

MAPPING YOUR COMMUNITY

using ArcGIS® 9.2



Revised February 25, 2010

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<http://www.litzsinger.org/mapping/>

This material is based upon work supported by the National Science Foundation under Grants No. 0639638 and 0833663. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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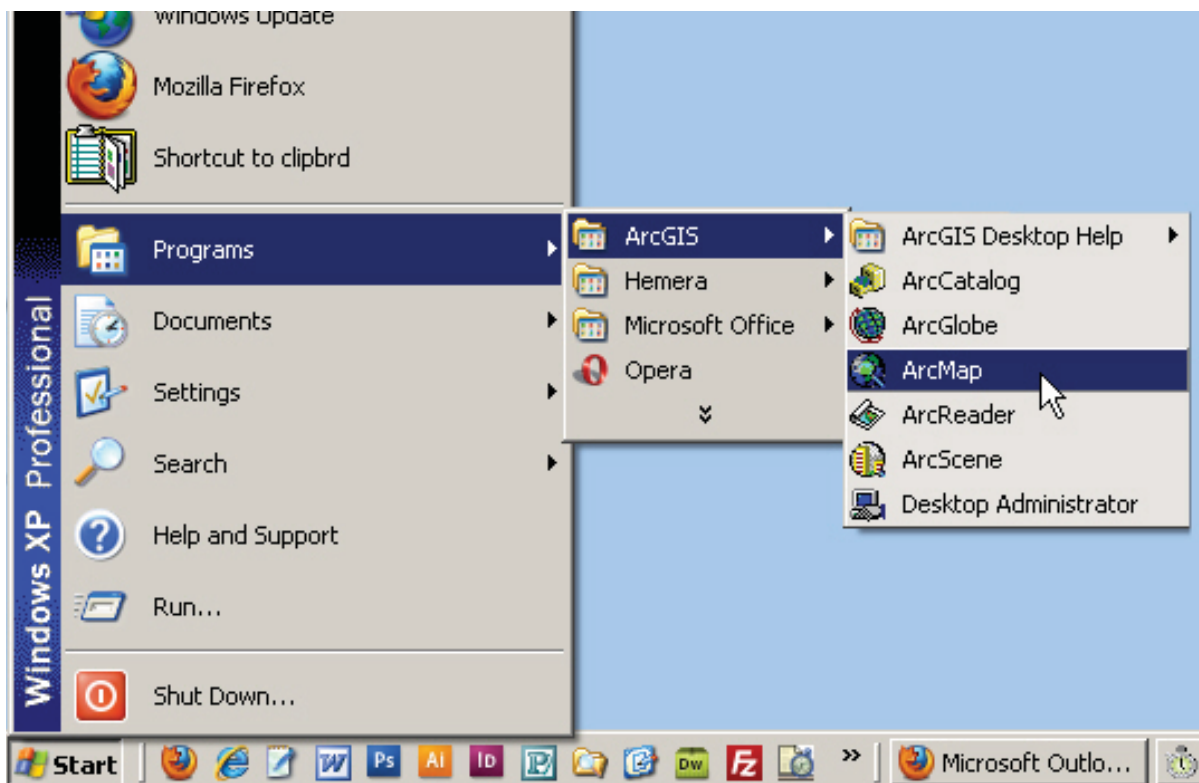
SECTION 1: INTRODUCTION TO ARCGIS 9.2

A main component of ArcGIS 9.2 software is ArcMap. It can be used to create and edit maps and analyze spatial data.

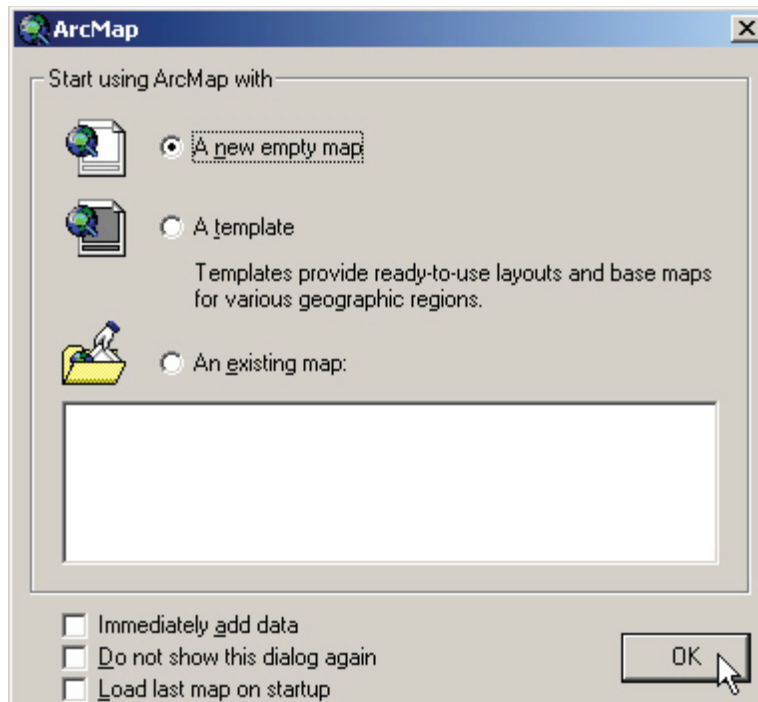
1.1 Getting Started

Start ArcMap. If you do not have an ArcMap icon on your desktop or in your Windows “Start” menu, you can locate ArcMap from the Start Menu:

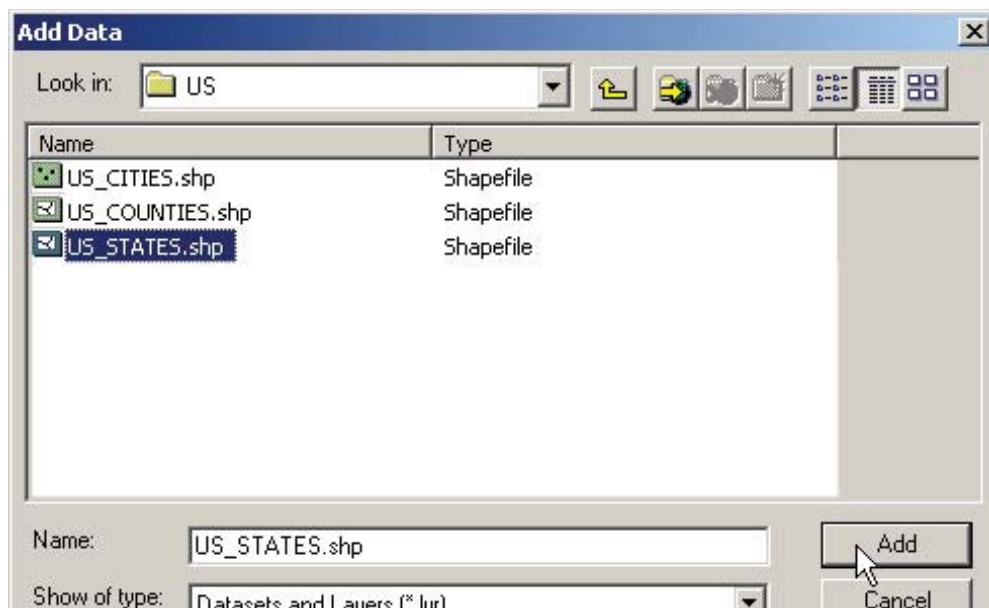
- 1) Click on the “Start” menu in the lower left corner of your screen.
- 2) Choose “Programs” or “All Programs” which will cause a submenu to pop up.
- 3) Choose “ArcGIS”, which will cause another submenu to pop up.
- 4) Choose “ArcMap”.



In the dialog box that appears, choose to make a new empty map and then click “OK”:

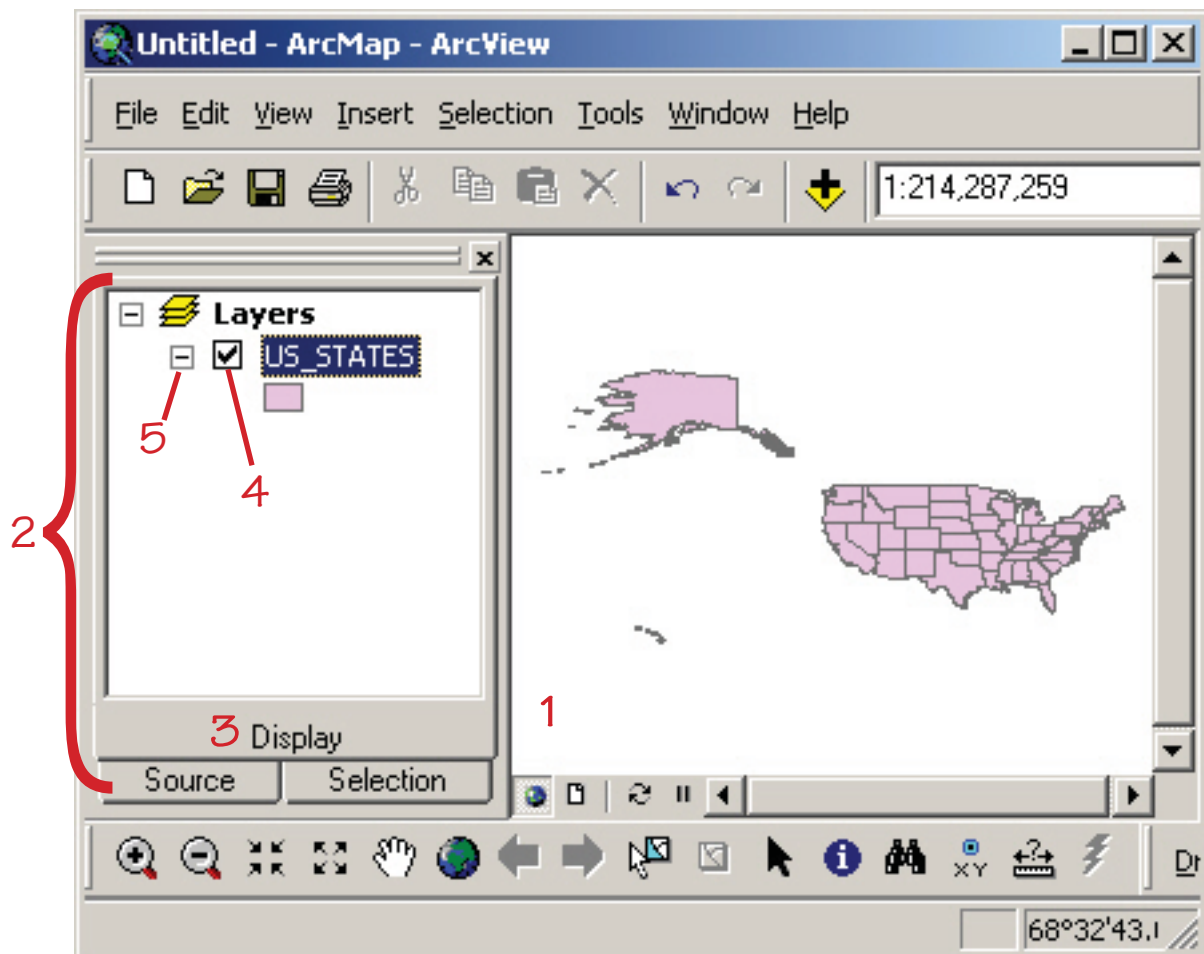


Next, to add data, click on the “Add Data” button () and navigate to where your file is stored. Click on the file you want to use and then click “Add”.




Here we’ve used the “US_STATES” file to add a data layer representing the United States with state boundaries.

Before we go further, notice a few things on your screen:

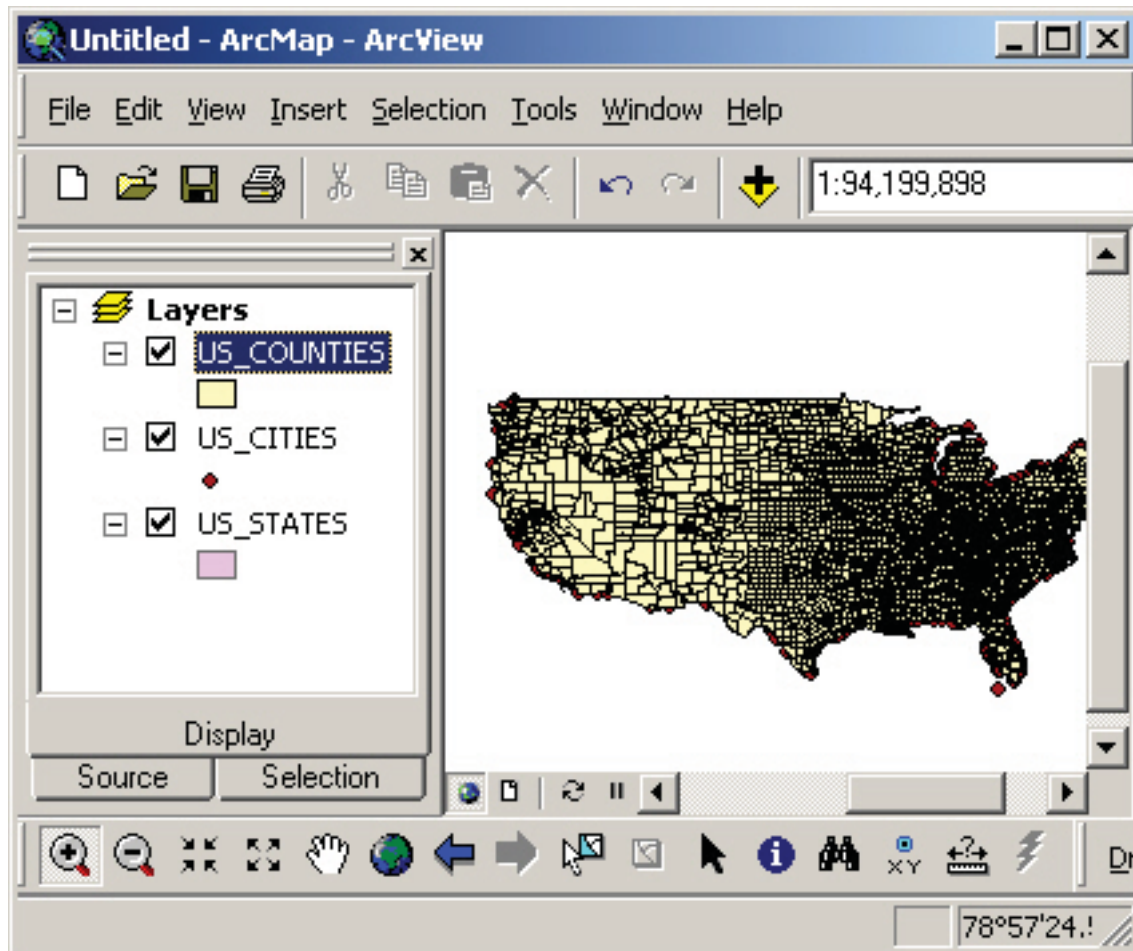


- 1) When working with map layers, the part of the screen in which the layers are drawn is called the **data frame**.
- 2) The column to the left of the data frame, which shows a list of your data layers, is called the **Table of Contents**.
- 3) The Table of Contents can show different data about the map layers in your project. You can switch modes by clicking on the tabs at the bottom of the Table of Contents. We will be using the "Display" mode.
- 4) Next to each layer name there is a small check box. If you click it, the layer will turn on or off. You can use this to display (or not display) an individual layer.
- 5) To the left of that check box, there is a smaller box showing a + or - character. This controls the display of the color coding or "symbology". (Working with symbology will be covered in Lesson 1.3: Editing the Legend.) If the - character is displayed, the color coding ("symbology") is already shown—in this case pink with a black border. If you want to compact your Table of Contents, you can turn this off by clicking on the -, which will hide the symbology. Click on the + to display the symbology again.

Adding more data

Click the “Add Data” button () again as you did on page earlier to add more layers to your map. In the dialog box that appears, double-click a different file (or click on it once and then click “Add”).

Here we’ve added two more layers: “US_CITIES” and “US_COUNTIES”:

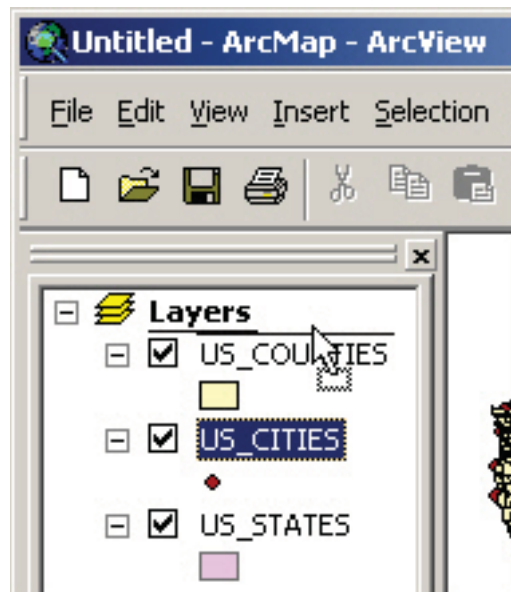


Changing the “stack” order

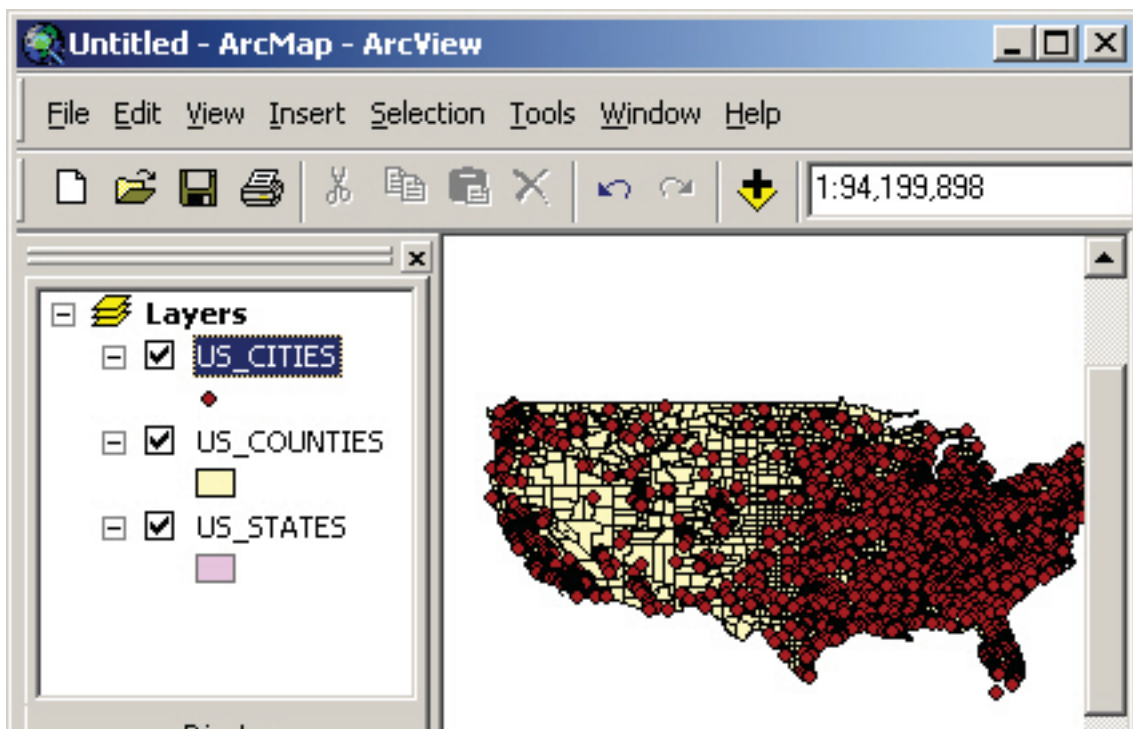
Notice that the software “stacks” the data layers in the map in the same order in which they are listed in the Table of Contents. Sometimes one layer will completely cover another. For example, in the map above, the US counties are covering the US cities.

To re-arrange the order in which the layers are displayed, be sure the Table of Contents is set to “Display” (you can adjust this via the tabs at the bottom of the Table of Contents).

Then simply click on the layer name in the Table of Contents, hold the mouse button down, and slide it up or down.




The map is redrawn with the new stacking order. Now we can see cities on top of the counties:



1.2 Adjusting Your View

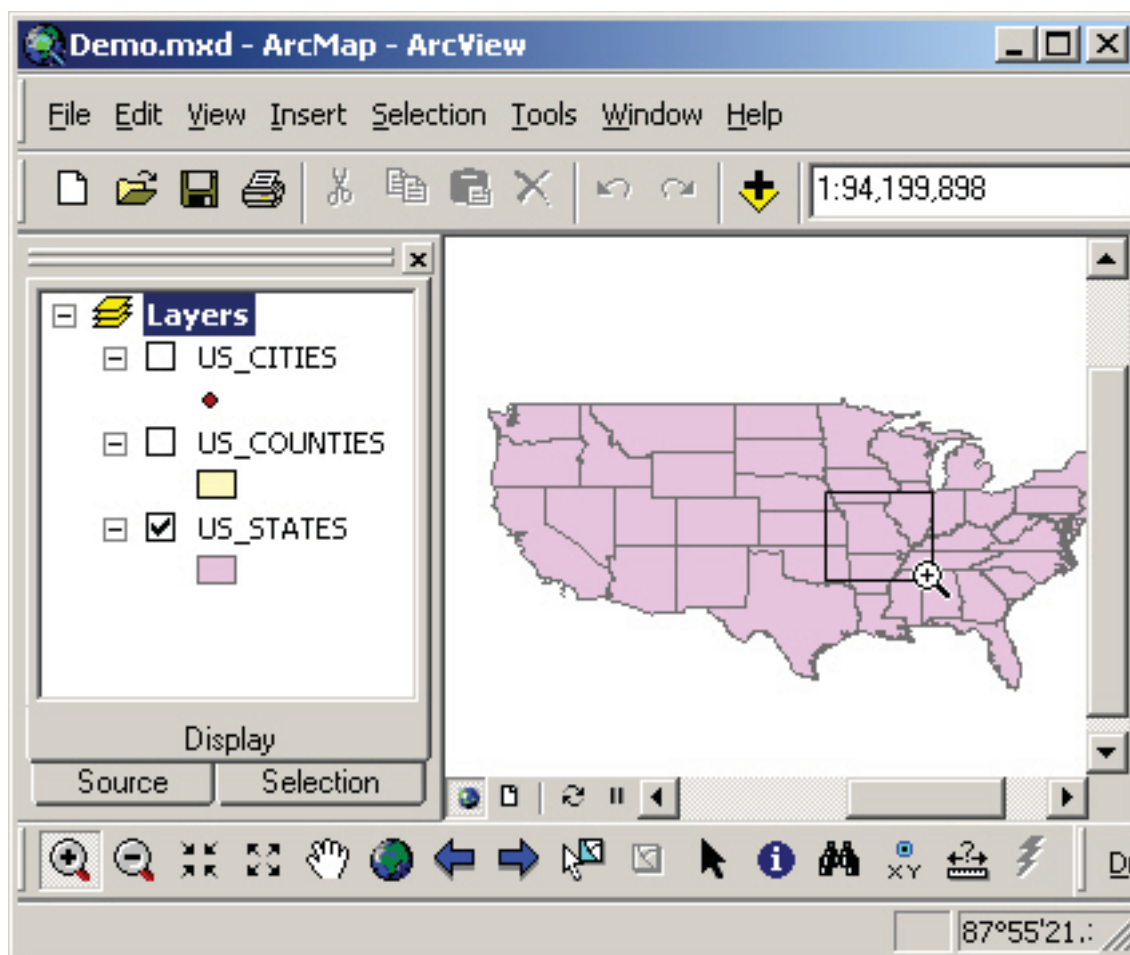
Often you will want to zoom in on an area to see the kind of detail you need. For example, if you want to see the streets of your city, looking at a map of the whole United States wouldn't be very useful. To look at a smaller area, you need to use the zoom tools.

Zooming in

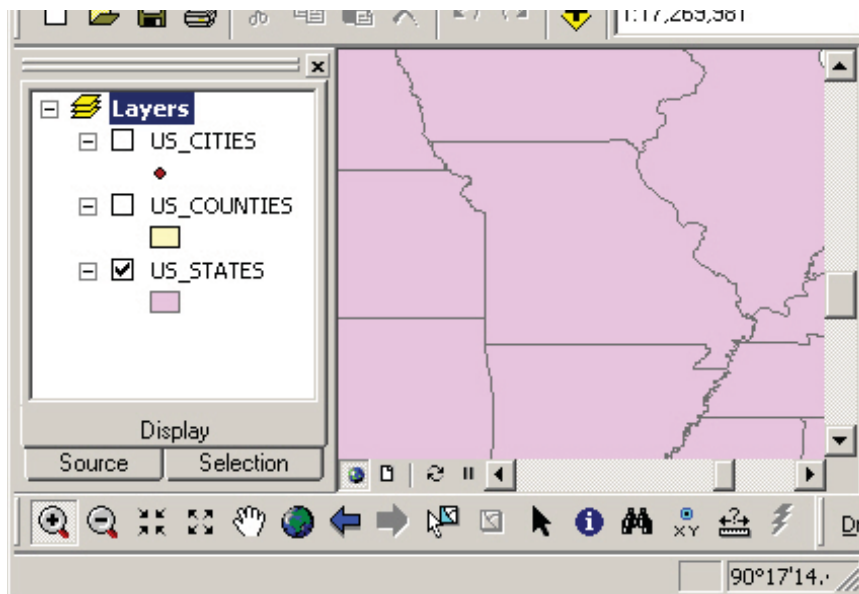
To zoom in (enlarge a small area to see more detail), select the “Zoom In” tool (). When your cursor is over the map, it takes the shape of a small magnifying glass with a + symbol.

The simplest way to zoom in on an area is to simply click on the area of interest. The map will zoom in and center the map on the point where you clicked.


Another approach that will give you more control is to envision a box around the area of interest. Using the “Zoom In” tool, click where you would like the upper left corner to be, hold the mouse button down, and drag down and to the right.



When the box encloses the area of interest, release the mouse button. The map will zoom into the area you chose:



Zooming out

To look at a larger area, click on the “Zoom Out” button () and then click the map. Your view will zoom out, staying centered on where you clicked.


