the context menu.

Once selected, the feature is highlighted.

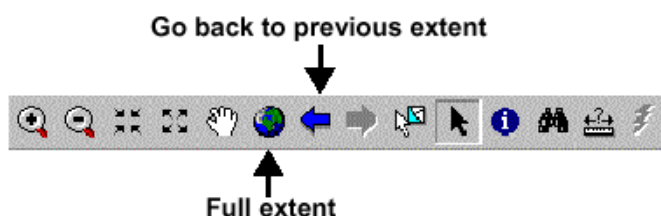
**NOTE:** If you want to change the color used to highlight selected features, go to the Selection Options dialog by clicking Selection > Options.

- Set a spatial bookmark to the extent of the selected feature using the *Set Bookmark* command on the context menu.

**NOTE:** After you set this bookmark, when you want to go back to this building later, you can click View > Bookmarks and select the name of the owner whose building you want to look at again. You can also set, access, and manage bookmarks from the View menu.

- Zoom in to the selected feature by choosing *Zoom to feature(s)*.
- Unselect the feature by choosing the *Unselect feature(s)* command.
- When finished experimenting, close the *Find* window.
- On the *Tools* toolbar, click the *Full Extent* button.
- Click *View > Bookmarks > William Holthaus*.

The display will immediately zoom to the extent of the building. To return to the original extent, click on either of the following tools:



#### STEP 5: TAKE MEASUREMENTS

Now you will take measurements from the displayed map.

- Click the *Measure* tool.



- Place the plus sign of your pointer at a corner of any building and click once.

- ☐ Move the pointer to the corner of another nearby building and double-click.

Your measured line ends and the distance in layer units is reported in the status bar at the bottom left corner of the ArcMap application. You can measure a line of several segments by clicking once at the end of each segment. Your figures will differ from the ones shown in the example below. You will also notice that these values are only displayed temporarily, and cannot be copied or exported.

Segment: 121.953570 Total: 121.953570 Feet

You can change the display units to better suit your needs.

- ☐ Right-click on the *Layers* data frame, click *Properties*, and click the *General* tab.
- ☐ Choose *Meters* from the *Display Units* dropdown list.
- ☐ Click *OK*.

Question 5: What is the distance from the lower-left corner of the largest building to the lower-left corner of the second largest building (in meters)? \_\_\_\_\_

- ☐ Change *Display Units* to *Kilometers*, and answer the next question.

Question 6: What is the approximate length (in kilometers) of the flood area at its longest axis? \_\_\_\_\_

- ☐ Change *Display Units* back to *Meters*.

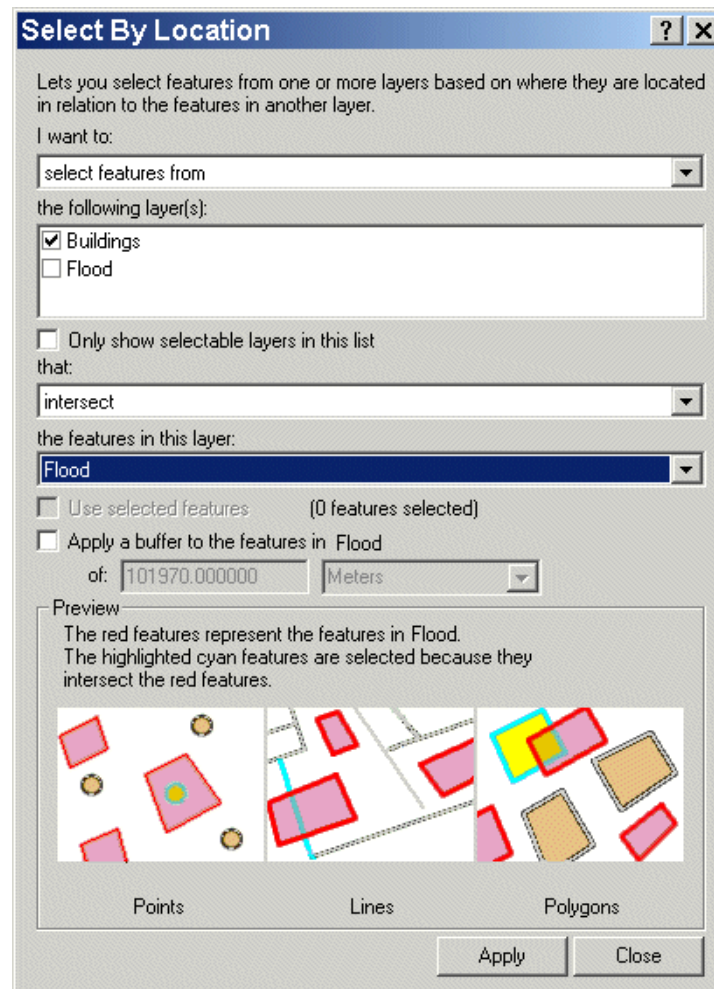
#### **STEP 6: MAKE A SPATIAL QUERY**

So far, this exercise has taught you basic query tools. Now you will help the governor determine exactly which buildings are affected by the flooded area.

In this step, you will perform a spatial query to find the buildings inside the flood area.

- ☐ From the main ArcMap menu, click *Selection > Select By Location*.

- In the *Select By Location* dialog, ensure your settings match those shown below to select features from *Buildings* that are inside the flood area.



- Click *Apply*.

After the query is applied, features in the Buildings layer are selected and their boundary lines are highlighted in a different color (cyan by default).

This selection is now available for you to use in other operations. You might use it to create another dataset (i.e., a layer with fewer features), or you might calculate statistics for it.

This operation shows the importance of spatial queries. You are able to use the features of one layer to choose features in another. It also demonstrates the power of GIS to use spatial relationships in finding answers that will help in decision making.

- Click *Close*.

### STEP 7: EXAMINE YOUR SELECTION IN THE TABLES

Remember that each layer has a table that contains one record of attributes for each feature. You can examine, analyze, and edit these tables. Next, you will open the table for the Buildings layer.

- ☐ Right-click the *Buildings* layer and click *Open Attribute Table*.

Notice that the total number of records (115) appears in the status bar of the table along with the number of records selected from the query.

- ☐ Scroll down in the table to examine the selected records (the selected records are highlighted).

**NOTE:** You can change the selection color. Click the Options button in the status bar of the table document. Click Appearance. The invoked menu has options for selection and highlight colors that allow you to change the appearance of the selection records to any color you desire.

When features are selected, their corresponding records in the layer table are also selected and highlighted.

If you want to, you can examine only the selected records rather than all the records in the layer.

- ☐ At the bottom of the table, click the *Selected* button.

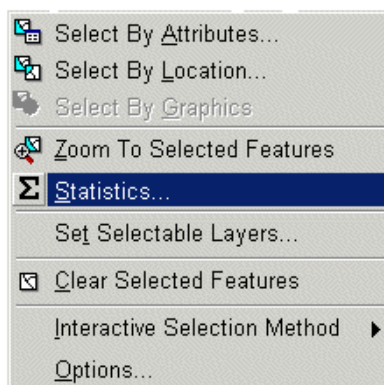
Notice that this table only shows the 28 selected records (notice the number in the table's status bar). These are the buildings that are inside the flood area. The governor will share a list of the owners' names at an Emergency Relief Board meeting. Before printing a report, you might want to hide or rearrange some of the fields. For now, you will not do any more work on the table.

- ☐ Close the table.

**STEP 8: CALCULATE STATISTICS FOR YOUR SELECTION**

The *Statistics* option produces a report of some common statistical information about your data.

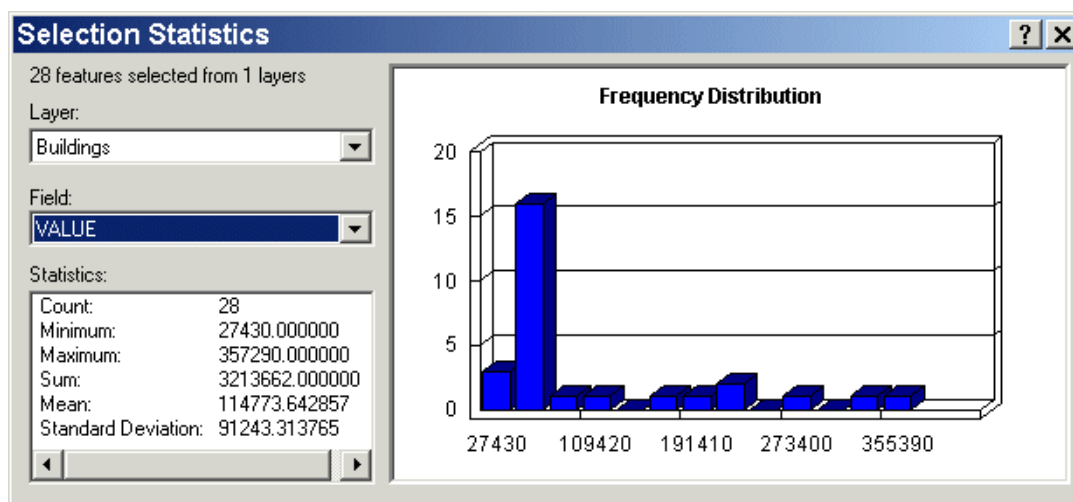
- From the main ArcMap menu, click *Selection > Statistics*.



- In the *Selection Statistics* dialog, for *Layer*, verify or click *Buildings*.

- For *Field*, click *VALUE*.

The reported statistics will give you a screen display of minimum, maximum, mean, standard deviation, and total building values as well as the count of buildings in the flood area.



- Examine the resulting numbers and answer the following questions:

Question 7: What is the total building value for these selected buildings? \_\_\_\_\_



Question 8: What percentage of buildings was flooded in this dataset? \_\_\_\_\_

Hint: Use your calculator.

Question 9: What is the price of the most expensive building in the flooded area?  
\_\_\_\_\_

The governor will use these numbers in an assistance request from the Emergency Relief Board.

☐ Close the *Selection Statistics* dialog.

### **STEP 9: CREATE A SELECTION LAYER**

A selection layer is a separate layer that contains only the selected features. You will create a selection layer of the flooded buildings. ArcMap still remembers your selection set.

☐ Right-click the *Buildings* layer, click *Selection*, and click *Create Layer From Selected Features*.

A new layer called *Buildings selection* is added to the Table of Contents, and the layer is shaded in the display area with a uniform color.

☐ Replace the new layer's name with **Flooded buildings**, and if necessary, change its symbol properties to some aesthetically contrasting shade. This new layer contains only the buildings inside the flooded area. You will use this layer in your final map for the governor.

☐ Uncheck the *Buildings* layer to turn it off.

### **STEP 10: EXPLORE OTHER SPATIAL SELECTIONS**

The Selection menu has other spatial selection tools. You will investigate the tool for selecting by drawing a box. You will limit your selection to the Flooded buildings layer.

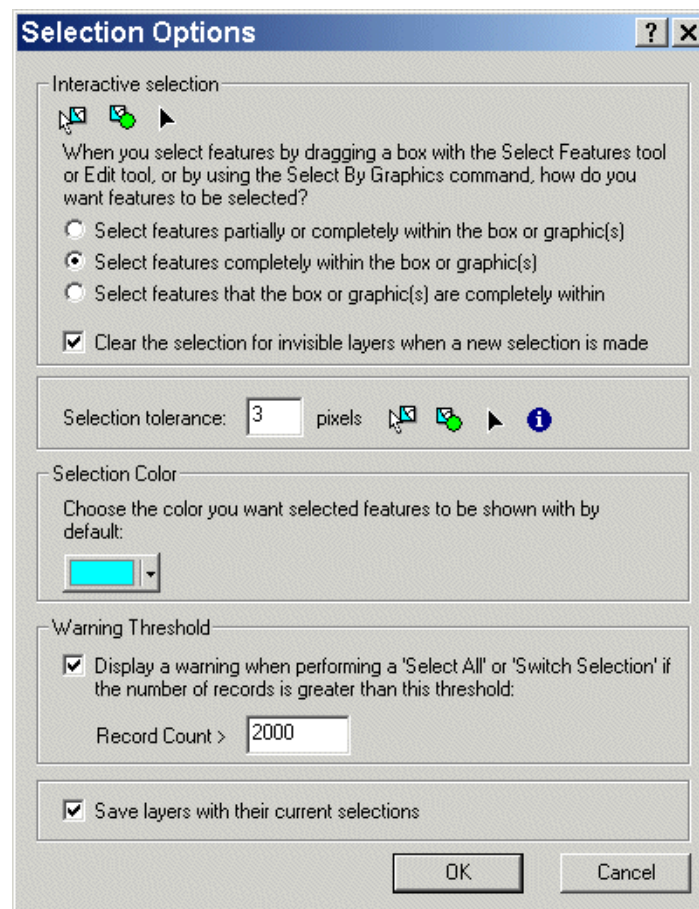
☐ On the main ArcMap menu, click *Selection > Set Selectable Layers* and uncheck the *Buildings* and *Flood* check boxes to exclude them from the next procedure.

This leaves *Flooded buildings* as the only checked layer.

☐ Click *Close*.

Now you will use the Interactive selection option.

- On the main *ArcMap* menu, click *Selection > Options*.



- In the *Selection Options* dialog, click *Select features completely within the box or graphic(s)*.

- Click *OK*.

Now start selecting by drawing a box around features.

- On the *Tools* toolbar, click the *Select Features* button.



You will better understand the *Select features completely within the box or graphic(s)* method if you will select one building and a portion of an adjacent building when creating the selection box.

- ☐ On the map, click and drag a box with your pointer, which is now a selection pointer.

Notice that only the building that falls completely within the selection box is highlighted. The other building was not selected.

- ☐ Repeat this operation again for another selection.

Notice that you do not need to clear the previous selection before making a new one. You will not use this selection; it was only an example. If time permits, explore the other spatial selection tools.

- ☐ Clear the selection when finished.

**NOTE:** To clear the selection, right-click the Flooded buildings layer, click Selection, and click Clear Selected Features.

### **STEP 11: EXPLORE ATTRIBUTE SELECTIONS**

Suppose you are interested in all the buildings that are in the flooded area that are valued at more than \$200,000. You would perform an attribute selection. You will now practice working with attribute selections.

- ☐ From the main ArcMap menu, click *Selection > Select by Attributes*.
- ☐ For *Fields*, double-click "VALUE".
- ☐ Click the *greater than* button ( > ).
- ☐ In the *expression* panel, type 200000 (200,000).

Your expression should read "VALUE" > 200000.

- ☐ Click *Apply*.
- ☐ Click *Close* to close the dialog.


Your display should highlight those buildings that are in the flooded area and are of a value greater than \$200,000. Your expressions can become more complex if more criteria are involved in the selection process.

Question 10: How many flooded buildings have a value over \$200,000? \_\_\_\_\_

**STEP 12: SAVE YOUR LAYER IN ANOTHER FORMAT**

With ArcMap, you can export any layer to a permanent feature class in your geodatabase or save it as a shapefile. You will use the Flooded buildings layer for this step. The building information is currently stored in a shapefile, but you will export selected features from the shapefile and create a new data source stored as a feature class in a geodatabase.

**NOTE:** When you create the feature class, it will contain only the features that you last selected using the Definition Query option.

- ☐ Right-click the *Flooded buildings* layer and click *Data > Export Data*.
- ☐ Verify that *Export* is set to *Selected Features*.
- ☐ Click the *Browse* button  and change the *Save as type:* entry to *Personal Geodatabase feature classes* (this dropdown list is located at the bottom of the dialog).
- ☐ Navigate to *C:\Student\igis1\Maplewood\Maple.mdb*. This is the geodatabase in which you will store the new feature class containing the selected buildings.
- ☐ Double-click on the *Maple.mdb*.
- ☐ Change the name of the new feature class to **Flood\_Bldg**
- ☐ Click *Save*.
- ☐ Click *OK* in the *Export Data* window.
- ☐ Click *No* to the message asking if you would like to add it as a new layer to your map.
- ☐ Clear the selected features.

**STEP 13: SAVE YOUR DOCUMENT AND EXIT ARCMAP**

Now save your map document and exit ArcMap.

- ☐ On the main ArcMap menu, click *File > Save*.
- ☐ Click *File > Exit*.

In this exercise, you experimented with querying your data in ArcMap using different techniques. You learned how to add MapTips, identify features, use the Find utility, take measurements, make spatial and attribute selections and queries, and create a selection layer.

You will use these skills later when you investigate your data for analysis.

***EXERCISE END***

## ***ANSWERS TO EXERCISE 4 QUESTIONS***

Question 1: Who owns the largest building?

**Answer: William Holthaus**

Question 2: Who owns the building valued at \$239,400?

**Answer: Martin Shippers**

Question 3: What is the value of the building that crosses the flooded boundary?

**Answer: \$231,900**

Question 4: Who owns the building that crosses the flooded boundary?

**Answer: S. Kopp**

Question 5: What is the distance from the lower-left corner of the largest building to the lower-left corner of the second largest building (in meters)?

**Answer: approximately 89 m**

Question 6: What is the approximate length (in kilometers) of the flood area at its longest axis?

**Answer: approximately 0.7 km**

Question 7: What is the total building value for these selected buildings?

**Answer: \$3,213,662**

Question 8: What percentage of buildings was flooded in this dataset?

**Answer:  $(28 / 115) * 100 =$  approximately 24 percent**

Question 9: What is the price of the most expensive building in the flooded area?

**Answer: \$357,290**

Question 10: How many flooded buildings have a value over \$200,000?

**Answer: six**



# *Working with spatial data*

## **Exercise 5: Explore spatial data formats**

**5-1**

Start ArcCatalog and create a new folder connection

5-1

Work with the Contents view

5-3

Work with the Preview tab and explore a shapefile

5-4

Explore a coverage

5-6

Explore metadata

5-8

Explore a geodatabase

5-9

Explore a CAD data source

5-13

Convert a shapefile to a geodatabase feature class

5-14

Explore raster datasets

5-17

Challenge: Create a thumbnail

5-19

Challenge: Use ArcCatalog to add a new file type

5-19

*contents*





## EXERCISE 5: EXPLORE SPATIAL DATA FORMATS

In this exercise, you will familiarize yourself with ESRI spatial data formats using ArcCatalog and ArcMap.

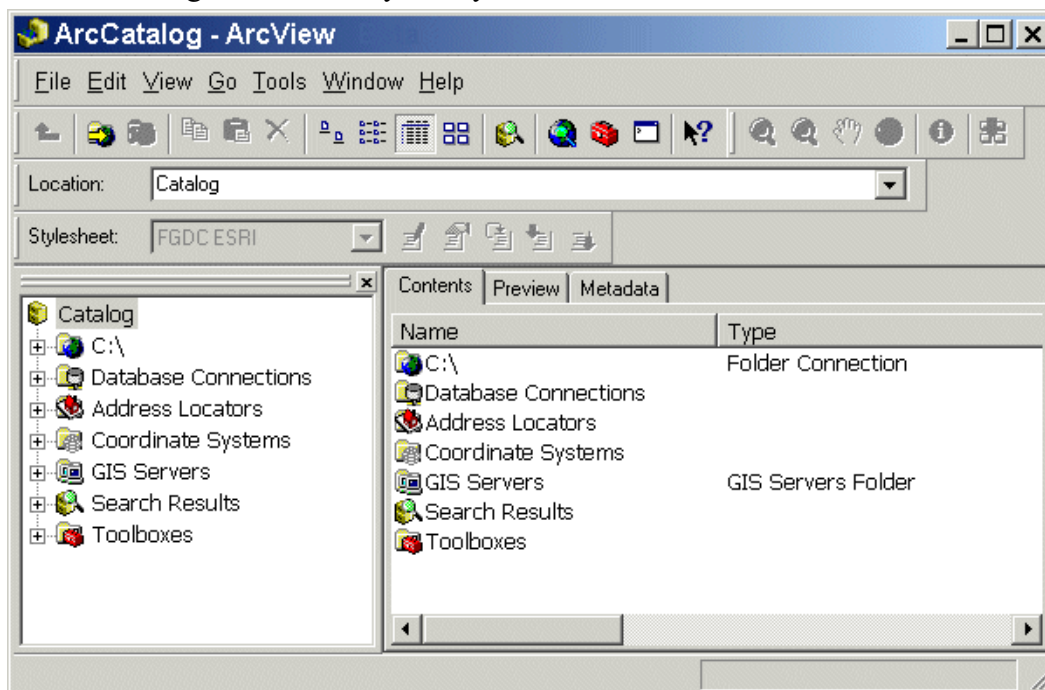
### STEP 1: START ARCCATALOG AND CREATE A NEW FOLDER CONNECTION

The focus of this exercise is data exploration. You will use ArcCatalog to browse, preview, and manage data.

□ Start *ArcCatalog*.


When ArcCatalog opens, you see the catalog tree on the left side of the window. The catalog tree lists your current connections.

Notice that ArcCatalog may not have a direct connection to the course database. The default connection is usually to the C:\ drive. While this connection will work for the purposes of the training class, without a more direct connection, you may need to navigate to the training database every time you want to view the data.

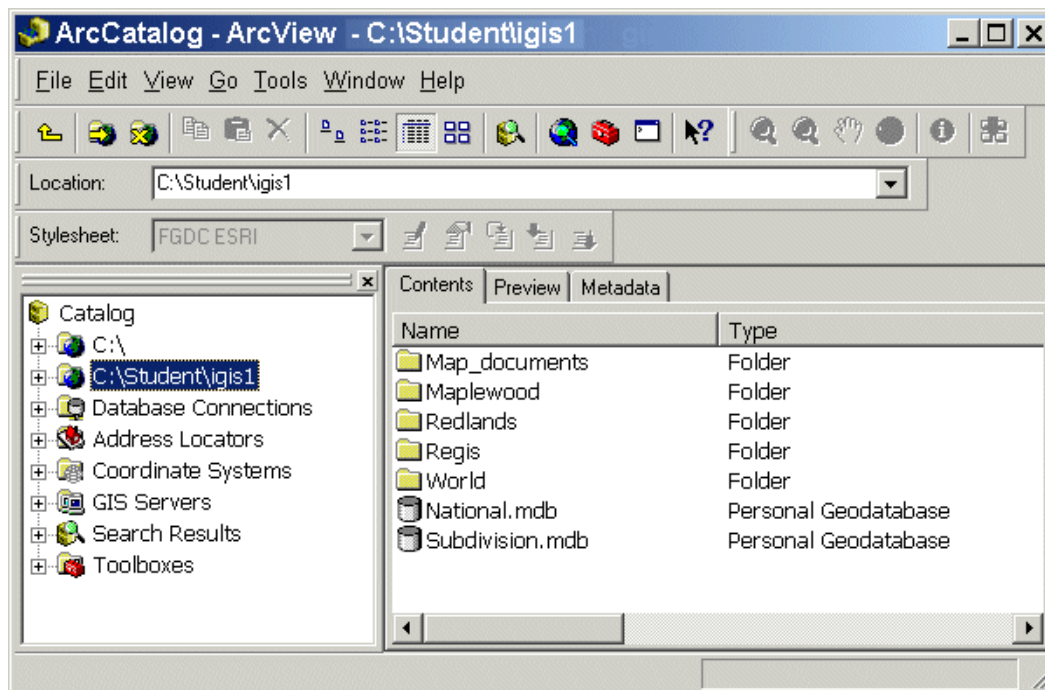


**NOTE:** You may have a different list of the top level entries in your ArcCatalog tree. To check this, click Tools > Options and click the General tab.

You can simplify the navigation process by adding a new folder connection directly to the course database.

- ☐ Click the *Connect To Folder* button , navigate to the *C:\Student\igis1* folder, and click *OK*.

The path to the course data folder has been added as an additional connection.



From now on you can use this folder connection to access data located in the database. In addition, ArcMap uses this when you are adding feature classes to the display view

Next, you will remove the connection to the root *C:\* drive.

**NOTE:** You should generally remove any ArcCatalog connections to root drives to speed up your searches for spatial data, as well as ArcCatalog's initialization.

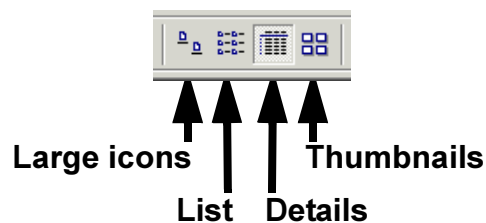
- ☐ Select the catalog tree connection to the *C:\* drive.
- ☐ Click the *Disconnect From Folder* button.

## STEP 2: WORK WITH THE CONTENTS VIEW

ArcCatalog lets you view your data using any one of three different options. In this step and the following steps, you will use these views to examine your data in ArcCatalog.

The three views in ArcCatalog are: Contents view, Preview view, and Metadata view. You can switch between them by clicking on the tabs at the top of the display panel.

Contents view displays the objects contained in the folder or connection you have selected in the catalog tree. There are four types of Contents views: Large icons, List, Details, and Thumbnails. You can switch between the view types by clicking the various buttons on the Standard toolbar.



You will use the Details view (the default) to examine the icons representing each type of data in ArcCatalog.

- ❑ Use the folder connection to navigate to the class data directory and click the *Redlands* folder so its contents are displayed in the *Contents* view.

**NOTE:** Your list might be slightly different than what it is shown in the example.

The Redlands folder contains data in several formats (coverage, shapefile, CAD, TIN, and raster datasets). Each format is represented with an icon and is listed under the Type column. There are two shapefile feature classes shown with different icons.

Contents   Preview   Metadata	
Name	Type
landusecov	Coverage
mastercov	Coverage
railroadcov	Coverage
soilscov	Coverage
subdiv.dxf	CAD Feature Dataset
zonecov	Coverage
censusBlk.shp	Shapefile
cfcc.dbf	dBASE Table
donut.shp	Shapefile
RedlandsArea.sid	Raster Dataset
redtin	TIN Dataset
redwam.dbf	dBASE Table
street.shp	Shapefile
subdiv.dxf	CAD Drawing
zone_code.dat	Info Table

The icon for the Donut shapefile tells you that the shapefile contains point features, while the icon for the Street shapefile tells you that the shapefile contains line features.

Question 1: How many coverages are in the *Redlands* folder? \_\_\_\_\_

Question 2: How many shapefiles are in the *Redlands* folder? \_\_\_\_\_

Question 3: How many CAD data sources are in the *Redlands* folder? \_\_\_\_\_

Question 4: How many raster datasets are in the *Redlands* folder? \_\_\_\_\_

If the file extensions are not already visible, you may find it useful to display them in ArcCatalog.

☐ Click *Tools > Options*.

☐ On the *General* tab, uncheck the *Hide file extensions* check box.

☐ Click *OK*.

Notice that the file extensions are now included as part of the file name.

Now view the contents using the other view types: Large icons, List, and Thumbnails.

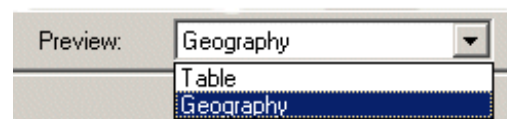
☐ Click each of the four view buttons.

*Thumbnails* are a static snapshot of the data and appear for maps and for layers and data that have an embedded thumbnail image. Currently, only the RedlandsArea MrSID image has a thumbnail. The rest of the data is represented by default data type icons. You cannot change the size of the thumbnails, and the view is automatically formatted to display as many thumbnails across the width of the Contents panel as possible. You will create a thumbnail later in the exercise.

### STEP 3: WORK WITH THE PREVIEW TAB AND EXPLORE A SHAPEFILE

The Preview view displays the geographic data you have selected in the catalog tree. You can view the geography or the attribute table of a feature class. With the Preview tab you are viewing the actual data, so it is always correct and current (unlike the thumbnails in the Contents view).

In the bottom of the *Preview* tab, you can view the *Geography* preview or *Table* preview.



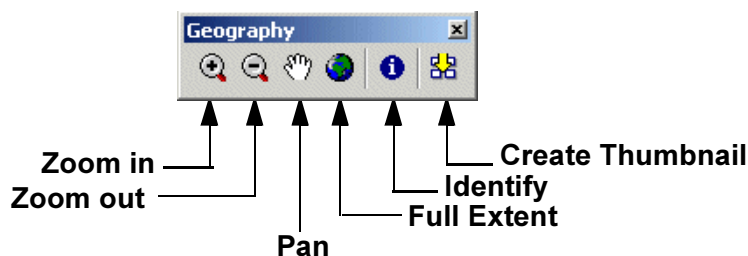
**NOTE:** You may have more preview choices available depending upon which additional ArcGIS extension products are installed.

Next, you will examine the street shapefile.

- ☐ If necessary, navigate to the *Redlands* folder.
- ☐ Click the *street* shapefile.
- ☐ If necessary, click the *Preview* tab.