The example below shows the previous map centered on Missouri after two clicks with the “Zoom Out” tool:



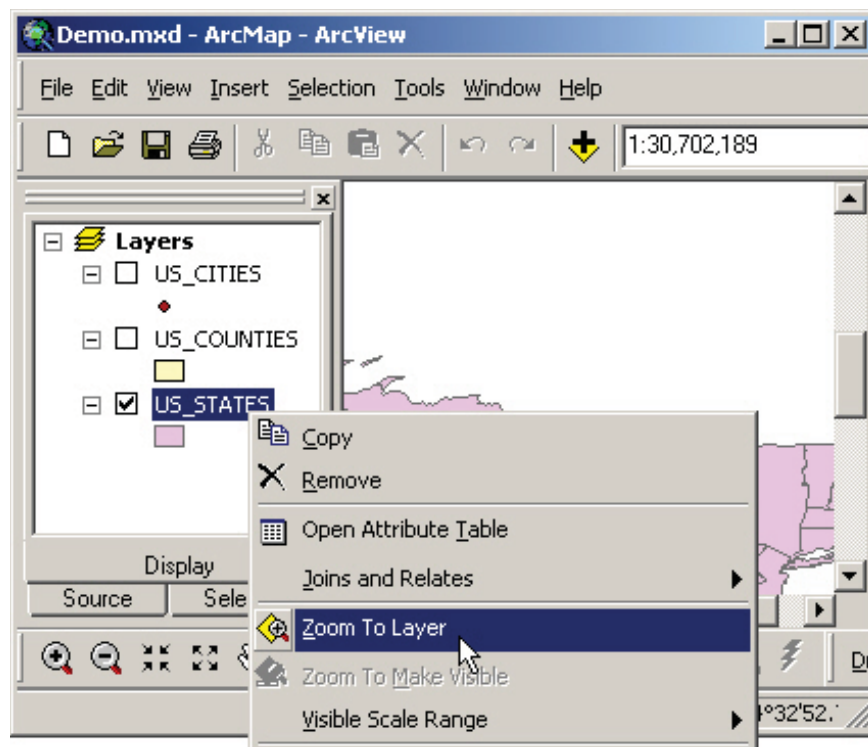
Other zoom options



It takes some practice to master the “touch” needed to zoom efficiently.

To go back to the last view you had, simply click the “Go Back to Previous Extent” button ().


If you are much too far in or out, it may be quicker to click the “Full Extent” button (). This will take you to a zoom level that is wide enough to include all of the data layers in the Table of Contents, whether they are turned on or not.

Another zoom option is to zoom to a level that shows the extent of a particular data layer. To do this, simply right-click on the map layer in the Table of Contents and choose “Zoom to Layer”:

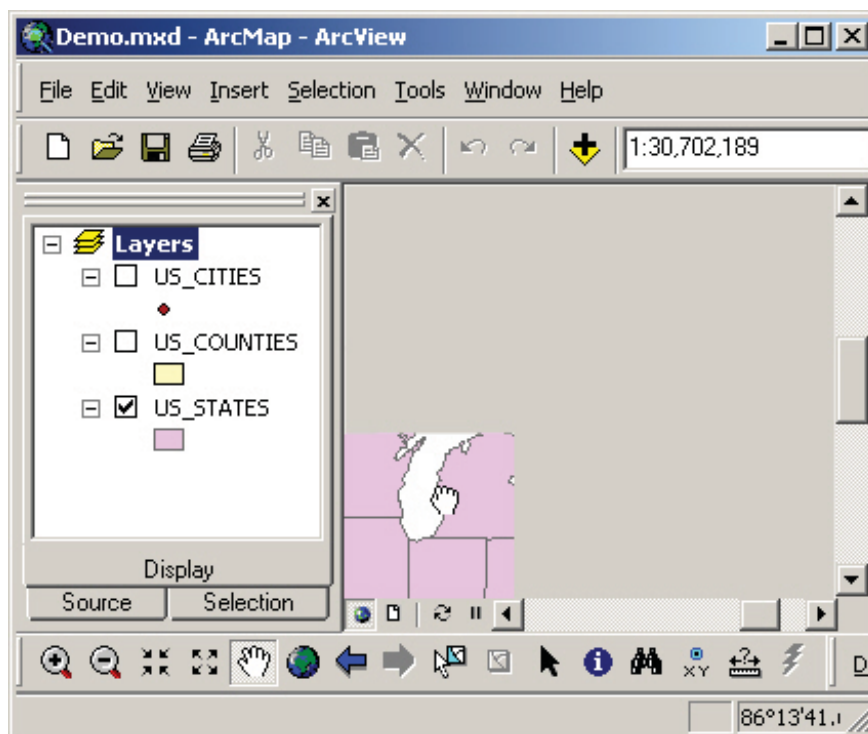


Additionally, the “Zoom In on the Center of your Map” button () and the “Zoom Out on the Center of your Map” button (), can also be used to quickly zoom in and out.

Panning


If you are satisfied with your zoom, but just need to “slide” the map a bit, use the “Pan” tool ()

With the “Pan” tool selected, click anywhere on the map, and then—holding the mouse button down—slide the map into position. Note: the new area you are panning to will not be displayed until you release the mouse button.



Tip

If you are not panning or zooming, it is a good idea to change from those tools to the

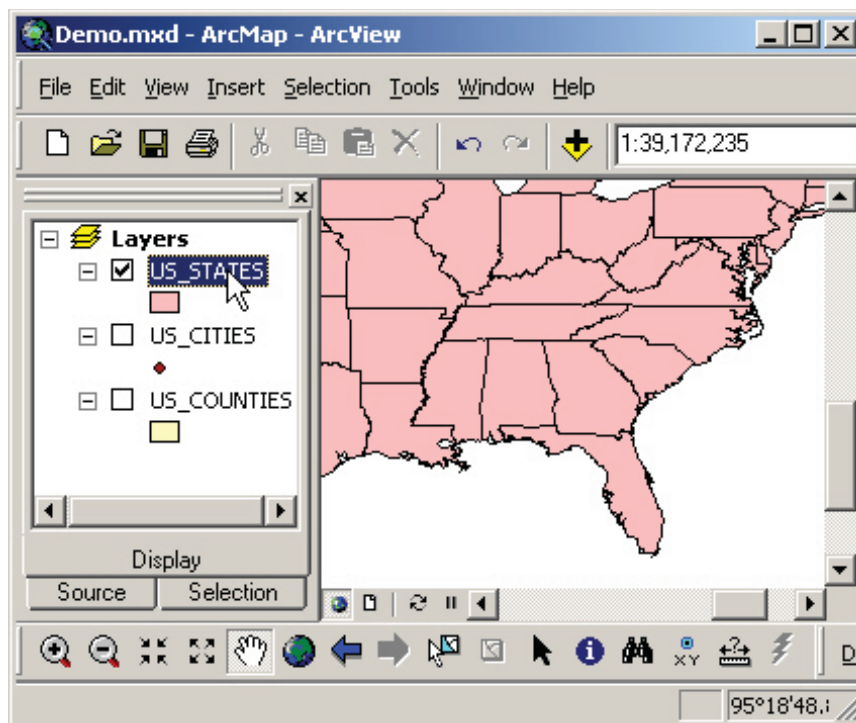
“Select Elements” () tool. This helps you avoid accidentally shifting or zooming your map.

1.3 Editing the Legend

As you make maps, you will want to change the color of the map layers themselves, or change the shape, size, or color of the symbols. In many cases, color-coding parts of the map will help in your analysis. To make these changes, you will use the symbology controls within the layer's properties.

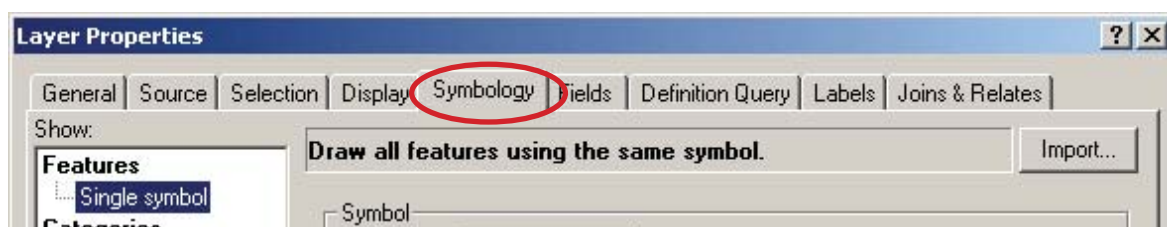
Changing symbology

To change a map layer's symbology, in the Table of Contents double-click on the name of the layer you want to change.



This will open the “Layer Properties” dialog box.

If it is not already selected, click on the “Symbology” tab.

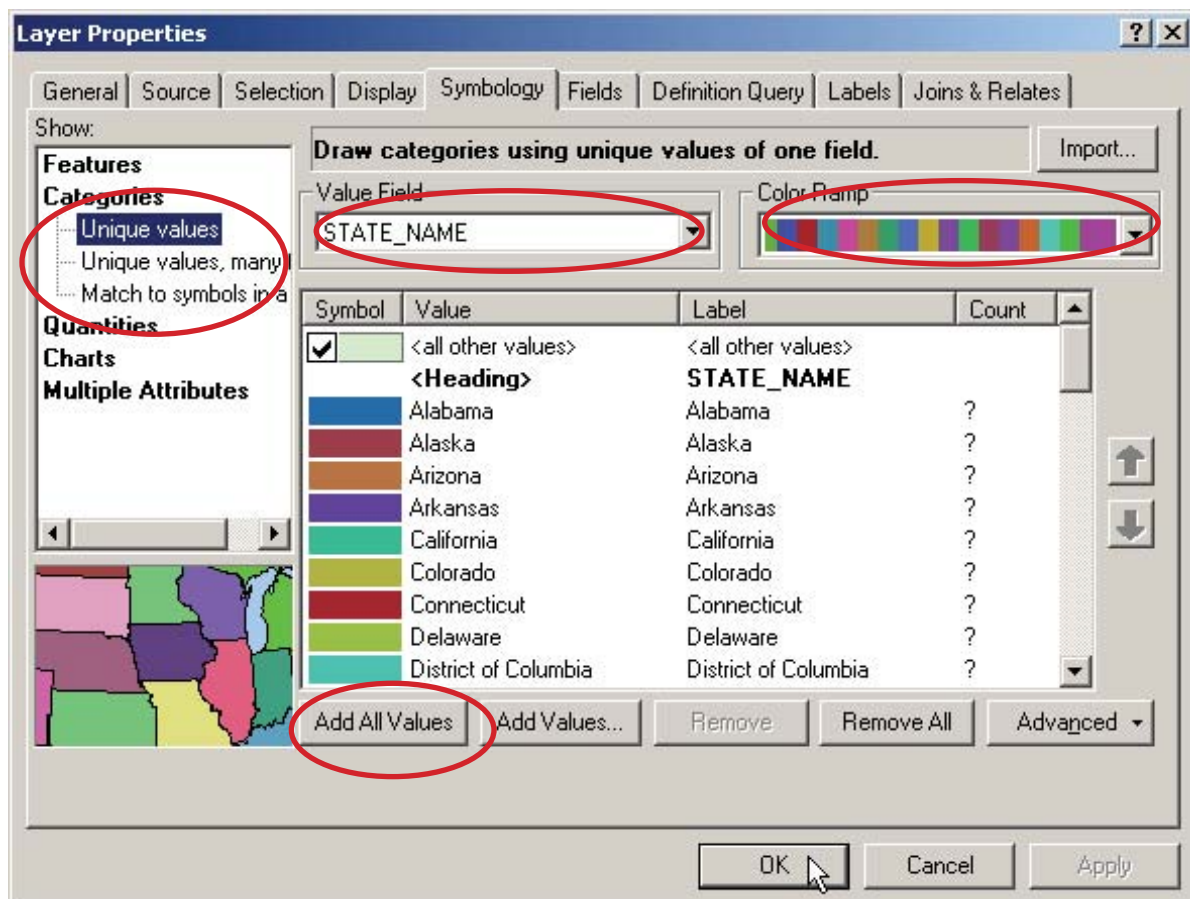


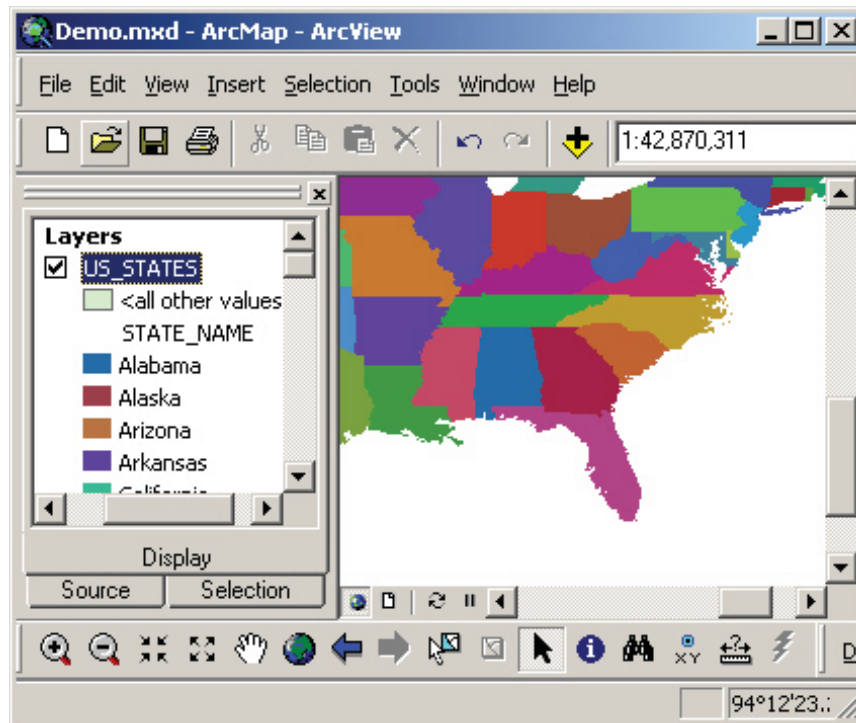
There are many things to control here; we will focus on only a few. First, we will change how the data is colored. In the example map, all states are currently as one color, or what ArcGIS calls “Single Symbol.”

To change the US_STATES layer so that each state shows a different color:

- 1) Click on the “Categories” label on the left.
- 2) Choose “Unique Values” when that choice appears (in the “Categories” submenu).
- 3) Using the dropdown arrow, choose “STATE_NAME” from the “Value Field”.
- 4) Finally, click the “Add All Values” button to populate the small display box with the list of states and the colors they are assigned.
- 5) If you’d like, you can choose a different color ramp. Your result of your choices is previewed in the lower left side of the box.

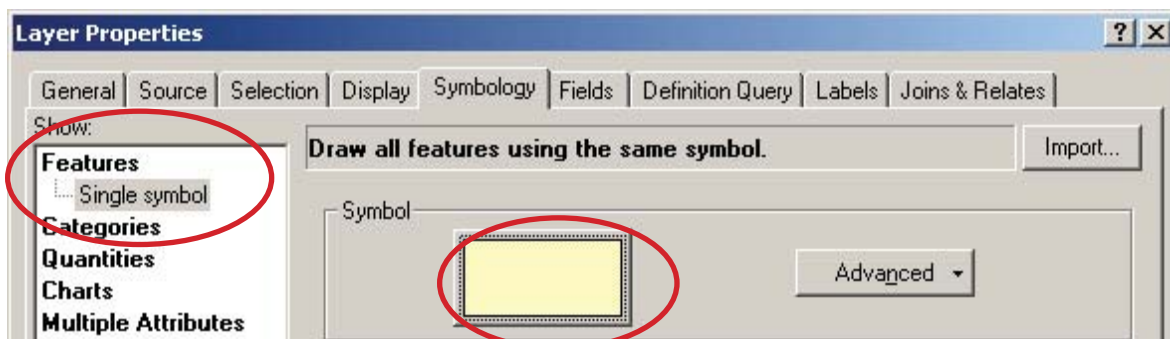
When you are satisfied with your selection, you can click “OK”. The choices you made will take effect in the map and the dialog box will go away:





However, for later examples in this tutorial, keeping the states a single color may be a better choice. To return the states to a single color:

- 1) Re-open the “Layer Properties” dialog box (by double-clicking on the “US_STATES” layer name in the Table of Contents) .
- 2) In the “Symbology” tab, choose to show “Features” and then “Single Symbol”.
- 3) Choose a color for the states by clicking on the colored box in the “Symbol” section.
- 4) To finish, click “OK”.

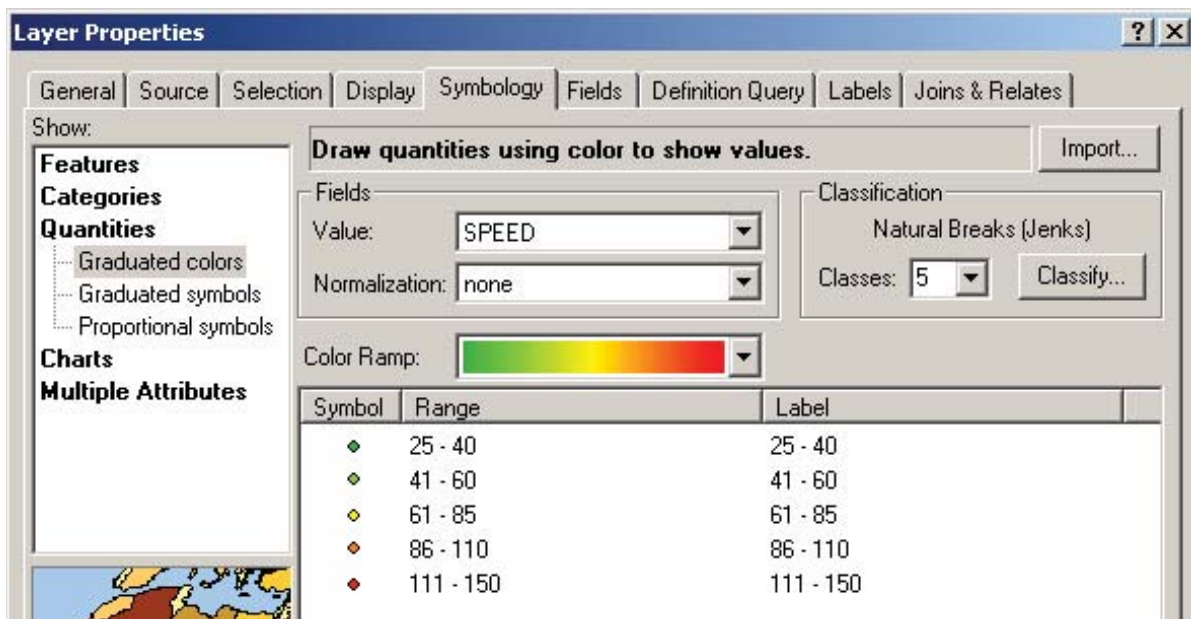


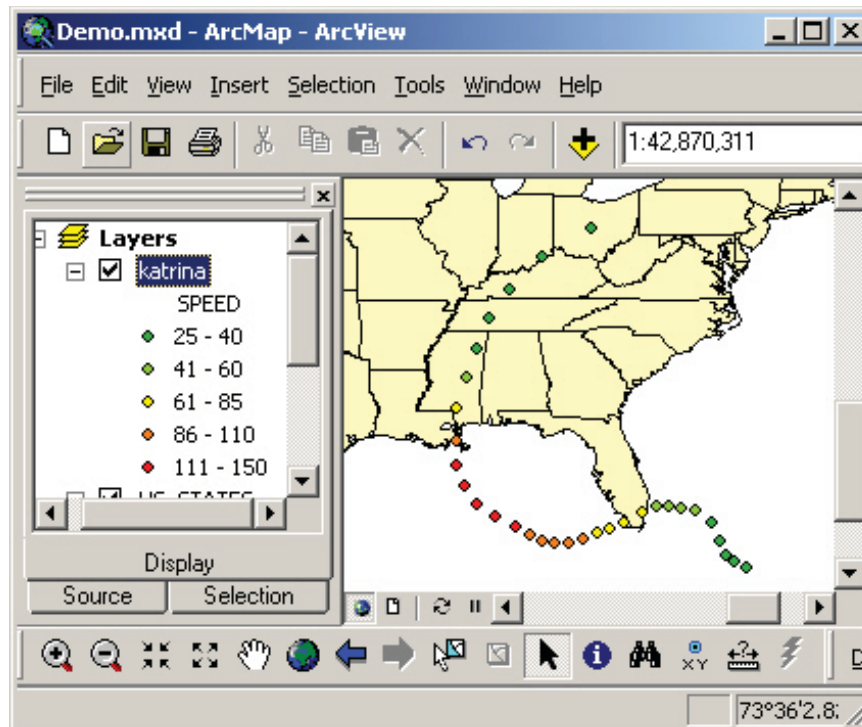
So far we've looked at how to assign a single color to a layer and how to assign a unique color based on an attribute. Coloring by unique values is useful when you have descriptive data like names, but it can be confusing if you want to show the size or degree of something that is continuous (like temperatures, or in the case of hurricane data, the wind speed).

Color coding data

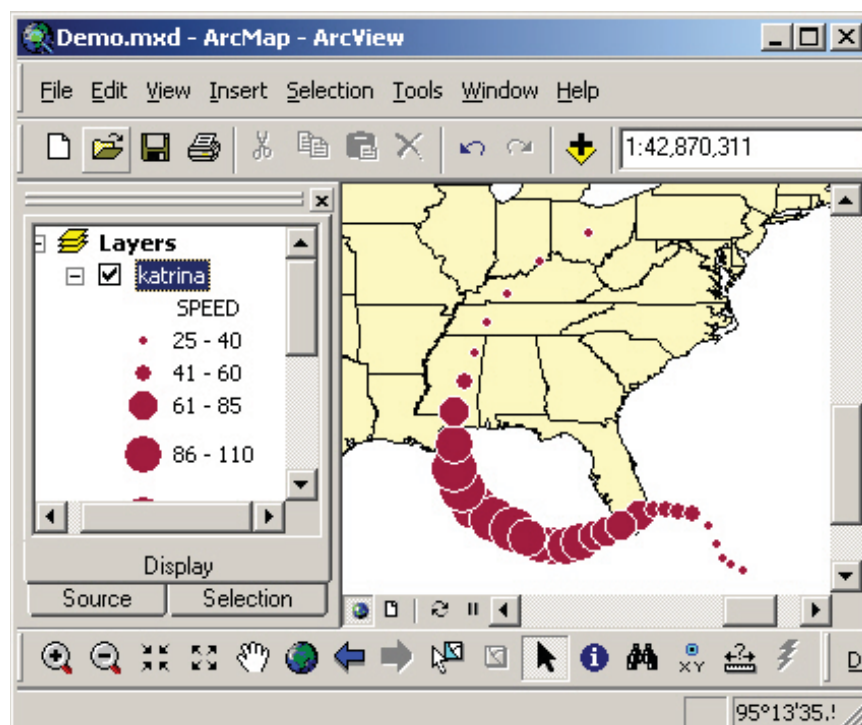
One of the most powerful tools you have for mapping your data is the ability to use colors to represent the data. This requires careful thought on your part as you make choices in how to display the data. For this example, we've added data for 2005's Hurricane Katrina to the map (instructions for adding data can be found on page 1.1.4). We will now color code the data based on wind speed.

- 1) Open the "Layer Properties" box by double-clicking on the "katrina" layer name in the Table of Contents.
- 2) In the "Symbology" tab, choose to show "Quantities" and then "Graduated Colors".
- 3) For the "Value" field, choose "SPEED" to color code based on the magnitude of the earthquakes.
- 4) Change the color ramp if you prefer.
- 5) Click "OK" to have the changes take effect.





Another option to consider is to code the data with **graduated symbols** rather than graduated colors. You could use larger dots to signify greater wind speed, for example.




SECTION 2: DOWNLOADING AND PROCESSING DATA

2.1 Joining Data Tables

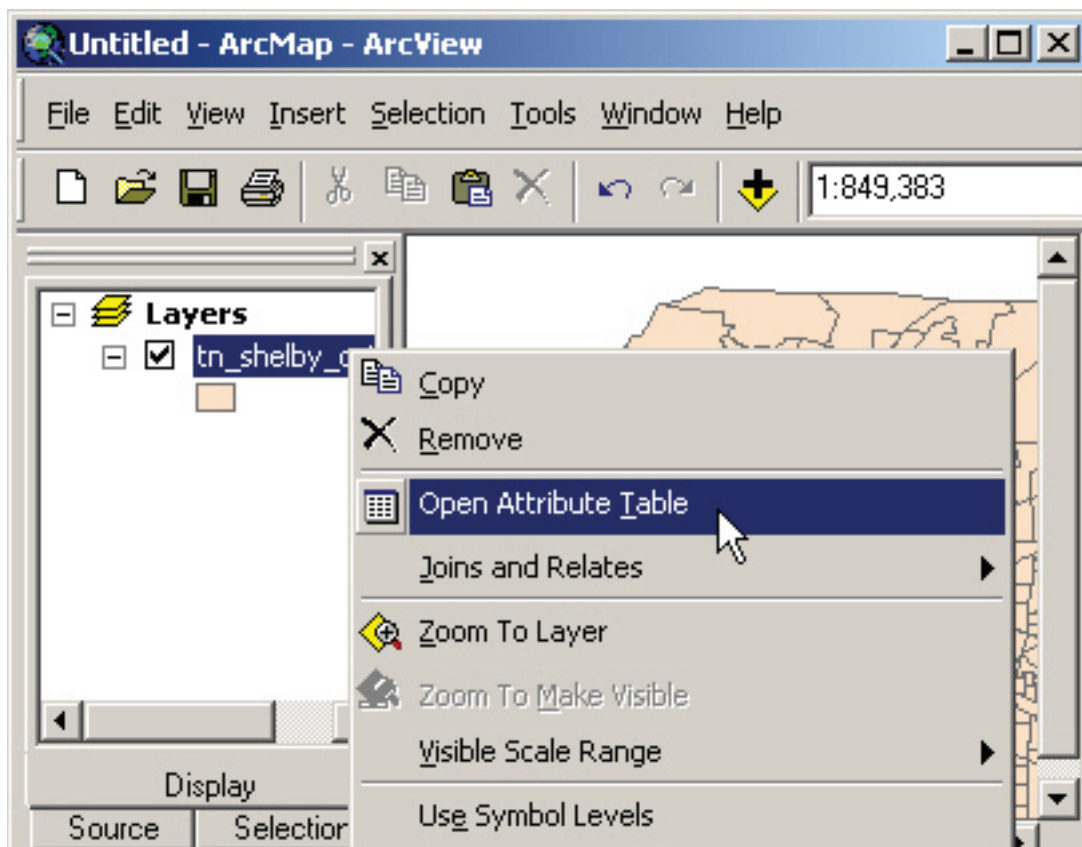
Many times you will find a table of data that you want to map, perhaps as an Excel spreadsheet or on a web page. If you have a shapefile that has the relevant geography, you can join the two pretty readily. For example, a table of data with crime statistics by zip code can be joined to a zip code shapefile, allowing you to map the data.

In this example, we will map the demographics of Shelby County (including Memphis), Tennessee. More information on how to access this kind of data is included on page 2.1.9.

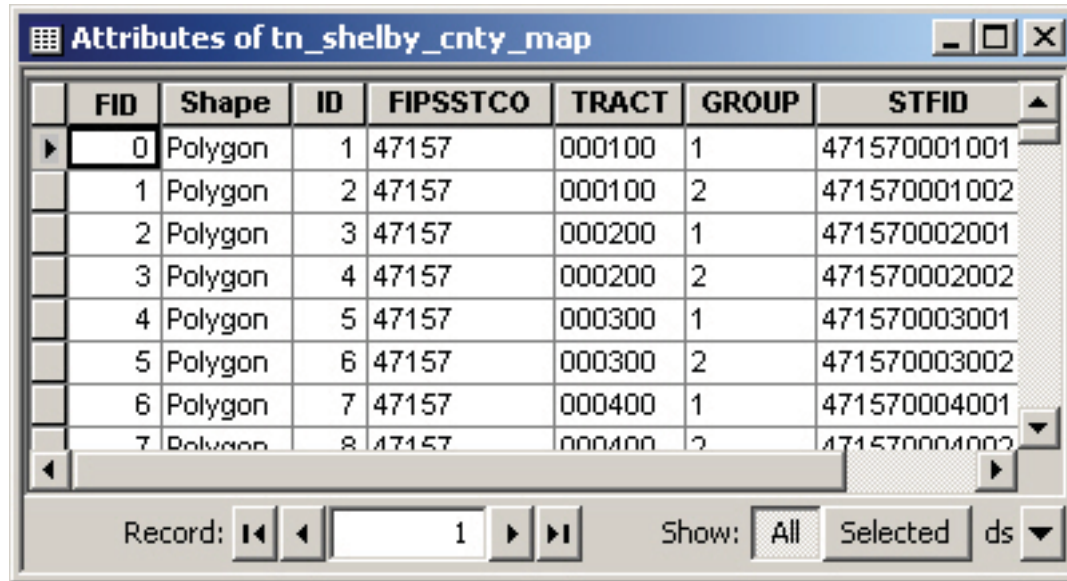
Mapping the base shapefile

In ArcMap, create a new map. Add the shapefile with the relevant geography—in this case a map of Shelby County, Tennessee—by clicking on the “Add Data” button () and navigating to the file.

If you’d like to see what data you have available in this shapefile, right-click on the layer name in the Table of Contents, and then click “Open Attribute Table.”



Notice that the table contains primarily just coding to identify each block group—nothing much of interest here:



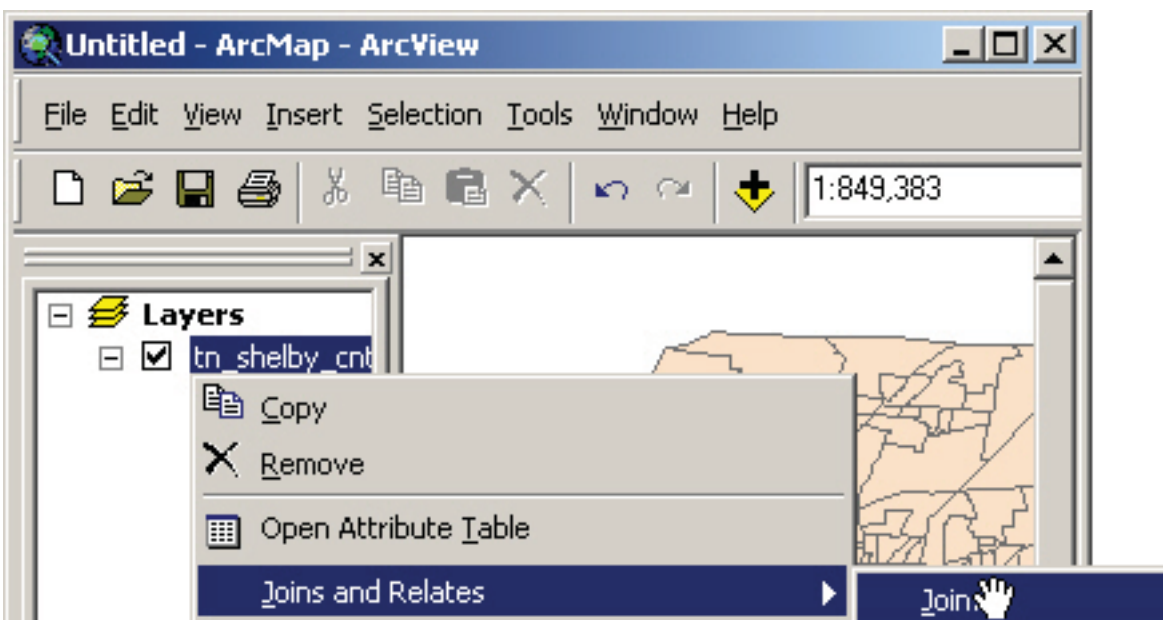
FID	Shape	ID	FIPSSTCO	TRACT	GROUP	STFID
0	Polygon	1	47157	000100	1	471570001001
1	Polygon	2	47157	000100	2	471570001002
2	Polygon	3	47157	000200	1	471570002001
3	Polygon	4	47157	000200	2	471570002002
4	Polygon	5	47157	000300	1	471570003001
5	Polygon	6	47157	000300	2	471570003002
6	Polygon	7	47157	000400	1	471570004001
7	Polygon	8	47157	000400	2	471570004002

You can close the Attribute Table window now.

Adding data from a table

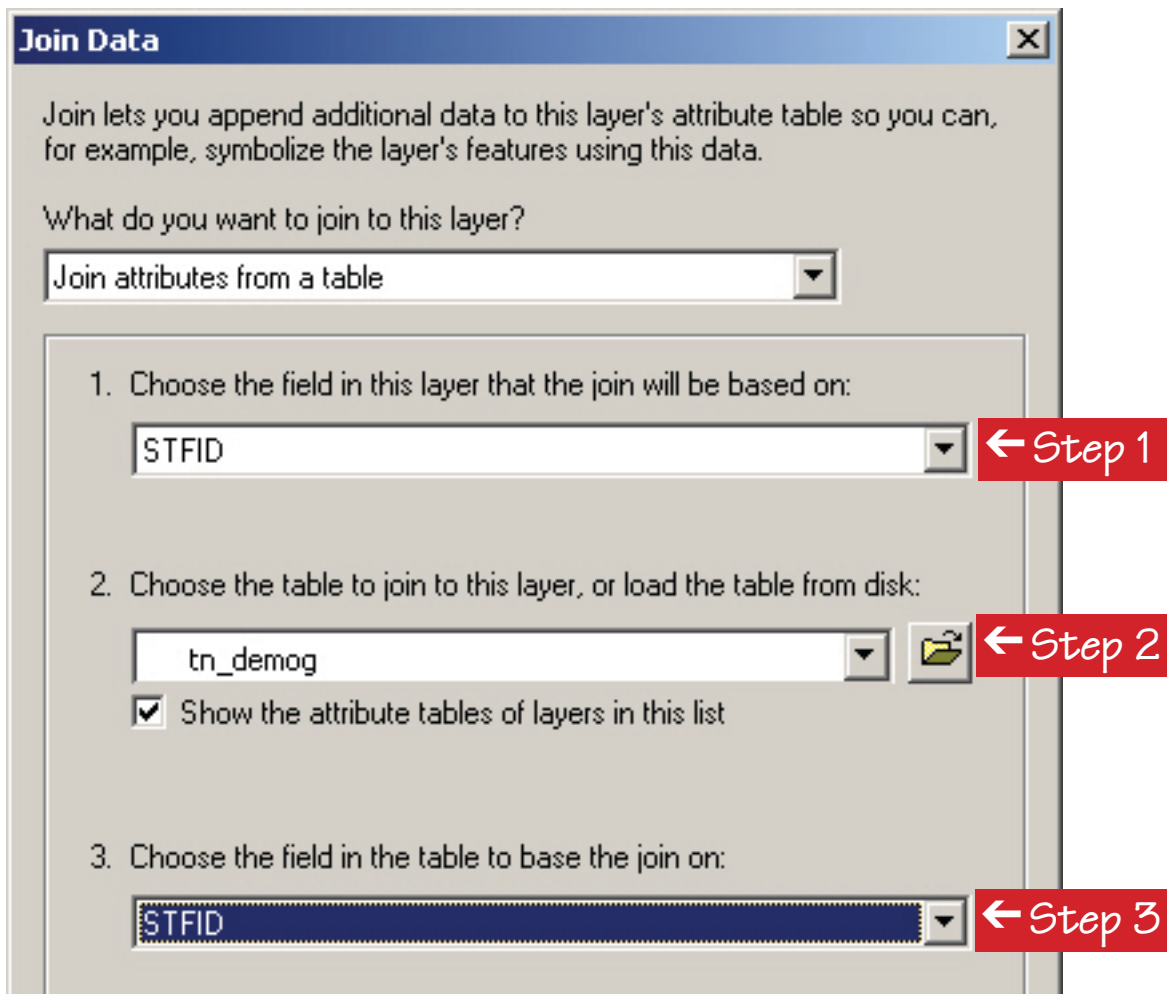
If you have information in a table for the area you just mapped, you can add this data to your map.

Right-click the layer name in the Table of Contents. Choose “Joins and Relates” from the popup menu, and then choose “Join” from the submenu.



In the first box in the Wizard that appears select “Join attributes from a table.”

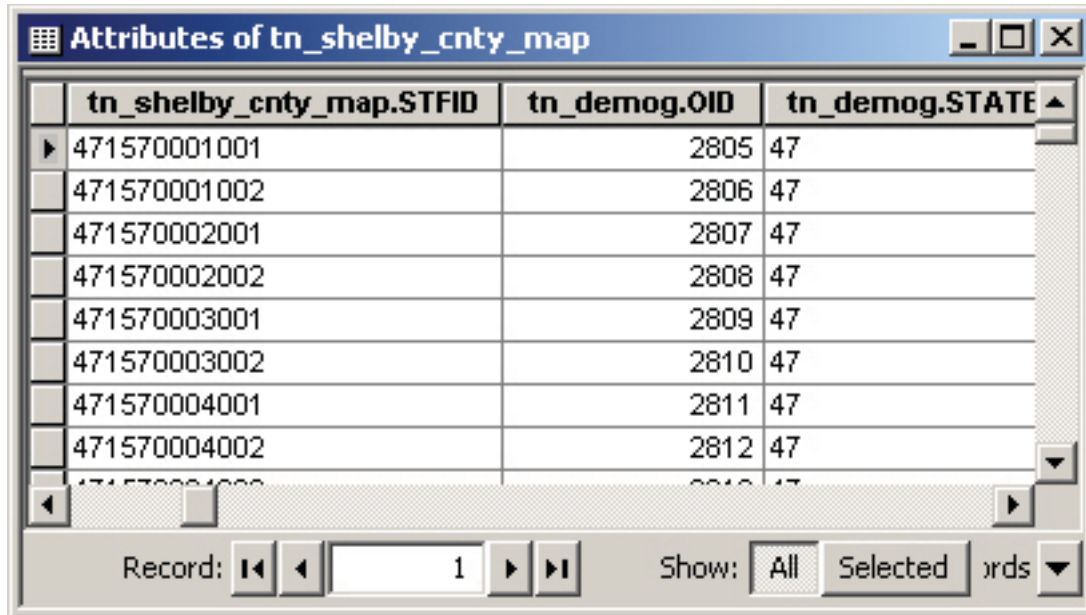
- 1) You are going to make the join based on columns that your base map layer and your data table have in common. In this example, we will choose the **STFID** column since this identifies each census block group in the country uniquely.
- 2) Click on the small folder icon and navigate to where you saved the table file. When you have found the file, select it and click “Add.”
- 3) Next choose the field in the table that corresponds with the base layer’s field you chose in step 1. In this case, the field is again called STFID, but the column headings don’t necessarily have to have the same names in both tables. The key is for each record in each table to match up one to one, regardless of what the columns are called. (For example: one column might be called STFID and the other census_block_group_id.)



Click the “OK” button at the bottom and ArcMap will join the data for you. When asked, allow ArcMap to index the data.

If you right-click on the block group layer again and choose “Open Attribute Table,” you can see many fields of useful demographic data attached to the layer.

Notice also that each column now has a label showing from which file the data originated (e.g. tn_demog). This can be helpful if you need to trace the origin of data you are analyzing. It also allows data fields from both tables with the same name to be used.



tn_shelby_cnty_map.STFID	tn_demog.OID	tn_demog.STATE
471570001001	2805	47
471570001002	2806	47
471570002001	2807	47
471570002002	2808	47
471570003001	2809	47
471570003002	2810	47
471570004001	2811	47
471570004002	2812	47
471570004003	2813	47
471570004004	2814	47

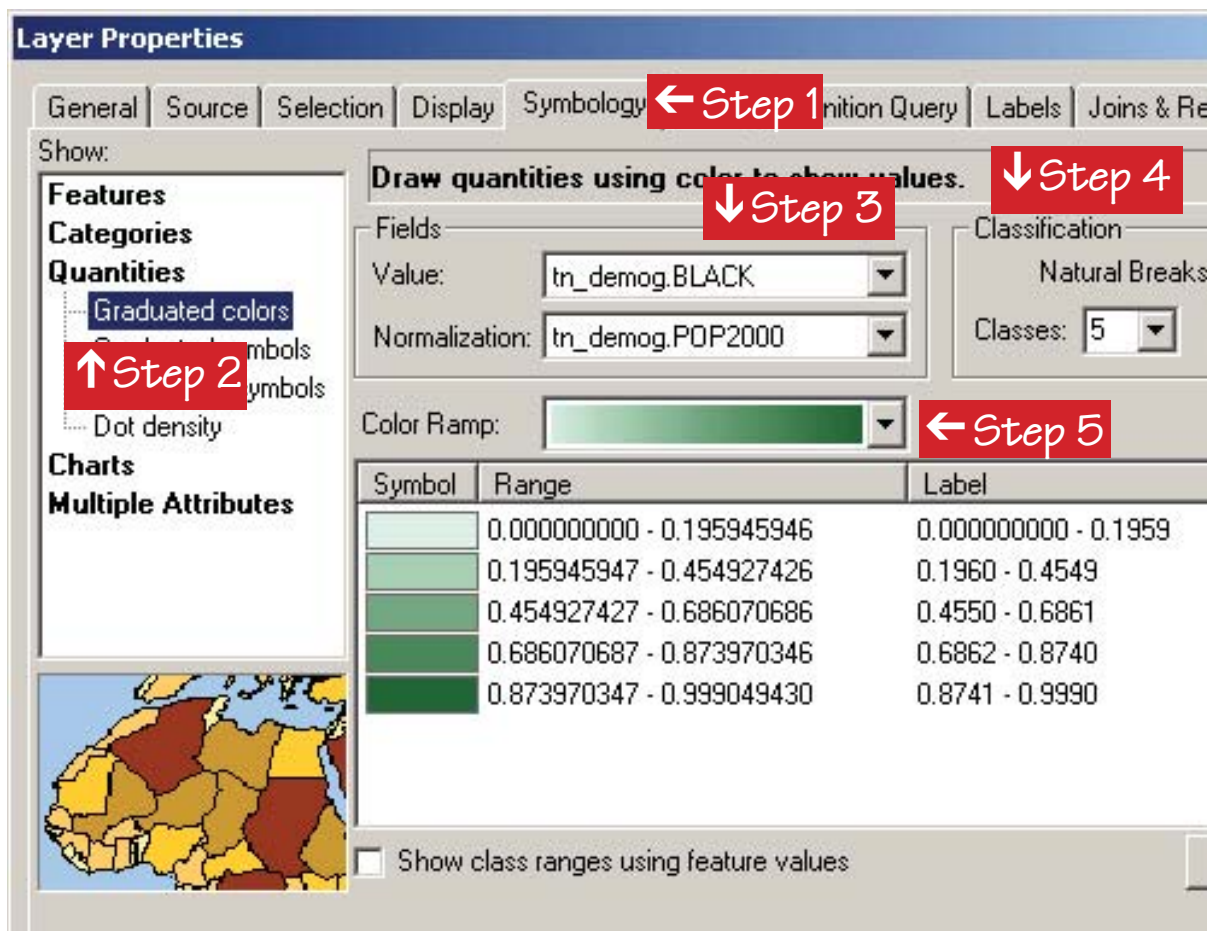
Record: 1 Show: All Selected Records

Mapping the combined data

To map the demographic data, simply double-click the layer name in the Table of Contents to open the Layer Properties dialog box.

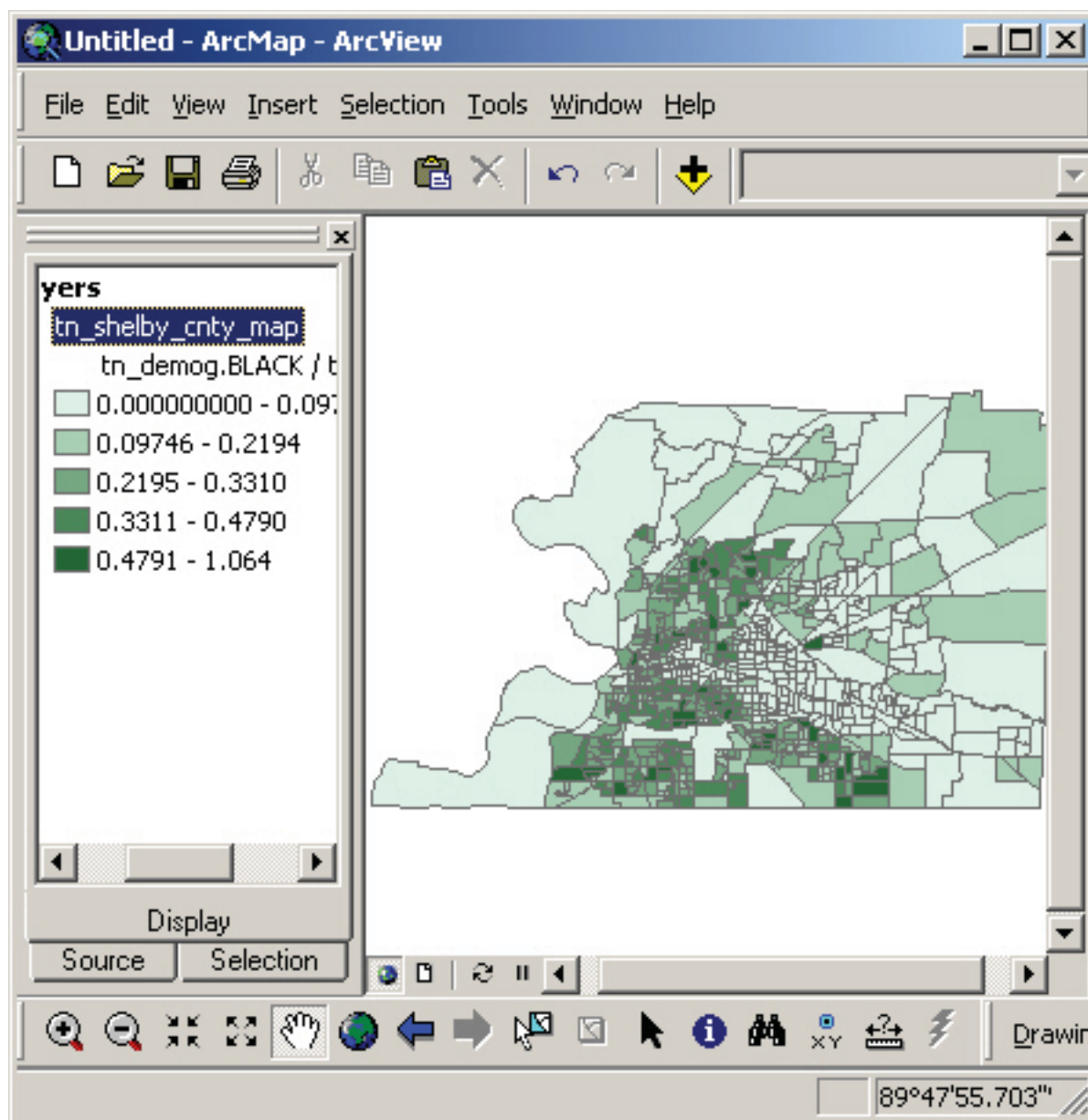
In the “Layer Properties” box:

- 1) Choose the “Symbology” tab
- 2) In the “Show” section, click “Quantities” and then click “Graduated colors.”
- 3) Now look at the “Fields” section. In this case, I’m choosing fields from the dropdown menu so the map will show the Black population (tn_demog.BLACK), divided (normalized) by the total population within each block group (tn_demog.POP2000).
- 4) Under Classification I want five levels or *classes*.
- 5) You can adjust the Color Ramp to whatever colors you desire.



Click “OK” close the dialog box and see the mapped data.

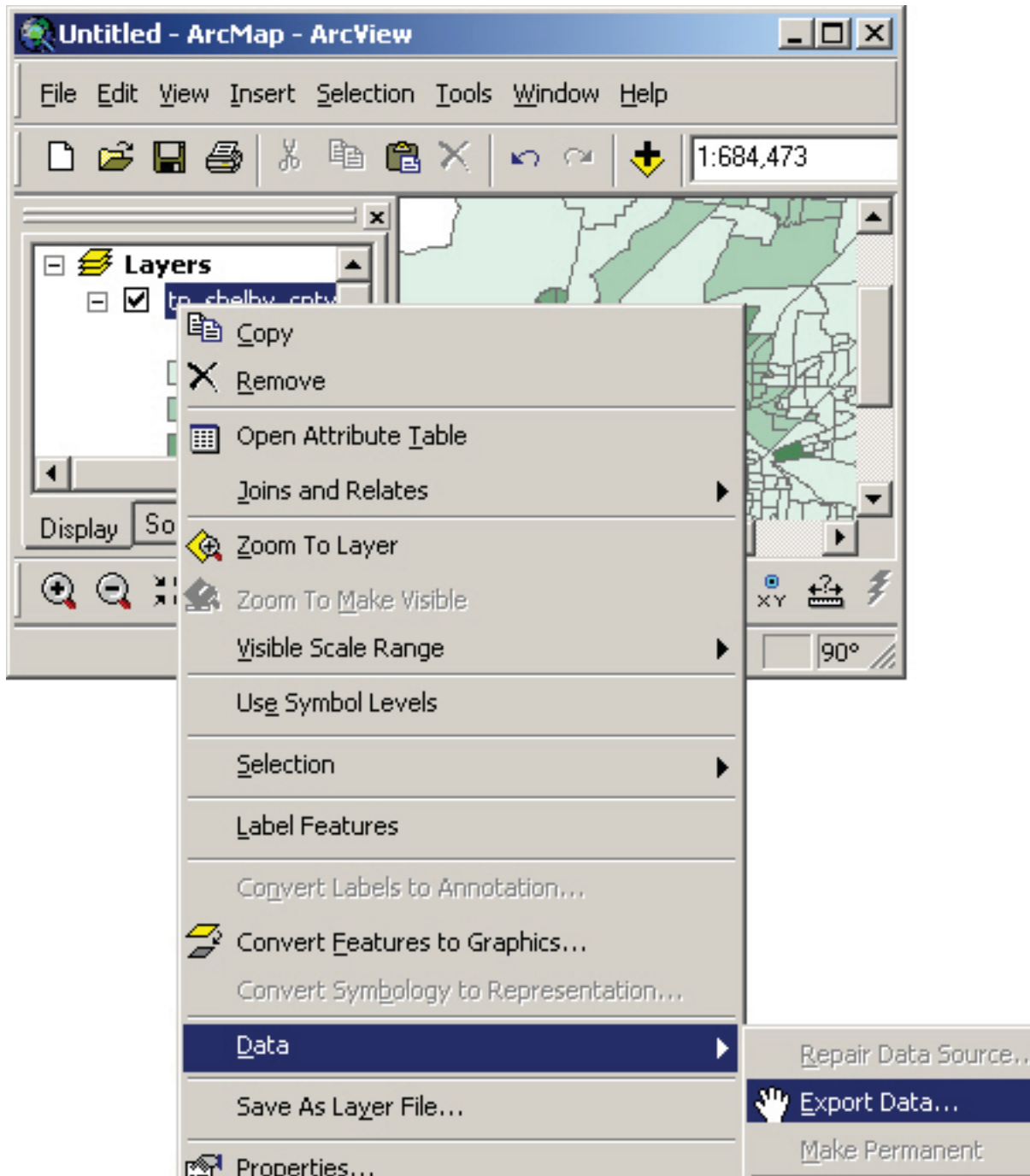
In this case, it shows distinctive segregation patterns:



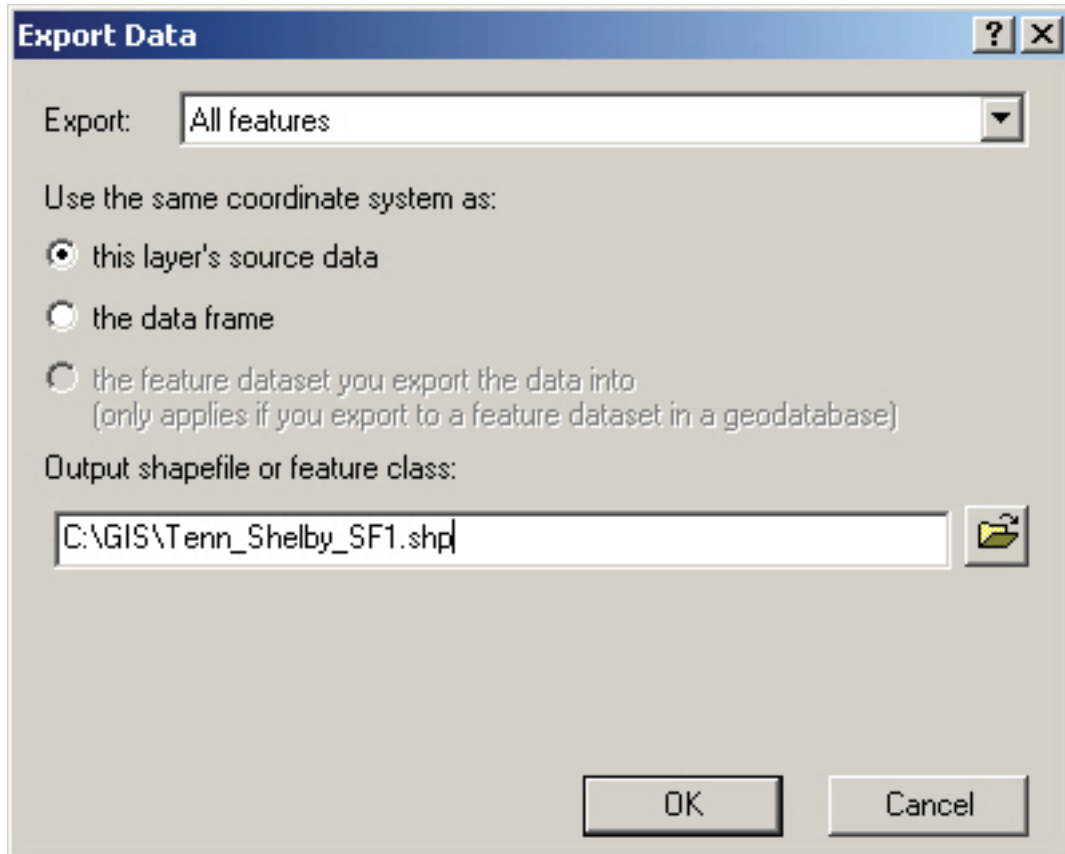
Saving the combined data as a shapefile

The data you just joined will not automatically be kept together; you need to make the join permanent by making a new shapefile.