In the Preview window, the lines are displayed for the shapefile's street feature class. Shapefiles can only have one feature class.

When previewing spatial features with ArcCatalog, the Geography toolbar provides tools to zoom and pan through the view. The button at the far right of the toolbar creates and embeds a thumbnail image in an ArcCatalog layer icon or in metadata based on the current extent.



- ☐ Practice zooming and panning in the *street* shapefile.
- ☐ Change the *Preview* to display the table.

Next, view the attributes stored for the Redlands streets.

- Use the scroll bars to examine the feature class table.

Contents Preview Metadata									
	FID	Shape*	STREET_ID	ADDRESS				CLASS	
▶	0	Polyline	1	8219 8499 8218 8498	CONE CAMP	RD		5	Local Str
	1	Polyline	2	8311 8361 8310 8360	CHURCH	ST		5	Local Str
	2	Polyline	3	8501 8575 8500 8574	OPAL	RD		5	Local Str
	3	Polyline	4	2601 2799 2600 2798	NCHURCH	ST		5	Local Str
	4	Polyline	5	1 799 2 798	DISHONG	ST		5	Local Str
	5	Polyline	6	2551 2679 2550 2678	STATE 30	HwY N		5	Local Str
	6	Polyline	7	2501 2549 2500 2548	STATE 30	HwY N		5	Local Str
	7	Polyline	8	2487 2499 2486 2498	STATE 30	HwY N		5	Local Str
	8	Polyline	9	2461 2485 2460 2484	STATE 30	HwY N		5	Local Str
	9	Polyline	10	8823 8855 8822 8854	OPAL	AV		5	Local Str
	10	Polyline	11	8857 8869 8856 8868	OPAL	AV		5	Local Str
	11	Polyline	12	8871 8875 8870 8874	OPAL	AV		5	Local Str
	12	Polyline	13	32300 32498 32301 32499	GREENSPOT	RD		5	Local Str
	13	Polyline	14	2401 2459 2400 2458	STATE 30	HwY N		2	Major Hic

Record: 1 Show: All Selected Records (of 3220) Options

Preview: Table

- Switch back to preview the geography.
- Click the *Launch ArcMap* tool. If the *Startup* menu appears, confirm or click *A new empty map*; then click *OK*.
- Resize the *ArcMap* and *ArcCatalog* application windows as needed so you can see both of them on the screen at the same time.
- In *ArcCatalog*, drag and drop the *street* shapefile into *ArcMap*.

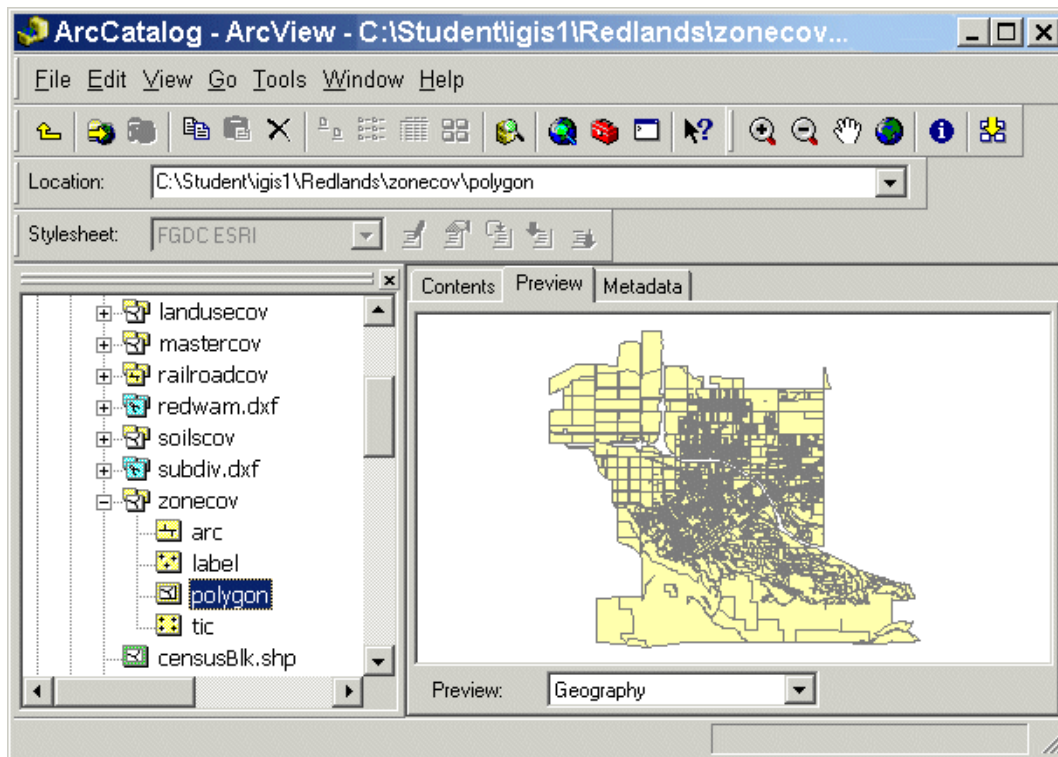
Notice that the street shapefile is added to the display and to the Table of Contents. The line color is randomly generated; you can change it by right-clicking the line symbol.

#### STEP 4: EXPLORE A COVERAGE

Unlike shapefiles, coverages can contain multiple feature classes. You will examine the city zoning coverage.

- In the *ArcCatalog* tree, navigate to the *Redlands* folder and click on the plus sign next to the *zonecov* coverage.

- Click on the *polygon* feature class.



The polygons are displayed for the *zonecov* coverage. Polygons in a coverage are composed of arcs. The arcs themselves can have attributes independent of the polygons. Next, view the coverage arcs.

- Click on the *arc* feature class for the *zonecov* coverage in the ArcCatalog directory tree.

Question 5: What is the difference between rendering arc and polygon feature classes? \_\_\_\_\_

Arcs are stored as a separate feature class, but the topological relationships between arcs and polygons are explicitly stored in a coverage. Arcs form the boundaries of polygons.

**NOTE:** Explicitly defining arc-polygon relationships allows you to model the association between them, such as each arc's left and right polygon. That way you can find all the arcs that represent the border between Open Space and Commercial zoning.

The spatial relationship between features (arcs and polygons) allows the polygon attribute table to store information about a shape's area and perimeter. Preview the table for the *zonecov* polygons.

- ☐ Click on the *polygon* feature class of the *zonecov* coverage in the ArcCatalog directory tree.
- ☐ Click the *Preview* tab and at the bottom of its panel, from the *Preview* dropdown list, click *Table*.

Question 6: Which polygon identifier (FID) has the largest area? \_\_\_\_\_

Hint: Right-click the area column name and sort the area field in descending order.

- ☐ Now preview the geography for the *zonecov tic* feature class.

The ties are displayed. Every coverage contains tic points. These represent known coordinates that are used to geographically reference the coverage.

Question 7: Which feature classes are in the *zonecov* coverage? \_\_\_\_\_

### STEP 5: EXPLORE METADATA

In order to decide whether or not a data source is suitable to use in your map, you often need more information than its basic properties and a look at its features. You may need information about the data's accuracy or about how a set of measurements was collected. An item's metadata includes this type of documentation, along with many properties that are automatically derived from the data.

The Metadata tab presents this information in an easy-to-read format.

- ☐ Click on *zonecov* in the ArcCatalog directory tree.
- ☐ Click the *Metadata* tab.

The information stored in the metadata can be formatted by a number of style sheets. You will explore the metadata using the FGDC ESRI stylesheet. It has tabs to categorize the metadata according to Description, Spatial, and Attribute information.

- ☐ On the *Metadata* toolbar, confirm that *Stylesheet* is set to *FGDC ESRI*. If it is not, change the stylesheet to *FGDC ESRI*.



- ☐ Browse the metadata in the different tabs by clicking on the hyperlinks for *Description*, *Spatial*, and *Attribute*.
- ☐ Under the *Spatial* tab, scroll down to *Spatial data description* and click on *SDTS description*.

Question 8: How many polygons are in the *zonecov* coverage? \_\_\_\_\_

- ☐ From the *Stylesheet* dropdown list, choose another stylesheet and view how it formats the metadata.
- ☐ Change the stylesheet back to *FGDC ESRI*.
- ☐ Click on the *Contents* tab.

Like shapefiles, coverages can be explored in ArcCatalog and displayed in ArcMap. However, you cannot edit coverages in ArcMap.

- ☐ Drag and drop the *polygon* feature class (under *zonecov*) into *ArcMap*.

The *zonecov* polygons are added to the display and the Table of Contents in ArcMap. They are automatically added at the bottom of the Table of Contents draw list so that the street lines will display on top of the polygons instead of being obstructed by the polygons.

Question 9: Coverages can be stored as both a raster and a vector. (TRUE/FALSE)

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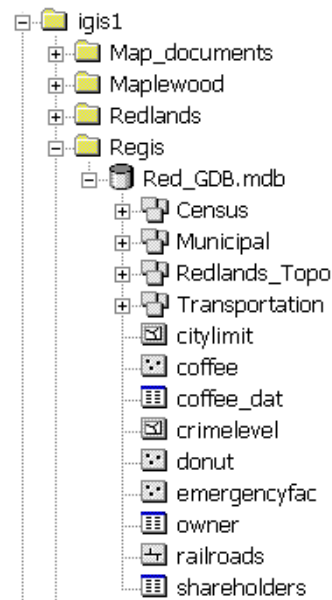
## **STEP 6: EXPLORE A GEODATABASE**

Geodatabases are the primary data format available to ArcGIS users. First, use ArcCatalog to navigate to a geodatabase in the class data directory.

- ☐ In *ArcCatalog*, navigate to the *Regis* folder and double-click the *Red\_GDB* geodatabase to expand its contents.

Notice, from the icon to its left and the .mdb extension at the end of its name in the catalog tree, that *Red\_GDB* is a personal geodatabase. A personal geodatabase is a geodatabase stored in a Microsoft MDB file (a database file format supported by Microsoft Access).

Notice the contents of the geodatabase. Currently, there are four feature datasets: *Census*, *Municipal*, *Redlands\_Topo*, and *Transportation*. A geodatabase feature dataset contains a collection of feature classes that share spatial relationships. Now you will examine these feature datasets.



- ☐ Click the plus sign next to the *Municipal* feature dataset to expand it.

Question 10: How many feature classes are in the *Municipal* dataset? \_\_\_\_\_

A feature class is a collection of features with the same type of geometry. There are four types of geodatabase geometry: point, multipoint, polyline (arcs), and polygon. The icon used for each feature class reveals the geometry type of the features.

**NOTE:** A multipoint feature type is a logical grouping of points. For example, if you had a number of islands in Indonesia, instead of individually assigning points to them you could group them together into a single multipoint object.

Feature classes may also exist independently within the geodatabase.

- ☐ Right-click the *coffee* feature class and click *Properties*.
- ☐ Click the *Fields* tab.

File-based formats (i.e., coverages, shapefiles, CAD) store spatial and attribute data in separate files and link the files together based on numerical identifiers. A geodatabase stores the spatial and attribute information in a number of related tables in one database.

Question 11: Which field stores the spatial coordinate data for the feature class?

\_\_\_\_\_

- ☐ Under *Field Name*, click the *Shape* field.

Question 12: What is the geometry type for the coffee feature class? \_\_\_\_\_

- ☐ Click *Cancel* to close the *Feature Class Properties* dialog.

Now preview the spatial data in the coffee feature class.

- ☐ If necessary, click the *Preview* tab.

Question 13: How many features are displayed? \_\_\_\_\_

Feature classes in a feature dataset can be organized into a geometric network. Geometric networks store topological relationships for their features, such as the connectivity of lines. They combine line and point feature classes to model linear features such as electrical or water networks.

All feature classes in a feature dataset must share the same coordinate system, and their features must fall within a common geographic area.

- ☐ Right-click the *Transportation* feature dataset and click *Properties*.

Question 14: Notice the spatial reference information. What is the projected coordinate system for this feature dataset? \_\_\_\_\_

- ☐ Click *Cancel* to close the *Feature Dataset Properties* dialog.

- ☐ Click the plus sign next to the *Transportation* feature dataset.

- ☐ Right-click the *Traffic\_net* geometric network and click *Properties*.

In the General tab, examine the feature classes participating in the network. The street and *Traffic\_net\_Junctions* feature classes are participating in this network. These feature classes are both in the *Transportation* feature dataset.

Click through the tabs and briefly examine the kind of information stored in a geometric network. Working with geometric networks can be sophisticated and may require some experience when modeling complex geographic objects like utility networks.

- ☐ Click *Cancel* to close the *Geometric Network Properties* dialog.

Next, you will explore a feature dataset that has a topology. The primary purpose of topology is to define spatial relationships (e.g., adjacency, coincidence, and connectivity) between one or more feature classes. Incorporating topology into a feature dataset allows you to better model the real world and manage the spatial integrity of your data. The spatial integrity is managed by a set of rules defined by you, which will help you find and fix topologic errors. In ArcView®, you must use an existing topology; you cannot create a new topology or modify an existing one.

**NOTE:** ArcView users can create more limited topological relationships with a *Map Topology*. More details can be found in the ArcGIS Desktop Help, in the *Introduction to ArcGIS II* course, or on the ESRI Virtual Campus.

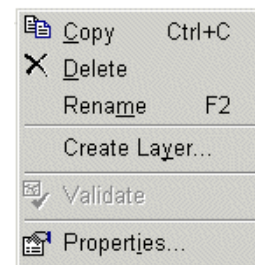
- ☐ Expand the *Redlands\_Topo* feature dataset.

Notice that this feature dataset has two feature classes (*Parcels\_topo* and *Streets\_topo*). They are identified with the topo suffix to indicate that these are dedicated feature classes for this topology. This feature dataset also has a geodatabase topology associated with it, named *Redlands\_Topology*.



- ☐ Right-click on *Redlands\_Topology* topology.

Two things happen when you do this: first, if the Preview is active, you will see dark pink squares indicating that the topology has been validated (i.e., checked for errors) and that some topology rules have been violated; second, you will see this context menu.



- ☐ Click *Properties*.
- ☐ On the *Topology Properties* dialog, click on the different tabs (*General*, *Feature Classes*, *Rules*, and *Errors*) and examine the different properties that were assigned for this topology. Use this information to answer the following questions:

Question 15: On the General tab, what is the Status of this topology? \_\_\_\_\_

\_\_\_\_\_

Question 16: On the Feature Classes tab, what are the feature classes that participate in this topology? \_\_\_\_\_

\_\_\_\_\_

Question 17: On the Rules tab, what topology rules are set for each feature class?

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Question 18: On the Error tab, click the Generate Summary button. How many errors are there in the data, and which topology rule was violated? \_\_\_\_\_

---



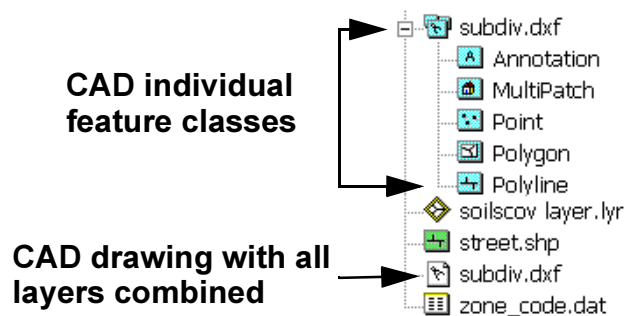
---

☐ Click *Cancel* to close the *Topology Properties* dialog.

You have just examined the properties of an existing topology in a geodatabase. A topology can only be created for a dedicated feature dataset. You can only view topology in ArcView. You will need ArcEditor® or ArcInfo to create features, handle edits, and fix errors using a topology. In the *Introduction to ArcGIS II* course, you will create a topology, assign rules, and edit features in the topology.

### STEP 7: EXPLORE A CAD DATA SOURCE

A CAD data source can be viewed as a single unit, or each layer can be viewed separately. CAD data sources have two entries in the catalog: first, the CAD drawing that represents all layers combined and second, the collection entry that can be expanded to view individual feature classes for the points, lines, polylines, polygons, or annotation in the various layers.



**NOTE:** A polyline is any line defined by three or more points. ArcInfo often refers to line features in feature classes (e.g., boundaries, roads, streams, and streets) as polylines when it interprets the unconverted CAD file.

Complete the following steps to examine a CAD data source.

☐ In the *ArcCatalog* tree, navigate to the *Redlands* folder and click the *subdiv.dxf* file that represents the CAD drawing with all layers combined.

Next, preview the individual feature classes.

- ☐ Click the plus sign ( + ) next to the *subdiv.dxf* entry that contains the feature classes.
- ☐ Click *Point*.
- ☐ Click the *Preview* tab.

Nothing is displayed because the DXF file does not contain points. CAD files may contain empty feature classes.

- ☐ Click *Polyline*.

The lines are displayed. CAD data sources can also be displayed in ArcMap and converted to other formats in ArcToolbox™.

- ☐ Click and drag and drop the *subdiv.dxf polyline* feature class into *ArcMap*.

**NOTE:** If your data is missing spatial reference information, you will get a warning message stating that the layer cannot be projected. This is logical because you must know the starting coordinate system before you can project into a new coordinate space. Click OK to close the warning window.

Notice that this dataset has a very small spatial extent compared to the other Redlands datasets shown on your map. You may need to change the symbol color (by right-clicking the current line symbol) to clarify its location. You can also zoom to the extent of a specific layer in ArcMap.

- ☐ Right-click the *subdiv.dxf polyline* layer in the ArcMap *Table of Contents*.

Hint: You might need to symbolize this layer with a highly contrasting color.

- ☐ Click *Zoom To Layer*.


### **STEP 8: CONVERT A SHAPEFILE TO A GEODATABASE FEATURE CLASS**

Performing data analysis often demands that you convert spatial information from one data format to another. ArcToolbox provides a number of tools, which allow you to convert between a variety of data formats. One of the most common conversions, which you are likely to perform, is to convert a shapefile into a geodatabase feature class.

- ☐ In *ArcCatalog*, click the *Show/Hide ArcToolbox Window* button .

A new window will open in ArcCatalog, which contains all of the available toolboxes.

**NOTE:** Different ArcGIS licence levels will have different available toolboxes; ArcView has the fewest, and ArcInfo has the most.

- ☐ In *ArcToolbox*, expand the *Conversion Tools*; then expand the *To Geodatabase* tools.
- ☐ Double-click *Feature Class to Feature Class* to open the tool.
- ☐ For *Input Feature class*, click the *Browse* button  and navigate to the *C:\Student\igis1\Redlands* folder.
- ☐ Click the *street.shp* shapefile and click the *Add* button.

Next, you need to specify a name and location for the output geodatabase.

- ☐ For *Output Location*, click the *Browse* button and navigate to the *\igis1\Regis* folder in your student directory.
- ☐ Click *Red\_GDB* and click *Add*.
- ☐ For the *Output Feature Class Name*, enter **NewRoads**

Leave the other settings as is; your dialog should look like this:

**Feature Class To Feature Class**

Input Features  
C:\Student\igis1\Redlands\street.shp

Output Location  
C:\Student\igis1\Regis\Red\_GDB.mdb

Output Feature Class Name  
NewRoads

Expression (optional)  
SQL

Field Info (optional)

FieldName	NewFieldName	Visible	SplitPolicy
STREET_ID	STREET_ID	TRUE	NONE
ADDRESS	ADDRESS	TRUE	NONE
CLASS	CLASS	TRUE	NONE
CLASS_DE...	CLASS_DESC	TRUE	NONE
BUS_RT	BUS_RT	TRUE	NONE
L_ADD_FR	L_ADD_FR	TRUE	NONE
L_ADD_TO	L_ADD_TO	TRUE	NONE
R_ADD_FR	R_ADD_FR	TRUE	NONE
R_ADD TO	R_ADD TO	TRUE	NONE

Output will contain Measure (M) values (optional)  
SAME\_AS\_TEMPLATE

Output will contain Z values (optional)  
SAME\_AS\_TEMPLATE

Configuration Keyword (optional)

First Spatial Grid (optional)  
0

OK Cancel Environments... Show Help >>

□ Click *OK*.

The geoprocessor window will automatically open, showing you the status of the conversion operation. It may take a few moments to convert the data.

□ Close the *Geoprocessing* window when the conversion is finished.

□ In the *catalog tree*, navigate to and open the *\Regis\Red\_GDB.mdb*




- ☐ Confirm that your new *NewRoads* feature class has been added; you may need to refresh the *Red\_GDB.mdb*. Refresh by right-clicking the geodatabase and selecting *Refresh*.
- ☐ Take a few moments to preview the geography and the table.
- ☐ Close the *ArcToolbox* window.

### STEP 9: EXPLORE RASTER DATASETS

Raster formats store data as equally sized cells, or pixels, arranged in rows and columns. Each cell stores a value that is constant throughout the entire cell. The resolution of the data is related to cell size: smaller cell size can show more detail within the study area, but it can also increase the size of the file. ArcGIS supports display and conversion of many raster file formats including several popular image formats.

- ☐ In the *ArcCatalog* tree, click the *C:\Student\igis1\Redlands\RedlandsArea* MrSid image and preview it.

The image displays in the Preview panel.

- ☐ Click the *Zoom In* tool  and draw a small box anywhere on the image.

Objects displayed on the image become clearer as you zoom in, but if you try to zoom in too far, the image becomes blurry, or ‘pixilated’. Next, examine the properties of the image.

- ☐ Right-click *RedlandsArea.sid* and click *Properties*.

Question 19: How many rows does the image contain? \_\_\_\_\_

Question 20: How many columns does the image contain? \_\_\_\_\_

Question 21: How many bands does the image contain? \_\_\_\_\_

Question 22: What is the image cell size (in meters)? \_\_\_\_\_

Hint: You might need to use the *Metadata* tab in *ArcCatalog*.

Notice that the image is actually composed of three separate layers. Many types of imagery are collected and stored in multiple layers, where each layer stores the amount of reflectance from a different wavelength of the electromagnetic spectrum (e.g., ultraviolet, visible, infrared). By assigning different colors to each layer, analysts can evaluate factors such as landcover type and vegetation density. In ArcMap, you can alter the colors assigned to the individual layers.

- ☐ Click *Cancel* to close the *Raster Dataset Properties* dialog.

- ☐ Drag and drop the *RedlandsArea.sid* image onto *ArcMap*.

Notice the colors automatically assigned to the layers. This is called a true color representation. If you wanted, you could change the symbology properties of the layer to alter the image display.

Changing colors on an image is especially useful with natural resource data. For instance, modifying the color visualization of a soils image may highlight areas where nutrient levels are low and provide information about if and where remediation action is needed.

Now use ArcCatalog to view another image.

- ☐ Preview the *redquadimg.jpg* file.

- ☐ Zoom in for a closer look by drawing a small box anywhere on the image using the *Zoom In* tool.

Notice that the image is a scanned USGS 7.5-minute quadrangle sheet for part of the Redlands study area.

You have now explored many of the data formats supported by ArcGIS and have become familiar with the icons used to represent them. Next, you will turn off the file extension visibility for ArcCatalog.

- ☐ Click *Tools > Options*.

- ☐ On the *General* tab, check the *Hide file extensions* check box.

- ☐ Click *OK*.

- ☐ Unless you want to continue to the challenge step, exit *ArcCatalog* and *ArcMap* without saving.

### CHALLENGE: CREATE A THUMBNAIL

Thumbnails are small images that make it easy to see what a particular dataset, map, or layer looks like without having to draw it. You can use the Create Thumbnail button located on the Geography Toolbar in ArcCatalog to create a snapshot of your data.

☐ In the catalog tree, navigate to the *Redlands* folder.

☐ Click on the *soilscov* coverage.

☐ Click the *Preview* tab.

Notice that all the Geography toolbar buttons are now enabled.

☐ Zoom in on the center of the *soilscov* coverage.

☐ Click the *Create Thumbnail* button to create a new thumbnail image.



☐ Navigate back to the *Redlands* folder, click the *Contents* tab, and click the *Thumbnails* button to view the thumbnail image you just embedded in *soilscov*.

☐ Experiment with creating thumbnails for the different data types in the *Redlands* folder.

### CHALLENGE: USE ARCCATALOG TO ADD A NEW FILE TYPE

ArcCatalog recognizes a wide variety of default spatial data formats and file types. However, you may want to add new file types to enhance ArcCatalog's data management capability. For example, it is possible to use OLE DB Connections to link to external data sources, among them Microsoft Excel Worksheets (.xls). You could use ArcCatalog to search for or view where any .xls files are stored on your computer or the network instead of having to open another desktop application to locate these files.

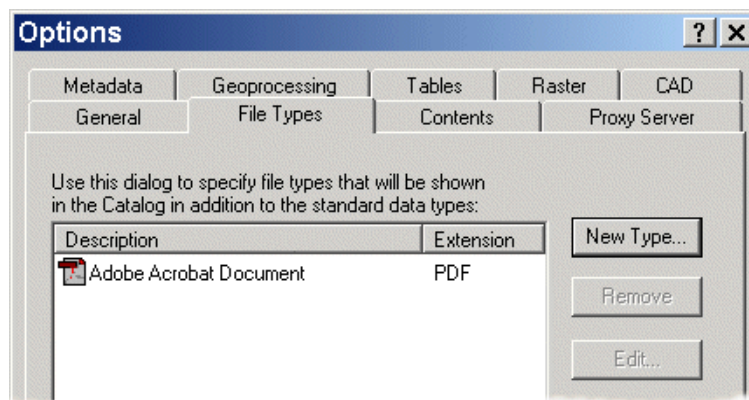
In this challenge step, you will add an Adobe Acrobat PDF file type and open a PDF file contained within your *\Student\igis1* folder.

**!** If your computer does not have Adobe Acrobat Reader installed, you will not be able to continue with this challenge step. Your options are to download and install this freeware and continue or end the exercise.

- ☐ Open *ArcCatalog*.
- ☐ Navigate to and open *\Student\igis1\Map\_Documents*.
- ☐ Confirm that the *Contents* view is active in *ArcCatalog* and note the visible file types contained within the folder (you should see only .mxd files).
- ☐ Click *Tools > Options*.
- ☐ On the *File Types* tab, click *New Type*.
- ☐ On the *File Type* dialog, click *Import File Type From Registry*.
- ☐ In the *Registered File Types* window, scroll down until you reach the entry for *Adobe Acrobat Document PDF*. (Note that the file extensions are listed alphabetically).
- ☐ Click *OK* to close both the *Registered File Types* and *File Type* dialogs.

You should see the Adobe Acrobat Document type added to the *File Types* window.

- ☐ Click *OK* to close the *Options* dialog
- ☐ If necessary, click *View > Refresh* to update the view in the *Contents* window.
- ☐ In the *Contents* window, double-click *What\_Is\_ArcGIS.pdf*.



- ☐ If time allows, examine the contents of this document. It is a very useful resource for additional information on many of the topics introduced in this course.
- ☐ Close *Adobe Acrobat* and *ArcCatalog*.

## EXERCISE END

## ***ANSWERS TO EXERCISE 5 QUESTIONS***

Question 1: How many coverages are in the Redlands folder?

**Answer: five**

Question 2: How many shapefiles are in the Redlands folder?

**Answer: three**

Question 3: How many CAD data sources are in the Redlands folder?

**Answer: one**

Question 4: How many raster datasets are in the Redlands folder?

**Answer: two**

Question 5: What is the difference between rendering arc and polygon feature classes?

**Answer: Arc features render as outlines while polygon features render as solid-fill areas.**

Question 6: Which polygon identifier (FID) has the largest area?

**Answer: polygon FID 1150, with an area of 7,707,022 square meters**

Question 7: Which feature classes are in the zonecov coverage?

**Answer: arc, label, polygon, tic**

Question 8: How many polygons are in the zonecov coverage?

**Answer: 1,264**

Question 9: Coverages can be stored as both a raster and a vector. (TRUE/FALSE)

**Answer: false—They are vector only.**

Question 10: How many feature classes are in the Municipal dataset?

**Answer: two**

Question 11: Which field stores the spatial coordinate data for the feature class?

**Answer: Shape**

Question 12: What is the geometry type for the coffee feature class?

**Answer: point**

Question 13: How many features are displayed?

**Answer: five**

Question 14: Notice the spatial reference information. What is the projected coordinate system for this feature dataset?

**Answer: NAD\_1983\_UTM\_Zone\_11N**

Question 15: On the General tab, what is the Status of this topology?

**Answer: Validated-Errors Exist**

Question 16: On the Feature Classes tab, what are the feature classes that participate in this topology?