Simply right-click on the original layer's name in the Table of Contents, choose "Data" from the popup menu, and then "Export Data" in the sub-menu.



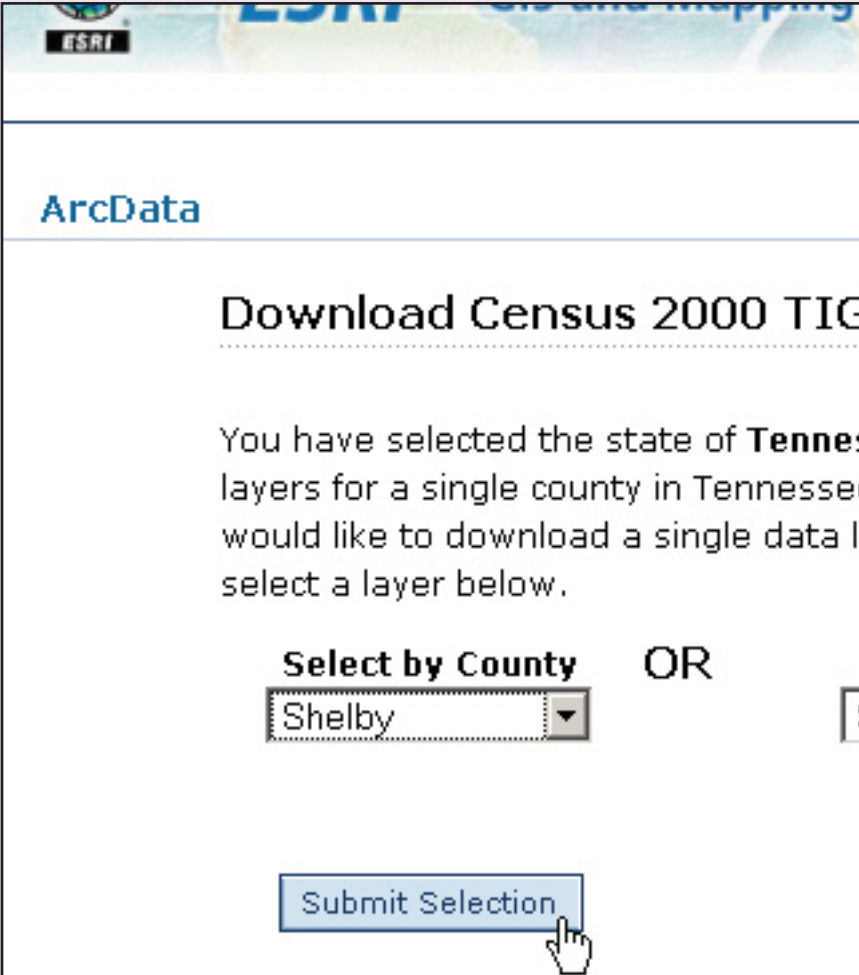
In the dialog box that appears, choose to export “All features” and use the same coordinate system as “this layer’s source data.” Then choose a name and location for the new shapefile and click “OK.”



Getting the data

You can map similar data for your county by downloading the data from http://arcdata.esri.com/data/tiger2000/tiger_download.cfm.

From this web page choose your state via the dropdown box or the map. On the next web page choose the county you want and click the “Submit Selection” button below the county dropdown box:



ESRI

ArcData

Download Census 2000 TIGER

You have selected the state of **Tennessee**
layers for a single county in Tennessee
would like to download a single data layer
select a layer below.

Select by County OR

Shelby ▼

Submit Selection

Now you need to check the box or boxes next to the data layer or layers you want to download. Then click “Proceed to Download.”

For this example, I downloaded the **block groups** (this is a map of the county) for the year 2000 and the **SF1 demographics for block groups**:

Download Census 2000 TIGER/Line® Shapefiles

You have selected **Shelby County** for the state of **Tennessee**. Below is a list of the data layers that are available for this county. Not all data layers are available for each county. You can check the data layers that you would like to include in your download. Each data layer is listed with its compressed file size (.ZIP). You may select up to 20.0 MB of compressed data in a single download.

<u>Available data layers</u>	<u>File Size</u>
<input type="checkbox"/> Block Groups 1990	247.4 KB
<input checked="" type="checkbox"/> Block Groups 2000	236.6 KB
<input type="checkbox"/> CMSA/MSA Polygons 2000	7.6 KB
<input type="checkbox"/> Census 2000 Collection Blocks	1.2 MB
<input type="checkbox"/> Census Blocks 1990	2.3 MB
<input type="checkbox"/> Census Blocks 2000	1.3 MB
<input type="checkbox"/> Census Tracts 1990	108.4 KB
<input type="checkbox"/> Water Polygons	32.3 KB

<u>Available Statewide Layers</u>	<u>File Size</u>
<input type="checkbox"/> Census Block Demographics (PL94)	15.9 MB
<input type="checkbox"/> Census Block Demographics (SF1)	6.2 MB
<input checked="" type="checkbox"/> Census Block Group Demographics (SF1)	305.3 KB
<input type="checkbox"/> Census County Demographics (PL94)	22.0 KB
<input type="checkbox"/> Census County Demographics (SF1)	10.6 KB
<input type="checkbox"/> Census Place Demographics (PL94)	59.0 KB
<input type="checkbox"/> Census Place Demographics (SF1)	32.8 KB
<input type="checkbox"/> Census State Demographics (PL94)	1.5 KB
<input type="checkbox"/> Census State Demographics (SF1)	657.0 bytes
<input type="checkbox"/> Census Tract Demographics (PL94)	195.6 KB
<input type="checkbox"/> Census Tract Demographics (SF1)	108.5 KB

[Proceed to Download](#)

Once you have this data downloaded, unzip the zip files and save the extracted files somewhere easy to find. You may want to rename the files to something more straightforward.

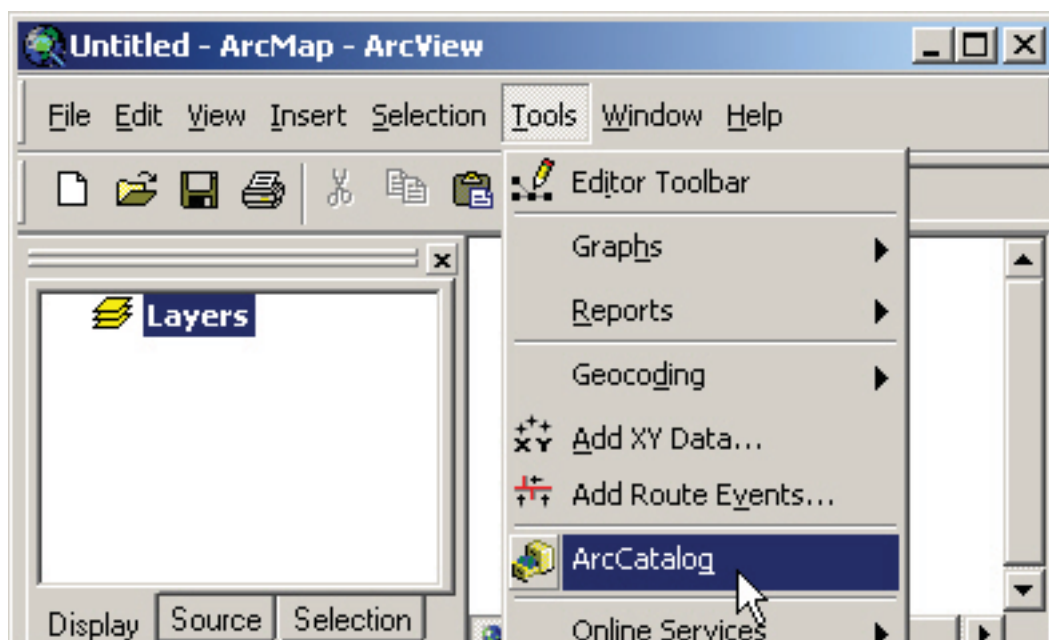
In this case, I’ve changed the name of all block group files from “tgr47157grp00” to “tn_shelby_cnty_map” since it is a map of Shelby County, Tennessee. (All three files from this zip group must be changed to the same thing, without changing their file type extensions: .dbf, .shp, .shx.) And I renamed the “tgr47000sf1blk” file “tn_demog” since it is the demographic information for the entire state of Tennessee.

2.2 Managing .e00 Files

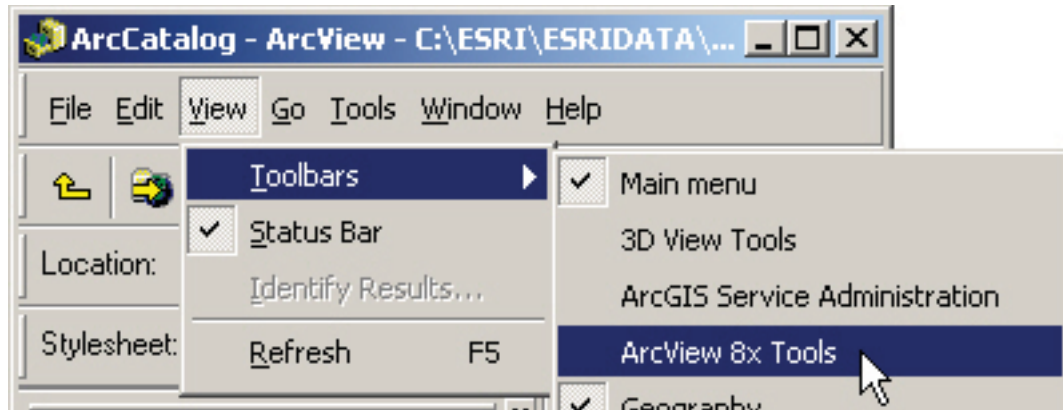
Many times, the geospatial data you download will be in an export or interchange format. These are files that end in .e00. Please note that you will usually need to “unzip” files you download from the internet before processing them as described here. Zipped files typically end in a .zip or .gz. Thus, you could have filename.e00.gz to begin with. Unzip the file using any of a wide range of utilities designed for that purpose and you will be ready to proceed.

In this example, we will be preparing a road map for the city of St. Louis, Missouri. This was downloaded from the Missouri Spatial Data Information Service (<http://msdis.missouri.edu/>). Once you have located and successfully downloaded (and unzipped, if necessary) your .e00 file, you need to perform at least one more step in processing it for use in ArcMap.

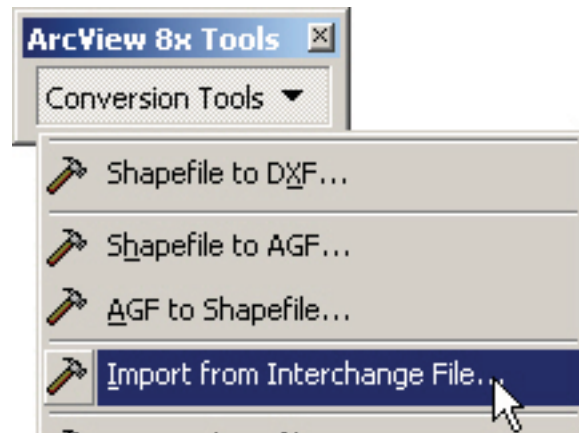
To process an .e00 file, start **ArcCatalog**. If you have ArcMap open, click on the “Tools” menu and then select “ArcCatalog.”



In **ArcCatalog**, click on the “View” menu. Choose “Toolbars” from the popup menu and then choose “ArcView8x tools” from the submenu:

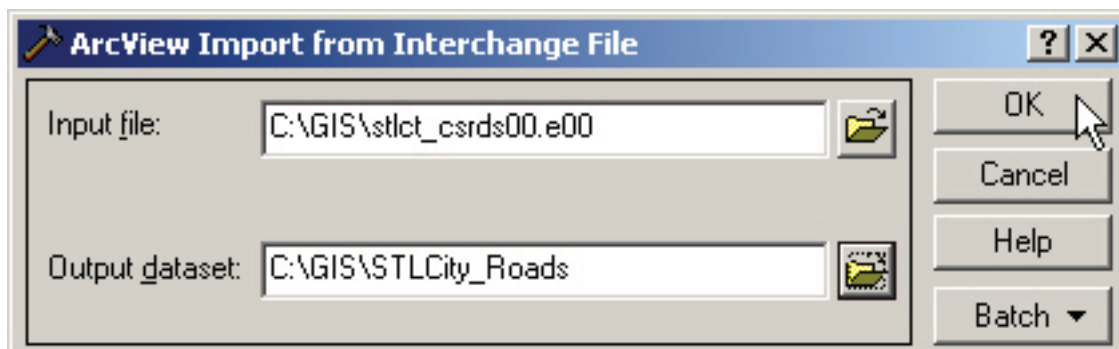


You will get a small, dockable window. From its pull-down menu, choose “Import from an Interchange File:”




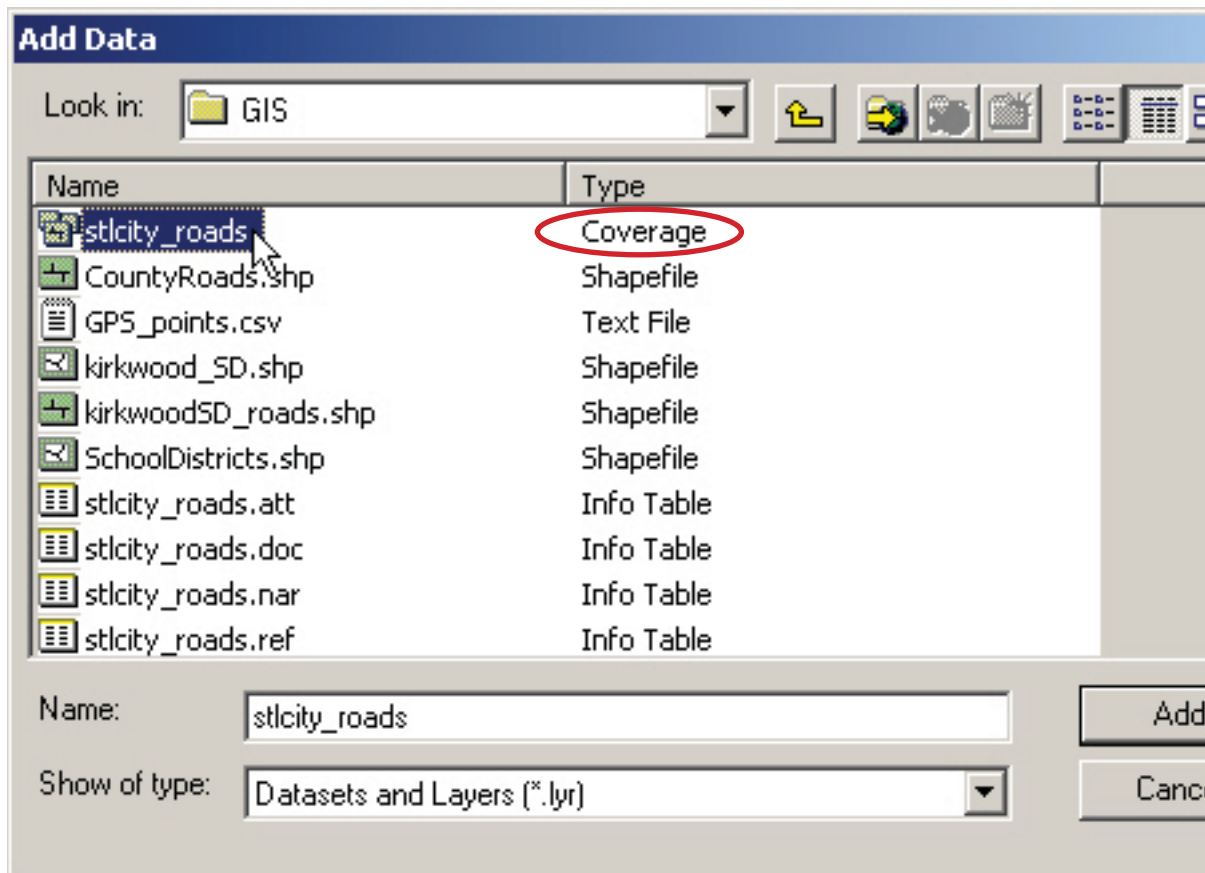
In the dialog box that appears, navigate to the .e00 file you downloaded earlier as the input file. Clicking on the folder icon will let you change your folder location to the one holding the .e00 file.

Similarly, navigate to the directory in which you want to place the output dataset, and assign a name for the file. When this is done, you can click “OK” and the file will be converted to a coverage file that can be mapped. **Note: there can be no spaces anywhere in the path names.**

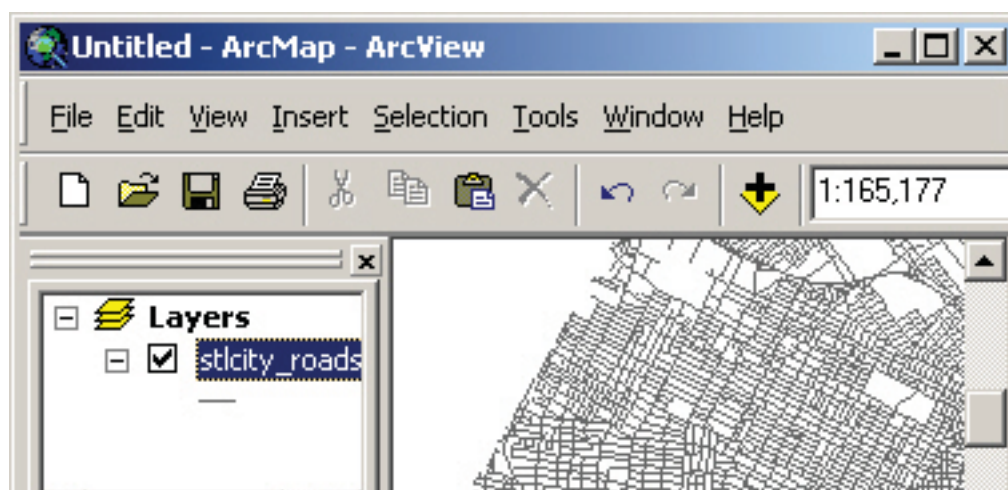


The new coverage will now be available for mapping in ArcMap.

In ArcMap click the “Add Data” button(). Choose the file from the “Add Data” dialog box (make sure you are choosing the **coverage** file from among the files with the same name—look in the “Type” column to see the file types).



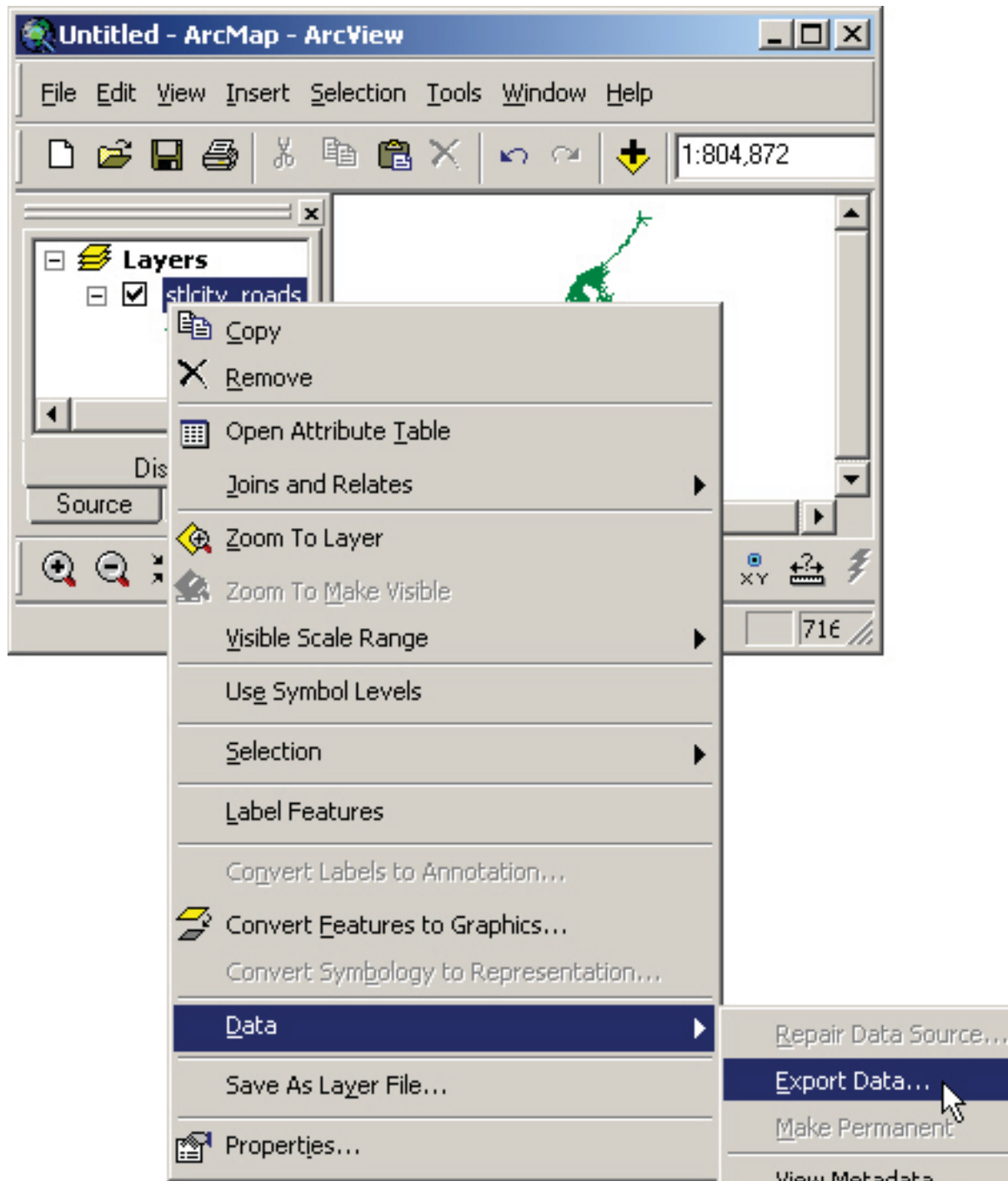
Click “Add” and the data is mapped:



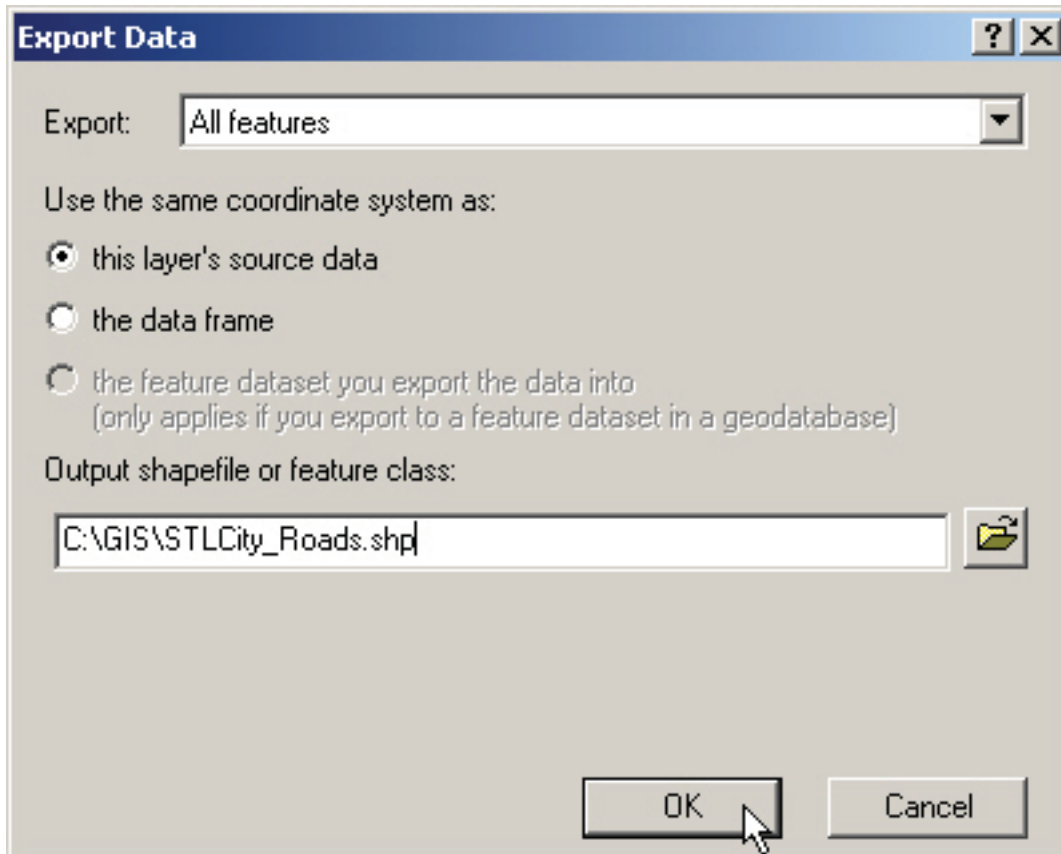
Converting the coverage into a shapefile

For ease of use, you may want to convert this coverage into a shapefile. A shapefile allows you to reproject the data, and makes it easier to move the file around.

To make a shapefile, right-click on the layer name in the Table of Contents, choose “Data” from the popup menu, and then choose “Export Data” from the submenu:



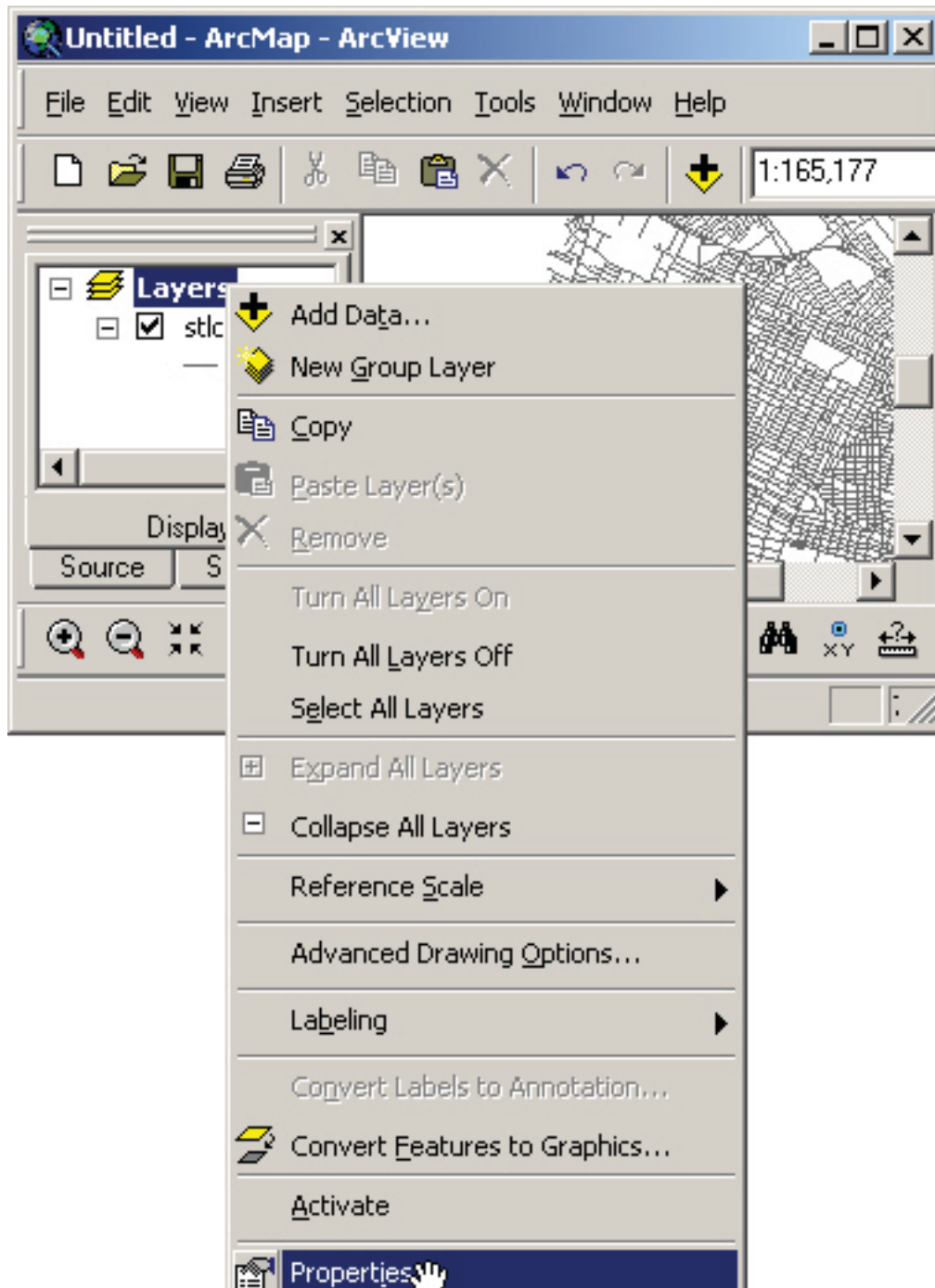
In the “Export Data” dialog box choose to export “All features” and then use the same coordinate system as “this layer’s source data.” Finally select a location and file name for your new shapefile and click “OK.”



2.3 Importing Imagery

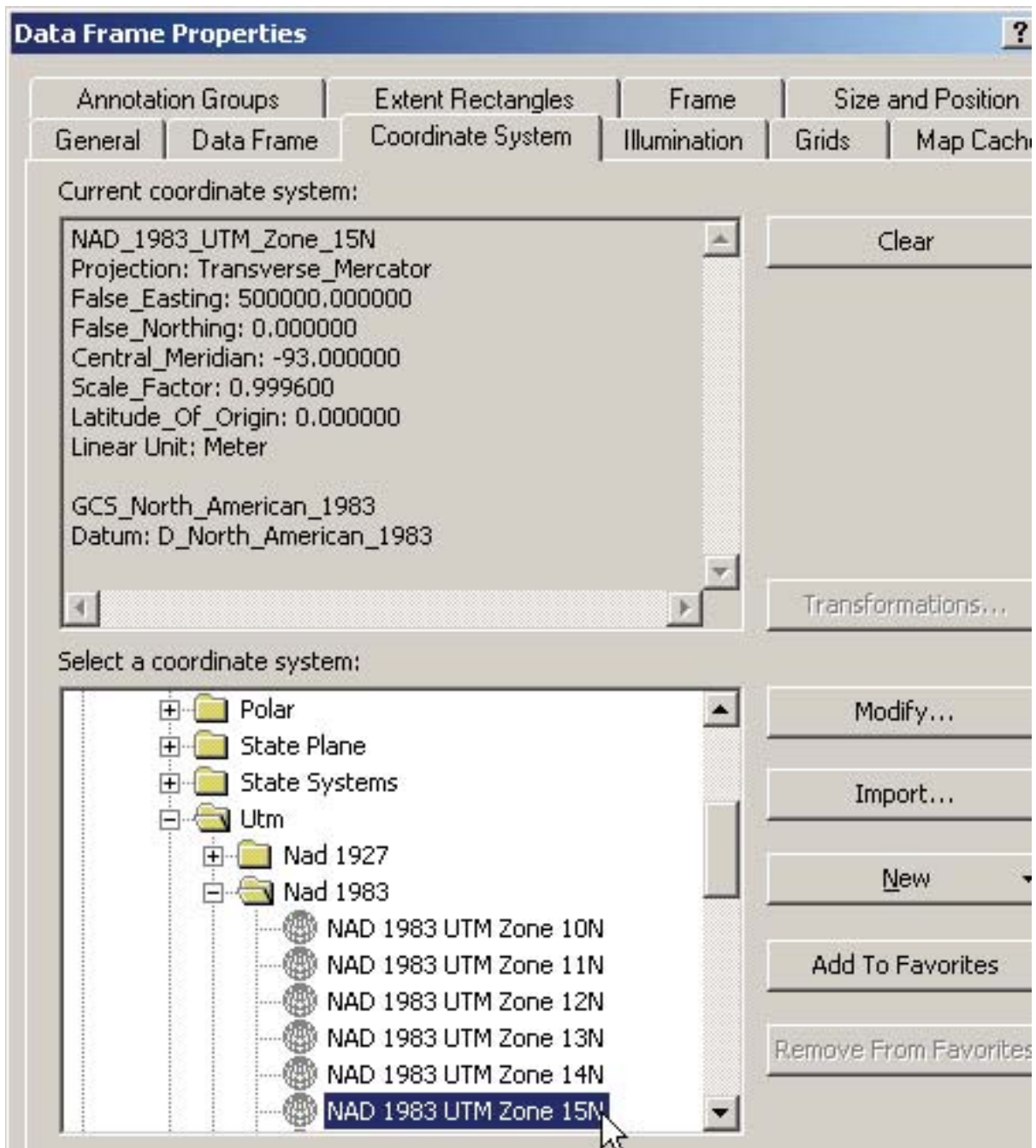
You may want to add an aerial photograph or topographic map to your project. (Instructions on how to get and prepare imagery can be found on page 2.3.4.) As a first step, it will be necessary to define the projection that will be used in the data frame so that it matches the projection of your imagery.

Open ArcMap. In the Table of Contents right-click “Layers” and then choose “Properties.”

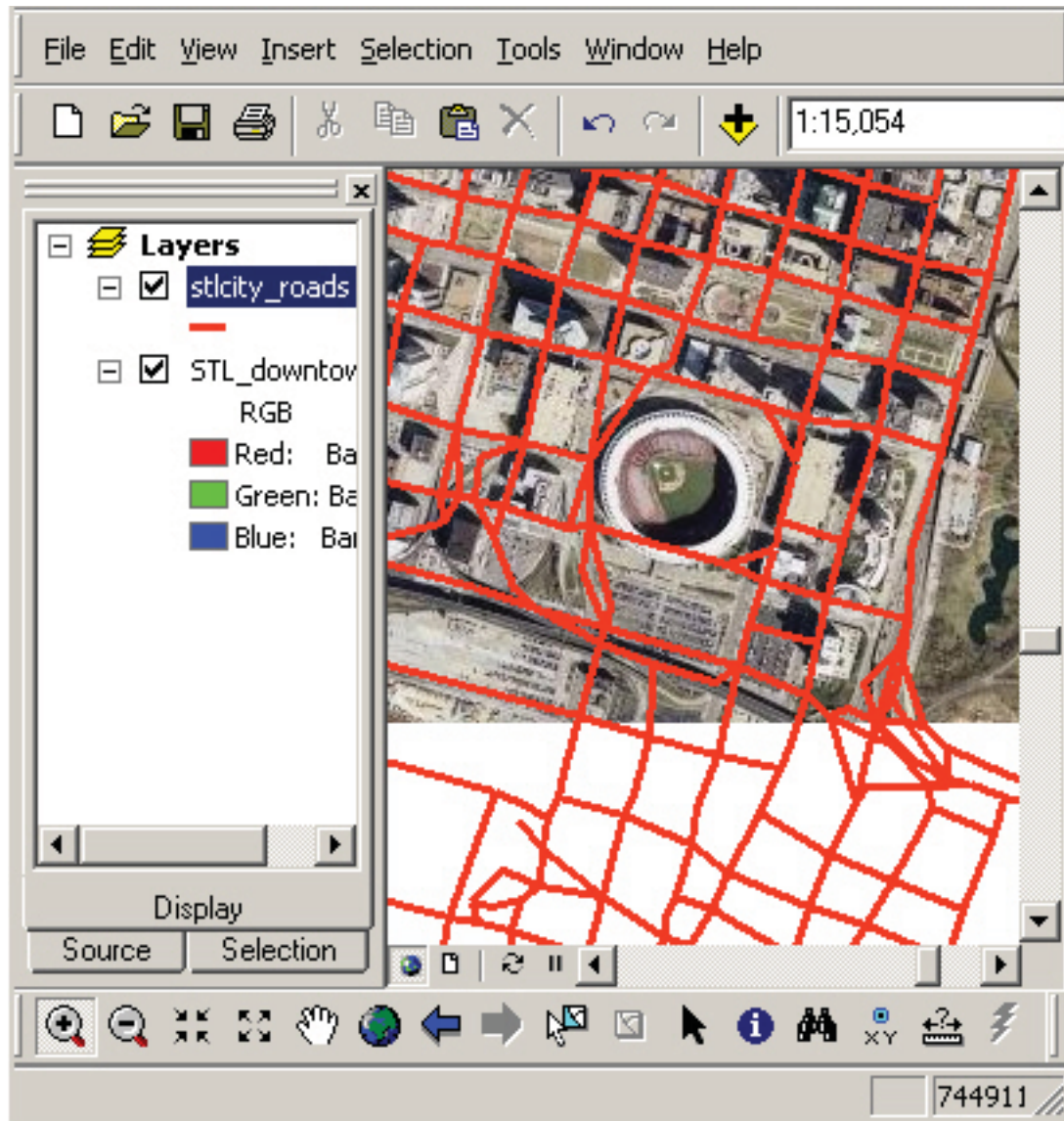


In the “Data Frame Properties” dialog box that appears, click on the “Coordinate System” tab, and navigate to the coordinate system used by your raster image, in this case NAD 1983 UTM Zone 15N. Once you have chosen your coordinate system click “Apply” and then “OK.”

The coordinate system for an aerial photo will typically be UTM, with the zone determined by where you are located on Earth (U.S. zone map available at <http://www.tinyurl.com/UTMzones>). (UTM is located under Predefined > Projected Coordinate Systems; more information on coordinate systems and defining projections can be found in section 3.1.)



In ArcMap, click on the “Add Data” button () from the general toolbar, and navigate to the raster image file (the .jpg file). You can now add it to your project, along with other data.



Note: if you want to plot coordinates on an image, see section 4.4 for special projection instructions.

Finding and preparing imagery

The Microsoft Research Maps web site (<http://msrmaps.com>) offers aerial photography and topographic maps for use in mapping projects. Both of these types of data are often called raster imagery. Following these steps will help you to locate and download the raster you need.

First, at the Microsoft Research Maps site, at the upper left corner of the web page, enter a location for which you want an aerial photo or topographic map. Then click the “Go” button.

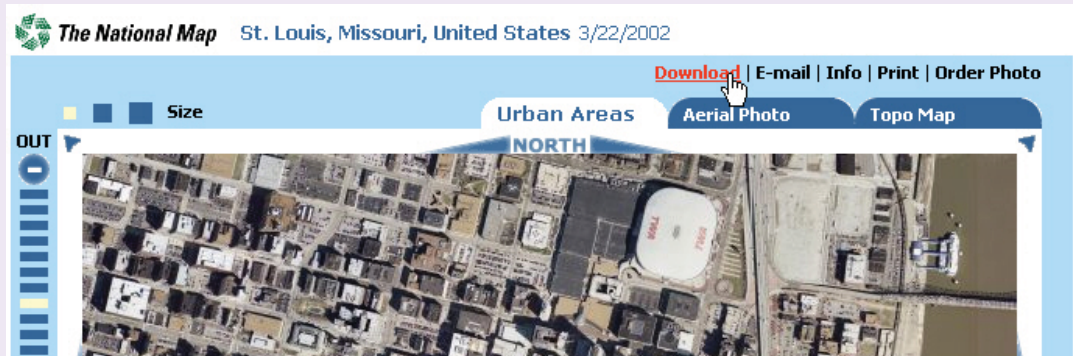
The site will return the choices available for that area.

Select one and it will appear in a window within the web site. Be sure to note how current the photo or topographic map is—quite often it can be a decade or more old, which may affect its usefulness.

	Place Name	Available Imagery
1	St. Louis, Missouri, United States	Urban Areas 3/22/2002 Aerial Photo 4/2/1998 Topo Map 7/1/1985
2	St. Louis Centre, Missouri, United States	Urban Areas 3/22/2002 Aerial Photo 4/2/1998 Topo Map 7/1/1985
3	St. Louis Downtown Airport, Missouri, United States	Urban Areas 3/22/2002 Aerial Photo 4/2/1998

Note that after your image or map is chosen, you can further navigate north, south, east, or west, and zoom in or out to alter the scope of your selection.

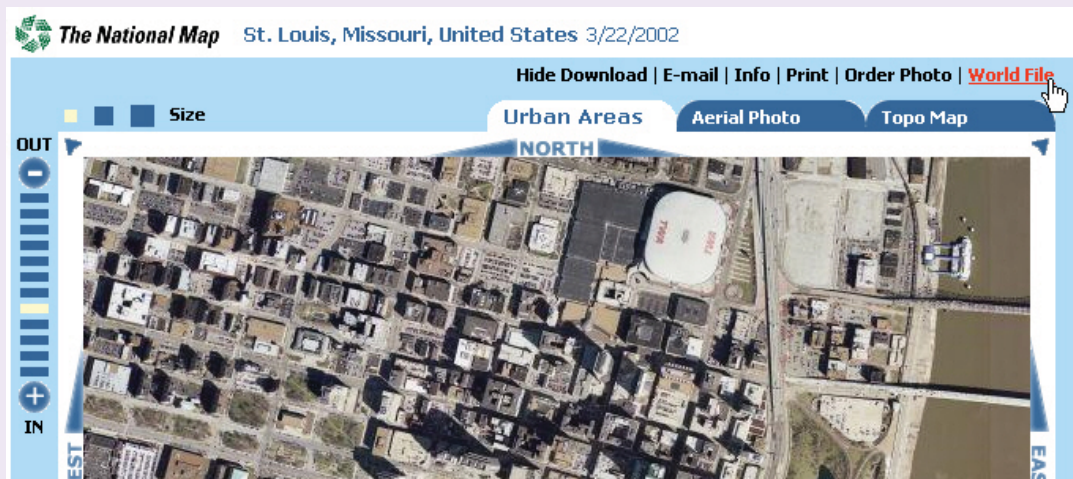
Once you have finalized your selection, click on the “Download” option in the top right corner of the image box. This engages processing on the server, preparing the photo for your use.



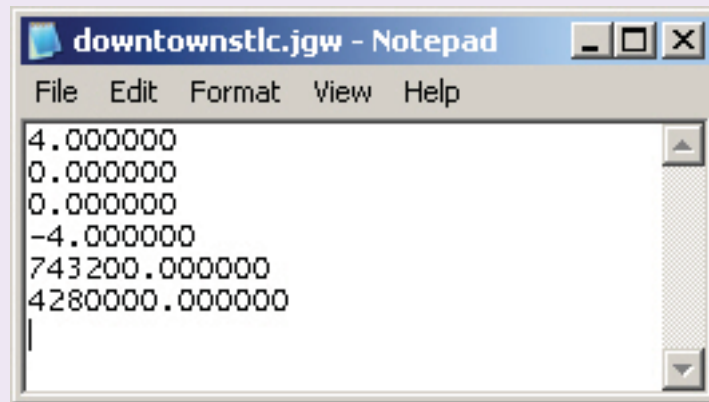
Once the photo is restored on screen, simply right-click on it and choose “Save picture as...” or a similar command for the browser you are using.

Save the image in JPG format (with the .jpg file ending) in a location you will remember. Remember that ArcMap handles the Desktop and My Documents locations poorly. Pick another place if you can.

Once you have saved your image, choose the “World File” option which has now appeared in the top right corner of the image box.



A series of numbers will appear in a new browser window. Copy and paste these numbers into a new Notepad file. Save the file with same file name you used for the image earlier, except now the ending must be “.jgw”.



These two files must be stored in the same folder.

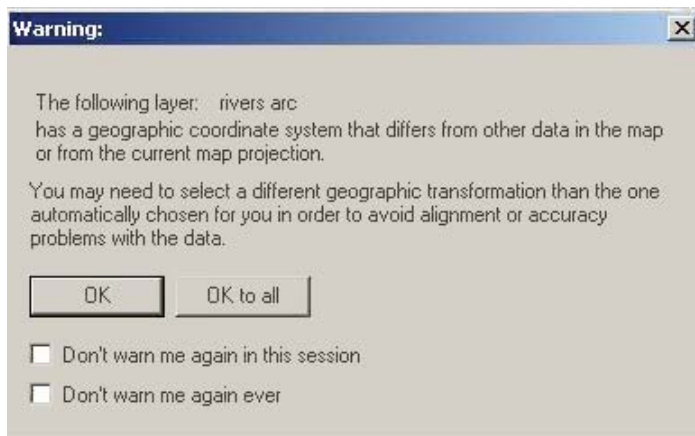
Double-check that your two files have the same names and have the file endings .jpg and .jgw. You can do this by navigating to the folder using Windows Explorer. Before adding the photo to your project, be sure your world file was saved properly and that no extra file type ending was added after the .jgw.

Microsoft Research Maps files use NAD 83 UTM as their coordinate system. You will need to add a zone. (See zone map available at <http://www.tinyurl.com/UTMzones>). St. Louis, Missouri is in zone 15. Thus the projection for this image is NAD 83 UTM Zone 15N. (The “N” stands for north because it is in the Northern hemisphere.)

SECTION 3: ADVANCED DATA MANAGEMENT

3.1 Defining Map Projections

ArcMap generally does an adequate job of “projecting on the fly,” or making the necessary translations between different projections. This allows data from different projections to be mapped in the same project. When a projection is being done “on the fly,” you will receive a message like the one below, but in most cases the accuracy will be sufficient for your purposes.



What is a map projection?

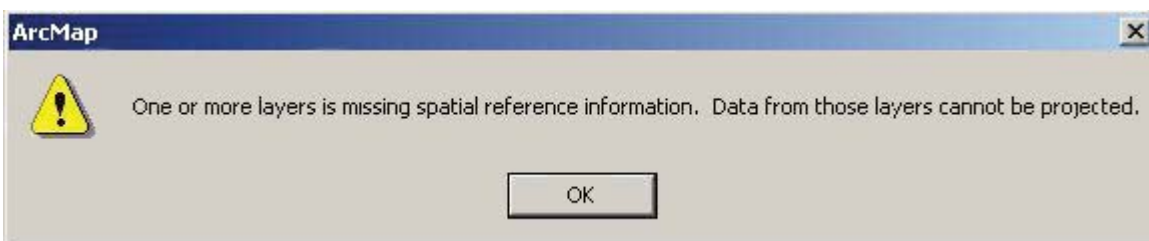
A map projection is used to portray all or part of the round Earth on a flat surface. This cannot be done without some distortion.

Every projection has its own set of advantages and disadvantages. There is no “best” projection.


The mapmaker must select the one best suited to the needs, reducing distortion of the most important features.

From the USGS web page “Map Projections.” (<http://egsc.usgs.gov/isb/pubs/MapProjections/projections.html>)

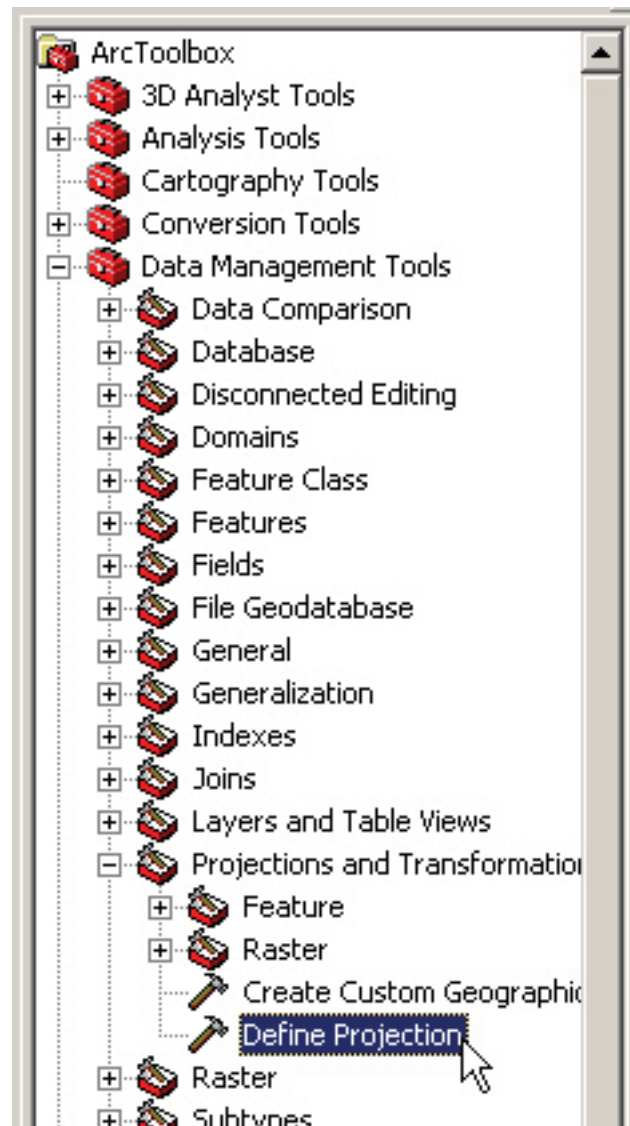
Occasionally, this doesn’t work, however, and a projection must be defined for one or more map layers. You know this is the case when ArcMap returns a message such as this:



When you encounter this, a projection must be defined for that layer to be used properly.


To do this, start **ArcToolbox** by clicking on the small toolbox icon () in ArcMap.

Within ArcToolbox, double-click “Data Management Tools” to expand that menu, then double-click “Projections and Transformations,” and finally, double-click “Define Projection”:



This opens a wizard that will guide you through the process.


In the first box, specify the map layer (known formally as the dataset or feature class) by clicking on

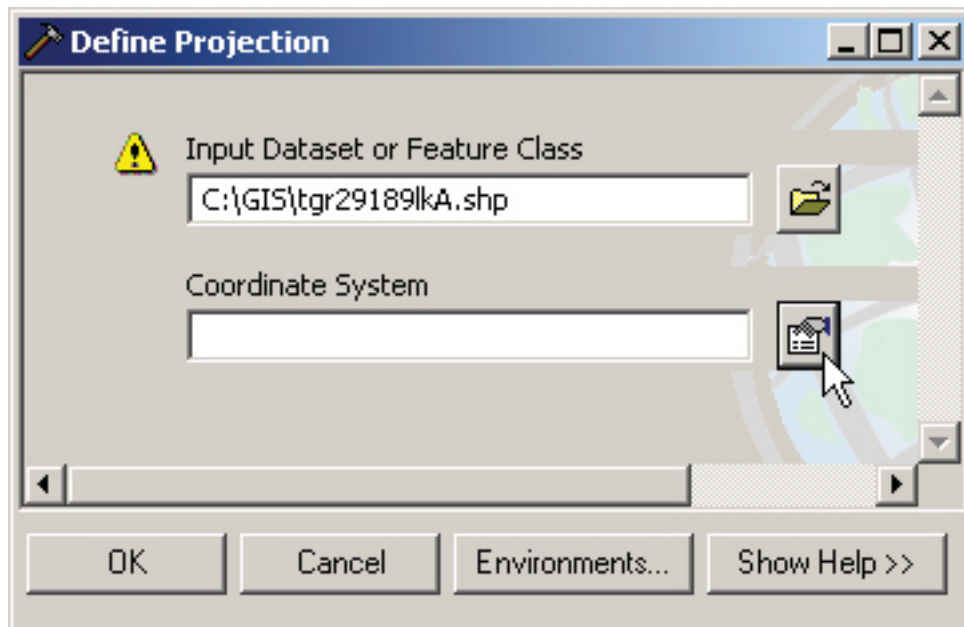
the folder icon () and navigating to the file.