**Answer: Streets\_topo and Parcels\_topo**

Question 17: On the Rules tab, what topology rules are set for each feature class?

**Answer: Must not have dangles and Must not overlap**

Question 18: On the Error tab, click the Generate Summary button. How many errors are there in the data, and which topology rule was violated?

**Answer: 537; Must Not Have Dangles**

Question 19: How many rows does the image contain?

**Answer: 20,395**

Question 20: How many columns does the image contain?

**Answer: 30,000**

Question 21: How many bands does the image contain?

**Answer: three**

Question 22: What is the image cell size (in meters)?

**Answer: Approximately 0.61**

# *Working with tables*

## **Exercise 6A: Relate and join tables**

Start ArcCatalog and view a shapefile attribute table  
 Examine the properties of the fields  
 Examine geodatabase tables  
 Examine table cardinality  
 Create the join  
 Modify the appearance of the joined table  
 Create the relate  
 make a selection and examine the related table  
 Label features with joined attributes  
 Exit ArcCatalog and ArcMap  
 Challenge: Display labels on separate lines

6-1

6-1

6-1

6-3

6-4

6-5

6-6

6-8

6-9

6-12

6-14

6-14

## **Exercise 6B: Create a graph and report in ArcMap**

Start ArcMap and open the map document  
 Open the graph properties and change the graph type  
 Modify the graph's properties  
 Export the graph  
 Display report properties and specify fields  
 Set the sorting and summary options  
 Set display properties  
 Change the number format  
 Embed the graph in the report  
 Add the report to the layout  
 Exit ArcMap

6-17

6-17

6-18

6-20

6-22

6-22

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6-29

6-30





## EXERCISE 6A: RELATE AND JOIN TABLES

In addition to knowing the variety of spatial data formats supported by ArcGIS, you also need to be familiar with their associated tabular attribute formats. By exploring various formats, this exercise will show you how to merge tables through relates and joins.

### STEP 1: START ARCCATALOG AND VIEW A SHAPEFILE ATTRIBUTE TABLE

☐ Start *ArcCatalog* and navigate to *C:\Student\igis1\Redlands*.

You will use *ArcCatalog* to preview some feature class attribute information. The features in this tabular data all have similar spatial attributes. For example, a point feature class table consists of records pertaining to only point features, and a polygon feature class table contains only records pertaining to polygon features. Remember that each feature is represented as a row in the table

First, you will view the attribute table for a shapefile.

☐ In *ArcCatalog*, in the catalog tree, click the plus sign ( + ) next to the *Redlands* folder to expand it.

☐ In the catalog tree, click the *donut* shapefile.

☐ Confirm you have clicked the *Preview* tab, and click the bottom dropdown list to view the table for the *donut* shapefile.

☐ Resize the columns as needed by clicking on the dividing line between the column names and dragging the line to make the column larger or smaller.

**donut.dbf**  
(shapefile  
attribute table)

FID	Shape	NAME	ADDRESS	PHONE_NUMB
0	Point	Mr. J's Donut House	1591 West Redlands Blvd.	792-5866
1	Point	Foster's Donuts	758 Tennessee Ave.	793-9737
2	Point	Donut Factory	802 West Colton Ave.	798-1156
3	Point	Winchell's Donut House	514 East Redlands Blvd.	792-8417
4	Point	Mo Do Nuts	1752 East Lugonia Blvd.	794-0197
5	Point	B & F Donuts	1154 Brookside Ave.	792-8606
6	Point	Happy Donut & Burger	16 West Colton Ave.	335-1022

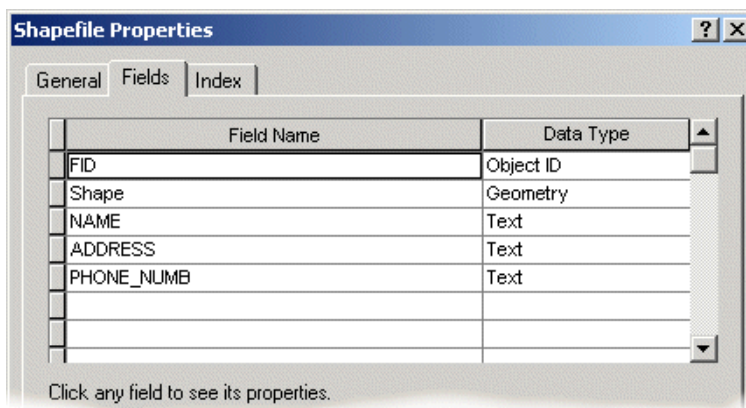
### STEP 2: EXAMINE THE PROPERTIES OF THE FIELDS

The donut shapefile is associated with a dBASE (.dbf) file that contains the attributes for each of the donut shops represented in the shapefile. You can explore the definitions of the table fields in the Shapefile Properties dialog.

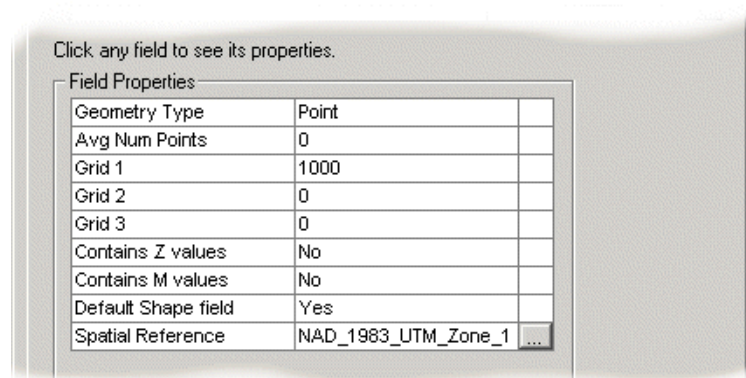
□ In the *ArcCatalog* catalog tree, right-click on the *donut* shapefile, and click *Properties* from the context menu that appears.

□ In the *Shapefile Properties* dialog, click the *Fields* tab.

A list of the fields in the donut shapefile's attribute table is displayed along with the field's data type.



□ Click the *Shape* field. Notice that the field properties change to show the properties of the field.



Try clicking some of the other fields to see their properties.

□ Click *Cancel* to close the *Shapefile Properties* dialog.

□ If necessary, collapse the *Redlands* folder in the catalog tree to reduce clutter.

### STEP 3: EXAMINE GEODATABASE TABLES

A geodatabase can store additional attribute information that is not directly associated with spatial features.

- ☐ In *ArcCatalog*, navigate to the *Regis* folder and expand the *Red\_GDB* geodatabase.
- ☐ Click the *owner* table and preview it, paying special attention to the *Own\_ID* field.

**owner**  
(geodatabase table)

OBJECTID*	OWNER_NAME	Own_ID
1	BETTY BEANE	10
2	JOHN SMITH	20
3	JANE ARABICA	30
4	JOE ROBUSTA	40
7	HOWARD SCHULTZ	50

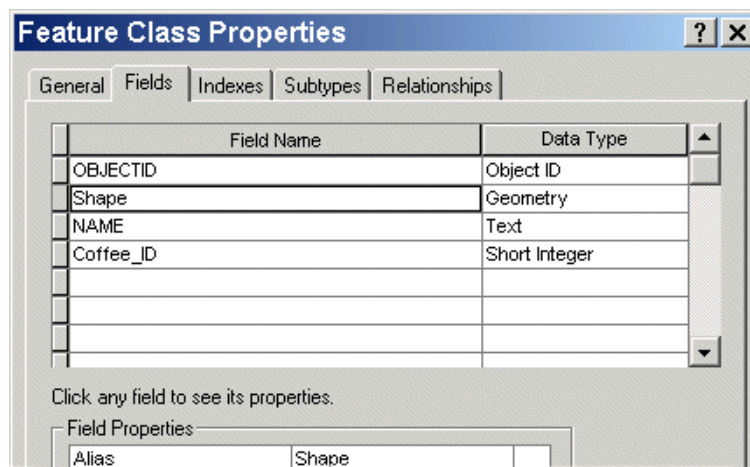
In addition to stand-alone tables like the one you have just examined, the geodatabase stores tables, which store spatial feature attributes. Next you will examine a feature class and its attributes.

- ☐ Click the *coffee* feature class and preview the table.

Notice the Shape field is contained within the attribute table.

- ☐ Right-click on the *coffee* feature class and click *Properties* from the context menu.

Note that the Feature Class has more properties tabs than the shapefile format.



**STEP 4: EXAMINE TABLE CARDINALITY**

In ArcMap, an association between two tables can be established by creating a relate or a join. Both allow you to link two or more tables (e.g., a table containing attribute code descriptions to a table of spatial features). A relate simply sets up a relationship between two tables; you need to open both in order to view the associated records. The associated data is not appended to the layer's attribute table as it is with a join, where all columns from both tables appear in one window. Relates and joins work with different types of table cardinality.

For example, by defining a relate between the coffee feature class table and the shareholders table, you are creating a one-to-many relationship, where a coffee shop may have more than one shareholder.

- In *ArcCatalog*, click the *shareholders* table and preview the attributes.

**coffee**  
(geodatabase feature class table)

FID*	Shape*	NAME	Coffee_ID
1	Point	Grounds-R-Us	1
2	Point	The Coffee Place	2
3	Point	Coffee and Sons	3
6	Point	The Perkalator	4
7	Point	Java Quik	5

**shareholders** (geodatabase table)

OBJECTID*	COFFEE_ID	PER_OWN	Own_ID
1	1	100	10
2	2	100	10
3	3	50	20
4	3	50	30
5	4	100	40
6	5	75	40
7	5	25	50

**1:many cardinality**

Compare the shareholders table's fields to the fields in the coffee feature class table. Notice that the tables have matching Coffee\_ID records. The coffee feature class has only unique values for the Coffee\_ID field while the COFFEE\_ID field in the shareholders table contains the same value more than once.

In Step 7, you will establish a relate between these two tables based on the field named Coffee\_ID, but first you will join the shareholders table to the owner table.

- Now click on the *owner* table and preview the attributes.

***shareholders*** (geodatabase table)

OBJECTID*	COFFEE_ID	PER_OWN	Own_ID
1	1	100	10
2	2	100	10
3	3	50	20
4	3	50	30
5	4	100	40
6	5	75	40
7	5	25	50


***owner*** (geodatabase table)

OBJECTID*	OWNER_NAME	Own_ID
1	BETTY BEANE	10
2	JOHN SMITH	20
3	JANE ARABICA	30
4	JOE ROBUSTA	40
7	HOWARD SCHULTZ	50




The shareholders table has a relationship to the owner table through the Own\_ID field. There is a many-to-one relationship from the shareholders table to the owner table. Before you establish a relate between the coffee feature class table and the shareholders table, you will create a join between the shareholders and the owner tables to append the information in these two tables together.

#### STEP 5: CREATE THE JOIN

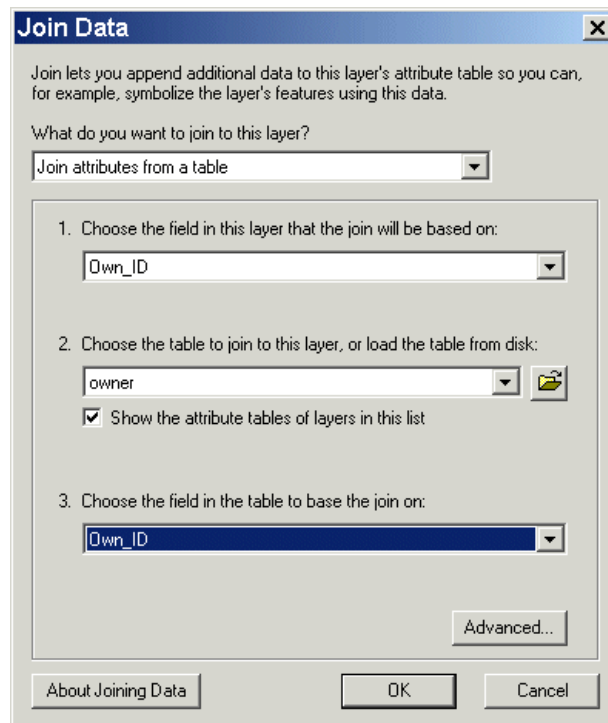
- Launch *ArcMap* with *A new empty map* by clicking the *ArcMap* button .

Next, you will need to join the shareholders table with the owner table, a many-to-one relationship. This will help you see that some people have an interest in more than one coffee shop and that certain coffee shops are owned by several people.

First, you will add the data to ArcMap.

- Click the *Add Data*  button and navigate to the *C:\Student\igis1\Regis\Red\_GDB* geodatabase.
- Double-click *Red\_GDB* to open it, and select the *coffee* feature class and both the *owner* and the *shareholders* tables (hold down the **Ctrl** key and use the mouse to select multiple objects).
- Click the *Add* button.
- Double-click on the *coffee* layer to open the *Properties* dialog.
- On the *Labels* tab, check *Label Features in this layer*, confirm that label field is set to *NAME*, and click *OK*.

- ❑ Right-click the *shareholders* table in the *Table of Contents*, click *Joins and Relates* in the context menu, and click *Join*.
- ❑ In the *Join Data* dialog, for item 1, select *Own\_ID* as the field that the join will be based on.
- ❑ For item 2, choose *owner* as the table to join to, and for item 3, choose *Own\_ID* as the field in the *owner* table to base the join on.



- ❑ Click *OK*.
- ❑ Right-click on *shareholders* and click *Open*.

The attributes of both tables have been appended. Now you can see the name of which owner is a shareholder and what percentage of a business they own.

- ❑ Close the table.

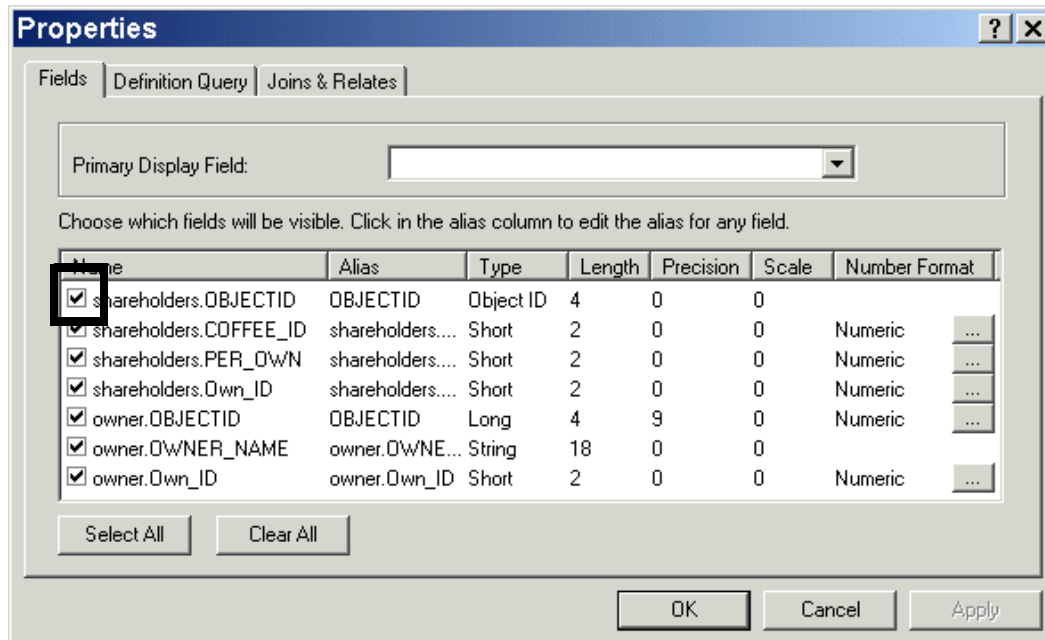
#### **STEP 6: MODIFY THE APPEARANCE OF THE JOINED TABLE**

To make the joined table easier to read, you will turn off several of the fields.

- ❑ Right-click *shareholders* and click *Properties*.

□ If necessary, click the *Fields* tab.

□ Click *shareholders.OBJECTID*, then uncheck the check box to the left of the name.



□ Uncheck the check box for three additional fields: *shareholders.Own\_ID*, *owner.OBJECTID*, and *owner.Own\_ID*.

**NOTE:** You may need to resize the width of the *Name* column—simply hover your cursor over the bars separating the column titles until the cursor changes and drag the bar. This is a temporary display edit and will not alter the table

□ Click *OK*.

- Right-click *shareholders* and click *Open Attribute Table* to view your changes.

**NOTE:** Internally, ArcMap named the new shareholders table *shareholders\_owner* (using the names of the two joined tables with an underscore between the names).

#### ***shareholders table***

(after join and disabling the visibility of four fields)

<b>shareholders.COFFEE_ID</b>	<b>shareholders.PER_OWN</b>	<b>owner.OWNER_NAME</b>
1	100	BETTY BEANE
2	100	BETTY BEANE
3	50	JOHN SMITH
3	50	JANE ARABICA
4	100	JOE ROBUSTA
5	75	JOE ROBUSTA
5	25	HOWARD SCHULTZ

- Close the *shareholders* table.

### **STEP 7: CREATE THE RELATE**

Now you will create a relate between the coffee feature class table and the shareholders table (internally named *shareholders\_owner*) that has now been joined with the owner information. Remember the cardinality between the coffee feature class table and the shareholders table is a one-to-many relationship.

#### ***coffee***

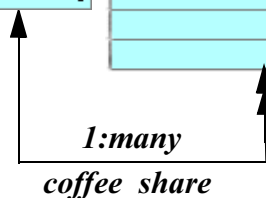
(geodatabase feature class table)

<b>FID*</b>	<b>Shape*</b>	<b>NAME</b>	<b>Coffee_ID</b>
1	Point	Grounds-R-U's	1
2	Point	The Coffee Place	2
3	Point	Coffee and Sons	3
6	Point	The Perkulator	4
7	Point	Java Quik	5

#### ***shareholders***

(geodatabase joined table)

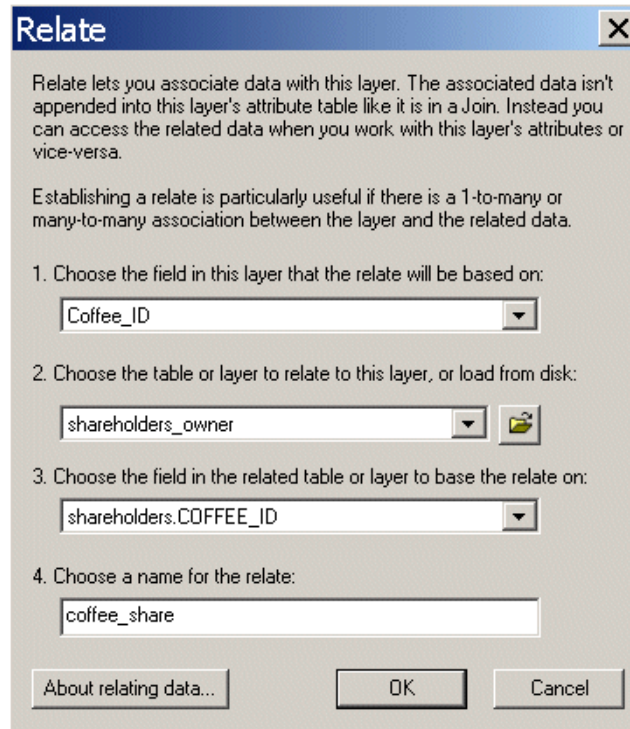
<b>shareholders.COFFEE_ID</b>	<b>shareholders.PER_OWN</b>	<b>owner.OWNER_NAME</b>
1	100	BETTY BEANE
2	100	BETTY BEANE
3	50	JOHN SMITH
3	50	JANE ARABICA
4	100	JOE ROBUSTA
5	75	JOE ROBUSTA
5	25	HOWARD SCHULTZ



- Right-click on *coffee* and click *Joins and Relates > Relate*.
- In the *Relate* dialog, for item 1, choose *Coffee\_ID* as the field that the relate will be based on in the *coffee* feature class table.
- For item 2, choose *shareholders\_owner* as the table that you want to relate to.



- ☐ For item 3, choose *shareholders.COFFEE\_ID* as the related table's field to base the relate on.
- ☐ For item 4, name the relate `coffee_share`




- ☐ Click *OK*.

You have just established a relate between the coffee feature class table and the results of the join between the shareholders and owner tables.

#### **STEP 8: MAKE A SELECTION AND EXAMINE THE RELATED TABLE**

In this step, you will make a selection from the coffee feature class, and using the relate you created between this feature class table and the shareholders joined table, the related records will also be selected. First, you will select a coffee shop and open the layer's attribute table.

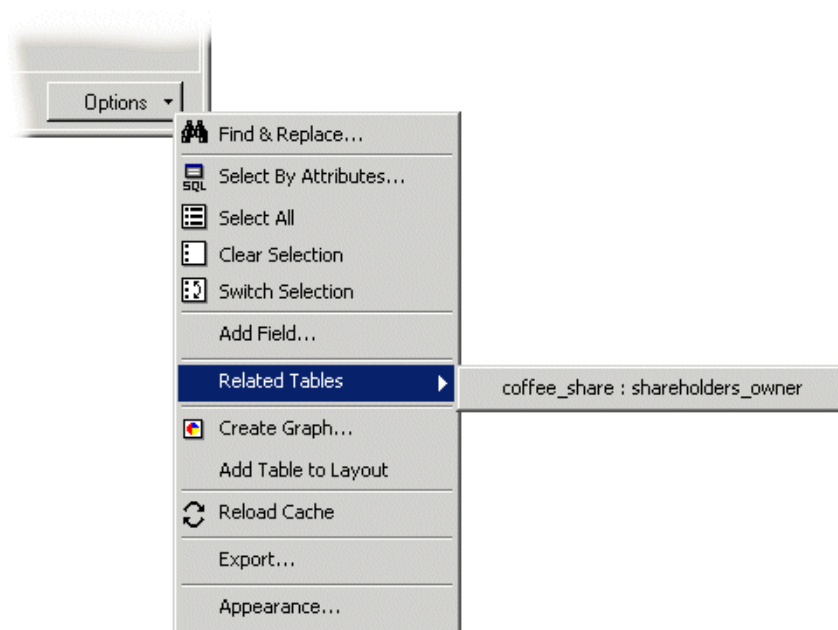
- ☐ On the *Tools* toolbar, use the *Select Features* tool  to select the coffee shop labeled *Java Quik*.
- ☐ Open the attribute table for the *coffee* layer.

The record for the Java Quik coffee shop is highlighted.

FID*	Shape*	NAME	Coffee_ID
1	Point	Grounds-R-Us	1
2	Point	The Coffee Place	2
3	Point	Coffee and Sons	3
6	Point	The Perkalator	4
7	Point	Java Quik	5

Next, you will open and observe the related records in the shareholders joined table by activating the relate between these two tables.

- ☐ Click the *Options* button at the bottom-right corner of the *Attributes of coffee* dialog (you may need to resize the attribute table window).
- ☐ Click *Related Tables* on the context menu and click *coffee\_share:shareholders\_owner* (the name of the relate you created previously and the name of the related table).



**NOTE:** The attribute tables may display on top of each other. Click and drag the top table to see the other table behind it.

## Relate and join tables

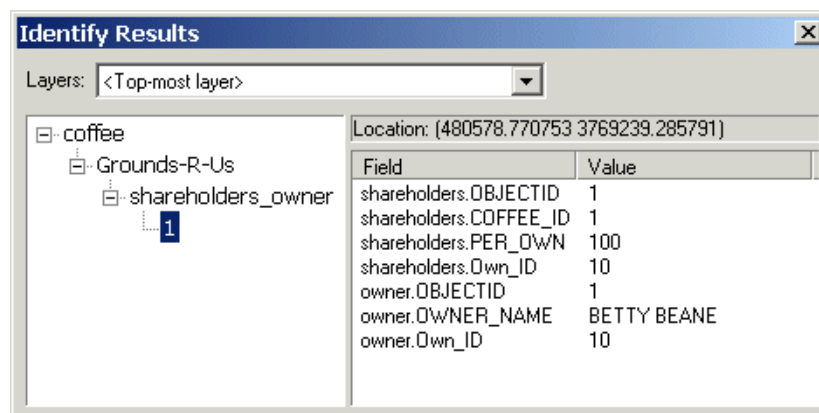
The attributes in the *shareholders* table (the joined table) appear with the records selected that relate to Joe Robusta and Howard Schultz, who are the joint owners for this coffee shop.

shareholders.COFFEE_ID	shareholders.PER_OWN	owner.OWNER_NAME
1	100	BETTY BEANE
2	100	BETTY BEANE
3	50	JOHN SMITH
3	50	JANE ARABICA
4	100	JOE ROBUSTA
5	75	JOE ROBUSTA
5	25	HOWARD SCHULTZ

- ☐ Close the *Attributes of shareholders* table and select a different coffee shop.
- ☐ Click *Options > Related Tables > coffee\_share:shareholders\_owner* relate again and examine the related table.
- ☐ When finished, close all tables.
- ☐ If necessary, use the *Select Features* tool to click on an area away from a point feature to clear the selected coffee shop.

You can also access the related information for each coffee shop using the *Identify* tool.

- ☐ Use the *Identify* tool to click on the *Grounds-R-Us* coffee shop.
- ☐ In the *Identify Results* window, expand the results in the left-hand side, and click *1* (the FID value of the identified point) to see the related information update in the right panel.



- ☐ Close the *Identify Results* window.

**STEP 9: LABEL FEATURES WITH JOINED ATTRIBUTES**

You can open related tables and view selected records through the Table Options items and the Identify tool. However, you cannot use the information accessed through a *relate* for labeling or symbolizing features. Only records that have been *joined* to a layer's attribute table can be used to label or symbolize features in that layer. In this step, you will join the coffee feature class table to a table listing health inspection information.

- Click *Add Data* and add the *health\_code* table from the *Red\_GDB.mdb*.

This table has a one-to-one match with the coffee feature class table, and you will use it to label the coffee shops with their latest health inspection code and date.

<i>coffee</i> (geodatabase feature class table)				<i>health_code</i> (geodatabase table)			
FID*	Shape*	NAME	Coffee_ID	OID	Coffee_ID	Inspect_Date	Health_Code
1	Point	Grounds-R-U's	1	1	1	11/25/2002	A
2	Point	The Coffee Place	2	2	2	10/17/2002	B
3	Point	Coffee and Sons	3	3	3	8/4/2002	B
6	Point	The Perkalator	4	4	4	9/23/2002	A
7	Point	Java Quik	5	5	5	12/2/2002	C

1:1

- Right-click on the *coffee* layer and click *Joins and Relates > Join*.
- Create the join to match the graphic below.

**Join Data**

Join lets you append additional data to this layer's attribute table so you can, for example, symbolize the layer's features using this data.

What do you want to join to this layer?

Join attributes from a table

1. Choose the field in this layer that the join will be based on:

Coffee\_ID

2. Choose the table to join to this layer, or load the table from disk:

health\_code

☒ Show the attribute tables of layers in this list

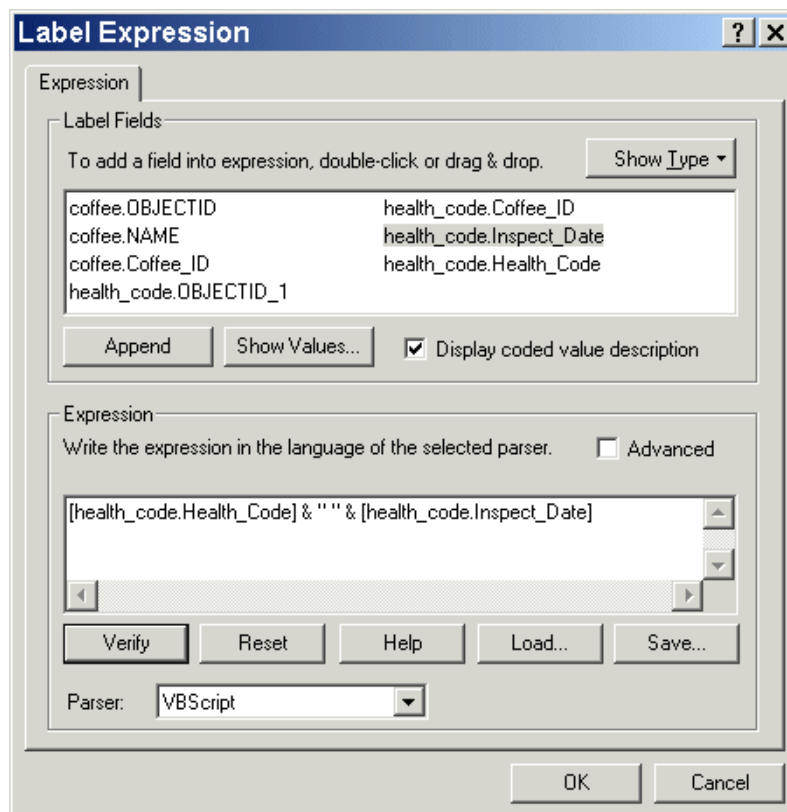
3. Choose the field in the table to base the join on:

Coffee\_ID

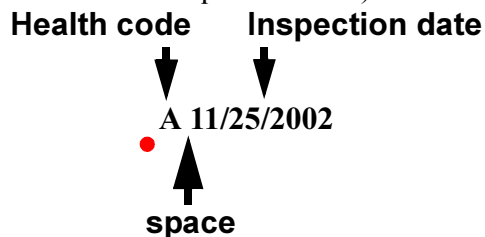
- ☐ Click *OK*.
- ☐ Right-click on the *coffee* layer and click *Properties*.
- ☐ Click the *Labels* tab.
- ☐ Click *Expression*.
- ☐ Highlight and delete *[NAME]* from the *Expression* box.
- ☐ From the *Label Fields* box, double-click *health\_code.Health\_Code* to add it to the Expression box.
- ☐ Click *health\_code.Inspect\_Date* (only click once) and then click *Append*.