In the second box you will specify the coordinate system. *(The coordinate system should be known or available from the source of the data. If not, you will need to contact the data provider.)*

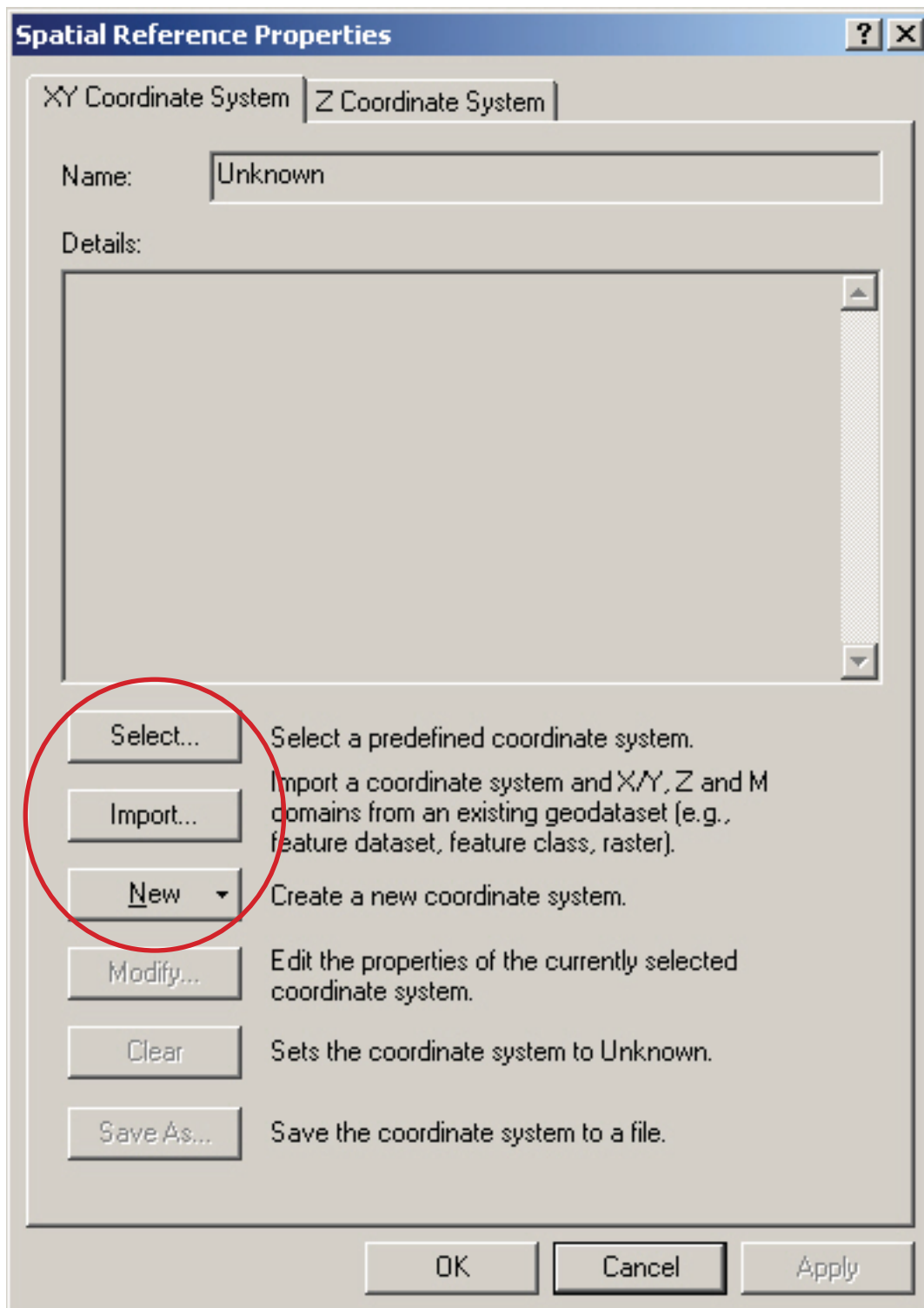
Sometimes the coordinate system will automatically fill in when you specify the map layer. If it fills in for you, the projection is already assigned. Click “Cancel” to close the dialog box.

If the coordinate system does not automatically fill in, you will have to specify it.

To specify the Coordinate system, click on the small icon () to the right of the box.




The “Spatial Reference Properties” dialog box will pop up, and you can select one of three common options:




1) 

If you opt to **select** the coordinate system, you will need to navigate to an appropriate geographic or projected coordinate system. At the risk of over-simplification, the geographic coordinate systems use a latitude / longitude system that assign every point on Earth a unique coordinate. In other instances, usually for maps covering a smaller area, projected systems are used. In either case, selecting the appropriate coordinate system is a matter of navigating through the folders to find the appropriate choice.

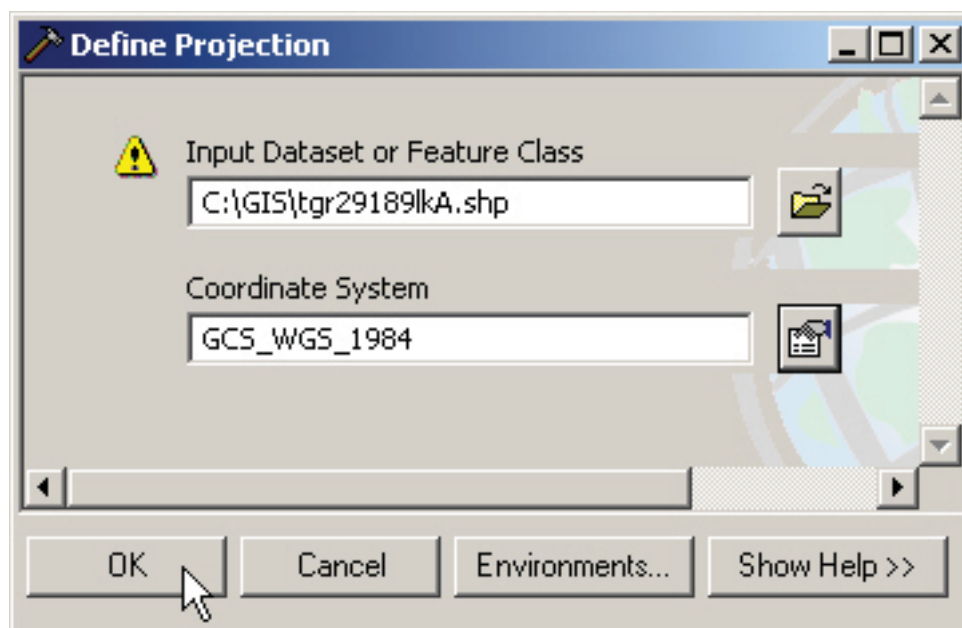
2) 

If you choose to **import** a projection already used by another shapefile, you will be prompted to locate the layer with the projection you want to use. When the data file has been located, simply double-click on it or click it and then click “Add.” This will assign the projection of the shapefile you just chose to the unprojected one.

3) 

If you need to define a **new** coordinate system not available in the selections covered in the first two options, you will need the relevant data from the data provider to complete the dialog box. (Note that this is very rarely needed; in almost all cases one of the other two options above is the right choice.)

Whichever of the three options you use, click “OK” when you have completed the “Spatial Reference Properties” dialog box. Then click “OK” to close the “Define Projection” dialog box, and a projection will have been defined for the layer.




3.2 Clipping Data Layers

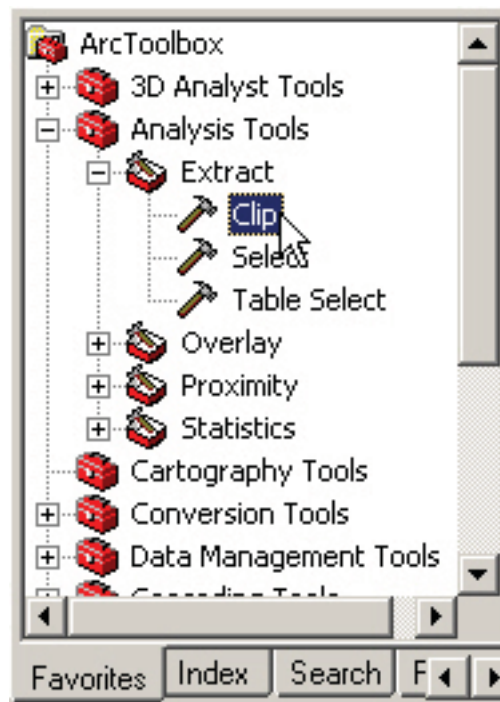
Many times you will want to use a smaller part of a layer (like only the roads in one school district or town, not the whole county). This technique, called “clipping,” is pretty easy to use.

Clipping Out Part of a Layer

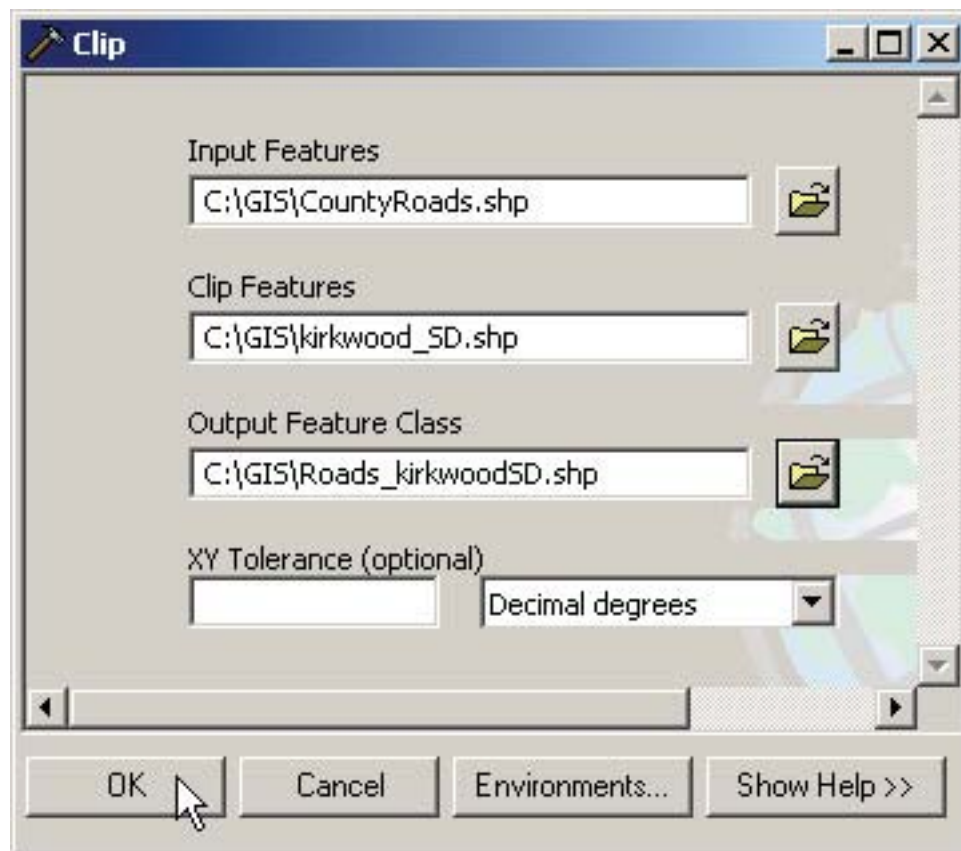
To clip out part of a layer, you actually need two layers: the one you are clipping and the one that provides the boundaries of the “clip.”

In this example, we’ll clip out the roads for one school district from the larger county road layer. Metaphorically, the school district boundary will be the cookie cutter and the road layer the dough. **If you need to make the cookie cutter first, see the suggestions on page 3.2.3.**

- 1) Within ArcMap, open ArcToolbox by clicking on the small red toolbox icon ().
- 2) In ArcToolbox, double-click “Analysis Tools,” double-click “Extract,” and finally double-click “Clip.” This will open a dialog box where you can choose the layers you need.




- 3) In the “Clip” dialog box, choose the input features (the County Roads in this case) and the clip features (the Kirkwood school district). If the layers aren’t already loaded into the project you are working on, you can navigate to them by clicking on the folder icons next to each feature.
- 4) Choose the name and location for the output layer.

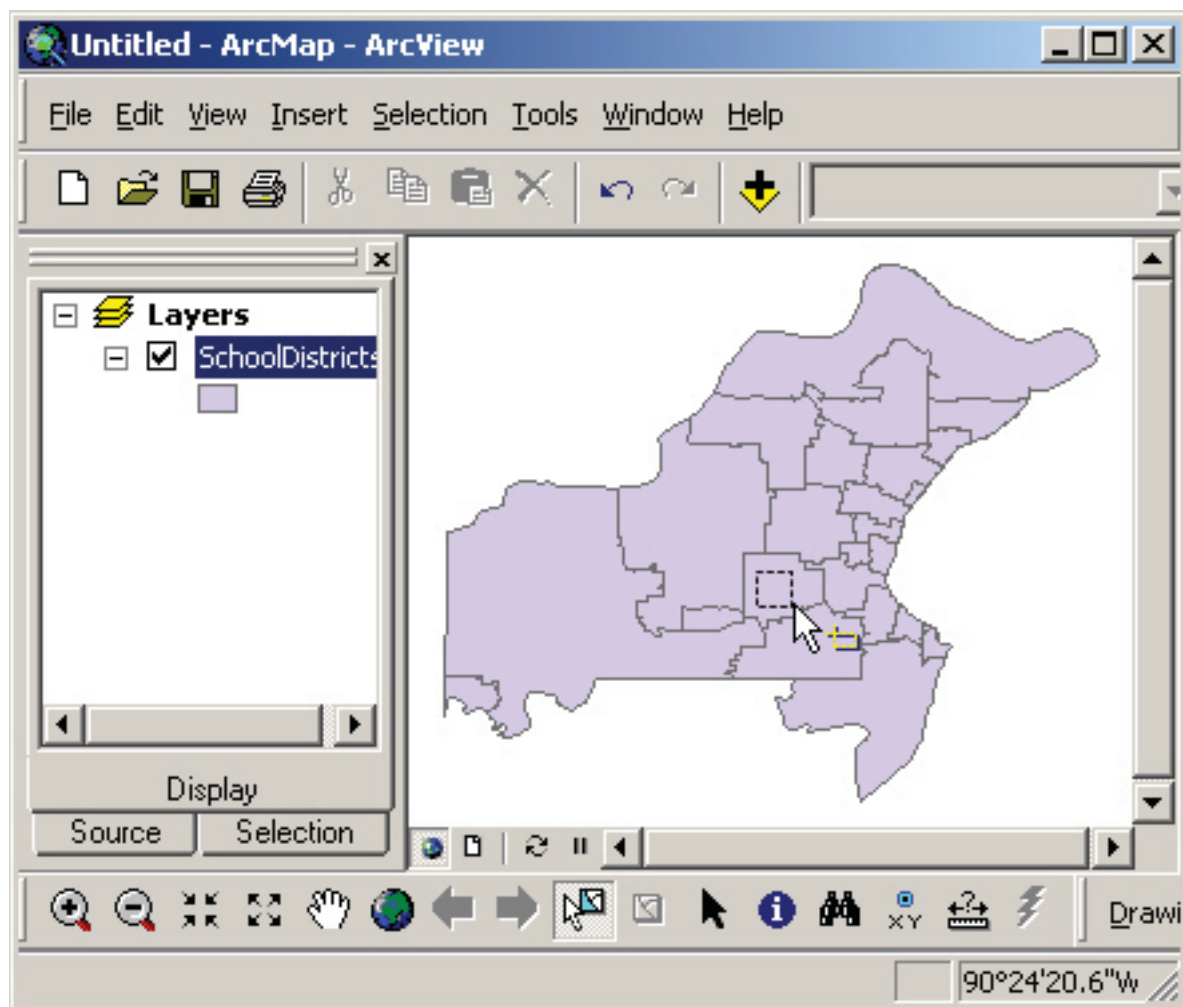


- 5) When you click “OK,” your clipped layer is created. The program will pop up a new window showing the progress of your clipping operation. When the clipping is complete, close the dialog box and you will see your layer in ArcMap.
- 6) You can turn off the county-wide road layer if you like, and zoom into your new layer by right-clicking (in the table of contents) on the layer name you just created and choosing “Zoom to Layer.”

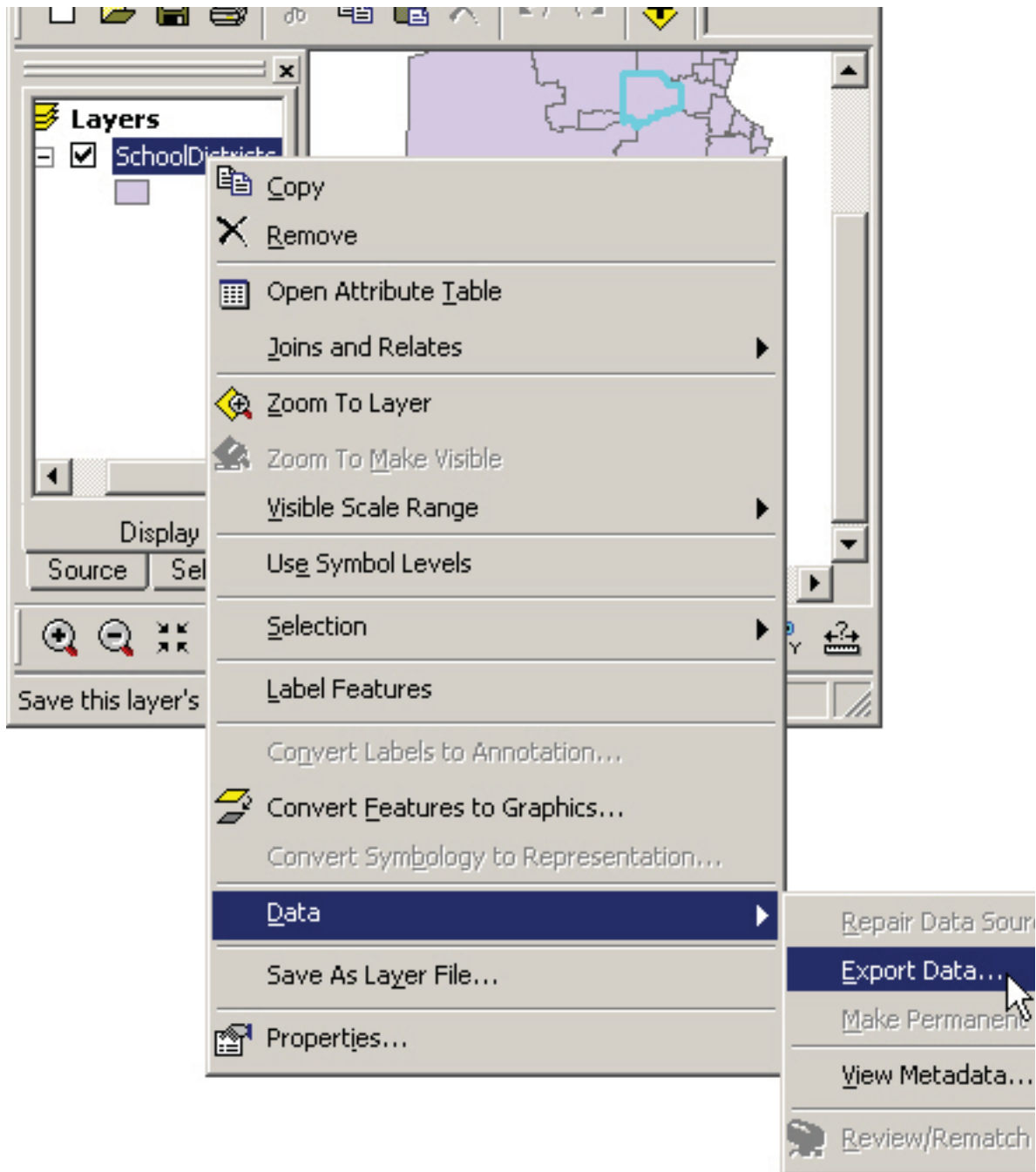
Making a Good “Clip Layer”

Many times you won’t have the specific area you are interested in as a separate layer ahead of time. In the example above, the Kirkwood School District clip layer started as a layer containing all of the school districts in St. Louis County. Just a few quick steps created a new layer that only contains the Kirkwood district.

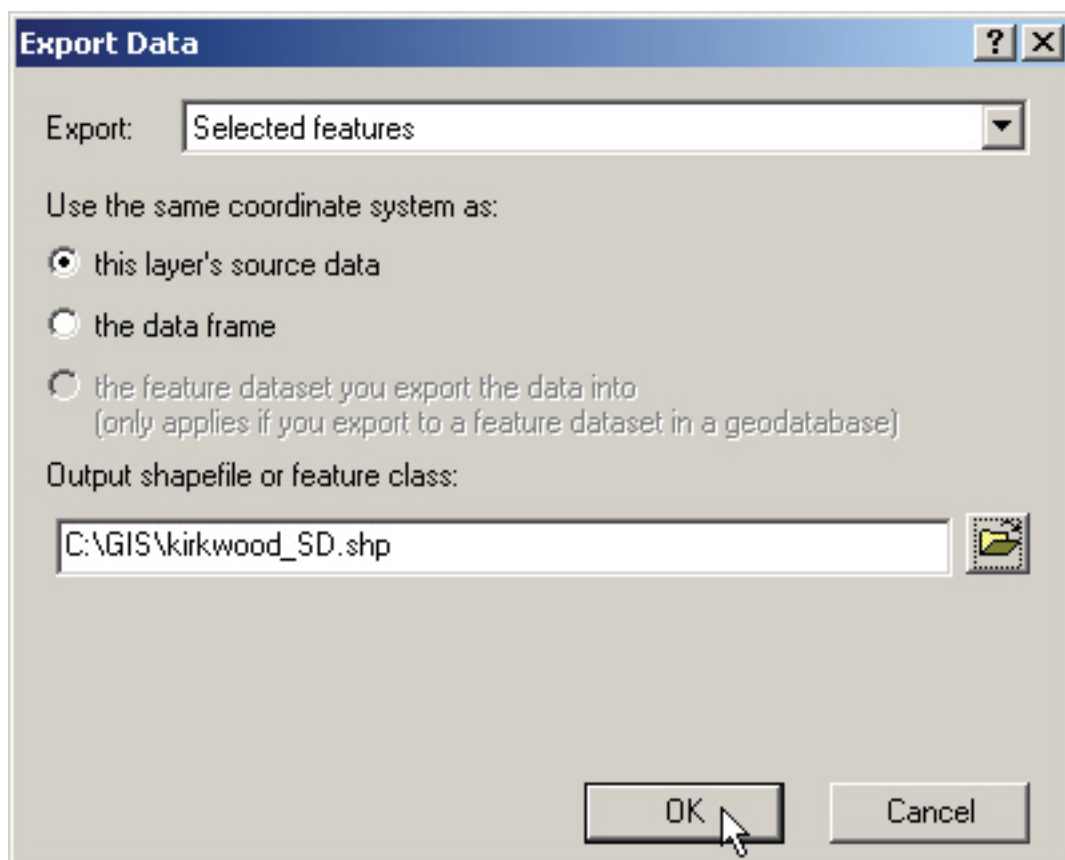
- 1) From the Selection menu, choose “Set Selectable Layers.” In the dialog box that appears, uncheck all of the layers except the one you are interested in (school districts in this case).
- 2) Choose the Select Features tool () from your tool palette.
- 3) Click and drag a small box in the area you want to select. Be sure your box does not go outside the boundaries of the area you want in your clip layer. The selected parts will be highlighted in cyan blue. If you accidentally select too much, you can go back to the Selection menu and choose “Clear Selected Features.” Then try your selection again.



- 4) In the Table of Contents, right-click on the layer containing the selected features, and choose “Data” and then “Export Data.”



- 5) In the dialog box that appears, choose to export “Selected features.” Use the same coordinate system as “this layer’s source data.” Then choose a name and location for your new file. ArcMap automatically calls the new file Export_Output.shp. You should rename it to something that makes sense (although leave the .shp ending intact). When you are finished renaming click “OK.”




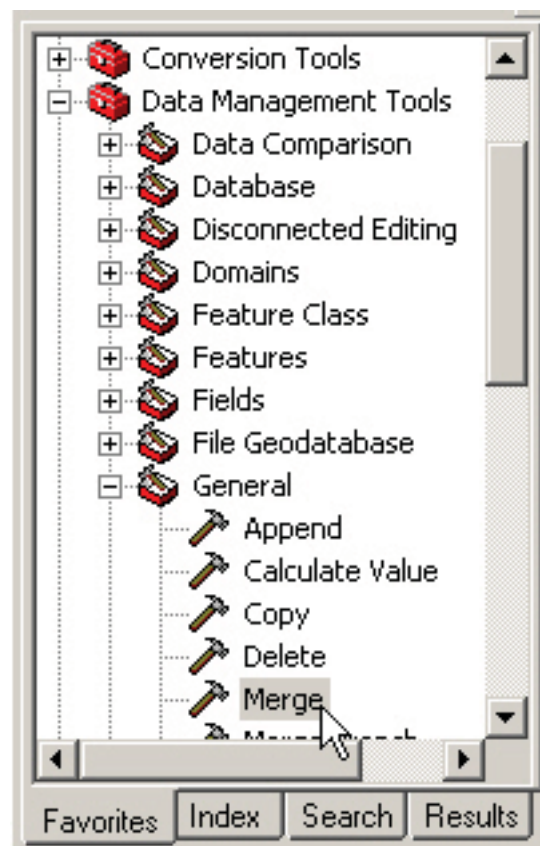
- 6) When asked, add the exported data to your project.

You can then proceed with the clipping operation with the layer you just created.

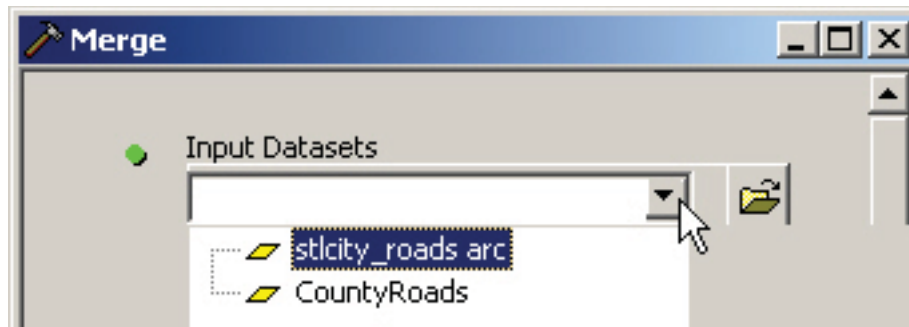
3.3 Merging Data Layers

There will be times when it will be useful to have more than one layer combined into a new layer. In this example, road layers from St. Louis city and county will be combined into one new layer.

- 1) Within ArcMap, open **ArcToolbox** by clicking on the small red toolbox icon ().
- 2) In **ArcToolbox**, double-click “Data Management Tools” and then double-click “General.” This will reveal a number of tools; double-click “Merge.”

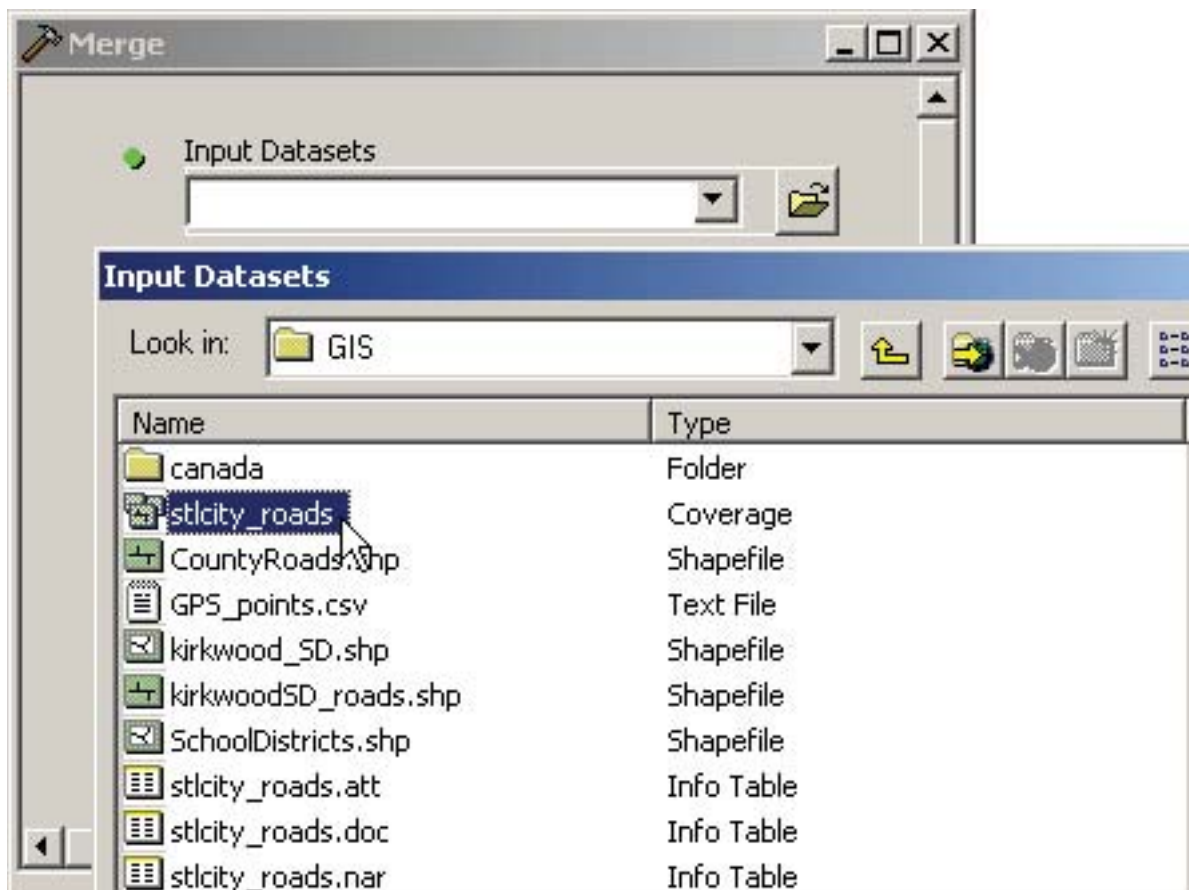


- 3) In the dialog box that appears, choose at least two input layers. To choose layers that have already been added to your project, click the small dropdown arrow next to the box. Choose the layers from the list that appears.

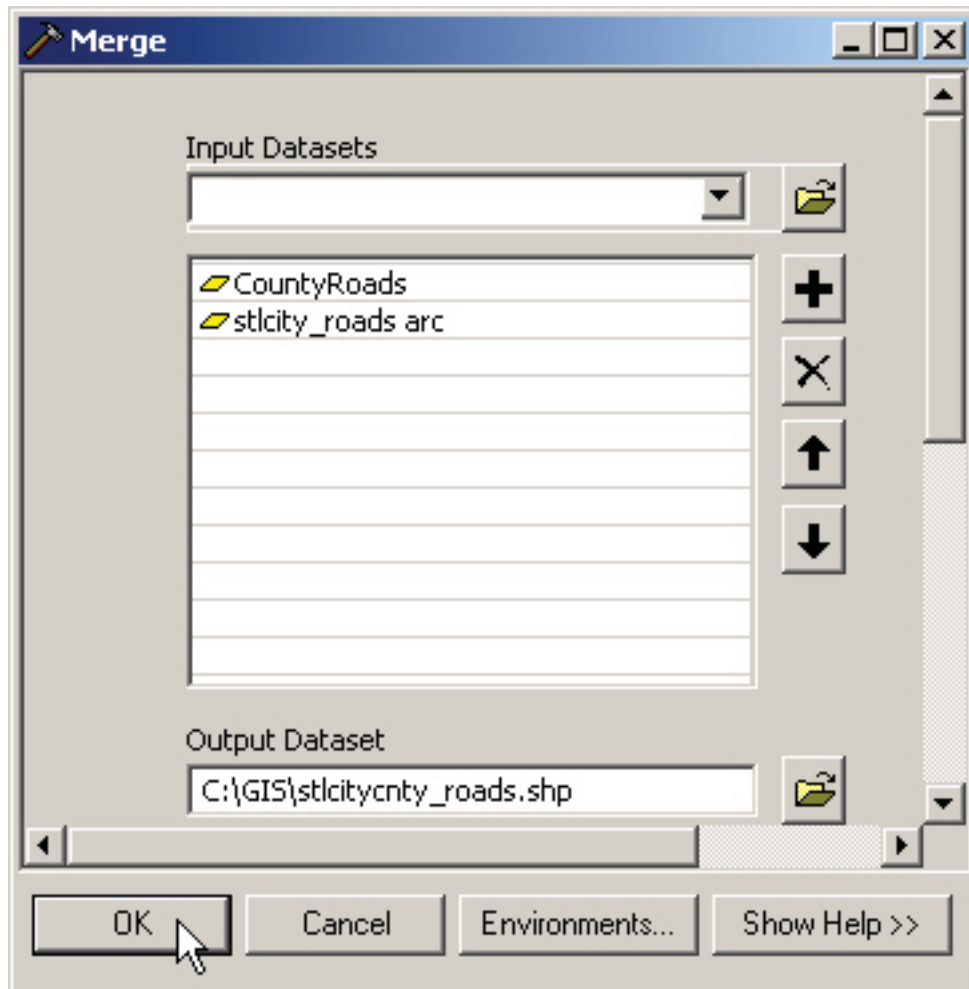


If you need input layers that are not part of your project you can choose them by clicking on the

folder icon () and navigating to the layers you need.



- 4) Give your new layer an appropriate name and location, using .shp as your file type. Click “OK.”




You can now use your new layer.

SECTION 4: PLOTTING LOCATIONS

For many projects you will want to plot individual street addresses on a map. There are several techniques that can be used.

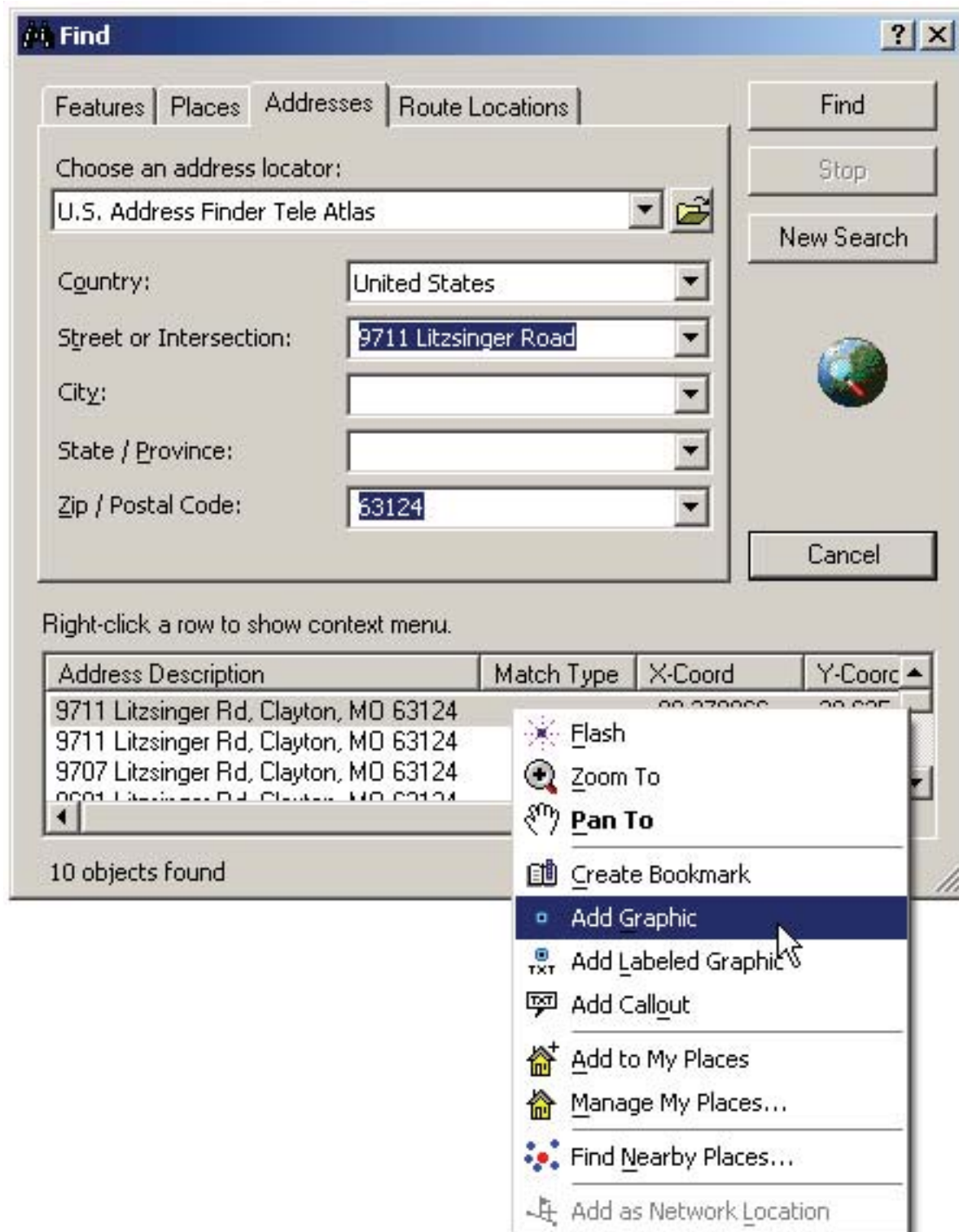
4.1 Plotting Single Addresses on a Map

If you have an individual address that you simply want to pinpoint on a map, you can use the “Find” tool to have the ArcGIS software mark your desired location.

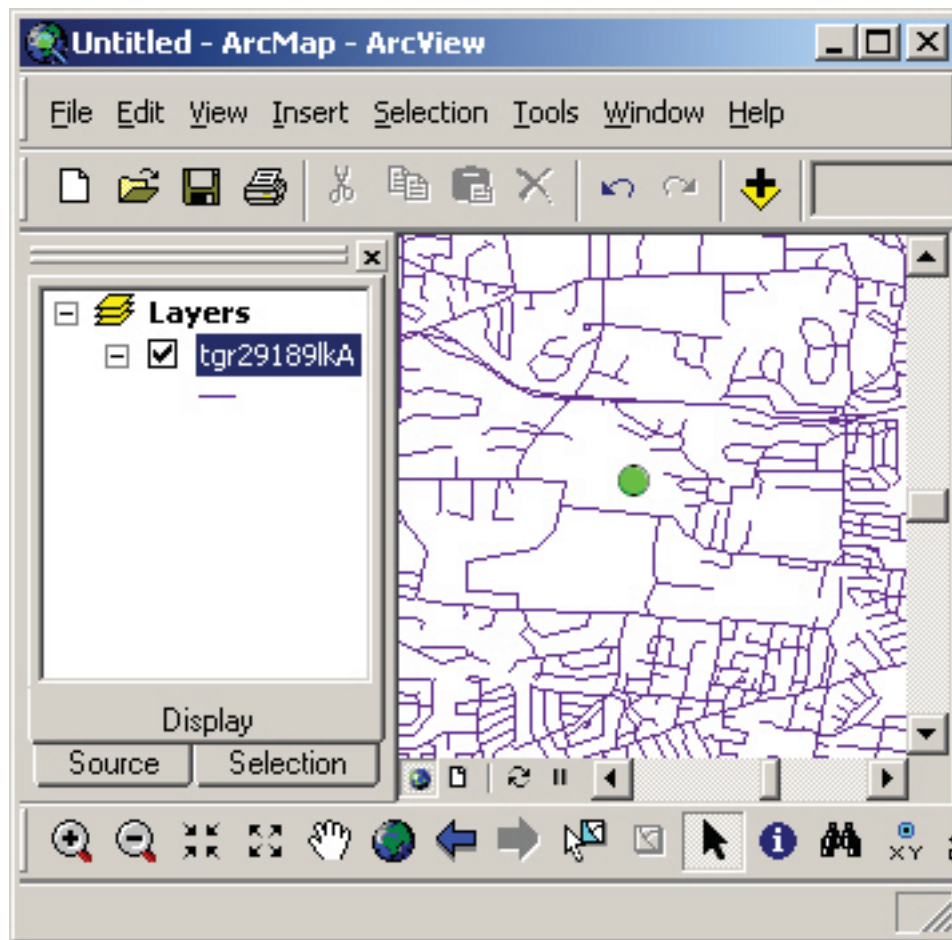
- 1) Once you have your street map displayed, choose the “Find” tool .
- 2) In the Find dialog box that appears, choose “Addresses” from the tabs at the top of the box.
 - a) In the Address Locator pulldown menu, choose the “U.S. Address Finder Tele Atlas” option.
 - b) Enter the address you are interested in. Usually a street and zip code are sufficient.
 - c) Click “Find.”



- 3) Matches will appear at the bottom of the dialog box. Right-click the one you want and choose “Add Graphic” ().



This will place a small dot at the geocoded location. The dot will stay in the correct location as you zoom in and out or pan around the map.



This technique is easy to use for locating addresses, but it is limited in that you can only identify the location. There are no attributes with the dot that you can use to color code based on an attribute, like you can with most geospatial data.

4.2 Preparing Multiple Addresses for Plotting on a Map

If you have several addresses to plot, you can simply repeat the directions in section 4.1 as many times as needed. This may be cumbersome if you have many addresses, however, and you are still limited to displaying a dot. A more powerful option is to use a batch geocoder that will process many addresses at once and give you more options once you have your points located.

To use this option, go online to www.gpsvisualizer.com/geocoder. From there, type in the addresses you are interested in geocoding:

The screenshot shows the 'GPS Visualizer's Address Locator' web page. The title is 'GPS Visualizer' in large green letters. Below it, there's a navigation bar with links: 'Ads by Google', 'GPS', 'Virtual Earth', and 'Map Data'. The main heading is 'GPS Visualizer's Address Locator' followed by the subheading 'Convert multiple addresses to GPS coordinates'. Under the 'Input:' section, there's a text area containing three addresses: '9711 Litzsinger Road, 63124', '100 South Taylor, 63122', and '429 South Clay, 63122'. Below the text area, there are two dropdown menus: 'Type of data:' set to 'raw list, 1 address per line' and 'Source:' set to 'Yahoo!'. There's also a 'Start' button. At the bottom, there's a field for 'Add a color:' and a dropdown for 'Field separator in output:' set to 'comma (,)'.

Click the “Start Geocoding” button and after a brief wait, your results will appear in a text file below a map of your points.

Results as text: (1 of 1 lines processed)

```
latitude,longitude,name,desc,color
38.62275,-90.376755,"9711 Litzsinger Road, 63124",-
38.581005,-90.403945,"100 South Taylor, 63122",-
38.576762,-90.408946,"429 South Clay, 63122",-
```

Copy and paste the results into Notepad or another text editor and save the file as a comma separated value (.csv) file. These points can then be plotted just as if they were GPS coordinates. (See section 4.3: Plotting GPS Coordinates, page 4.3.2.)

4.3 Plotting GPS Coordinates

For many projects you will want to plot coordinates. First you must set the projection of your map.

Setting the projection

Before plotting your GPS data, be sure that the projection of your map view has been set. To do this, go to the View menu and choose “Data Frame Properties.”

Within the dialog box that appears, choose the “Coordinate System” tab. In the box near the bottom of the dialog box, choose the coordinate system your map is using. In almost all cases this will be a “predefined” coordinate system.

- **Geographic Coordinate Systems** use latitude-longitude values. One good choice is WGS 1984 (navigate to it by clicking Predefined > Geographic Coordinate Systems > World > WGS 1984).
- **Projected Coordinate Systems** use x, y values. Among Projected Coordinate Systems, both State Plane and UTM are very useful.

The choice of projection is very dependent on the data you have and the location with which you are working. For our purposes, **set the projection to WGS 1984** unless you know your data is in a different projection.

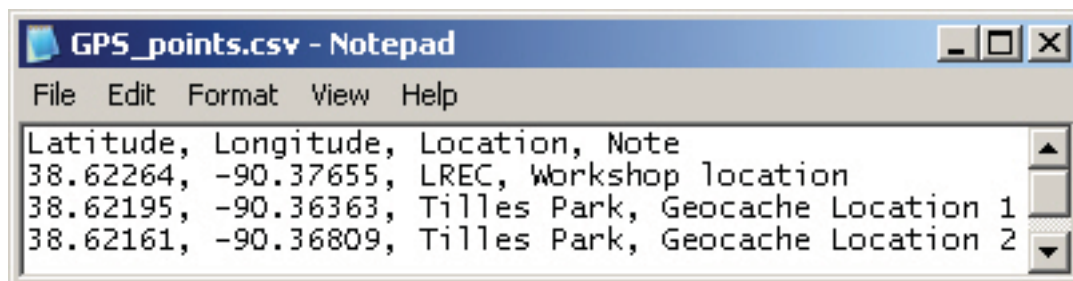
(Note: when combining imagery, such as aerial photos, with coordinates, special instructions apply. See section 4.4.)

When the coordinate system has been selected, click “Apply” and then “OK.”

You can then return to the main ArcGIS interface to map your points.

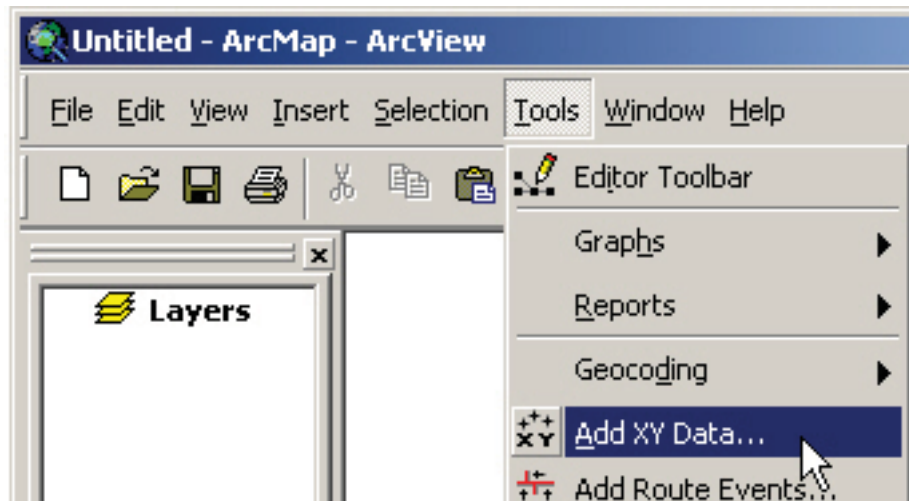
After you have set the projection for your map, put the coordinates (from a GPS receiver or other data source) into a table.


You can use Notepad or any other simple text editor to do this. In the first line type in the data headings separated by commas. Type the data in subsequent lines in the same order as the headings, again separated by commas:



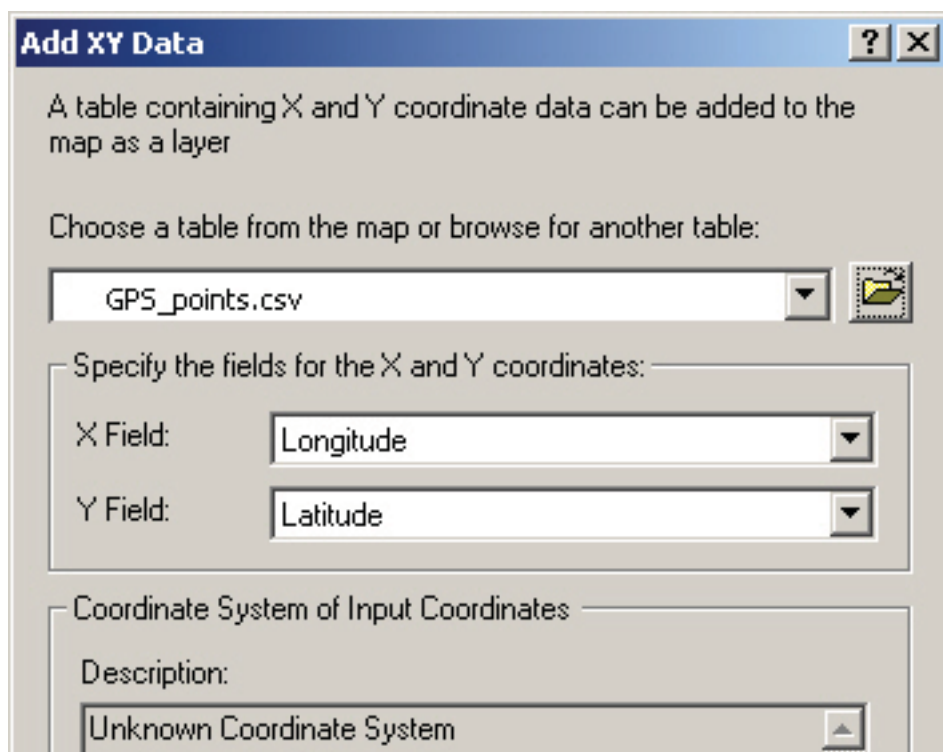
After you have entered your data, save the file as a comma separated value (.csv) file.

Within ArcMap, make the base map as you normally would, with whatever layers of data are appropriate. Then, from the Tools menu, choose “Add XY Data.”



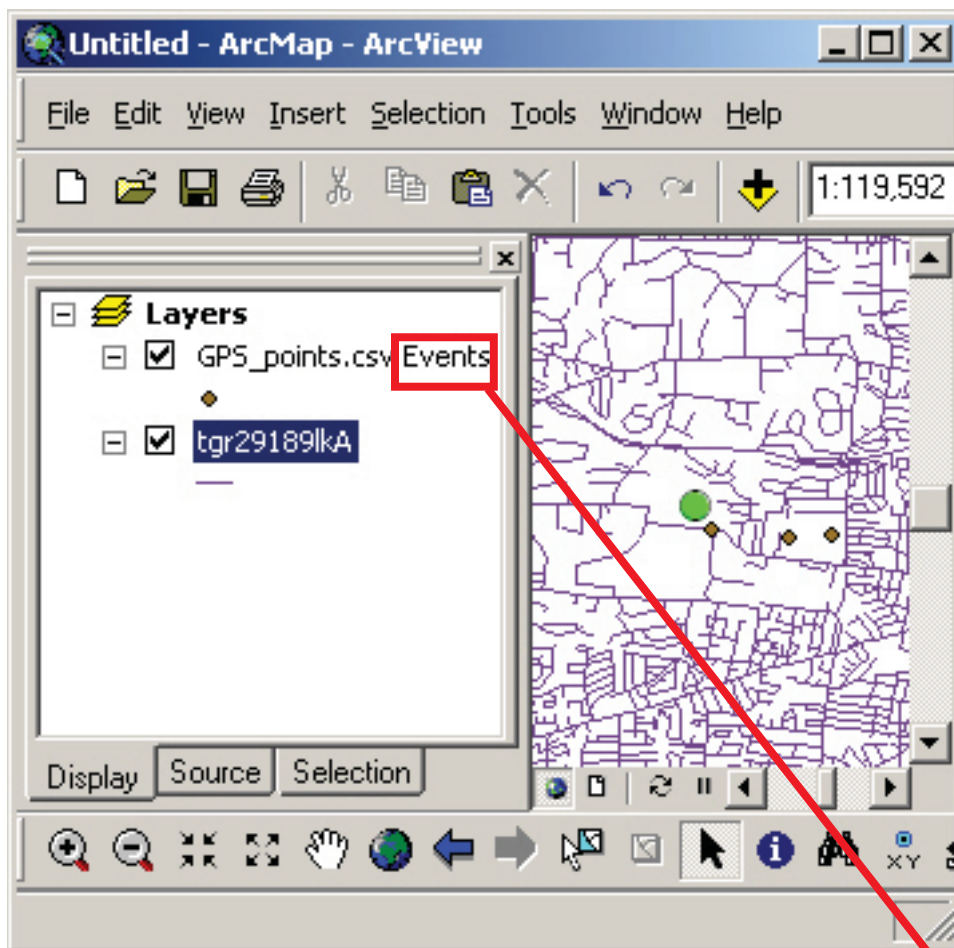
In the dialog box that appears, click the small folder icon (). Navigate to where you have saved the .csv file, select it, and click “Add.”