This adds the needed VBScript-specific characters to the expression to concatenate the two fields together with a space between them.

The Label Expression dialog should match the graphic below.



This expression will result in labeling each coffee shop location on your map with the following label components (a selected example is shown):



- ☐ Click *OK* to close the *Label Expression* dialog.
- ☐ Click *OK* to close the *Layer Properties* dialog.
- ☐ Right-click the *coffee* layer and turn on the labels.

Observe that the labels on the coffee shop features now show the results of their latest health inspection code and date. The Label Expression function is a very powerful tool for creating complex labels. If you want to learn more about how to use Label Expression, then move on to the challenge step; otherwise, continue to Step 10.

#### **STEP 10: EXIT ARCCATALOG AND ARCMAP**

- ☐ Close *ArcCatalog* and *ArcMap*.
- ☐ Click *No* when prompted to save your changes in *ArcMap*.

In this exercise, you explored various data formats and created relationships between tables by establishing a relate and performing joins. You also learned how to modify the appearance of a table by controlling which fields are visible. You were also introduced to advanced labelling techniques by using the Label Expression builder.

#### **CHALLENGE: DISPLAY LABELS ON SEPARATE LINES**

By using a table join, you can access attributes from a second table to label your spatial features. In some cases, you may need to add more text information to your label than can be fit on one continuous line. The following challenge step will show you how to further enhance your labels by using the Label Expression dialog.

- ☐ Using the skills you have just learned, navigate to the *Label Expression* dialog for the *coffee* layer.
- ☐ Clear any text which remains in the *Expression* box.

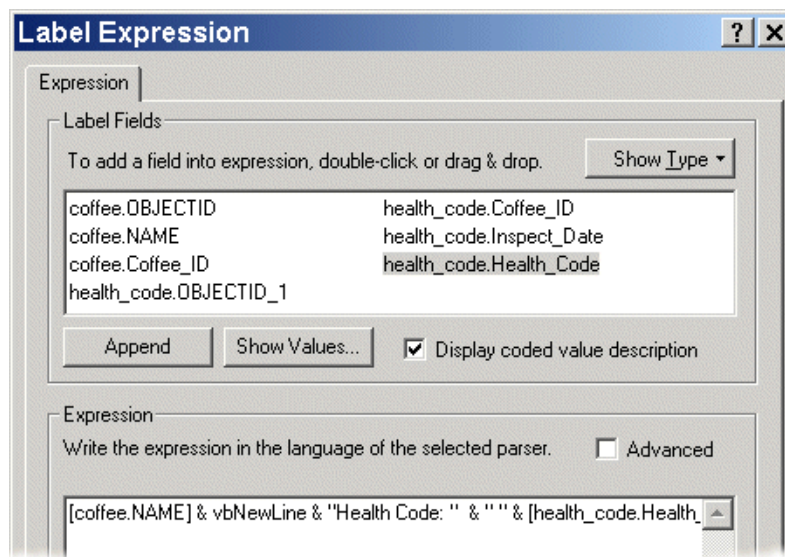
- From the *Label Fields* box, double-click *coffee.NAME*, then *health\_code.Health\_Code*

You have already learned how to add attribute fields. Next you will learn to add a VBScript command and new text to your labels.

- In the *Expression* box, insert your text cursor after the right square bracket around *coffee.NAME*

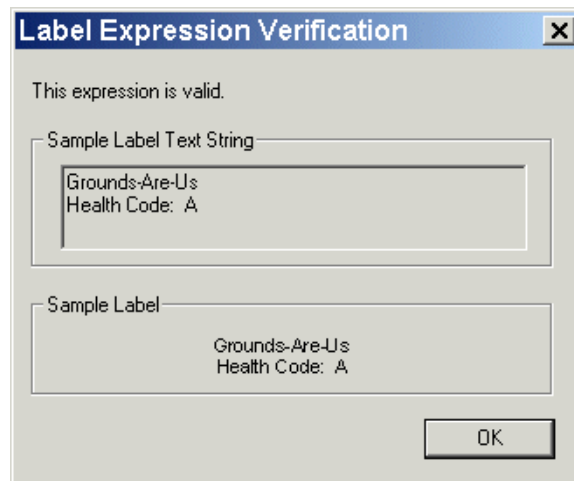
- Type: `& vbNewLine & "Health Code: " & " " &`

Your *Expression* box should look like this:



- Click the *Verify* button

If you have typed in your VBScript correctly, you should see this message box:



**NOTE:** If you receive an error message, first double-check your code. Then consult your instructor.

☐ Click *OK* to close both the *Label Expression* and *Layer Properties* dialogs.

Your labels should now display information from two attribute fields from separate tables, on two separate lines, with additional descriptive information added to the label.

☐ Close *ArcCatalog* and *ArcMap*.

☐ Click *No* when prompted to save your changes in *ArcMap*.

***EXERCISE END***



## ***EXERCISE 6B: CREATE A GRAPH AND REPORT IN ARCMAP***

In this exercise, you will learn how to create graphs and reports in ArcMap. You will quickly see how easy it is to create sophisticated elements that can greatly enhance your map products and help your audience interpret your data and analysis results.

### ***STEP 1: START ARCMAP AND OPEN THE MAP DOCUMENT***

First, you will start ArcMap using an existing map document.

- ☐ Click *Start > Programs > ArcGIS > ArcMap*.
- ☐ Click *An existing map*.
- ☐ Click *OK*.
- ☐ In the *Open* dialog, navigate to *C:\Student\igis1\Map\_documents*.
- ☐ Open the map named *ex6b.mxd*.

The map opens, revealing the states in the northeastern United States.



**STEP 2: OPEN THE GRAPH PROPERTIES AND CHANGE THE GRAPH TYPE**

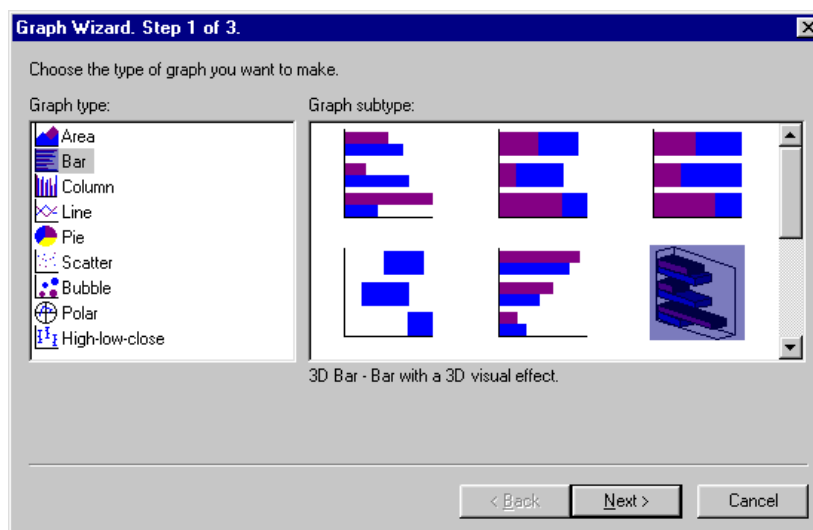
Next, you will work with the Graph Wizard, specifying graph type, variables you want to display, and different display properties (e.g., title, legend).

□ Click *Tools > Graphs > Create*.

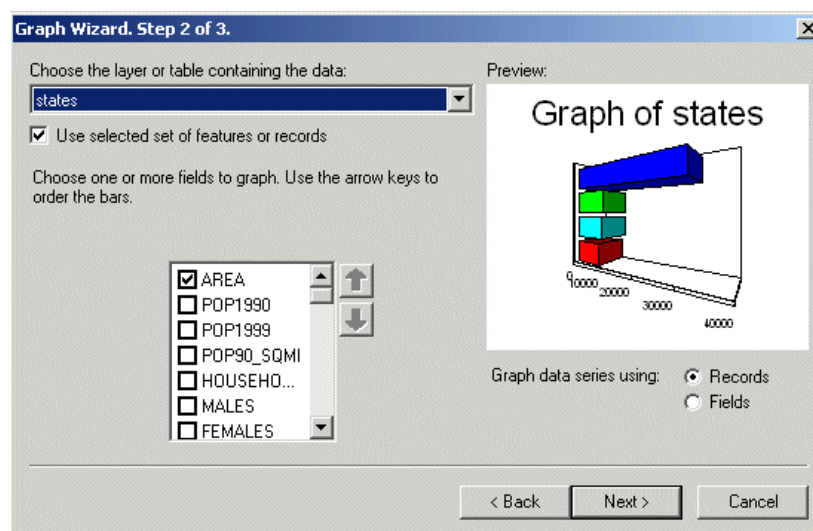
The Step 1 panel of the Graph Wizard appears.

□ Under *Graph type*, click the *Bar* graph symbol.

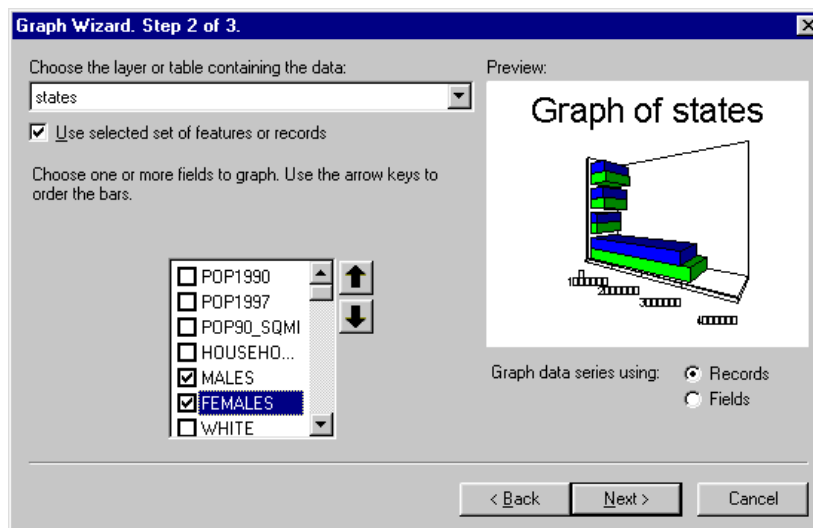
□ Under *Graph subtype*, click the *3D Bar* graph in the second row.



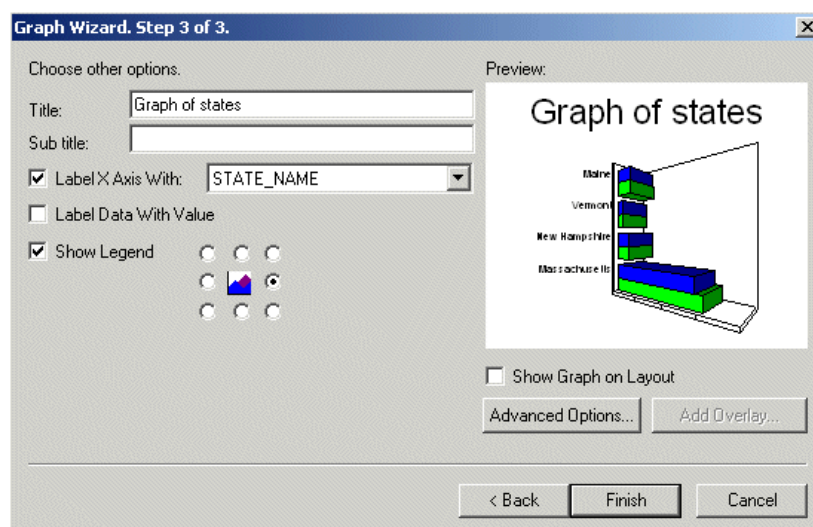
□ Click *Next*.



- ☐ Select *states* as the layer or table containing the data.
- ☐ In the *Fields* list, uncheck *AREA*, then check the check boxes next to *MALES* and *FEMALES*.



- ☐ Click *Next*.
- ☐ Under *Choose other options*, ensure that the *Label X Axis With* check box is checked.
- ☐ Set the dropdown list to *STATE\_NAME*.

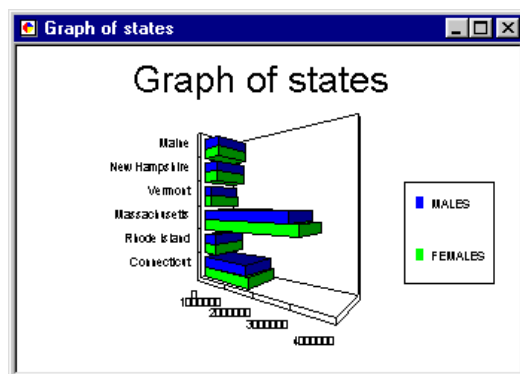


**NOTE:** The Advanced Options button allows you to set more properties for the graph. You will use this in the next step.

☐ Ensure the *Show Legend* check box is checked.

☐ Click *Finish*.

The new graph appears in your map.



### STEP 3: MODIFY THE GRAPH'S PROPERTIES

In this step, you will add titles to the graph and the y-axis.

☐ Right-click the title bar of the *Graph of states* window to display the context menu.

The context menu gives you many useful options. You can save this graph to disk so that at a later time you can print or export it to another file type (BMP, JPEG, PNG, or WFM). You can copy the graph to the Windows Clipboard and paste it into other applications, or add the graph to the Layout View of a map.

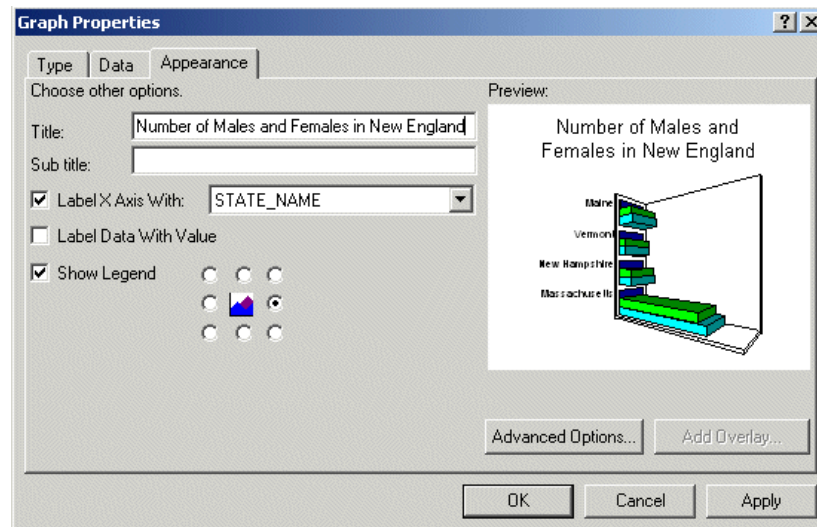
☐ Click *Properties* on the context menu.

☐ In the *Graph Properties* dialog, click the *Appearance* tab.



Create a graph and report in ArcMap

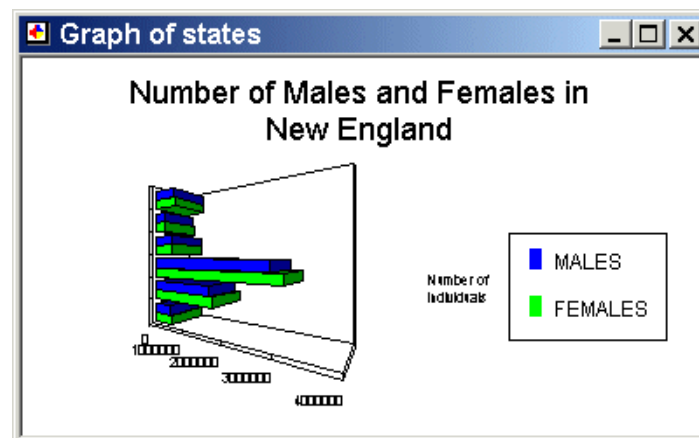
- For *Title*, type **Number of Males and Females in New England**



- Click the *Advanced Options* button.
- For *Right Title*, type **Number of Individuals**; then click *OK*.
- On the *Graph Properties* dialog, click *OK*.

**NOTE:** You will need to increase the size of the graph display to see the title.

The graph updates with your changes.



**STEP 4: EXPORT THE GRAPH**

- ☐ Right-click the *Graph of states* title bar and click *Export*.
- ☐ For *Save as type*, click *WMF(\*.wmf)* in the dropdown list.
- ☐ Save the graph in *C:\Student\igisI\Map\_documents* as **Males\_females.wmf**
- ☐ Close the *Graph of states* window.

The graph is finished for now. Next, you'll create a report, embed the graph into the report, and embed the report into a layout.

**STEP 5: DISPLAY REPORT PROPERTIES AND SPECIFY FIELDS**

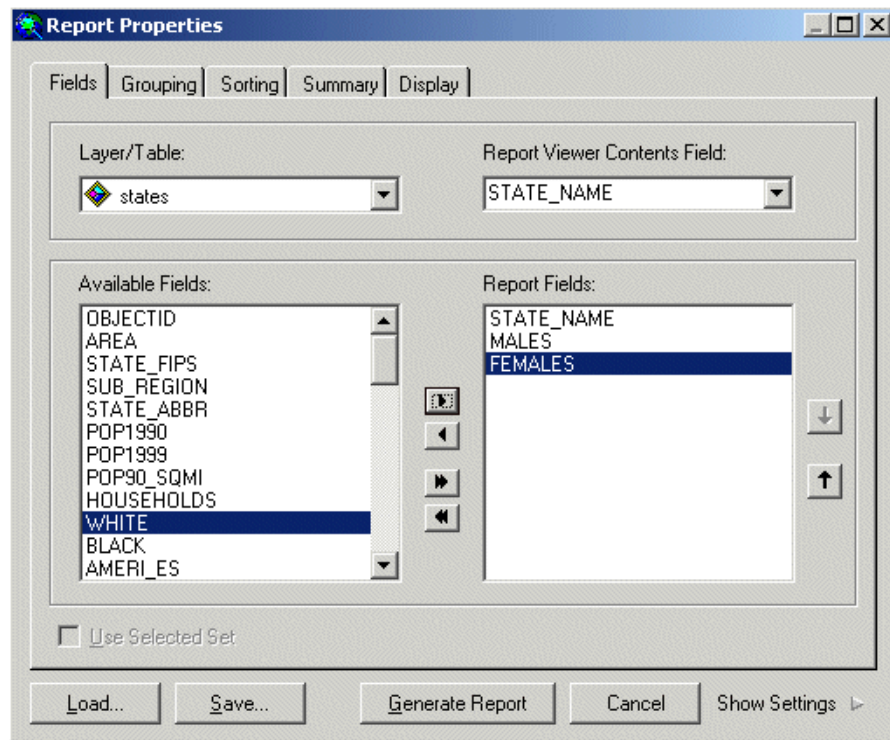
In this step, you will create a report that shows the population of men and women in the New England states.

- ☐ Click *Tools* menu > *Reports* > *Create Report*.

First, you need to specify which fields should be included in the report.

- ☐ Click the *Fields*. In the *Available Fields* list, select *STATE\_NAME*; then click the right arrow button to move *STATE\_NAME* into the *Report Fields* list.

- Do the same for the *MALES* and *FEMALES* fields.



**NOTE:** You might select multiple fields from the Available Fields list while holding the Ctrl key on your keyboard. Then click the right arrow button to move those into the Report Fields list.

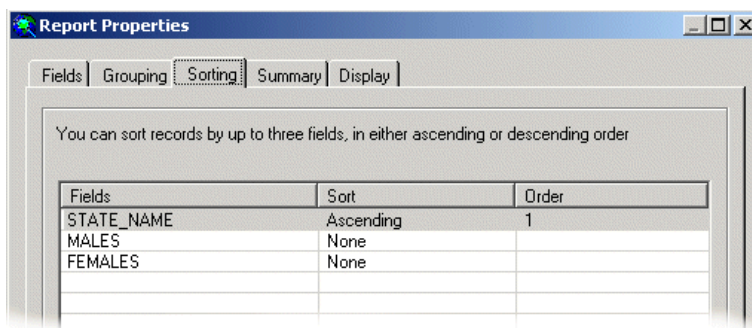
#### STEP 6: SET THE SORTING AND SUMMARY OPTIONS

Now you will set the sorting options for your report.

- Click the *Sorting* tab.
- For *STATE\_NAME*, in the *Sort field*, click *None*.

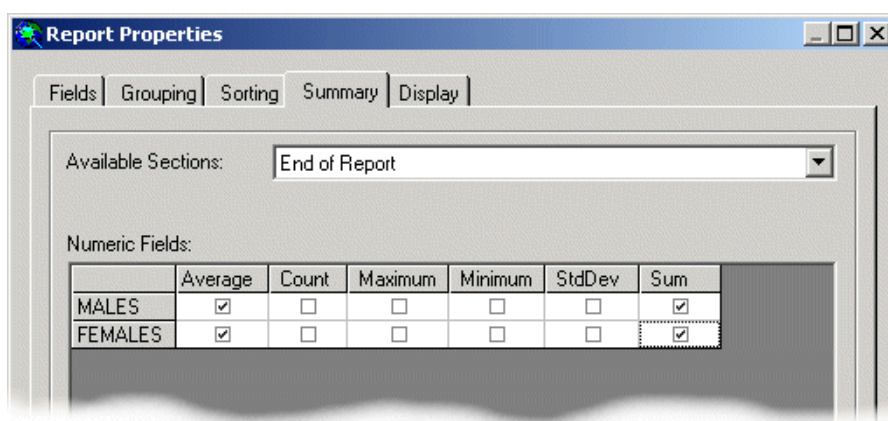
A dropdown list appears.

- Click *Ascending*.



Now you will specify which fields to summarize.

- Click the *Summary* tab.
- Check the *Average* and *Sum* check boxes for both males and females.

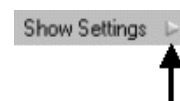


**NOTE:** When you are trying to check the Sum check boxes, the Average column may disappear. To prevent this, reduce the width of the columns.

### STEP 7: SET DISPLAY PROPERTIES


When you want to preview a report, you can click Show Settings to see a full-screen size view of your report. You can change settings in Show Settings mode as well as in the Report Properties dialog. To close the full screen window and return to the Report Properties dialog, click the arrow next to Hide Settings.

- Click the arrow just to the right of *Show Settings* (at the bottom right of the dialog).

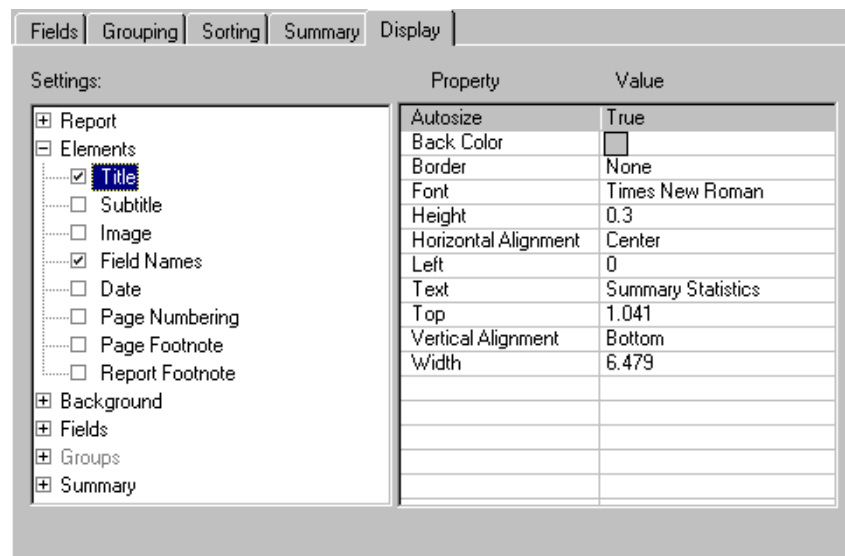




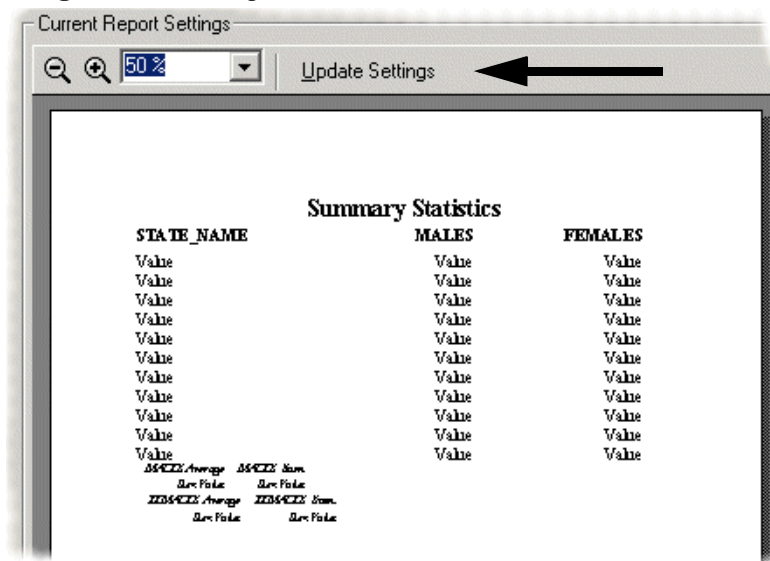
Each additional change you make can be previewed by clicking Update Settings. You may want to zoom in to see the report in better detail. The Display tab lets you control the placement, color, and other properties for the report.

- ☐ In the *Report Properties* dialog, click the *Display* tab.
- ☐ Click the plus sign (+) next to *Elements* to expand it, if necessary.
- ☐ Check the *Title* check box.
- ☐ Under *Property*, click *Text*.
- ☐ Under *Value*, replace the text *Report Title* with **Summary Statistics**
- ☐ Under *Property*, click *Font*.
- ☐ Under *Value*, click the *ellipses* button  to open the *Font* dialog.
- ☐ For *Font*, confirm that *Times New Roman* is selected.
- ☐ For *Font style*, confirm that *Bold* is selected.
- ☐ For *Size*, click 20
- ☐ Click *OK*

The left section of the Report Properties dialog should look like this:



- Click *Update Settings* to see the report title.



Notice that the report settings display only the format, not the actual data.

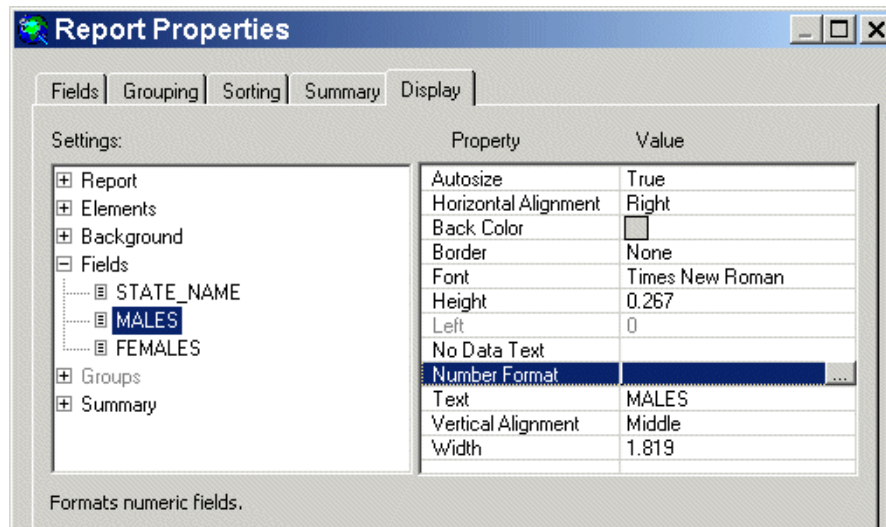
## STEP 8: CHANGE THE NUMBER FORMAT

Thus far, the report you have generated shows the numeric values for males and females populations without the thousands separators. To make reading these numbers easier, you will now add these separators.

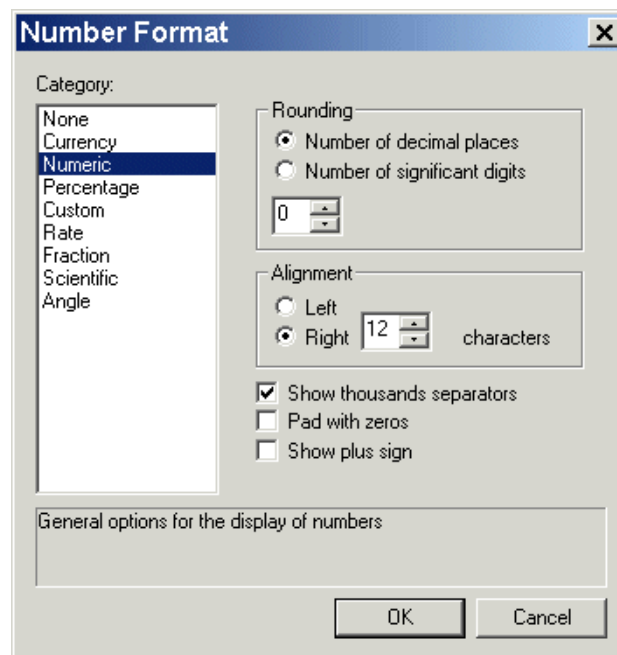
- ❑ Under *Settings*, expand the *Fields* item.
- ❑ Click on *MALES*.
- ❑ Under the *Property* column, click the *Number Format* property.

Create a graph and report in ArcMap

- Under the *Value* column, click the *ellipses* button for the *Number Format* property.



- On the *Number Format* dialog, check the *Show thousands separators* check box and click *OK*.



- Do the same for the *FEMALES* field.
- Click *Generate Report* and notice the results on the *Report Viewer*.

The Report Viewer opens, displaying the actual data with its current formatting.

Summary Statistics		
STATE_NAME	MALES	FEMALES
Connecticut	1,592,873	1,694,243
Maine	597,850	630,078
Massachusetts	2,888,745	3,127,680
New Hampshire	543,544	565,708
Rhode Island	481,496	521,968
Vermont	275,492	287,266
<i>MALES Average</i>	<i>MALES Sum</i>	
1,063,333	6,380,000	
<i>FEMALES Average</i>	<i>FEMALES Sum</i>	
1,137,824	6,826,943	

☐ Close the *Report Viewer* dialog.

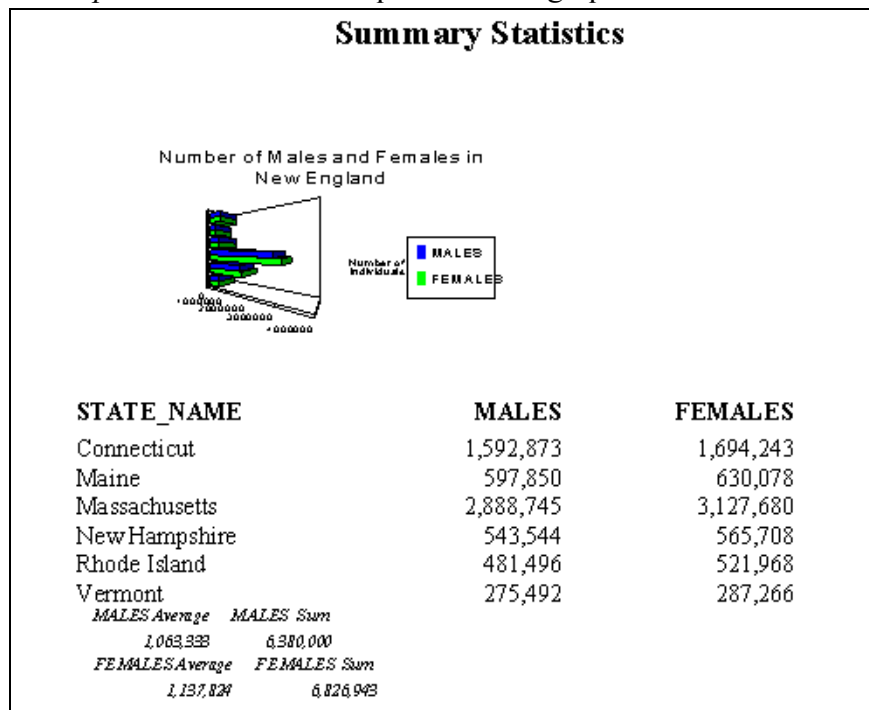
### STEP 9: EMBED THE GRAPH IN THE REPORT

In this step, you will embed the graph you created in the previous section of the exercise into your newly created report.

- ☐ Under the *Settings* list, click the plus sign (+) next to *Elements* to expand it, if necessary.
- ☐ Check the *Image* check box.
- ☐ Under *Property*, click *Picture*.
- ☐ Under *Value*, click the *ellipses* button to launch the *Open Image* dialog.
- ☐ Navigate to the *Males\_females.wmf* file you saved earlier and click *Open*.
- ☐ For the *Height* property, type 2
- ☐ For the *Left* property, type 0.5
- ☐ For the *Top* property, type 1
- ☐ For the *Width* property, type 3

Create a graph and report in ArcMap

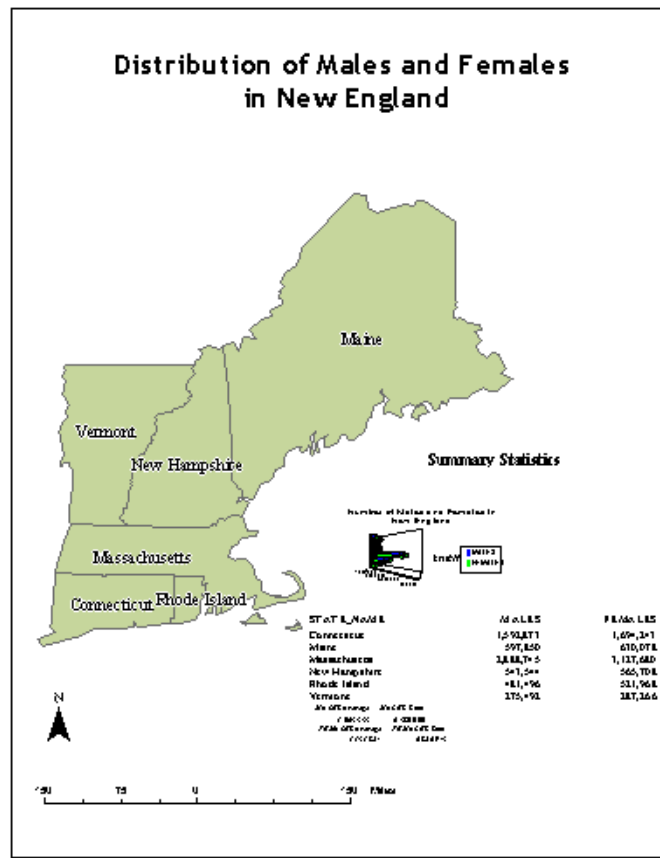
- ☐ Click *Generate Report* to see the final report with the graph included.



#### STEP 10: ADD THE REPORT TO THE LAYOUT

- ☐ In the *Report Viewer*, click *Add*.
- ☐ Click *OK* to add your report to the map's Layout View.
- ☐ Close the *Report Viewer*.
- ☐ In the *Report Properties* dialog, click *Save*.
- ☐ Save the file as `report.rdf` in the `C:\Student\igis1\Map_documents` folder.
- ☐ Close the *Report Properties* dialog.
- ☐ In *ArcMap*, click the box surrounding the report to reposition and resize the report graphic for a more aesthetically balanced layout.

**NOTE:** You may need to move the states frame off the layout temporarily before moving the report to the location you desire.



Remember this is not a final map yet. It still needs work to bring it to the standards of good cartography. However, the scope of this exercise was simply for you to learn how to create reports and graphs and embed them into a map layout in ArcGIS.

## STEP 11: EXIT ARCMAP

- Click the *Save* button and exit *ArcMap*.

**EXERCISE END**



# *Editing data*

## **Exercise 7A: Edit features with the Editor toolbar**

	<b>7-1</b>
Start ArcMap and load the data	7-1
Open the Editor toolbar and start an edit session	7-1
Select and move a parcel	7-2
Rotate a feature	7-3
Move the feature's selection anchor	7-3
Specify a rotation angle	7-4
Move a vertex	7-4
Delete a vertex	7-5
Add a vertex	7-6
Delete the parcel	7-6
Create a feature using the Sketch Tool	7-7

Add a feature using more sketch options	7-11
Use multiple Sketch Tools	7-14
Create a new Point Feature Class in ArcCatalog	7-18
Create new features in your new Feature Class	7-21

## **Exercise 7B: Edit attribute data**

	<b>7-24</b>
Add an attribute field	7-24
Start ArcMap and load the data	7-25
Open the Field Calculator	7-26
Create an expression	7-26
Select several parcels	7-28
View the attributes of the selected parcel	7-28
Examine the attribute values	7-29

Assign a LANDUSE code to a parcel	7-29
Copy and paste attributes	7-30
Assign attributes to all selected features	7-30
Save edits and exit ArcMap	7-31




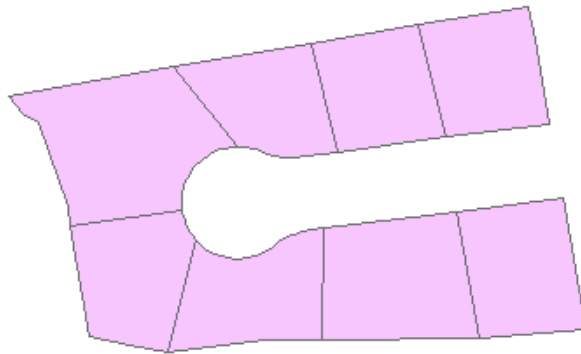


## EXERCISE 7A: EDIT FEATURES WITH THE EDITOR TOOLBAR

In this exercise, you will modify an existing parcel base map. You will learn how to use a variety of the tools available on the Editor toolbar.

### STEP 1: START ARCMAP AND LOAD THE DATA


- ☐ Start *ArcMap* using *A new empty map*.
- ☐ Click the *Add Data* button  and navigate to the *C:\Student\igis1\Subdivision.mdb* personal geodatabase.
- ☐ Click *SubdivisionParcels* and click *Add*.



The *SubdivisionParcels* layer contains eight parcels.

### STEP 2: OPEN THE EDITOR TOOLBAR AND START AN EDIT SESSION

Before you can start an edit session, you must add the Editor toolbar to the *ArcMap* interface.

- ☐ Click the *Editor Toolbar* button  on the *Standard* toolbar to add the *Editor* toolbar. Dock the toolbar above the map display area.



Notice that most of the controls on the Editor toolbar are disabled. This is because you have not yet started an edit session.


- From the *Editor* dropdown menu, on the *Editor* toolbar, click *Start Editing*.

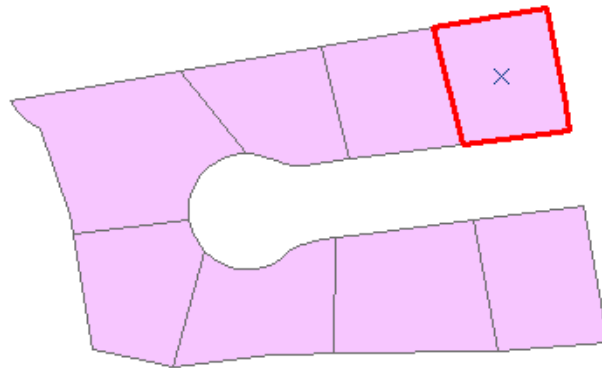


Now the tools on the toolbar are active.

### STEP 3: SELECT AND MOVE A PARCEL

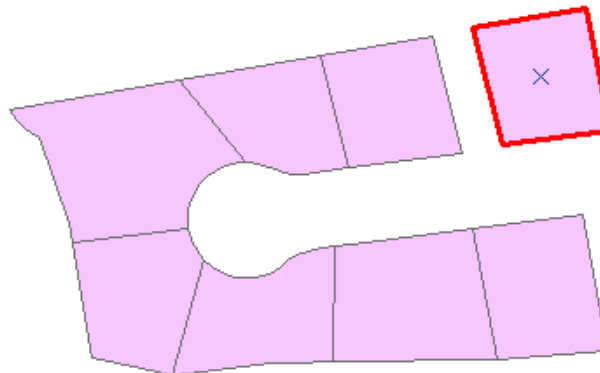
First, you will use the Edit button, which is the primary tool for selecting and moving features and manipulating vertices.

- Click the *Edit Tool* button .
- Click on the parcel in the northeast corner.



The parcel is highlighted and your mouse pointer changes to indicate that you can drag the feature. Notice that several controls are now enabled on the Editor toolbar.


- Click and drag and drop the parcel to the right of the other parcels.

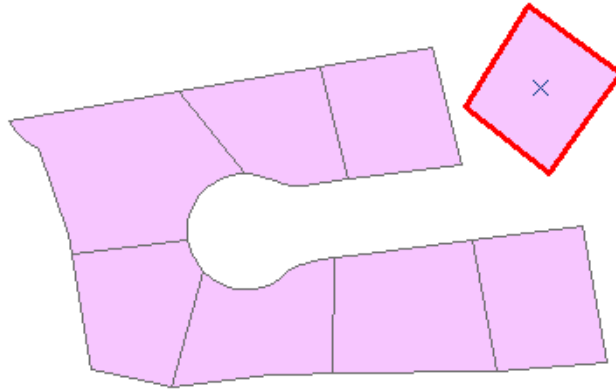


**NOTE:** If you drag and drop the parcel outside the extent of the map, click Fixed Zoom Out on the Tools toolbar until you can see the feature.

#### STEP 4: ROTATE A FEATURE

Next, you will rotate the selected parcel. The parcel will rotate around its selection anchor (the X in the center of the parcel). You may need to enlarge the ArcMap window to see the Rotate button (it is located third from the right of the Editor Toolbar).

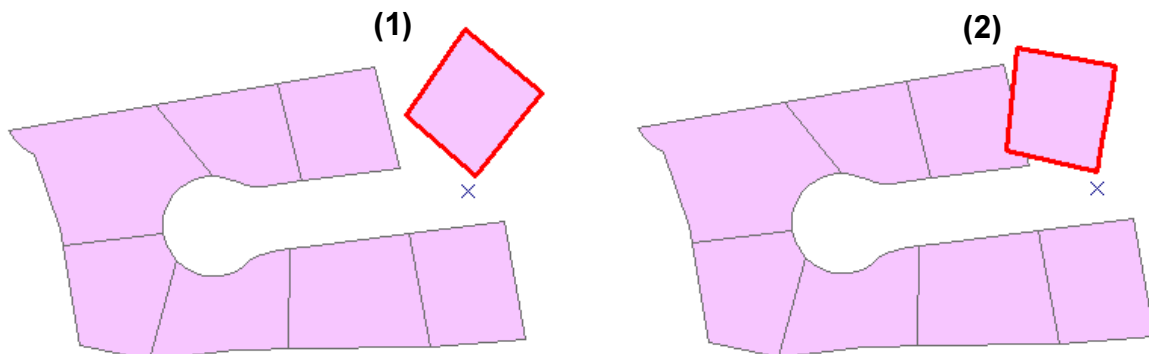
- ☐ Click the *Rotate* button .
- ☐ Click and drag and drop anywhere in the display to rotate the feature around its selection anchor.



#### STEP 5: MOVE THE FEATURE'S SELECTION ANCHOR

You can move the selection anchor to see how the anchor affects the rotation of the feature.

- ☐ Hold your mouse pointer over the selection anchor until its icon changes. Click the selection anchor and drag and drop it to a new location outside of the feature, slightly down and to the left. Rotate the parcel again.

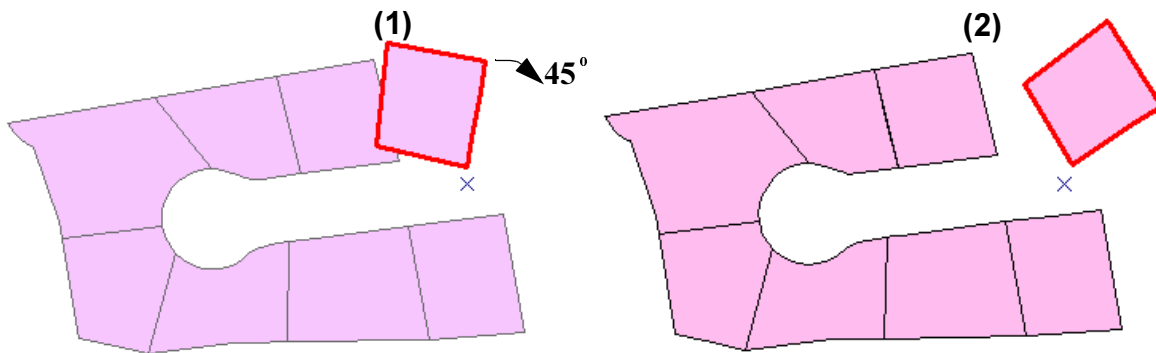


**STEP 6: SPECIFY A ROTATION ANGLE**

You can rotate a feature by specifying an angle. The angle is relative to the feature being rotated and is specified in degrees. A positive angle rotates the feature to the right; a negative angle rotates the feature to the left.

☐ Press **A** on the keyboard.

☐ Type **45** and press **Enter** to rotate the feature 45 degrees.

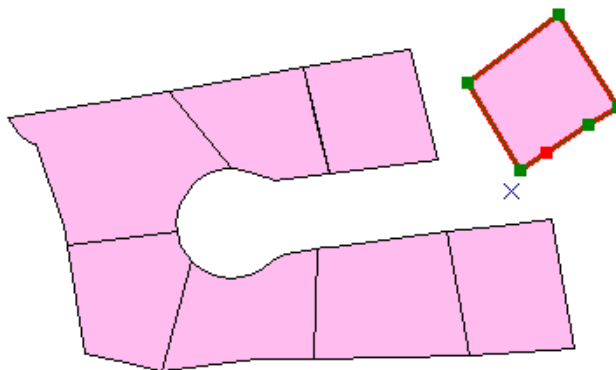
**STEP 7: MOVE A VERTEX**

You can use the Edit button to move a vertex.

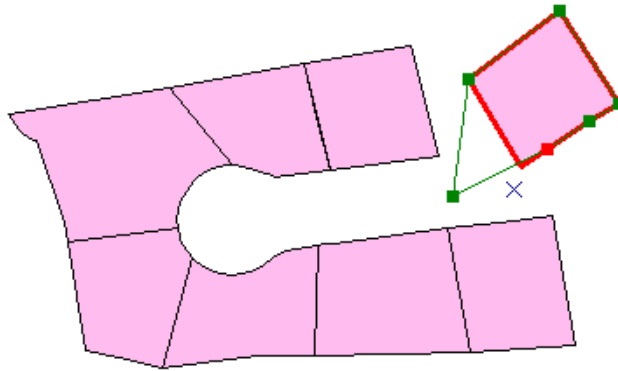
☐ Click the *Edit Tool* button .

☐ Double-click on the parcel you have been editing.

The parcel's sketch shows you the location of its vertices and segments.



- Move your mouse pointer over the lower-left vertex. Click the vertex and drag and drop it to a new location.



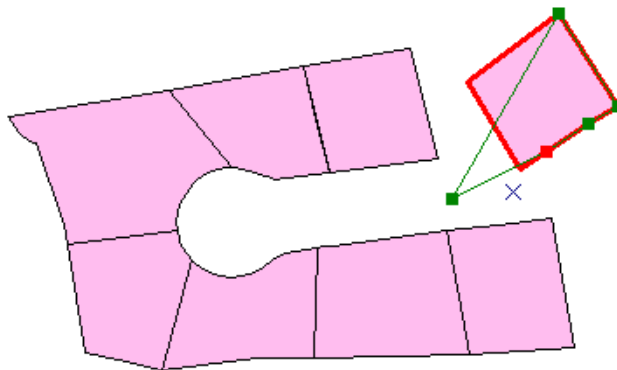
The lines showing the new shape are part of the sketch, not the feature.

#### **STEP 8: DELETE A VERTEX**

You can modify vertices quickly using the context menu that appears when you right-click on a sketch.

- Move your mouse pointer over the upper-left vertex until its icon changes shape. Right-click to access the context menu; then click *Delete Vertex*.

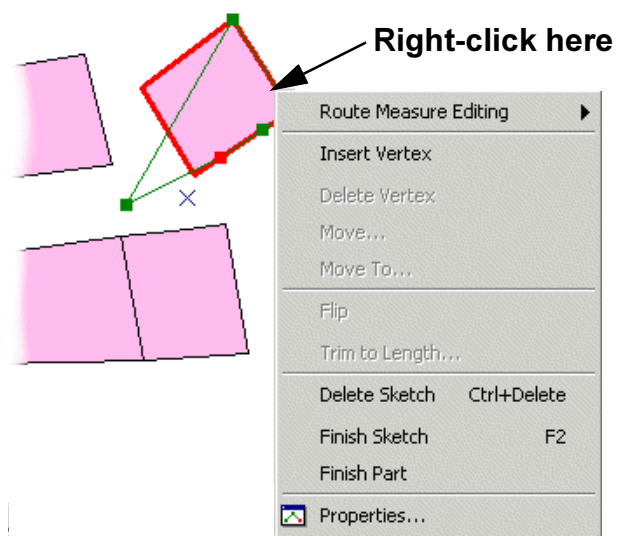
Your sketch should look similar to the one below, depending how you rotated the parcel.



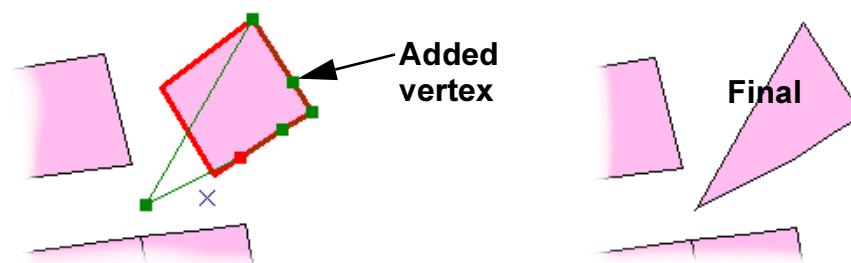
**STEP 9: ADD A VERTEX**


In addition to moving and deleting vertices, you can add vertices.

- Move your mouse pointer over the top-right line of the sketch. Right-click to open the context menu, and click *Insert Vertex*.

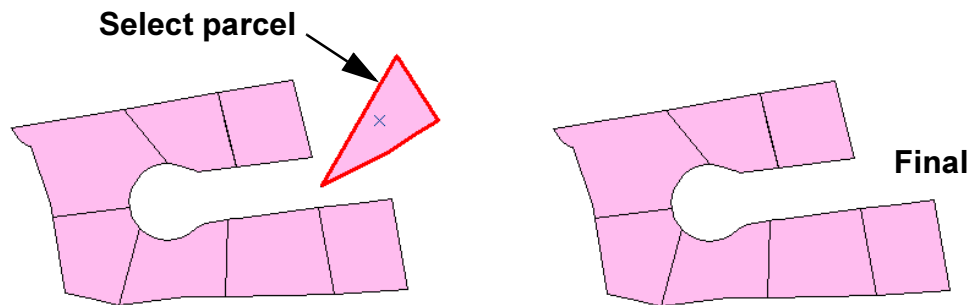


- Click anywhere away from the sketch to finish editing the parcel's vertices.

**STEP 10: DELETE THE PARCEL**

- Select the parcel by clicking on it.
- Click the *Delete* button  on the *Standard* toolbar or press **Delete** on the keyboard.

The parcel is deleted.



Now save your edits.

- ☐ Click *Editor > Save Edits*.

In the next steps, you will learn more about working with sketches. You will set snapping properties, use sketching options such as parallel and perpendicular, and experiment with tools that work in conjunction with the Sketch Tool.

### **STEP 11: CREATE A FEATURE USING THE SKETCH TOOL**

In this step, you will create new features using the Sketch Tool. The snapping environment will help you create features. Before using the Sketch Tool, you will set the snapping properties.

- ☐ Click *Editor > Snapping*.

For each layer, there are three options for where to snap sketch elements to existing features: Vertex, Edge, and End. Vertex snapping snaps to the vertices of features. Edge snapping snaps to any part of the lines in the layer and is not influenced by vertices. End snapping snaps to the endpoints of lines. You will set the snapping properties to snap to vertices.

- ☐ Check the *Vertex* check box.
- ☐ Close the *Snapping Environment* window, but remember how to open it as you will use it later in this exercise.

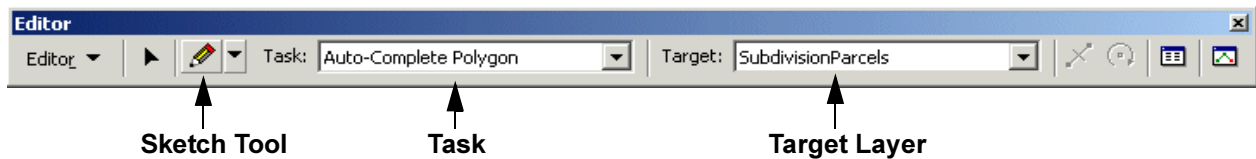
Now set the snap tolerance.

- ☐ Click *Editor > Options* and click the *General* tab.
- ☐ For *Snapping tolerance*, type 10

☐ For *Snapping Tolerance* units, click or confirm *pixels*.

☐ Click *OK*.

Now you will use the Sketch Tool to create a new feature. The Sketch Tool works in conjunction with the current task shown in the Task control. In the example below, the Task is set to Auto Complete Polygon because you will be adding a new parcel adjacent to an existing parcel. The Auto Complete Polygon task works also in conjunction with the Target layer. In this step new features will be created in the SubdivisionParcels layer.



**NOTE:** Notice that the Target layer receiving the edits is automatically set to SubdivisionParcels. This is because you only have one layer in your map. If you have multiple layers, you will need to set the Target to the layer you want to edit.

Now use the Sketch Tool to create a new parcel resembling the one you edited earlier.

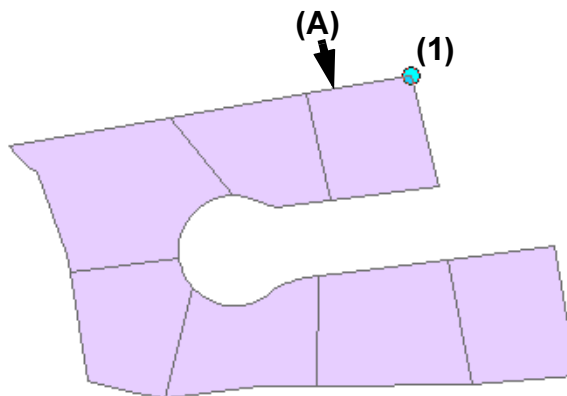
☐ Set the *Task* to *Auto-Complete Polygon*.

Auto-Complete Polygon allows you to add a polygon adjacent to other polygon features without having to sketch in a duplicate boundary between them.

☐ Click the *Sketch Tool* button .

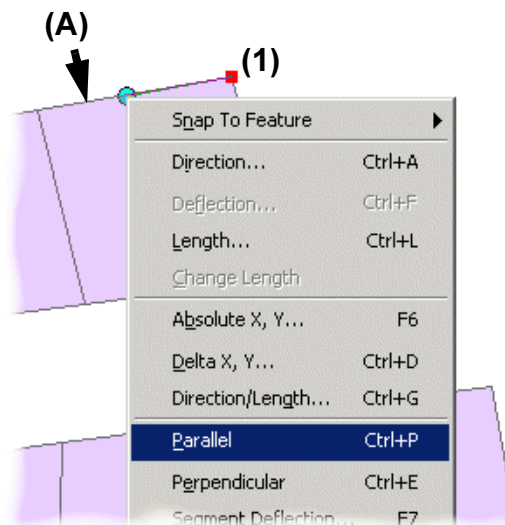
☐ Move your pointer close to the vertex marked (1). See the figure below.

Notice how the pointer snaps to the vertex when it is within the snap tolerance you set earlier.



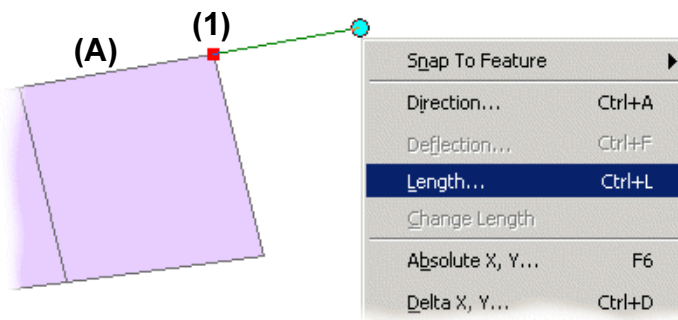


- Click to add the vertex at (1).
- Move the pointer to the parcel boundary marked (A), right-click on the boundary, and click *Parallel*.



You might notice that the selected polygon edge (boundary (A)) briefly flashes to show that it has been selected as the feature the sketch will become parallel to.

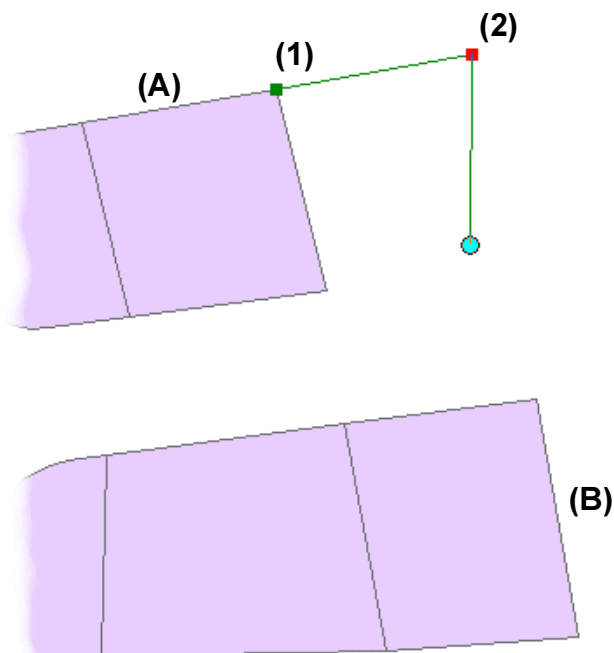
- Move the pointer horizontally left to right and notice that the sketch line is constrained to follow a path along the same direction of boundary (A).
- Move the pointer to the right of the vertex marked (1), right-click, and click *Length*.



- On the *Length* dialog, type 27 and press **Enter**.

This will establish the vertex marked (2). See the figure below.

You have just finished adding the northern boundary of the new parcel. You will now add the eastern boundary to be parallel to the existing boundary marked (B).



☐ Right-click on the boundary (B) and click *Parallel*.

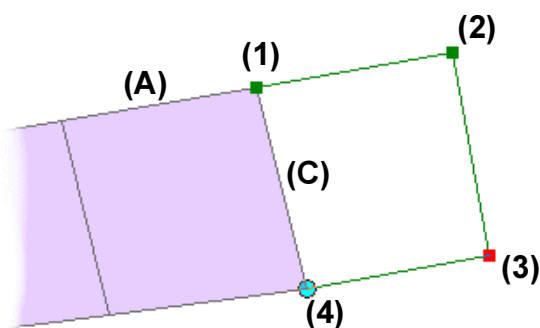
☐ Right-click and click *Length*.

☐ On the *Length* dialog, type 28 and press **Enter**.

This will establish the vertex marked (3).  
See the figure at right.

You have just finished adding the eastern boundary of the new parcel. You will now add the southern boundary and complete the parcel polygon.

☐ Move the pointer and double-click at the vertex marked (4).

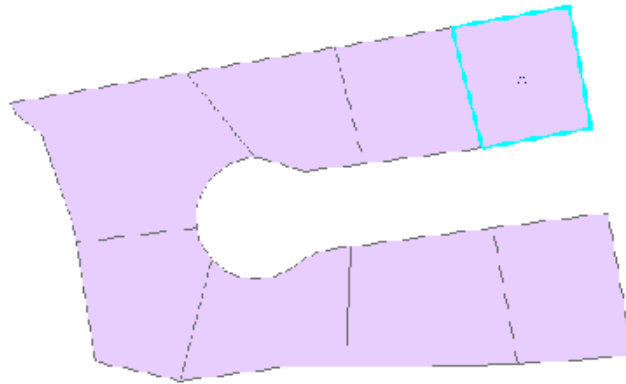


This will complete the parcel polygon.

**NOTE:** You could have also right-clicked and chose *Finish Sketch*, which will also auto-complete the parcel polygon.



Notice that throughout these steps of the Auto-Complete Polygon task, you did not need to physically add boundary (C) for the new parcel. The Auto-Complete Polygon task took care of that. The new parcel is created with a perfectly coincident boundary between it and the neighboring parcel. Your parcels should resemble the ones below:



☐ Click *Editor* > *Save Edits*.

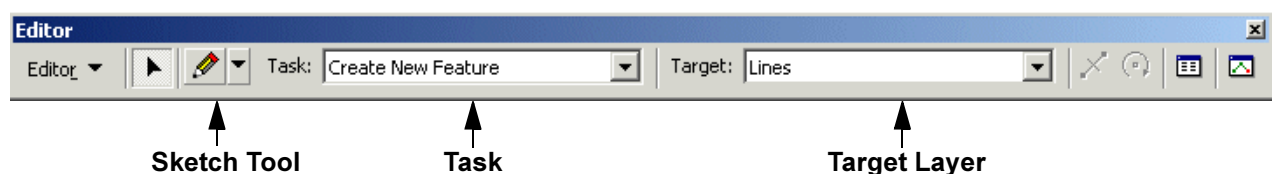
#### **STEP 12: ADD A FEATURE USING MORE SKETCH OPTIONS**

In this step, you will add a waterline for the subdivision.

☐ Click the *Add Data* button and from the *Subdivision* geodatabase, add the *Lines* layer to your map.

☐ If necessary, zoom out to see the entire water main.

To create new features, use the *Create New Feature* task, which works in conjunction with the Target layer.



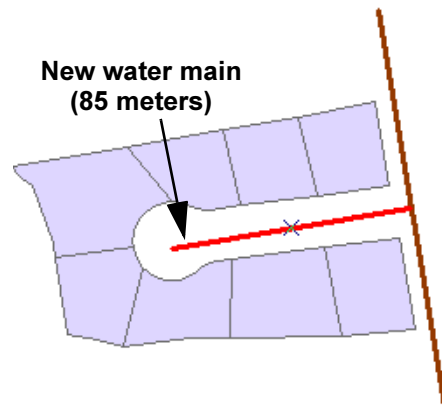
When new features are created, they are added to the Target layer. The Target layer only affects the creation of new features; you can still edit any features in editable layers of the map. The Target layer stores new features created by the Create New Feature task, Buffer command, Divide command, Copy Parallel command, Paste command, and other commands that create new features. You will use the Sketch Tool to create new features in the Lines layer.

- ☐ On the *Editor* toolbar, for *Target layer*, click *Lines*.
- ☐ Confirm that the *Task* is set to *Create New Feature* (it may still be set to *Auto-Complete Polygon*).

You will set the snapping to the vertices and edges of the *Lines* layer.

- ☐ Open the *Snapping Environment* window and check the *Vertex* and *Edge* check boxes for the *Lines* layer.
- ☐ Since you will not edit the *SubdivisionParcels* layer for now, turn off the *Vertex* snapping to this layer.
- ☐ Close the *Snapping Environment* window.

Next, add a waterline for the subdivision. The existing line is oriented along the through street to the right of the subdivision. The new water main will branch off from the exact middle of the existing line (toward the cul-de-sac). The new line will be 85 meters long and perpendicular to the existing line. Your finished waterline should resemble the one on the right.

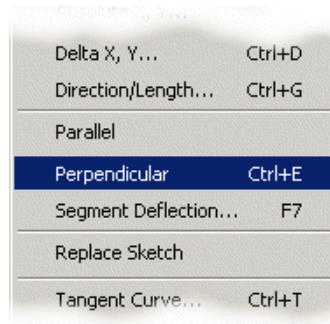


- ☐ Click the *Sketch Tool*.
- ☐ Hover the pointer over the existing water line.
- ☐ Right-click to access the *Sketch Tool context menu*.
- ☐ Click *Snap to Feature > Midpoint*.

The first vertex of the new line has been added and is snapped to the midpoint of the existing water line. The new water line needs to be added perpendicular to the existing line.

- ☐ Keep the pointer hovered over the existing water line and right-click to access the *Sketch Tool context menu*.

- Click *Perpendicular*.

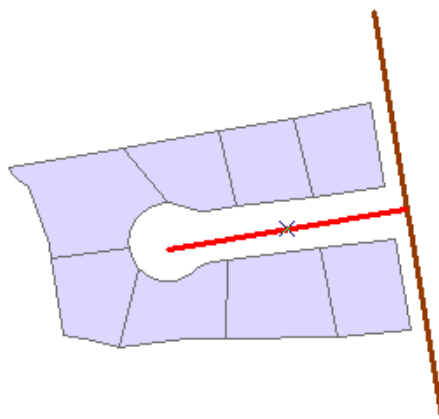


Parallel, Perpendicular, and Segment Deflection reference the feature you are holding the pointer over when you display the context menu.

Notice that the pointer is now fixed to move along a path perpendicular to the existing line you used. Now you add a line that is 85 meters long.

- Move the pointer towards the end of the cul-de-sac.
- Right-click to access the *Sketch Context Menu*.
- Click *Length*.
- For *Length*, type 85 and press **Enter**.
- Right-click and click *Finish Sketch*.

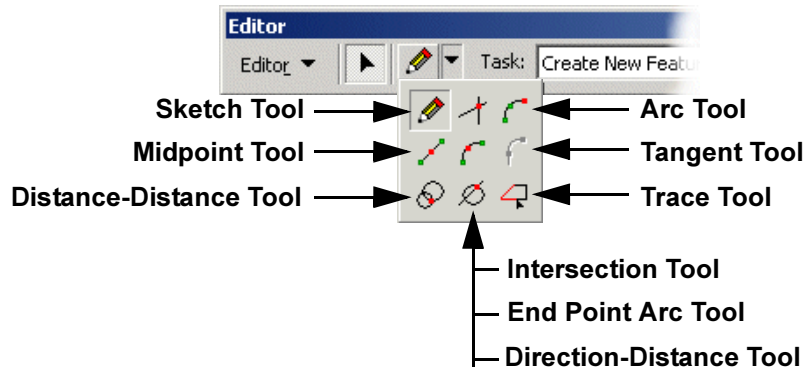
You should have a waterline going through the center of the cul-de-sac.



- Save your edits.

### STEP 13: USE MULTIPLE SKETCH TOOLS

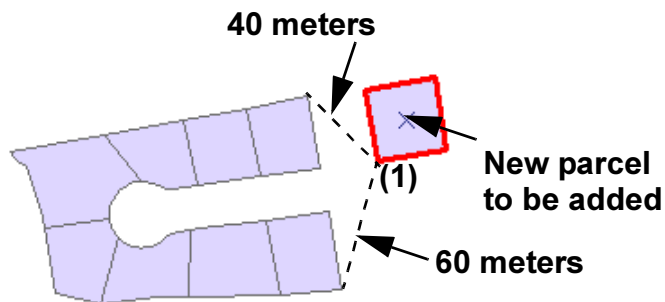
Eight other tools work in conjunction with the Sketch Tool. These tools are shown in the figure below and are available by clicking the down arrow next to the Sketch Tool.



The following is a brief description of what these tools do:

- The *Intersection tool* finds the implied intersection of two lines.
- The *Arc tool* creates circular arc segments for the current sketch. These arc segments are true curves with vertices at the beginning and end of the arc segment.
- The *Midpoint tool* places a vertex at the midpoint between two locations specified by the user.
- The *End Point Arc tool* creates a circular arc with an adjustable radius. The first two points are specified for the start and end of the curve. The third point controls the radius.
- The *Tangent tool* creates a circular arc based on the previously sketched segment.
- The *Distance-Distance tool* returns two possible points from the intersections of two circles drawn from two fixed points, you then pick which location to use in the sketch.
- The *Direction-Distance tool* allows you to enter in an angle and distance from known points to place a new vertex.
- The *Trace tool* allows you to trace along or at a specified offset from selected features.

You will create a parcel with a starting point 60 meters from the southeast lot corner and 40 meters from the northeast lot corner. When finished, your parcel should resemble the one on the right.




First, you will locate point (1), in the above figure, using the Distance-Distance tool.

☐ Turn off *Vertex* and *Edge* snapping for the *Lines* layer.

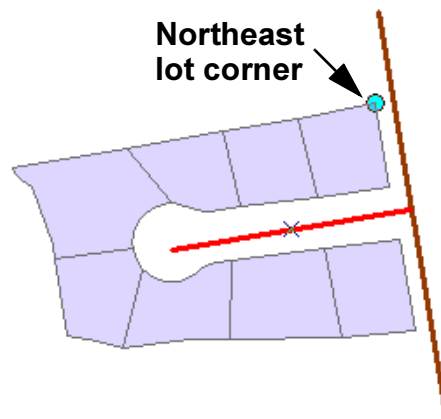
☐ Turn on *Vertex* snapping for *SubdivisionParcels* layer.

At this point, you are well acquainted with how the *Snapping Environment* window operates. For the remainder of this exercise, you can leave the *Snapping Environment* window open or closed, depending upon your preference.

☐ For *Target*, click *SubdivisionParcels*.

☐ Click the *Distance-Distance* tool .

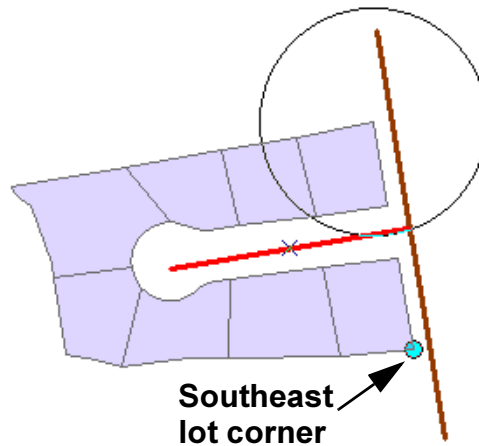
☐ Click the northeast lot corner.



The Distance-Distance tool lets you define distances using the mouse or by typing an explicit distance. If you choose to define the distance with the mouse, the distance is reported in the ArcMap message area in the lower-left corner of the application.

In this step, you will type an explicit distance. The R and D (radius and distance) keys on the keyboard allow you to type an explicit distance.

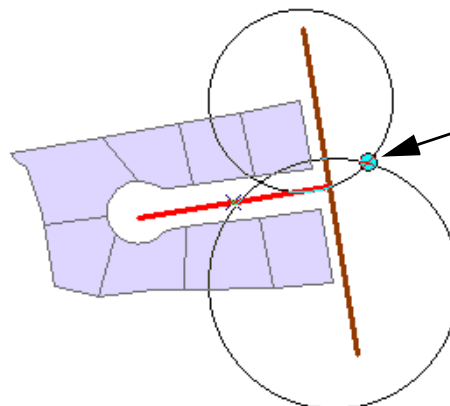
- ☐ Press **R** on the keyboard.
- ☐ Type **40** and press **Enter**.
- ☐ Click the southeast lot corner.



- ☐ Press **D** on the keyboard.
- ☐ Type **60** and press **Enter**.

After Distance-Distance specifies the two distances, you must pick the most appropriate location.

- ☐ Click the location east of the parcels.



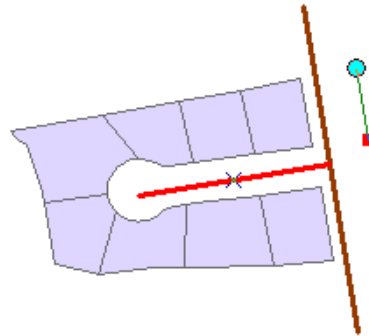
- ☐ Click the *Sketch Tool* button .



- ☐ Using the skills you just learned, add a segment that is 28 meters long and parallel to the waterline along the through street.

Hint: You will want to specify that the line is to be parallel to the waterline before you specify the length.

- ☐ Add the north boundary of the parcel perpendicular to the last segment (any length you want; 30 is suggested).

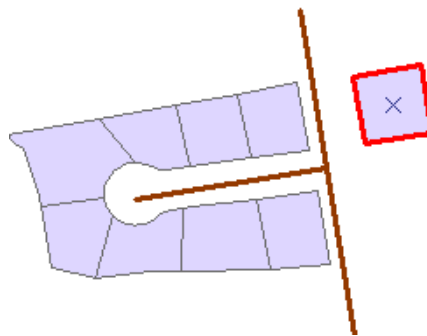


Hint: Use the Deflection command on the Sketch Tool context menu (you get this menu by right-clicking away from the current sketch) to specify that you want the next segment to be 90 degrees from the previous segment. Then use the Length command on the Sketch Tool context menu to specify that you want a length of 30.

Question 1: What is another method you can use to generate a right-angle with your sketch? \_\_\_\_\_

Hint: Examine the *Snapping Environment* window.

- ☐ Using the same method as above, add the east boundary of the parcel perpendicular to the last segment (any length you want; 28 is suggested).



- ☐ Right-click and click *Finish Sketch*.
- ☐ From the *Editor* menu, click *Stop Editing*; when prompted to Save Edits, click *Yes*.
- ☐ From the *ArcMap File* menu, click *Save As*.
- ☐ Save your map document to *C:\Student\igis1\Map\_Documents*, and name it **Ex07**
- ☐ Exit *ArcMap*.

**STEP 14: CREATE A NEW POINT FEATURE CLASS IN ARCCATALOG**

So far you have used edit tools to manipulate polygon and line feature geometries. Next, you will learn how to add point features. But before you can do that, you will need to create a new empty feature class in ArcCatalog, add it to your map, and then add new features.

- ☐ Open *ArcCatalog*.
- ☐ If necessary, navigate to the *C:\Student\igis1\Subdivision.mdb* personal geodatabase.
- ☐ Right-click on the *Subdivision.mdb* and click *New > Feature Class*.
- ☐ Enter *Hydrants* as the new feature class name and then click *Next*.
- ☐ Click *Next* to accept the default values for the *Configuration Keyword*.
- ☐ In the field definition dialog, click the *SHAPE* field.
- ☐ In the *Field Properties* box, click on the *Polygon* value to open the dropdown list.

- Select *Point* geometry type.

Field Name	Data Type
OBJECTID	Object ID
SHAPE	Geometry

Click any field to see its properties.

Field Properties	
Alias	SHAPE
Allow NULL values	Yes
Geometry Type	Point
Avg Num Points	Line
Grid 1	Multipoint
Grid 2	Point
Grid 3	Polygon
Contains Z values	No
Contains M values	No
Default Shape field	Yes
Spatial Reference	Unknown

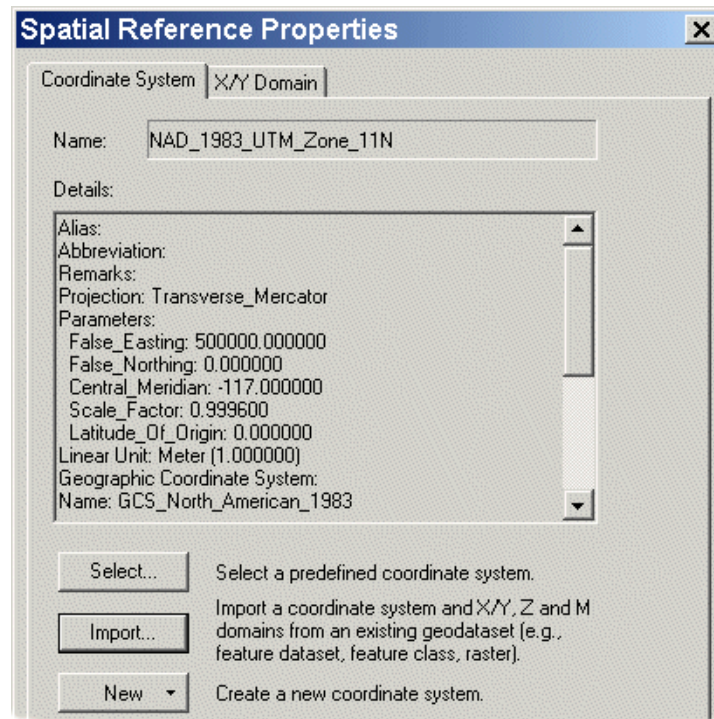
Import...

To add a new field, type the name into an empty row in the Field Name column, click in the Data Type column to choose the data type, then edit the Field Properties.

< Back   Finish   Cancel

- Click the *ellipses* button to the right of *Spatial Reference - Unknown* .
- Click the *Import* button in the *Spatial Reference Properties* window.
- If necessary, browse to *C:\Student\igis1\Subdivision.mdb* and select the *SubdivisionParcels* feature class.
- Click *Add*.

Notice that the spatial reference information for the existing *Subdivision Parcels* feature class has been transferred to your new *Hydrants* feature class.



☐ Click *OK* in the *Spatial Reference Properties* dialog.

You have just defined the geometry type and spatial reference for the spatial data in the new feature class. Next you will add a single user-defined attribute field, in this case, a text data type.

☐ Select the empty box below '*SHAPE*' in the *Field Names* column.

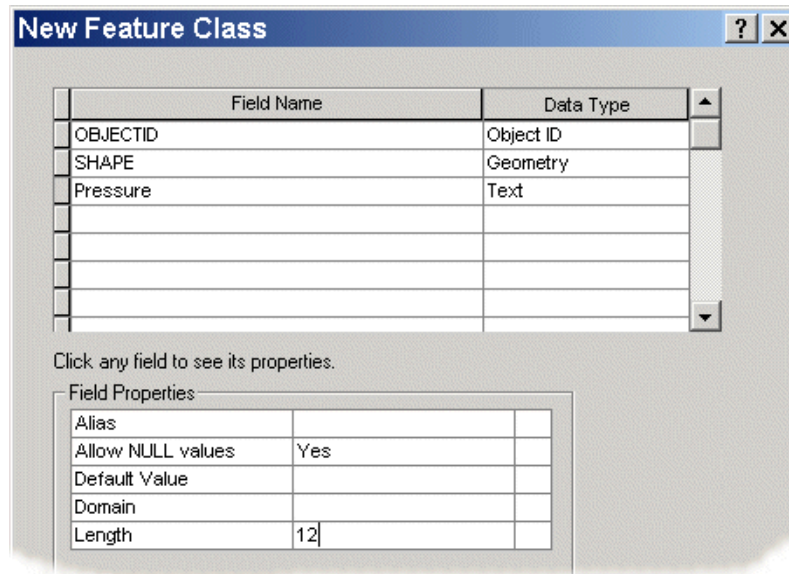
☐ Enter **Pressure**

☐ Under the *Data Type* dropdown list, select *Text* as the data field type.

- ☐ In the *Field Properties* section, change the default length of the text field to 12

- ☐ Click *Finish* in the *New Feature Class* dialog.

- ☐ If necessary, right-click the *Subdivision.mdb* personal geodatabase and click *Refresh* to confirm that the new *Hydrant* feature class has been successfully added.



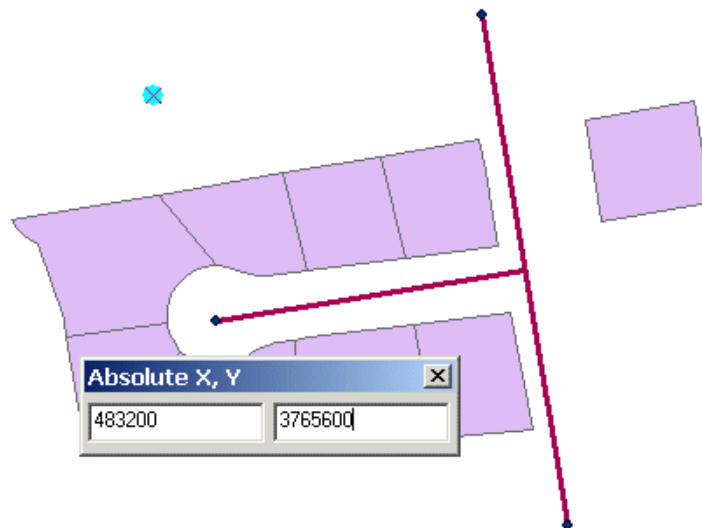
- ☐ Exit *ArcCatalog*.

### STEP 15: CREATE NEW FEATURES IN YOUR NEW FEATURE CLASS

Now that you have created a new empty feature class, you will need to add point features to it. In this step, you will learn to add point features manually using the *Sketch Tool* and by explicit location using the *Absolute X,Y* function.

- ☐ Start *ArcMap*.
- ☐ In the *Startup Dialog*, select the *Ex07.mxd* document you created in the step before last.
- ☐ Click the *Add Data* button and navigate to the *C:\Student\igis1\Subdivision.mdb* personal geodatabase.
- ☐ Click *Hydrants* and click *Add*.
- ☐ On the *Editor* menu, click *Start Editing*.
- ☐ Set your *Snapping Environment* so that only the three boxes for the *Lines* are checked.
- ☐ Confirm that your *Target* layer is set to *Hydrants*.

- ☐ Select the *Sketch Tool* and add a new hydrant at the three ends of the water line. You can add them in any order.
- ☐ Right-click to open the *Sketch Tool* context menu and select *Absolute X,Y*.
- ☐ In the *Absolute X,Y* dialog, enter 483200 and 3765600



- ☐ Press **Enter**.

You have now learned two methods for adding point data to a new feature class.

- ☐ From the *Editor* menu, click *Save Edits*.
- ☐ From the *Editor* menu, click *Stop Editing*.
- ☐ Exit *ArcMap*; do not save changes to the map document.

In this exercise, you learned to set the snapping options for editing. You created polygon, line, and point features using the Sketch Tool and used some of the sketch options: Parallel, Perpendicular, Length, and Absolute XY. You also used the Distance-Distance tool to create new features, and you created a new empty feature class in ArcCatalog.

## ***EXERCISE END***

## ***ANSWERS TO EXERCISE 7A QUESTIONS***

Question 1: What is another method you can use to generate a right-angle with your sketch?

**Answer: Use the ‘Perpendicular To Sketch’ snap agent in the Snapping Environment window.**

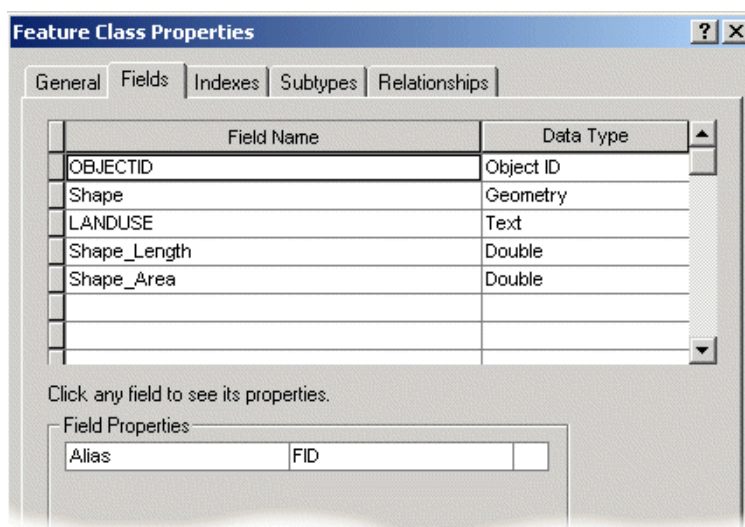
## EXERCISE 7B: EDIT ATTRIBUTE DATA

In this exercise, you will add a LandValue field to the SubdivisionParcels attribute table, and then calculate the values for that field in one operation using the Field Calculator. You will determine the value using an expression that calculates the value based on a cost per square meter. Then you will select several parcels to update their LANDUSE attribute values individually using the Attribute editor.

### STEP 1: ADD AN ATTRIBUTE FIELD

In this step, you will add a LandValue field to the SubdivisionParcels attribute table, and later you will populate its values using the Field Calculator.

- ☐ Start *ArcCatalog* and navigate to *C:\Student\igis1\Subdivision.mdb*.
- ☐ Right-click on the *SubdivisionParcels* feature class and click *Properties*.
- ☐ On the *Feature Class Properties* dialog, click the *Fields* tab.

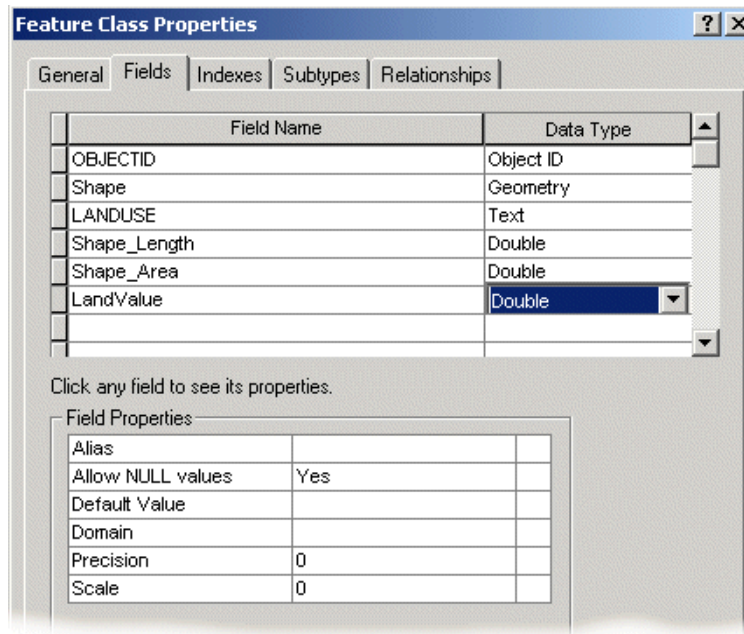


- ☐ Click the row underneath the *Shape\_Area* field and type *LandValue* for the *Field Name*.
- ☐ For *Data Type*, click *Double*.
- ☐ Ensure that the *Allow NULL values* field property is set to *Yes*.



Edit attribute data

- Click *OK*.



- Now preview the table for the *SubdivisionParcels* feature class. You should notice the new *LandValue* field exists on the table.

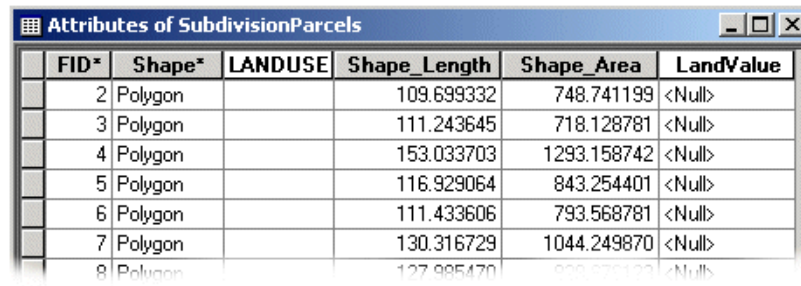
Next, you will use ArcMap to add values for this field.

## **STEP 2: START ARCMAP AND LOAD THE DATA**

In this step, you will add the *SubdivisionParcels* feature class to a new map document.

- Start *ArcMap* using *A new empty map*.
- In *ArcCatalog*, navigate to the *SubdivisionParcels* feature class from the *Subdivision* personal geodatabase and drag and drop it to your new map.

- In *ArcMap*, right-click on the *SubdivisionParcels* layer and click *Open Attribute Table*.



FID*	Shape*	LANDUSE	Shape_Length	Shape_Area	LandValue
2	Polygon		109.699332	748.741199	<Null>
3	Polygon		111.243645	718.128781	<Null>
4	Polygon		153.033703	1293.158742	<Null>
5	Polygon		116.929064	843.254401	<Null>
6	Polygon		111.433606	793.568781	<Null>
7	Polygon		130.316729	1044.249870	<Null>
8	Polygon		127.985470	822.276123	<Null>

Notice that LANDUSE has no values and LandValue has <Null> values. You will first populate, in one operation, the LandValue field using the Field Calculator. Later you will learn a different method, where you will populate the LANDUSE field by individually updating the attribute values using the Attributes editor on the Editor toolbar.

### STEP 3: OPEN THE FIELD CALCULATOR

In this step, you will use the Field Calculator to populate the LandValue field in the SubdivisionParcels layer.

- If necessary, clear all the selected records by clicking on the *Options* button > *Clear Selection*.

Notice the LandValue field has <Null> value for all the parcels. You will populate this field with values in the next step. First, you will start an edit session.

- On the *Editor* toolbar, click *Editor* > *Start Editing*.
- In the *Attributes of SubdivisionParcels* table, right-click on the *LandValue* field and click *Calculate Values*.

The Field Calculator displays.

### STEP 4: CREATE AN EXPRESSION

The value of each parcel is based on its size and is calculated at fifty dollars per square meter. To calculate the value of each parcel, you will multiply the area of each parcel by 50. The area of each parcel is contained in the Shape\_Area field.

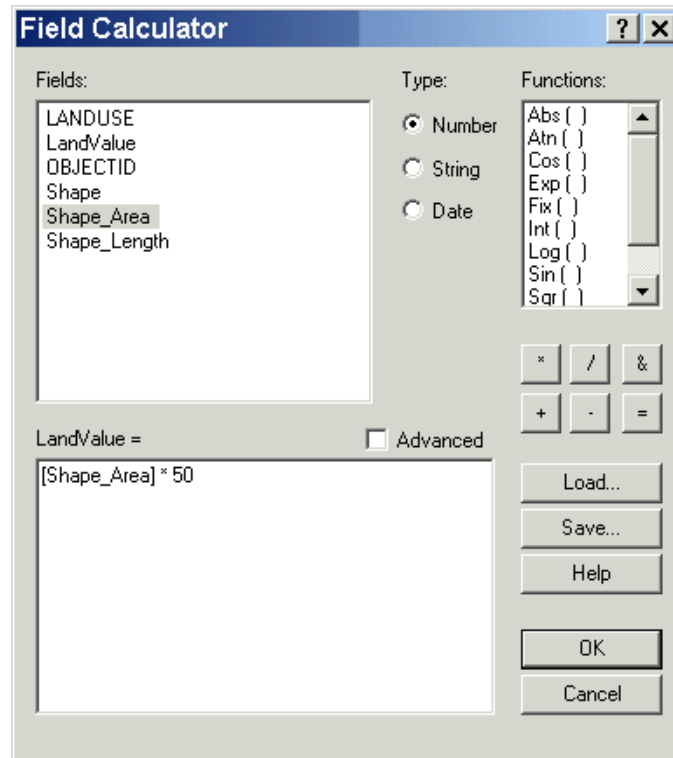
- In the *Fields* scrolling list, click on *Shape\_Area*.

## Edit attribute data

The field is added to the expression box.

□ Click the *Multiply* button (\*) to the right of the expression box.

□ Click in the expression box, add a space, and type 50



□ Click *OK* to update the *LandValue* field.

ArcMap calculates the new values for each record in the *LandValue* field and updates the attribute table.

	FID*	Shape*	LANDUSE	Shape_Length	Shape_Area	LandValue
	1	Polygon		110.405352	758.379839	37918.991925
	2	Polygon		109.698098	748.725684	37436.284200
	3	Polygon		111.245378	718.135263	35906.763150
	4	Polygon		153.033469	1293.154156	64657.707775
	5	Polygon		116.929064	843.254401	42162.720075
	6	Polygon		111.432593	793.558550	39677.927500
	7	Polygon		130.316728	1044.247779	52212.388950
	8	Polygon		127.984279	828.667892	41433.394600

Record: 0 Show: All Selected Records (0 out of 8 Selected.) Options ▾

☐ Close the *Attributes of SubdivisionParcels* table.

☐ Click *Editor > Save Edits*.

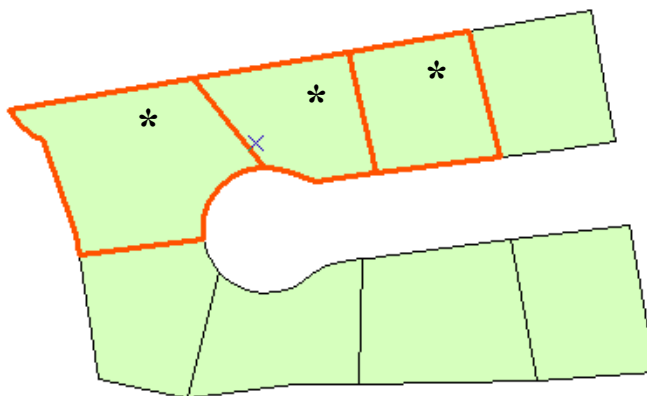
In this step, you used the Field Calculator to calculate all the values of the LandValue field in one operation. Next, you will experiment with a different method of individually updating attribute values.

#### **STEP 5: SELECT SEVERAL PARCELS**

In this step, you will use the Attributes editor on the Editor toolbar to populate the values for the LANDUSE field in the SubdivisionParcels layer. First, you'll select the parcels whose attributes you want to examine.

☐ Click the *Edit* button .

☐ Hold down the **shift** key and click on the three parcels in the top left (marked with \* in the figure below) to select them.

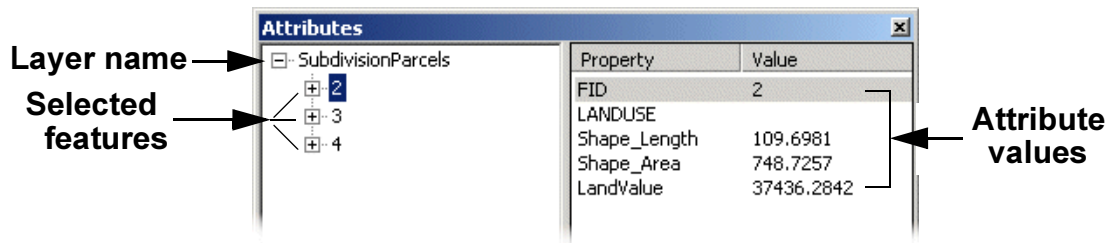


#### **STEP 6: VIEW THE ATTRIBUTES OF THE SELECTED PARCEL**

Next, you will open the Attributes editor for individually updating the LANDUSE field values.

☐ On the *Editor* toolbar, click the *Attributes* button .

The Attributes editor opens.



The Attributes editor displays the attributes of the selected parcels. Clicking on an attribute's number in the left panel updates the panel on the right with that parcel's attributes.

#### STEP 7: EXAMINE THE ATTRIBUTE VALUES

In this step, you will examine the attribute values.

- ☐ Click on one of the features in the left panel of the *Attributes* editor.

Notice that the feature flashes in the display. Examine its attributes.

- ☐ Click on another feature in the *Attributes* editor.

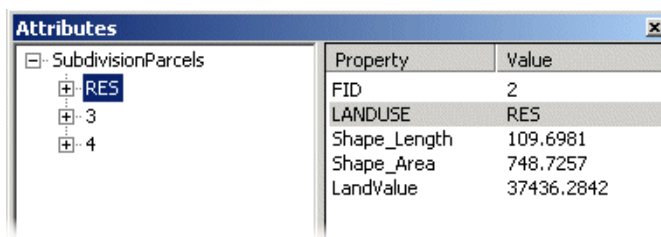
Notice that all the LANDUSE values of the selected parcels are blank. You will add these values in the next step.

#### STEP 8: ASSIGN A LANDUSE CODE TO A PARCEL

In this step, you will populate the LANDUSE field with landuse codes for these three selected parcels.

- ☐ In the left panel of the *Attributes* editor, click on parcel number 2.

- ☐ In the *Attributes* editor, click in the cell under the *Value* column for the *LANDUSE* property, type RES (for residential) and press **Enter**.

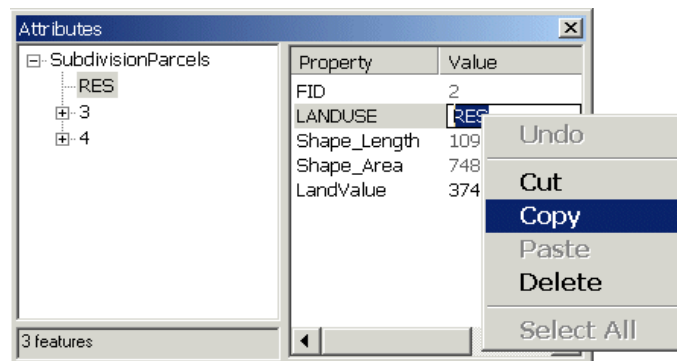


The LANDUSE field is updated with the value you typed. The primary display field, shown in the left panel, shows the updated value as well.

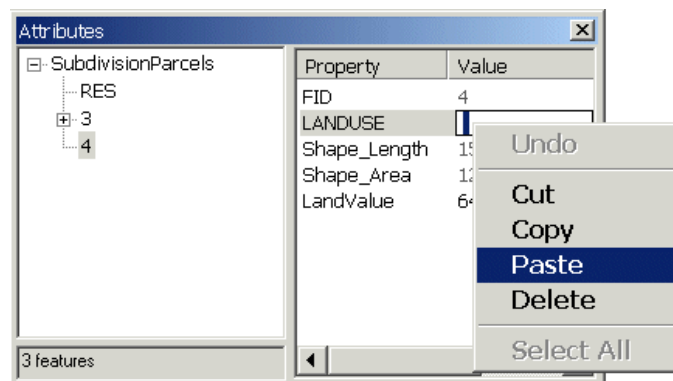
**STEP 9: COPY AND PASTE ATTRIBUTES**

You can also copy and paste attribute values from one feature to another.

- For parcel number 2, highlight the value for *LANDUSE*, right-click, and click *Copy*.



- Right-click on the value area for *LANDUSE* for a different parcel and click *Paste*.

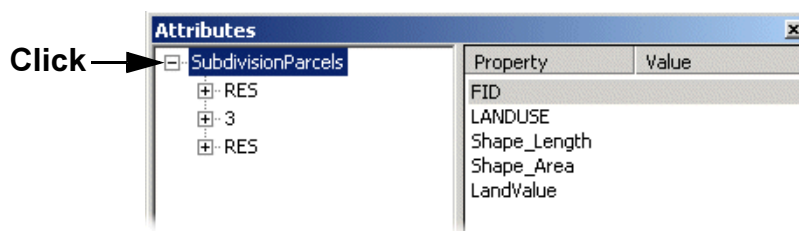


The LANDUSE value has been changed for parcel number 4.

**STEP 10: ASSIGN ATTRIBUTES TO ALL SELECTED FEATURES**

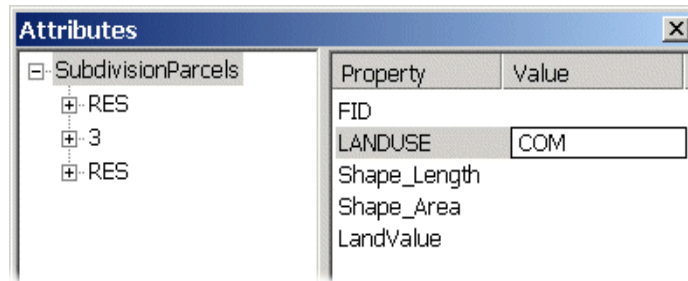
At times you may want to assign the same attribute value to several selected parcels in one operation using the Attributes editor.

- Click *SubdivisionParcels* in the left pane of the *Attributes* editor.



## Edit attribute data

- Look under *Property* for *LANDUSE* and under *Value*, type *COM* and press **Enter**.



All selected parcels are updated with a value of *COM* for *LANDUSE*.

- Confirm that all features have a *LANDUSE* value of *COM* by clicking on each of them in the *Attributes* editor.
- Close the *Attributes* editor.

### STEP 11: SAVE EDITS AND EXIT ARCMAP

- Click *Editor* > *Save Edits*.
- Click *Editor* > *Stop Editing*.
- Exit *ArcMap* without saving the map document.

In this exercise, you learned two methods of updating the attributes of a field in your feature class: one using the Field Calculator and the other using the Attributes editor.

## EXERCISE END







# *Working with georeferenced data*

**Exercise 8: Work with map  
scale and projections**

Recognize and set map scale  
Examine how a map's  
projection can affect distance  
Observe how a map's  
projection can affect shape  
Examine the Redlands data  
Project a shapefile

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## EXERCISE 8: WORK WITH MAP SCALE AND PROJECTIONS

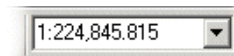
This exercise demonstrates how different projections can affect your data—specifically by distorting properties of shape, area, distance, and direction. You will also examine the projection properties of some of the data in the class database and use the projection tools in ArcToolbox to project a shapefile.

### STEP 1: RECOGNIZE AND SET MAP SCALE

First, you will start ArcMap, open an existing map document, and add the layers you will need in this exercise.

- ☐ Start *ArcMap*, click to open *An existing map*, and then click *OK*.
- ☐ Navigate to the *C:\Student\igis1\Map\_documents* folder.
- ☐ Double-click *ex\_projections.mxd* to open it.

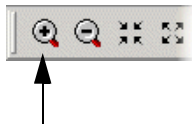
Selected city and world country features are drawn in ArcMap at a scale so they will fit in the ArcMap display area. The scale is displayed on the Standard toolbar. Your scale may differ from the one shown here depending on the size of your ArcMap application window.



The scale display tells you that one unit on the map (e.g., meters, feet, miles) is equal to, in this map's example, 224,845,815 of the same units on the ground.

Next, change the map scale by zooming in on the data.

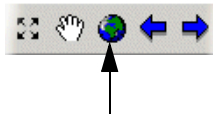
- ☐ Click the *Zoom In* tool.



- ☐ Click and drag a box around the island groups north and west of Australia (Indonesia, Philippines, and so on).

Notice that the current scale becomes larger as you zoom in and that the amount of detail in the map becomes more apparent with the enlarged scale.

- Click the *Full Extent* button.



You can also see coordinate locations in the status bar of ArcMap. Coordinate locations are shown on the right-hand side of the status bar. The numbers represent map units (i.e., the coordinates in which your data is stored or into which it is projected). The world's countries and selected cities are displayed using the Plate Carree world projection, which uses meters as the linear unit; therefore, the coordinates are displayed in meters.

**NOTE:** If your coordinates in the status bar display are in units other than meters, you can set it to display in meters. Right-click on the Layers data frame > Properties > General. For Units Display, select Meters.

- To confirm the projection is *World\_Plate\_Carree*, right-click on the *Layers data frame* > *Properties* > *Coordinate System*.

! If you receive a warning that the coordinate system differs from some of the data sources the map, check **Don't warn me again in this session** and click **YES**. (Some of the layers in this document are being projected on the fly in ArcMap from different coordinate systems)

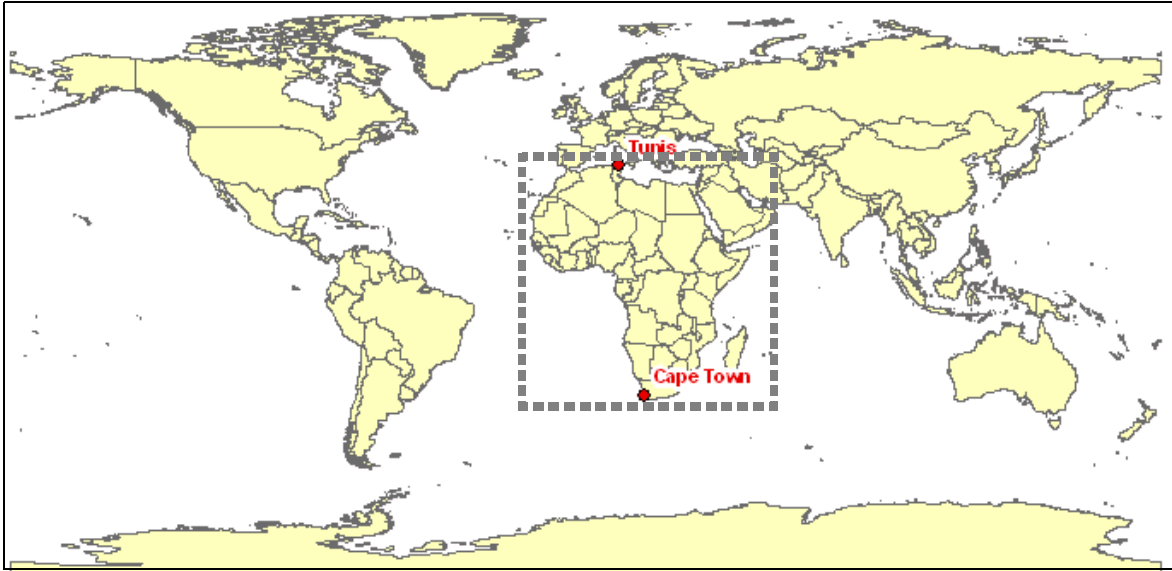
- Move your mouse around the display area and notice that the coordinates change.

## STEP 2: EXAMINE HOW A MAP'S PROJECTION CAN AFFECT DISTANCE

Projecting spatial data generally results in the distortion of at least one of the spatial properties of shape, area, distance, and direction. To demonstrate how projections can distort spatial properties, such as distance, you will measure the distance between two African cities (Tunis, Tunisia, and Cape Town, South Africa) using two different projections. First, you will need to zoom in to the area of interest.

- Click the *Zoom In* button.

- ☐ Click and drag a box around Africa, ensure that both Tunis and Cape Town are displayed within the map.



- ☐ Click the *Measure* tool. 
- ☐ Click *Tunis* and then double-click *Cape Town* to measure the distance between the two cities.

The distance displays on the left-hand side of the status bar. Your result should be around 8,000 kilometers (1 kilometer = 1,000 meters). Do not worry if your result is slightly different. Now you will change the projection and measure the distance again.

- ☐ In the *Table of Contents*, right-click the *Layers* data frame; then click *Properties*.
- ☐ Click the *Coordinate System* tab.
- ☐ For *Select a coordinate system*, click the *Predefined* folder to expand it.
- ☐ Click the *Projected Coordinate Systems* folder to expand it.
- ☐ Click the *World* folder.
- ☐ Click *Behrmann (world)*.
- ☐ Click *Apply*.
- ☐ Click the *General* tab.

- ☐ For *Display* units, click *Kilometers*.
- ☐ Click *OK*.
- ☐ Remeasure the distance between *Tunis* and *Cape Town*.

The new distance should be around 8,500 km, a difference of 500 km. If you were flying a plane between these two cities, how important do you think it would be to choose the right projection for your map?

### **STEP 3: OBSERVE HOW A MAP'S PROJECTION CAN AFFECT SHAPE**

In this step, you will see how shape changes when the projection changes. To see the shape changes clearly, you will project a layer that contains circular smiling faces. The circular shapes make it easy to see the distortion. Begin by setting the projection back to Plate Carree.

- ☐ In the *Table of Contents*, uncheck the *Selected cities* layer to turn it off.
- ☐ Click the *Full Extent* button to return to the full extent of all the layers.
- ☐ Right-click the *Layers* data frame and click *Properties*.
- ☐ Click the *Coordinate System* tab.
- ☐ For *Select a coordinate system*, click the *Predefined* folder.
- ☐ Click the *Projected Coordinate Systems* folder.
- ☐ Click the *World* folder.
- ☐ Click *Plate Carree (world)*.
- ☐ Click *OK*.

Next, add the circular smiling faces to your map.

- ☐ In the *Table of Contents*, check the box to display the *Circles* layer.

Now change projections and examine the distortion of the circles.

- ☐ Double-click on the *Layers* data frame to open the *Data Frame Properties* dialog.
- ☐ Click the *Coordinate System* tab.

- ☐ For *Select a coordinate system*, click the *Predefined* folder.
- ☐ Click the *Projected Coordinate Systems* folder.
- ☐ Click the *World* folder.
- ☐ Click *Miller Cylindrical (world)*.
- ☐ Click *OK*.

Notice that the faces along the equator seem to be less distorted than the ones to the north and south. Try a couple more projections to see how they distort the shapes of the faces. Mollweide (world) and Equidistant Conic (world) give some interesting results. You can also try measuring distances to see if shape and distance are distorted in the same projection. As you experiment, observe where distortion is minimized and where it increases for each projection. Also, try to imagine what applications each particular projection might be appropriate for.

- ☐ When finished, exit *ArcMap* without saving your changes.

#### **STEP 4: EXAMINE THE REDLANDS DATA**

- ☐ Start *ArcCatalog*.
- ☐ Navigate to the *C:\Student\igis1\Redlands* folder.
- ☐ Click *mastercov* and preview its geography.

The mastercov coverage stores the boundary polygon of the city of Redlands in a suitable projection chosen for your class database. The projection information can be viewed in the metadata.

- ☐ Click on the *Metadata* tab to activate the *Metadata* view.
- ☐ Click on the *Spatial* tab.
- ☐ Click on *Details* to expand the horizontal coordinate system information and examine the information displayed for the *mastercov*.

Question 1: What projection is used for storing the mastercov coordinates? \_\_\_\_\_

Question 2: What are the planar distance units (the measurement units)? \_\_\_\_\_

Question 3: Which datum is used to reference this data? \_\_\_\_\_

The Universal Transverse Mercator, or UTM, projection divides the globe into sixty zones, each spanning six degrees of longitude. Each zone has its own central meridian. Redlands falls right in the middle of Zone 11 North. UTM was chosen as the standard projection for the Redlands data used in this class.

### STEP 5: PROJECT A SHAPEFILE

While ArcMap is able to project data on the fly to match the coordinate system chosen for viewing layers in a data frame, it will sometimes be necessary to physically project data to a new coordinate system. Perhaps you received data from another agency that uses a different coordinate system than your organization. You want to project the new data to match your existing data before incorporating it into your database. Many of the spatial analysis techniques in ArcGIS require that data in different layers have the same coordinate system.

The censusBlk shapefile in the Redlands folder was converted from a Census TIGER file. Data from the US Census Bureau is stored and distributed in geographic coordinates.


- ☐ Click on *censusBlk* and view its *Spatial* properties in the *Metadata*. Notice that the *censusBlk* shapefile only has geographic coordinate parameters.

Question 4: Which datum is used to reference the censusBlk shapefile? \_\_\_\_\_

Question 5: What are the geographic coordinate units? \_\_\_\_\_

Latitude/Longitude is a good system for storing spatial data, but it is not very good for viewing, querying, or analyzing maps. Remember, degrees of latitude and longitude are not consistent units for measuring area, shape, distance, and direction.


Next, you will use the Project Tool in ArcToolbox to project this data to match the rest of the Redlands data.

- ☐ Open the *ArcToolbox* window.
- ☐ Click the plus sign  next to *Data Management Tools* to expand its contents.
- ☐ Expand the *Projections and Transformations > Feature* toolset.
- ☐ Double-click the *Project* tool to open the dialog window.
- ☐ Click the *browse* button next to *Input Dataset or Feature Class*. Navigate to and select the *censusBlk* shapefile in the *Redlands* folder.



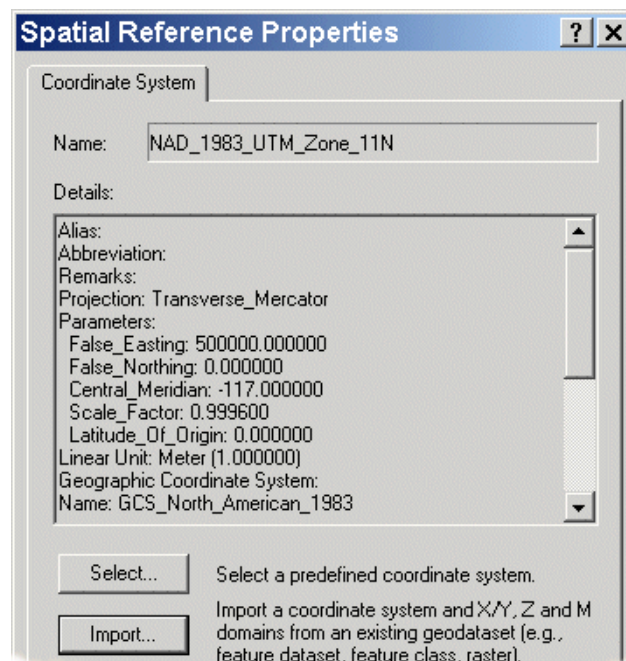
- ☐ Click *Add*.
- ☐ To select the *Output Dataset or Feature Class*, navigate to the *Redlands* folder.
- ☐ Enter *CensusBlock* as the name of your new projected shapefile.
- ☐ Click *Save*.

The Project tool allows you to match the coordinate system information of existing data through the Import option.

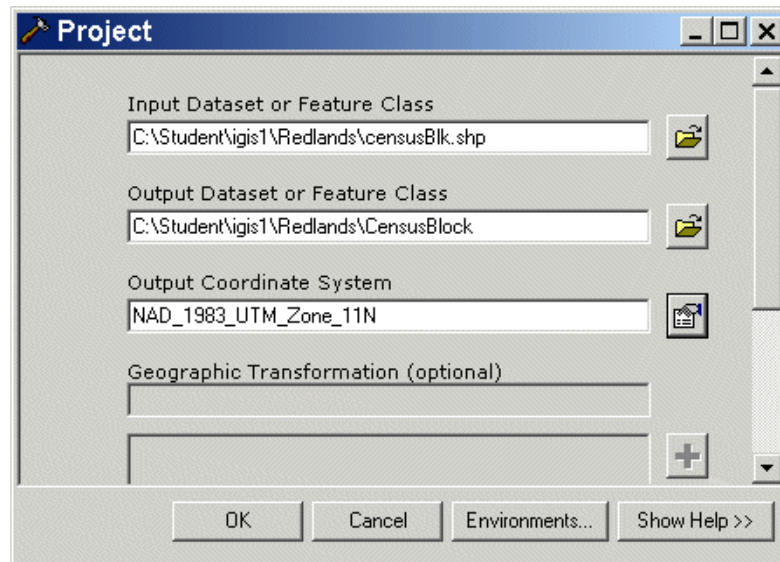
- ☐ Click the button to the right of the *Output Coordinate System* text box ; this will open the *Spatial Reference Properties* dialog.
- ☐ Click *Import*.
- ☐ From the *Redlands* folder, add *mastercov*.

The coordinate system information fills in on the Spatial Reference Properties dialog.

- ☐ Click *OK*.



Your Project dialog should look like this:



☐ Click *OK*.

It may take a few moments for ArcGIS to project the data, as there are almost 42,000 census blocks that need to be reprojected. You will notice that the Geoprocessing window has opened to display the status of your spatial operation.

☐ Close the *Toolbox* and *Geoprocessing* windows when the projection has finished

In ArcCatalog, check the Metadata for the new CensusBlock shapefile to see the changed projection information. You may need to refresh the ArcCatalog display to see the new shapefile.

☐ If necessary, click on the *Redlands* folder, and press the **F5** key to refresh the display.

☐ Click on *CensusBlock* and view the *Spatial* properties in the *Metadata*.

You have successfully projected the shapefile from a geographic coordinate system to a UTM projected coordinate system.

☐ Exit *ArcCatalog*.

## ***EXERCISE END***

## ***ANSWERS TO EXERCISE 8 QUESTIONS***

Question 1: What projection is used for storing the mastercov coordinates?

**Answer: Universal Transverse Mercator (UTM)**

Question 2: What are the planar distance units (the measurement units)?

**Answer: meters**

Question 3: Which datum is used to reference this data?

**Answer: North America Datum 1983 (NAD83)**

Question 4: Which datum is used to reference the censusBlk shapefile?

**Answer: North America Datum 1983 (NAD83)**

Question 5: What are the geographic coordinate units?

**Answer: decimal degrees**





# *Presenting data*

**Exercise 9: Create a map**

Start ArcMap and open  
an existing map  
Add a legend  
Add a scale bar  
Add a north arrow  
Add a title and other  
textual information  
Add a border and a  
background shade to  
your map  
Maintain visual balance  
Add your map layout to  
another document (optional)  
Save your map document  
and exit ArcMap  
Challenge: Add a reference  
grid to your map

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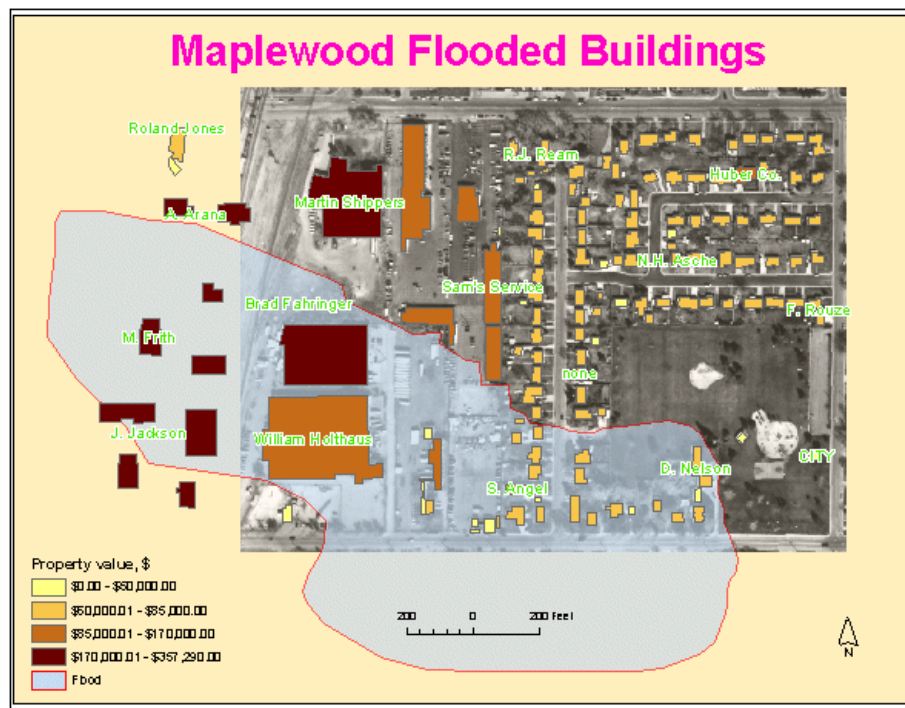
9-11

9-12



## EXERCISE 9: CREATE A MAP

A local insurance agency needs to formalize insurance premium guidelines for buildings that are in the Maplewood flood zone. You will create a map of all the buildings in the flood zone and add it to your report.



### STEP 1: START ARCMAP AND OPEN AN EXISTING MAP

- ☐ Start *ArcMap*.
- ☐ Select *Start using ArcMap with an existing map*.
- ☐ Click *OK*.
- ☐ In the *Open* window, navigate to *C:\Student\igis1\Maplewood*.
- ☐ Double-click *ex\_layout.mxd*.

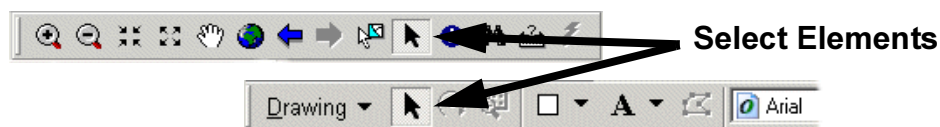
The ArcMap interface shows the *ex\_layout.mxd* file, which you saved in Exercise 3. It is in Layout View.

If you did not successfully finish Exercise 3 or if you did not save the Exercise 3 map document as instructed, you can open an existing map document called `ex_layout.mxd` from the `...\Results\Ex03` folder that comes on the CD-ROM for this course.

When you finished Exercise 3, you had a layout with one data frame on it. Your map was in landscape format, but it had no other map elements.

In this exercise, you will add map elements to the map to make it more useful. Map elements include a legend, a north arrow, a map title, a scale bar, dates for the data and map, the name of the author, other textual disclosures or pertinent information, and perhaps an inset map.

The tools for creating the main map elements are located on the Insert menu of the ArcMap application. Use the map on the previous page as a guide when placing your map elements. When in the Layout View, move and resize map elements with the Select Elements tool, and right-click any selected map element to change its properties.



## STEP 2: ADD A LEGEND

A legend is the key to your map. In ArcMap, you can easily create a legend and enhance its look. However, before you display the legend, you will change some text in the Table of Contents because whatever is present in the Table of Contents will later display in the map's legend when you add it there.

In the Table of Contents, notice that the heading of the Buildings legend inherits the name of the field `VALUE` used in the classification procedure. You will change this heading so the reader can better understand what it means.

- ☐ In the *Table of Contents*, click the *VALUE* heading to highlight it.
- ☐ Click the *VALUE* heading again to start editing.
- ☐ Type `Property value`, `$` and press `Enter`.

You will now display the legend on your map.

- ☐ On the main *ArcMap* menu, click *Insert > Legend*.



The Legend Wizard appears. A series of panels will step you through the legend creation process. You will accept all of the default settings for this exercise, but take some time to examine the extensive variety of settings you can change with the wizard.

- ☐ Accepting all of the defaults, click *Next* until you reach the end of the wizard.
- ☐ Click *Finish*.

By default, all new elements are added around the center of the map. You will move the legend to a better location.

- ☐ Drag and drop the frame to where you want the legend to appear on your map (it is suggested the bottom left corner).
- ☐ Zoom in on the legend.

Notice that the legend appears with a default heading Legend. You will delete this word, as it is obvious what this map element is. Also, you are using the image photo as a mere background in the map, so there is no need to have details of that image photo in the legend. You will fix this as well. First, you will remove the Legend heading.

- ☐ Verify that the legend is the selected element on your layout page. It should have a blue dashed line with blue selection handles surrounding it. If not, click on the legend to select it.
- ☐ In the layout display area, right-click the displayed legend and click *Properties*.
- ☐ In the *Legend Properties* window, ensure that the *Legend* tab is active.
- ☐ Under *Title*, uncheck the *Show* check box.

The title will be removed from the displayed legend when you click Apply.

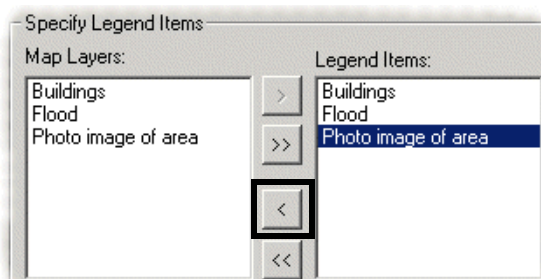
Next, you will remove the information about the image photo from the displayed legend.

- ☐ Click the *Items* tab.
- ☐ Under the *Legend Items* list, click the *Photo image of area*.

- ☐ Click the left arrow to transfer the *Photo image of area* to the *Map Layers* list. This will remove the photo image entry from the legend.

- ☐ Click *Apply*.

- ☐ Move the *Legend Properties* window aside to see the change on the map.



The legend now appears showing only the desired information.

The *Building* layer's name appears in the legend. This is also redundant information that you want to remove.






- ☐ Click *OK* to close the *Legend Properties* dialog.

- ☐ Double-click on the layer in the Table of Contents.

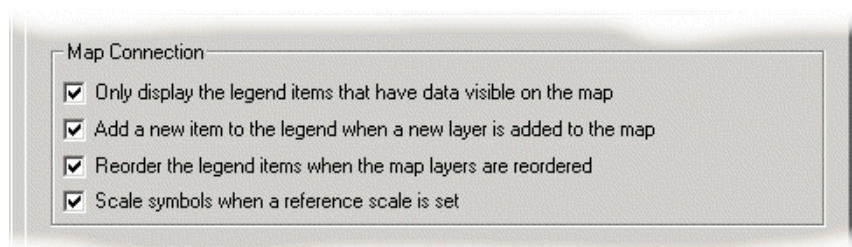
- ☐ Click the *General* tab of the *Layer Properties* dialog, erase the name from the *Layer Name* box, and click *OK* (ensure that you type the name of the layer in the Table of Contents after you print your map).

### Buildings

#### Property value, \$

	\$0.00 - \$50,000.00
	\$50,000.01 - \$85,000.00
	\$85,000.01 - \$170,000.00
	\$170,000.01 - \$357,290.00
	Flood

If time permits, return to the Legend Properties and explore the legend enhancement options under the different tabs in this menu. Of particular interest are the four Map Connection check boxes and the Style button under the Items tab.



These are on the wish list of any cartographer. As for this exercise, what you have done for the legend is enough.

### STEP 3: ADD A SCALE BAR

If the intended purpose of your map is to accurately measure distance, a scale bar is important to add to the map. On the other hand, some maps may not need a scale bar (e.g., a population density map of the USA), or perhaps the scale may not be consistent across your map because of the type of projection used, in which case a clear statement must be added to the map to warn the reader that the scale is not uniform throughout the map. Next, you will add a simple scale bar.

- ☐ Zoom out so you can see your entire layout (use the *Zoom Whole Page* button on the *Layout* toolbar).
- ☐ Click *Insert > Scale Bar*.
- ☐ In the *Scale Bar Selector* window, click *Scale Line 1*.
- ☐ Click *OK* to accept the defaults because you want to see how it looks before you decide on the changes you will make to its properties.

By default, the scale bar appears around the center of the page layout. You will want to move it to another location.

- ☐ Click and drag and drop the frame where you want the scale bar to appear on your map (preferably at the bottom; see the map on the first page of this exercise).

The scale bar appears with default properties that you will need to change. First, you will change the Scale and Units properties.

- ☐ Right-click the scale bar and click *Properties*.

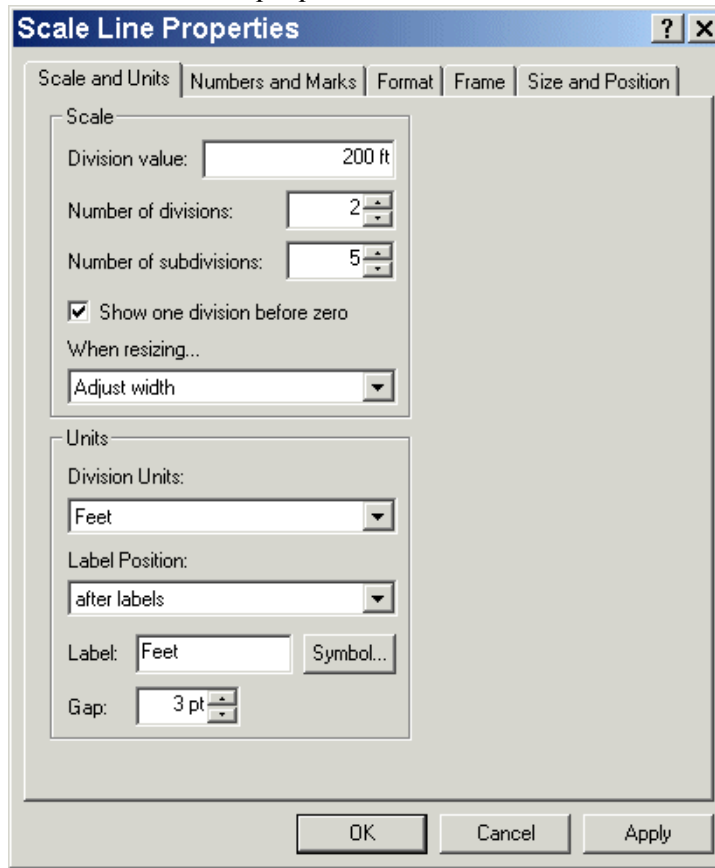
**NOTE:** Double-clicking on the scale bar will also result in the same effect.

- ☐ In the *Scale Line Properties* window, ensure that the *Scale and Units* tab is active.

Generally, the length of the scale bar should not exceed one third of the width of the map body. Your options are to add more intervals to a scale bar or increase the size of the interval. You will do the latter.

- ☐ On the *Scale and Units* tab, from the *When resizing* dropdown list, click *Adjust width*.
- ☐ For *Division value*, enter 200
- ☐ Confirm or enter 2 for the *Number of divisions*.

- ☐ For *Number of subdivisions*, enter 5
- ☐ Check the *Show one division before zero* check box.
- ☐ Keep the defaults for the rest of the properties.



- ☐ Click the *Apply* button to see how the scale bar looks.

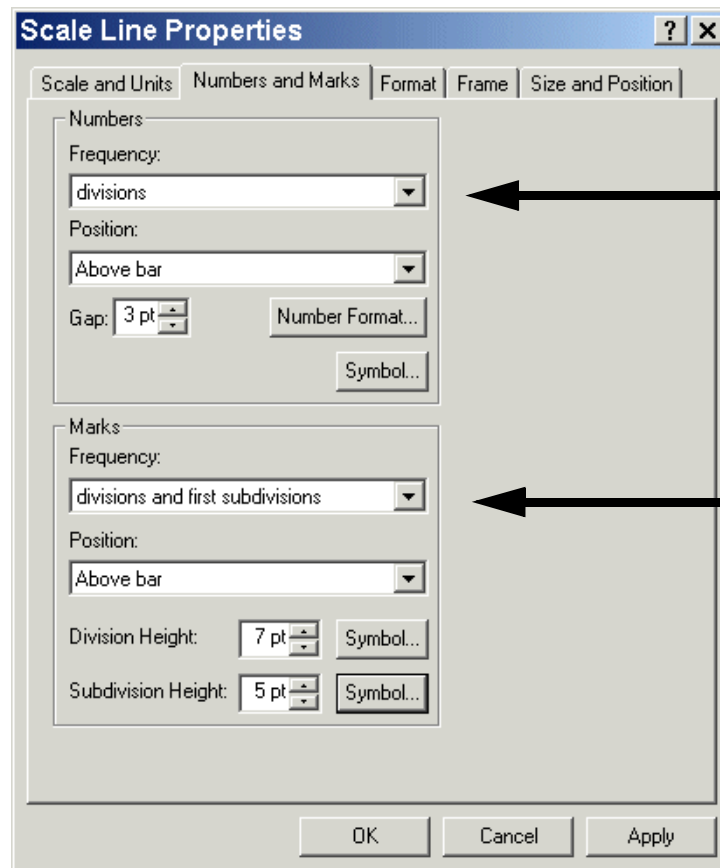
Notice that the 100 foot subdivision label on the left division appears to be redundant because there are five subdivisions, none of which are for the 100 foot mark.

Next, you will change the Numbers and Marks properties.

- ☐ In the *Scale Line Properties* dialog, click the *Numbers and Marks* tab.

Create a map

- On the *Numbers and Marks* tab, change the properties of the scale bar to match the graphic below.



- Click the *Apply* button to see how the scale bar looks thus far.

The scale bar should resemble what is shown below.



**NOTE:** The example above uses a boldfaced font and a thicker bar line. No instructions were given here on how this was done. You can change the properties of the scale bar lines and labels when you pick the *Format* tab on the *Scale Line Properties* dialog.

- Click *OK* to close the *Scale Line Properties* dialog.

#### STEP 4: ADD A NORTH ARROW

The north arrow gives the reader information about the orientation of the map. North arrows are not always desirable on maps. In fact, the appearance of a north arrow symbol on the map can be misleading; the north arrow may not point in the correct direction for the entire map area. Depending on the projection, the north arrow may be correct only along certain lines. The cartographer's responsibility is to clearly disclose this fact to the map reader in some form of textual information.

Next, you will add a north arrow symbol to your map.

☐ Click *Insert > North Arrow*.

☐ Choose *ESRI North 6*.

☐ Click *OK*.

The north arrow appears at a default location on the map that you will want to change.

☐ Click the north arrow frame and drag and drop it to where you want it to appear on your map, keeping in the mind the visual balance property of your map.

☐ Right-click the north arrow and click *Properties*.

☐ In the *North Arrow Properties* dialog, click the *North Arrow* tab, if necessary.

☐ For *Size*, type 50

☐ Click *Apply* and observe the change.

☐ Click *OK*.

☐ Click somewhere in the white space surrounding the map page to clear the selected north arrow.

#### STEP 5: ADD A TITLE AND OTHER TEXTUAL INFORMATION

The title of the map attracts people to the contents of the map. Now you will add a map title. First, you will select the text characteristics.

☐ On the *Draw* toolbar located at the bottom of the ArcMap window, choose 36 for the font size.



- ☐ Click the *B* button to get a boldface font.



- ☐ Click the arrow next to the *A* button to change the font color to a bright magenta shade (perhaps Ginger Pink).

Now you are ready to add the map title.

- ☐ Click the *New Text* button.
- ☐ Use the pointer (it appears as a cross with the letter *A* at its lower right) and click a position on the page. A box will appear with the word *Text* highlighted.
- ☐ Replace the word *Text* by typing **Maplewood Flooded Buildings** and press **Enter**.

The title will appear in magenta. You may want to move the title to a better location.

The magenta title may fall both on the white background (good contrast) and the black and white image (bad contrast). To reduce the darkness of the image, one of two things can be done: (1) Apply a Transparency to the Photo image of area layer by changing its display Properties, or (2) add a contrasting colored halo around the text by double-clicking the title to bring up the Text Properties window.

Similarly, you can add other textual information such as your name, the date of the data, the date you created the map, projection information, disclosures, sources of your data, and other pertinent information. Try not to overcrowd your map with lengthy paragraphs of text.

#### **STEP 6: ADD A BORDER AND A BACKGROUND SHADE TO YOUR MAP**

A border around your map contents will enhance your map's visual balance. A background shade is useful whenever you have a dark image on your map that makes the remaining white background area look empty or creates an unnecessarily high contrast.

First, you will add a border to your map.

- ☐ In the *Table of Contents*, right-click the *Layers* data frame and click *Properties*.

☐ In the *Data Frame Properties* window, click the *Frame* tab.

☐ For *Border*, click the dropdown arrow to choose a style.

☐ From the choices, click the *Triple, Ctr-W* border.

Next, you will add a background shade to your map.

☐ For *Background*, click the dropdown arrow and then click *Sand*.

☐ Click *Apply*.

☐ If you feel the background color and border reflect your aesthetic tastes, click *OK* to close the *Data Frame Properties* dialog.

If you want a reference grid on the map, you may not need a map border; the grid will provide one. See the second challenge step on page 9-12 for hints on adding a reference grid to your map.

### **STEP 7: MAINTAIN VISUAL BALANCE**

After all the necessary map elements are inserted in your map, some map elements may need to be brought up to a higher visual level, and others may have to be moved around in order to achieve good visual balance for your map. No explicit instructions are given here. If you have time and want to balance your map visually, consult your instructor.

### **STEP 8: ADD YOUR MAP LAYOUT TO ANOTHER DOCUMENT (OPTIONAL)**

Maps can be previewed, printed, exported, or added to any other OLE-compliant document. You will add your map to a Microsoft Word document if the application is available on your machine. First, create an export file containing your map; then import the file into Microsoft Word.

Export your map to an output file in BMP format.

☐ On the main *ArcMap* menu, click *File > Export Map*.

☐ For *Save in*, navigate to the *Maplewood* folder.

☐ For *Save as type*, click *BMP (\*.bmp)*—a *Windows Bitmap* format.

☐ For *File name*, type `flod`



## Create a map

☐ Click *Save*.

☐ Start *Microsoft Word*.

Now insert the BMP file into the Microsoft Word document.

☐ In *Word*, click *Insert > Picture > From File* to display the *Insert Picture* menu.

☐ For *Files of type*, click *Windows Bitmap (\*.bmp, \*.dib, \*.rle, \*.bmz)*.

☐ For *Look in*, navigate to where you saved the bitmap file (i.e., the *Maplewood* folder).

☐ Click *flood.bmp* and click *Insert*.

If your map does not fit well or if there are other problems, experiment with resizing the layout page and map elements in ArcMap.

☐ Save your *Microsoft Word* document as **Floodmap.doc** You may want to use this document as a report to submit to the insurance agency, which requires a map.

☐ Exit *Microsoft Word*.

### **STEP 9: SAVE YOUR MAP DOCUMENT AND EXIT ARCMAP**

Save your map document.

☐ On the main *ArcMap* menu, click *File > Save*.

If you are not going to continue on with the challenge steps, exit ArcMap.

☐ Click *File > Exit*.

In this exercise you created a complete map in ArcMap and added it to another document. You learned how to add text, a north arrow, a legend, a scale bar, and a border to your map.

*CHALLENGE: ADD A REFERENCE GRID TO YOUR MAP*

You can add a reference grid to your map. Your map is of a small area, so adding lines of latitude and longitude (known as graticules) may not be practical. Instead, you may want to divide your area into uniform blocks, known as an index grid, to make it easier to use. This is similar to what you see in city maps, where the map index shows the street names referenced by the block where the street lies. Next, you will add an index grid to your map.

☐ Right-click the *Layers* data frame and click *Properties*.

First, you will change the data frame name to a more meaningful name related to your project. Renaming the data frame is important if you want to add two or more data frames to your map (perhaps an index map and two inset maps). It would then be more practical to distinguish between the data frames by name.

☐ In the *Data Frame Properties* dialog, click the *General* tab.

☐ For *Name*, highlight the existing name and type **Maplewood**

Next, you will choose the type of reference grid that you want to add to your map.

☐ Click the *Grids* tab and click *New Grid*.

☐ In the first panel of the *Grids and Graticules Wizard*, click *Reference Grid: divides map into a grid for indexing*.

☐ Click *Next*.

☐ On the *Create a reference grid* panel, under *Appearance*, confirm that *Grid and index tabs* is chosen.

☐ For *Intervals*, confirm that your grid will be divided into *five* rows and *five* columns.

Next, you will change the properties of these grid lines.

☐ Click the *Line style* button.

☐ In the *Symbol Selector* dialog, for *Options*, click the *Color* button.

☐ On the color palette, choose *Delft Blue* (a dark blue color; ninth column, fifth row) for the grid lines.

**NOTE:** Remember this color as you will use it again shortly.

## Create a map

- ☐ On the *Symbol Selector* dialog, click *OK*.

- ☐ Click *Next* on the wizard panel.

Now you will design the grid tabs.

- ☐ On the *Create a reference grid* panel, under *Tab Style*, click *Rounded Tabs* from the *Tab type* dropdown list.

- ☐ For *Color*, accept the default: *Rose Quartz* (first row, second column).

Next, you will change the font properties, which will open the *Symbol Selector* dialog.

- ☐ Change the default *Arial* font to *Bold, Italic, Size 12*, and *Delft Blue* color.

- ☐ On the *Symbol Selector* dialog, click *OK*.

- ☐ Click *Next* on the wizard panel.

- ☐ On the next *Create a reference grid* panel, check the *Place a border between grid and axis labels* check box.

- ☐ Click the button with the line symbol on it, directly beneath the check box you just checked.

- ☐ On the *Symbol Selector* dialog, click the *Color* button.

- ☐ On the color palette, choose *Delft Blue* for the border.

- ☐ On the *Symbol Selector* dialog, click *OK*.

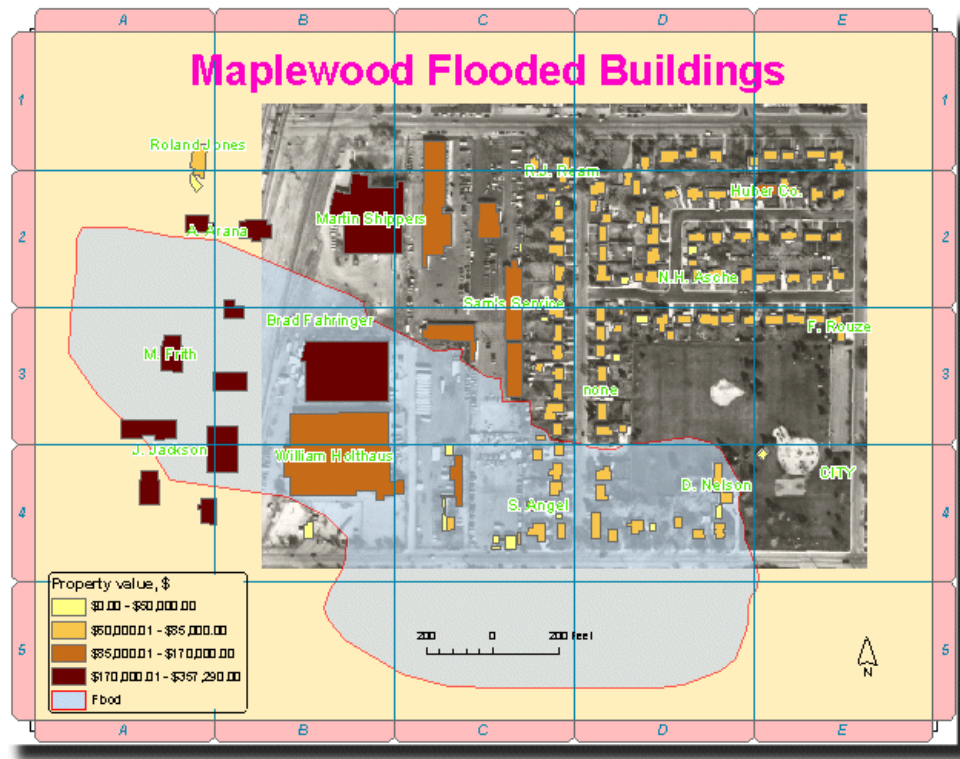
- ☐ On the *Create a reference grid* panel, click *Finish*.

- ☐ You have two options about how to store these reference grids in your map document: as static or dynamic graphic elements; you will store your reference grid as a *fixed grid*.

- ☐ On the *Data Frame Properties* dialog, click *OK*.

- ☐ If necessary, zoom to the *Full Extent* of your map layout, or press the **F5** key to refresh your Layout View.

The reference grid you created is now displayed on the map.



Notice that your legend and scale bar are both cut by the grid lines. Additional graphic manipulations are required to resolve this situation. Ask your instructor for hints about how this might be done.

**EXERCISE END**



A

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Important note
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*contents*



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