You should see that the file has been selected, and ArcGIS has made an effort to identify the X and Y coordinates of your data:



(You don't need to be concerned about the Unknown Coordinate System shown in the Description section of the dialog box, or the warning you receive after you click "OK." We'll take care of that in a minute by exporting to a shapefile.)

As a last step in this process, click "OK" and you will see your points plotted on your map:



Notice that your new points appear in the Table of Contents (to the left of the map) as an event. To be able to edit this layer later, you will want to make it into a "regular" data layer. You can do this by exporting it to a shapefile (see below).

Exporting to a shapefile

- Right-click the layer in the table of contents, choose "Data" from the popup menu, then select "Export Data" from the submenu.
- Click the "Export" drop-down arrow and select "All features"
- Select the output coordinate system you want to use. (In this case we will use "this layer's source data")




- Click the Browse folder icon () to navigate to a location to save the exported shapefile. Name your file and save it as a shapefile (.shp). Then click "OK."

4.4 Combining Imagery and Coordinates

Sometimes you will want to map both coordinates and an image. Getting the projections of the two to work together can be a challenge. This tutorial will walk you through one way to map the data.

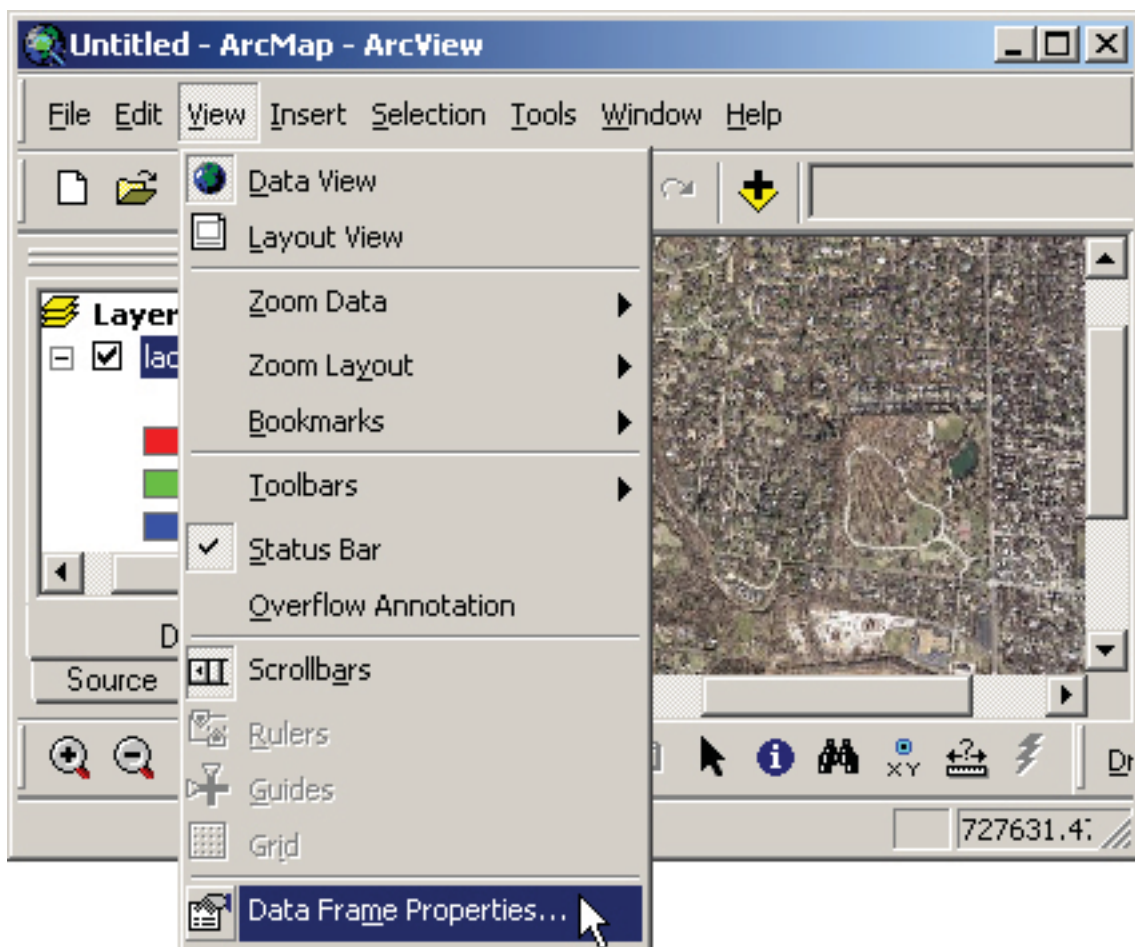
Getting the image set up

First, open ArcMap and begin a new map.

Click on the add data () button. Navigate to and select the image you want to map (such as an aerial photo). (*Instructions on finding, preparing, and downloading aerial photographs and topographic maps can be found in the section on importing imagery: 2.3.4.*)

In the example, an aerial photo of Ladue, Missouri was added.

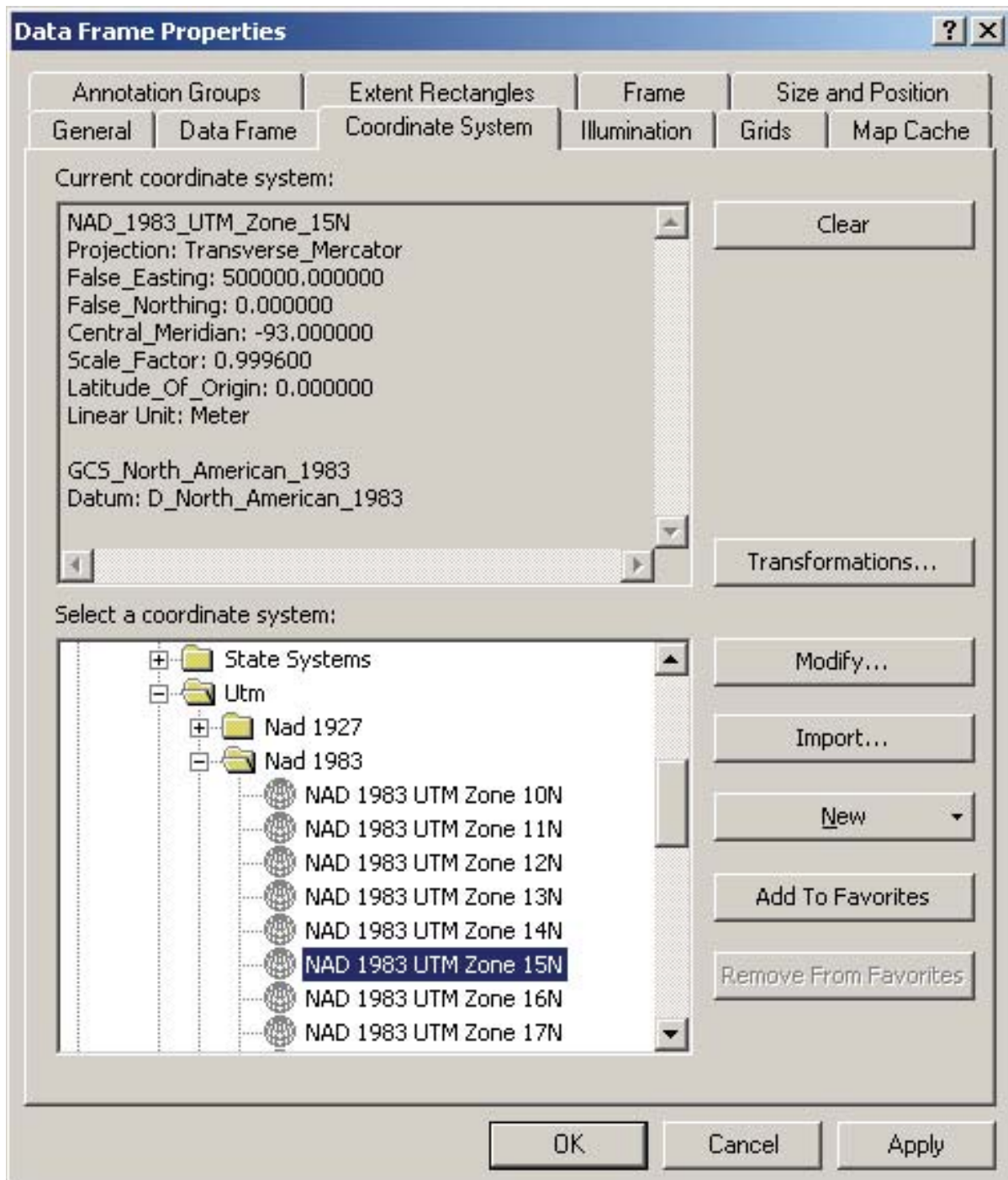
Next, we need to set the projection. To do this, click “View” and then click “Data Frame Properties” in the pop-up menu.



In the “Data Frame Properties” dialog box that appears, go to the “Coordinate System” tab.

Here select whatever coordinate system was used by the image. For the example, knowing that the coordinate system for the image is NAD 1983 UTM Zone 15N, choose:

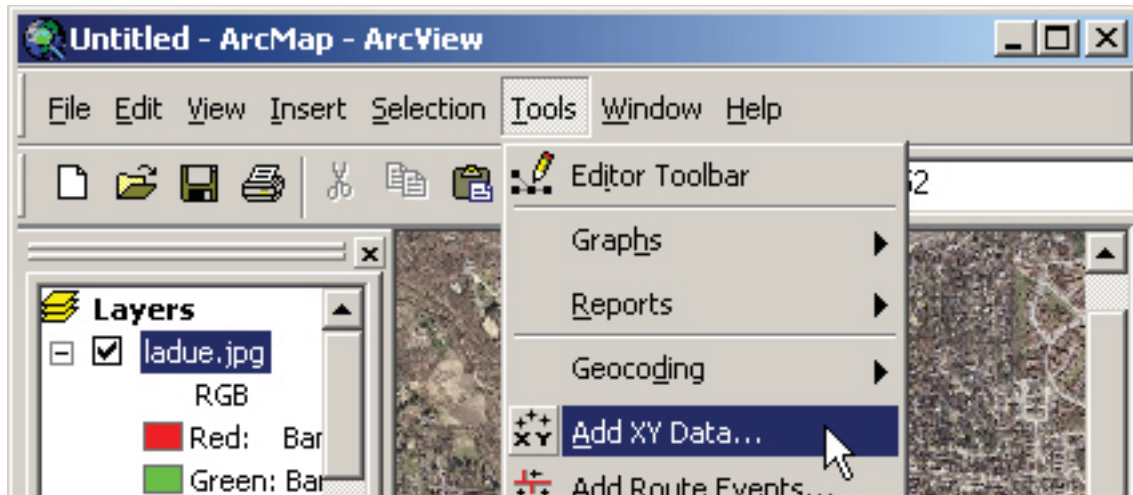
Predefined > Projected Coordinate Systems > Utm > NAD 1983 > NAD 1983 UTM Zone 15N




Click “OK” to set the coordinate system, close the box, and return to the map

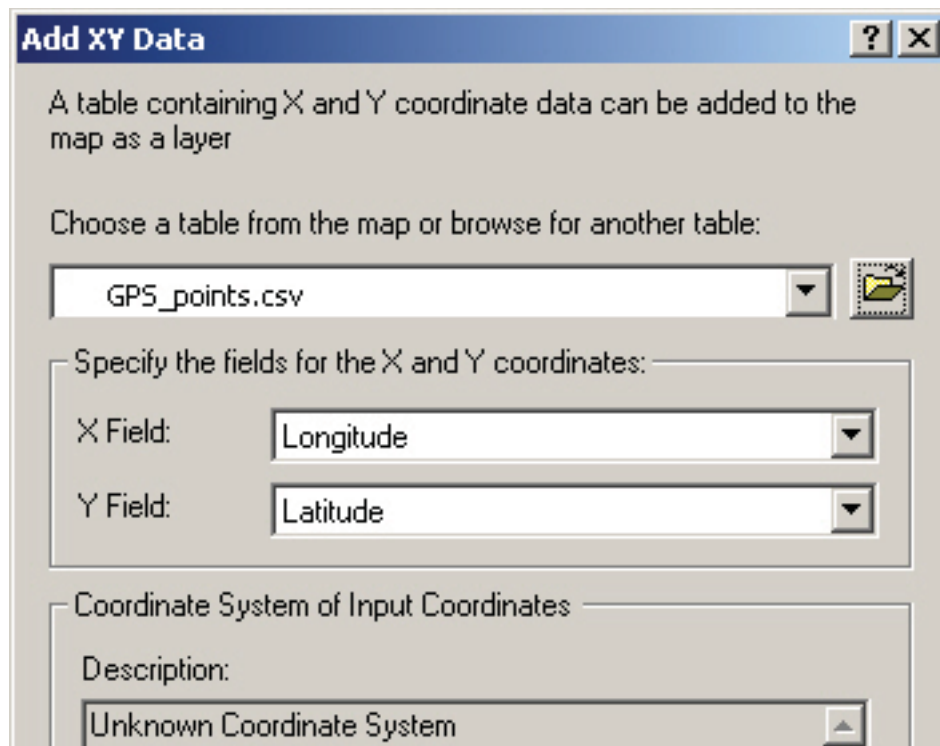
Adding the coordinates

From the “Tools” menu click “Add XY Data...”



In the dialog box that appears, click on the folder icon () and navigate to the .csv file you want to use. (*Instructions on saving coordinates as a .csv file can be found at 3.3.1.*)

The X Field and Y Field sections should fill themselves in with Longitude and Latitude respectively:

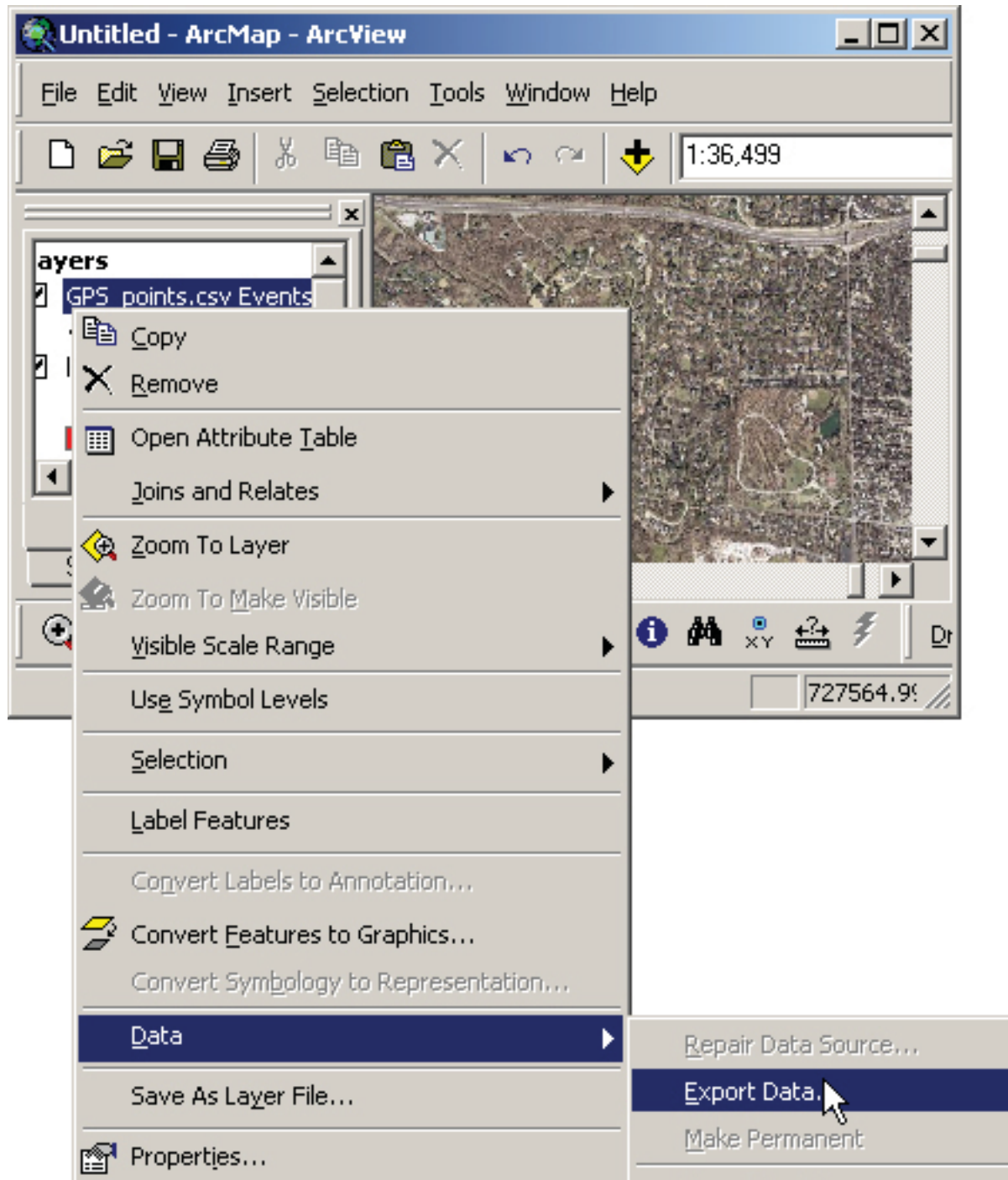


Click “OK.”

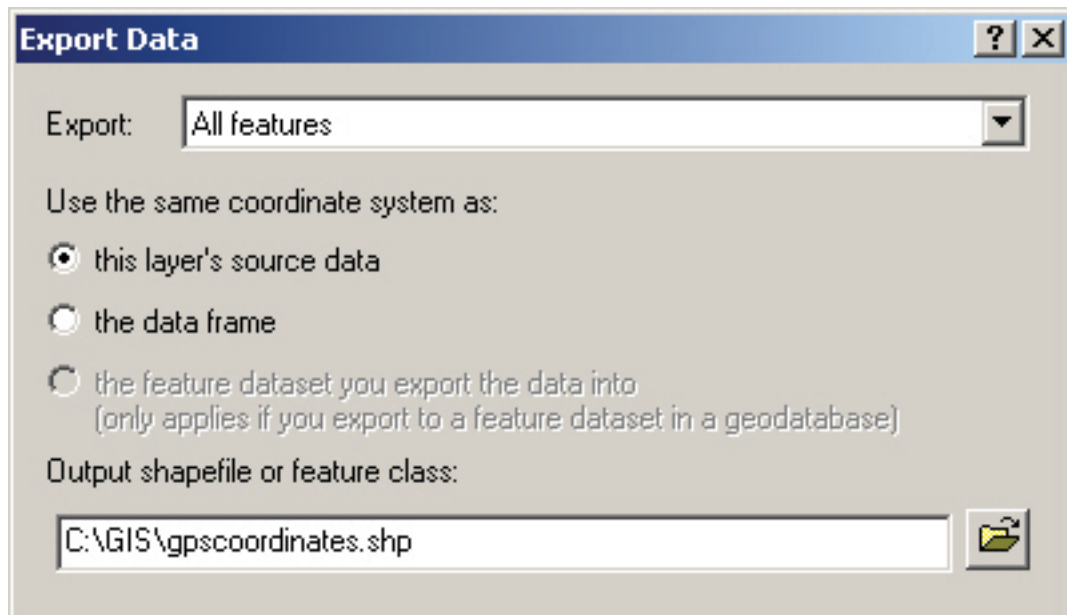
You may get an error box that your table does not have an Object-ID field. We will fix that in a moment. Click “OK” to close the error box.

Create a shapefile from the coordinate data

Right-click the .csv file name in the Table of Contents, then click “Data” and “Export Data...”



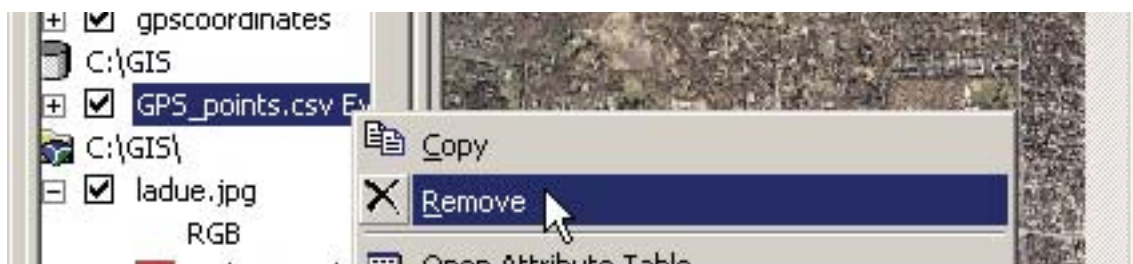
In the “Export Data” dialog box that appears, choose to export “All features” and use the same coordinate system as “this layer’s source data.” Select a file location and name for your new shapefile and click “OK.”



When asked, add the new shapefile to your map as a layer:

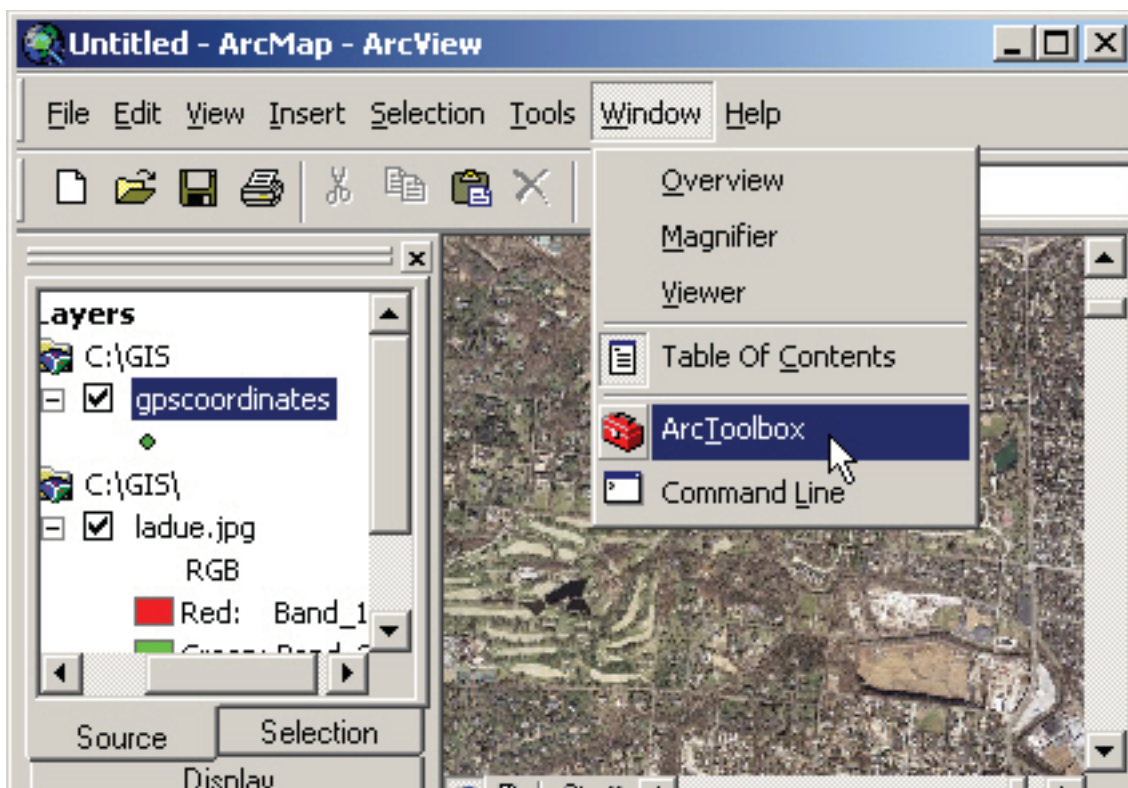


Back at your map, right-click on the .csv file name in the Table of Contents and then click “Remove.”




Setting the projection of the new shapefile


Open ArcToolbox by clicking on the ArcToolbox icon () or by clicking on “Window” and then clicking on “ArcToolbox.”



In ArcToolbox double-click on “Data Management Tools” then double-click “Projections and Transformations.” Finally double-click “Define Projection.”



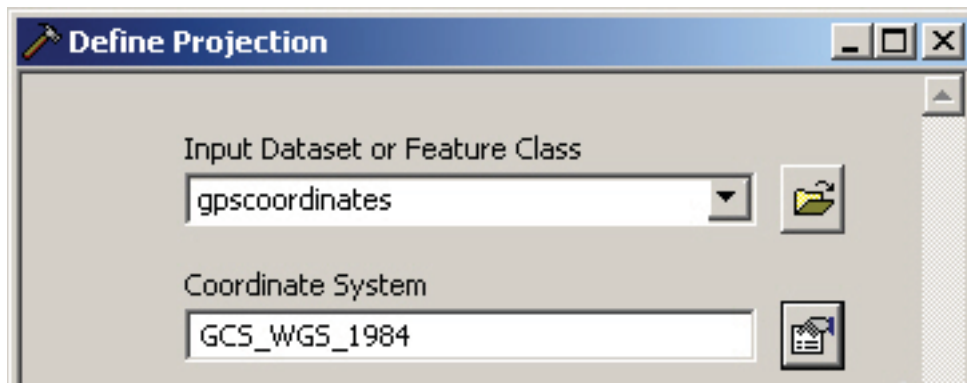
In the “Define Projection” dialog box, use the drop-down arrow or the click the folder icon () next to the “Input Dataset...” box to navigate to the file for which you want to define projection (in this case the new shapefile “gpscoordinates”).

Then click on the  icon next to the “Coordinate System” box. In the dialog box that appears, click the “Select” button. Then double-click:

Geographic coordinate system > World > WGS 1984.prj

Click “OK.”

Your “Define Projection” box should look like this:



Click “OK.”

After a moment, the coordinates will appear in the correct location on your map:

