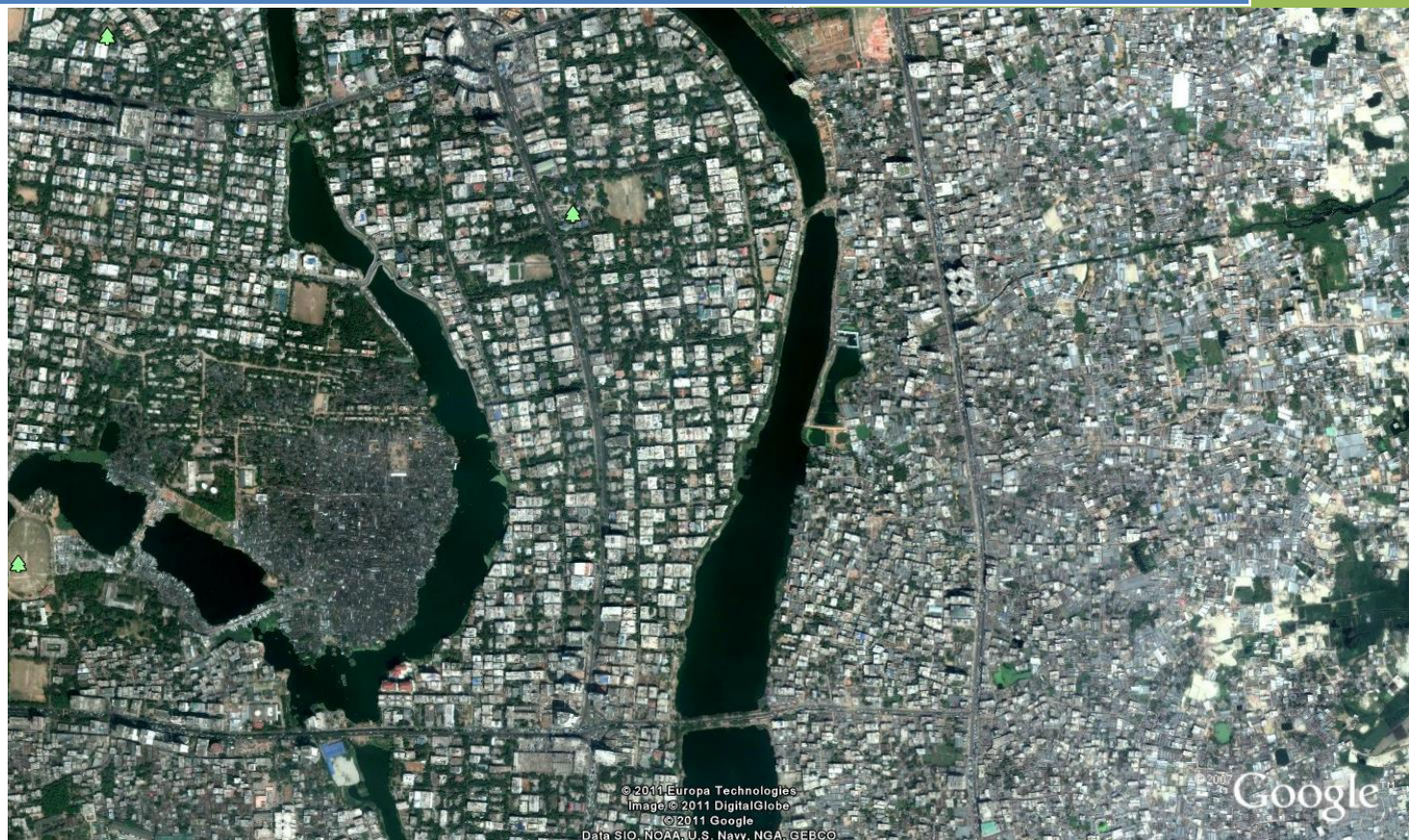




Ministry of Food and Disaster Management
Disaster Management and Relief Division
Comprehensive Disaster Management Programme

Think Spatially

ArcGIS Basic#



Australian Government
AusAID



Cover Image: A segment of Dhaka City showing planned (Gulshan) and unplanned (Badda) area captured from Google Earth.

Cover Design: Md. Shahidul Islam with the help of MS Office Cover Page Template

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Module I

Introduction: GIS, RS, GPS

In this module:

- What is Geographic Information Systems (GIS)
- Component of GIS
- GIS Setup
- Vector vs Raster
- Remote Sensing (RS)
- Global Positioning System (GPS)

What is GIS?

“In the strictest sense, a GIS is a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information, i.e. data identified according to their locations. Practitioners also regard the total GIS as including operating personnel and the data that go into the system.” USGS

A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps.” ESRI

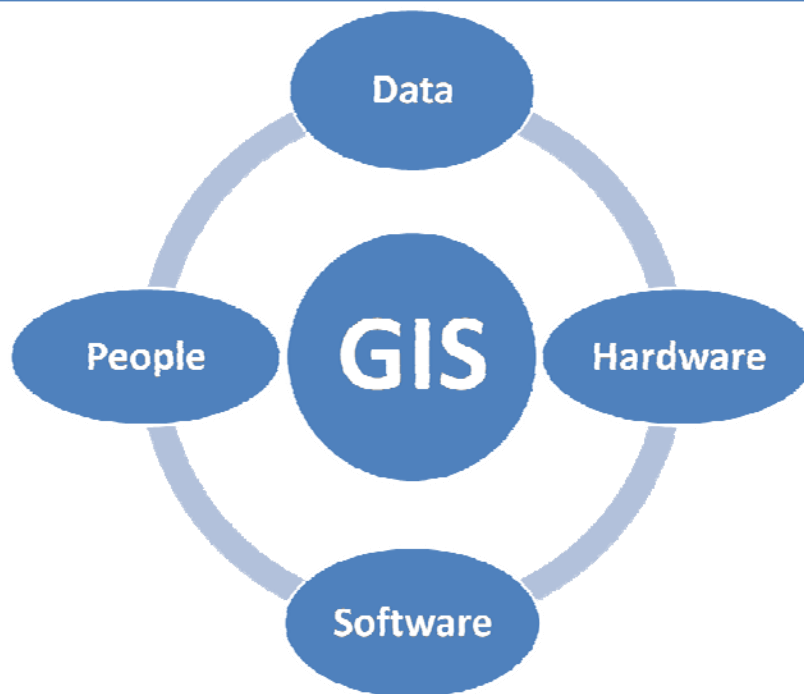
“GIS is an integrated system of computer hardware, software, and trained personnel linking topographic, demographic, utility, facility, image and other resource data that is geographically referenced.” NASA

Therefore, a geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. GIS allows us to view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts. A GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared.

GIS is a technological field that incorporates geographical features with tabular data in order to map, analyze, and assess real-world problems. The key word to this technology is Geography – this means that some portion of the data is spatial, in other words, data that is in some way referenced to locations on the earth. Coupled with this data is usually tabular data known as attribute data. Attribute data can be generally defined as additional information about each of the spatial features. An example of this would be schools. The actual location of the schools is the spatial data. Additional data such as the school name, level of education taught, student capacity would make up the attribute data. It is the partnership of these two data types that enables GIS to be such an effective problem solving tool through spatial analysis.

GIS operates on many levels. On the most basic level, GIS is used as computer cartography, i.e. mapping. The real power in GIS is through using spatial and statistical methods to analyze attribute and geographic information. The end result of the analysis can be derivative information, interpolated information or prioritized information.

Components of GIS



Hardware: comprises the equipment needed to support the many activities of GIS ranging from data collection to data analysis. The central piece of equipment is the workstation, which runs the GIS software and is the attachment point for ancillary equipment. Data collection efforts can also require the use of a digitizer/Scanner for conversion of hard copy data to digital data and a GPS data logger to collect data in the field. Plotter can be used for printing wide format Maps.

Software: is important for GIS. Application software is essential for GIS for creating, editing and analyzing spatial and attributes data. To perform some special GIS processing needs extra software, which comes as extension. There is also web GIS software that helps serve data through Internet browsers.

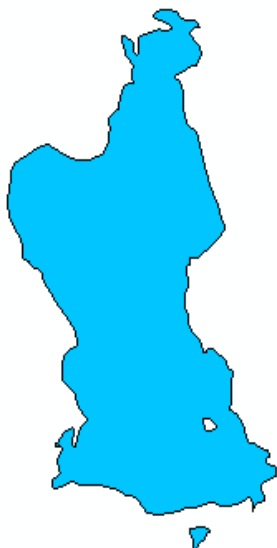
Data: the core of any GIS. There are two primary types of data that are used in GIS. A geodatabase is a database that is in some way referenced to locations on the earth. Geodatabases are grouped into two different types: vector and raster. Vector data is spatial data represented as points, lines and polygons. Raster data is cell-based data such as aerial imagery and digital elevation models. Coupled with this data is usually data known as attribute data. Attribute data generally defined as additional information about each spatial feature housed in tabular format. Documentation of GIS datasets is known as metadata. Metadata contains such information as the coordinate system, when the data was created, when it was last updated, who created it and how to contact them and definitions for any of the code attribute data.

People: Well-trained people knowledgeable in spatial analysis and skilled in using GIS software are essential to the GIS process. These can be analyst, programmer and operator

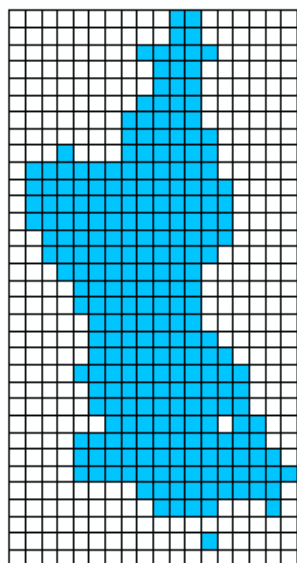
GIS Setup

Hardware	Software	Humanware	Data
<ul style="list-style-type: none"> • Server • PC/Laptop • Wide Format Plotter • A3 Size Laser Printer • Wide Format Scanner • GPS 	<ul style="list-style-type: none"> • ArcGIS Server • ArcGIS Desktop • ArcPad • ENVI/Erdas • Open Source 	<ul style="list-style-type: none"> • GIS Expert • GIS Operator • GIS Programmer 	<ul style="list-style-type: none"> • RS Dataset • GIS database • Attribute Data • Field Survey (GPS) • Hard copy data

More on Data (Vector Vs Raster)



Vector representation of lake polygon features. Note the detail maintained in the shoreline that defines the boundary between water and upland.



Raster representation of the same lake. With a raster data format, cells are used to encode geographic data. The entire area of each cell is assigned to a single category and boundary details are lost.

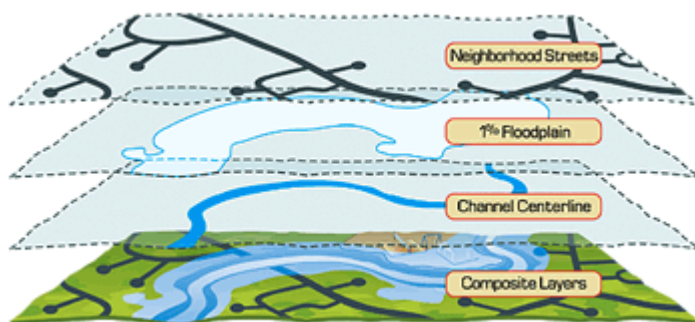
Raster and vector are two very different but common data formats used to store geospatial data.

Vector data use X and Y coordinates to define the locations of points, lines, and areas (polygons) that correspond to map features such as schools, roads, and parcels. As such, vector data tend to define centers and edges of features.

Raster data, on the other hand, use a matrix of square areas to define where features are located. These squares, also called pixels, cells, and grids, typically are of uniform size, and their size determines the detail that can be maintained in the dataset. Because raster data represent square areas, they describe interiors rather than boundaries as is the case with vector data.

Vector data are excellent for capturing and storing spatial details, while raster data are well suited for capturing, storing, and analyzing data such as elevation, temperature, etc. that vary continuously from location to location. Raster data formats also are used to store aerial and satellite imagery.

Concept of Layers



Data capturing for GIS

There are many sources for data capturing to feed into GIS. Here two options will be discussed very briefly

(a) Remote Sensing (RS) datasets; (b) Global Positioning System (GPS)

What is Remote Sensing (RS)

Remote Sensing is the science and art of acquiring information (spectral, spatial, and temporal) about objects, area, or phenomenon, without coming into physical contact with the objects, or area, or phenomenon under investigation. Without direct contact, some means of transferring information through space must be utilized.

Here are two main types of remote sensing: passive remote sensing and active remote sensing. Passive sensors detect natural radiation that is emitted or reflected by the object or surrounding area being observed. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge-coupled devices, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR is an example of active remote sensing where the time delay between emission and return is measured, establishing the location, height, speeds and direction of an object.

By satellite, aircraft, spacecraft images, data is created to analyze and compare things like vegetation rates, erosion, pollution, forestry, weather, and land use. These things can be mapped, imaged, tracked and observed. The process of remote sensing is also helpful for city planning, archaeological investigations, military observation and geomorphological surveying.

Resolution (Spatial): Spatial resolution is a measure of the smallest object that can be resolved by the sensor, or the linear dimension on the ground represented by each pixel or grid cell in the image

Resolution (Temporal): *Temporal Resolution is the frequency of flyovers by the satellite or plane which refers to the length of time it takes for a satellite to complete one entire orbit cycle. The revisit period of a satellite sensor is usually several days. Therefore the absolute temporal resolution of a remote sensing system to image the exact same area at the same viewing angle a second time is equal to this period*

What is Global Positioning System (GPS)

The Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver.

GPS was created and realized by the U.S. Department of Defense (USDOD) and was originally run with 24 satellites. It became fully operational in 1994.

In addition to GPS, other systems are in use or under development. The Russian GLObal NAVigation Satellite System (GLONASS) was in use by only the Russian military, until it was made fully available to civilians in 2007. There are also the planned Chinese Compass navigation system and the European Union's Galileo positioning system.

Basic Concept of GPS

A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include

- *the time the message was transmitted*
- *precise orbital information (the ephemeris)*
- *the general system health and rough orbits of all GPS satellites (the almanac).*

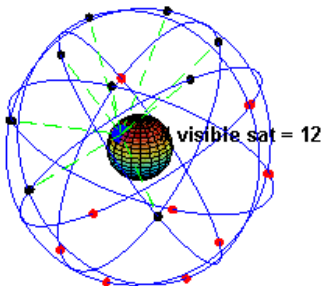
The receiver uses the messages it receives to determine the transit time of each message and computes the distance to each satellite. These distances along with the satellites' locations are used with the possible aid of trilateration, depending on which algorithm is used, to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes.

Three satellites might seem enough to solve for position since space has three dimensions and a position near the Earth's surface can be assumed. However, even a very small clock error multiplied by the very large speed of light — the speed at which satellite signals propagate — results in a large positional error. Therefore receivers use four or more satellites to solve for the receiver's location and time.

GPS Structure

The current GPS consists of three major segments. These are the space segment (SS), a control segment (CS), and a user segment (US.). The U.S. Air Force develops, maintains, and operates the space and control segments. GPS satellites broadcast signals from space and each GPS receiver uses these signals to calculate its three-dimensional location (latitude, longitude, and altitude) and the current time.

The space segment is composed of 24 to 32 satellites in medium Earth orbit. The control segment is composed of a master control station, an alternate master control station, and a host of dedicated and shared ground antennas and monitor stations. The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service and tens of millions of civil, commercial, and scientific users of the Standard Positioning Service.



Space Segment: The space segment (SS) is composed of the orbiting GPS satellites or Space Vehicles (SV) in GPS parlance. There are six orbits with four satellites each. The six orbits have approximately 55° inclination (tilt relative to Earth's equator) The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface. In general terms, the angular difference between satellites in each orbit is 30, 105, 120, and 105 degrees apart which, of course, sum to 360 degrees.

Orbiting at an altitude of approximately 20,200 km (12,600 mi); orbital radius of approximately 26,600 km (16,500 mi).



Control Segment: The control segment is composed of

- 1. a master control station (MCS),*
- 2. an alternate master control station,*
- 3. four dedicated ground antennas and*
- 4. six dedicated monitor stations*

The flight paths of the satellites are tracked by dedicated U.S. Air Force monitoring stations in Hawaii, Kwajalein, Ascension Island, Diego Garcia, Colorado Springs, Colorado and Cape Canaveral



User Segment: In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock (often a crystal oscillator). They may also include a display for providing location and speed information to the user. A receiver is often described by its number of channels: this signifies how many satellites it can monitor simultaneously. Originally limited to four or five, this has progressively increased over the years so that, as of 2007, receivers typically have between 12 and 20 channels

GPS Applications

- New data capturing
- Navigation
- Vehicle Tracking System
- Geo-referencing etc

Module II

ArcMap Basics (ArcGIS)

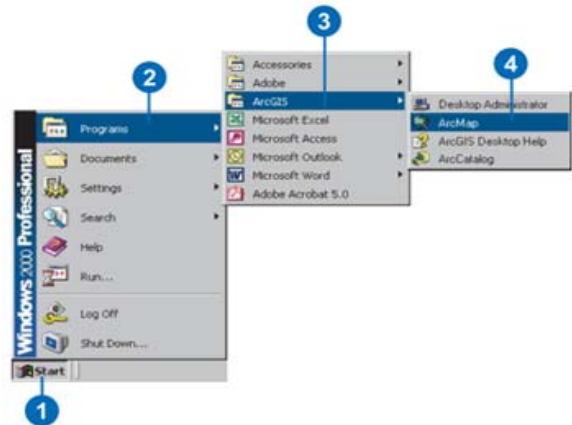
As it implies, ArcMap is used to make maps. It is a map-centric software application. In ArcMap, a map document (.mxd) is how a map is stored, shared, and managed on your computer. This map document contains not only the traditional cartographic elements of a map, but also the environment, or user interface, you use to work with that map. ArcMap is where you can perform your spatial analysis and querying along with editing, 3D analysis, data development, and display.

In this module:

- Starting ArcMap and opening a map
 - Using the table of contents
 - Data view and layout view
 - Moving around the map
 - Setting bookmarks
 - Opening magnifier and overview windows
 - Exploring data on a map
 - Getting help
 - Saving a map and exiting ArcMap
-

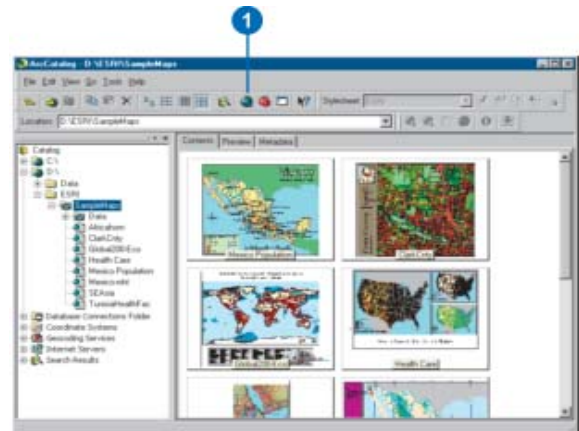
Starting ArcMap from the Start menu

1. Click the Start button on the Windows taskbar.
2. Point to Programs.
3. Point to ArcGIS.
4. Click ArcMap.

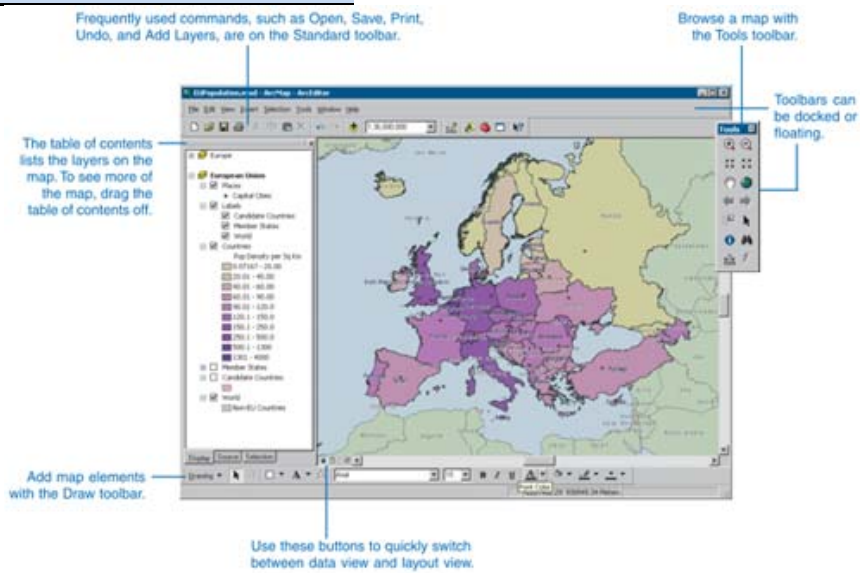


Starting ArcMap from ArcCatalog

1. Click the Launch ArcMap button on the Standard toolbar.

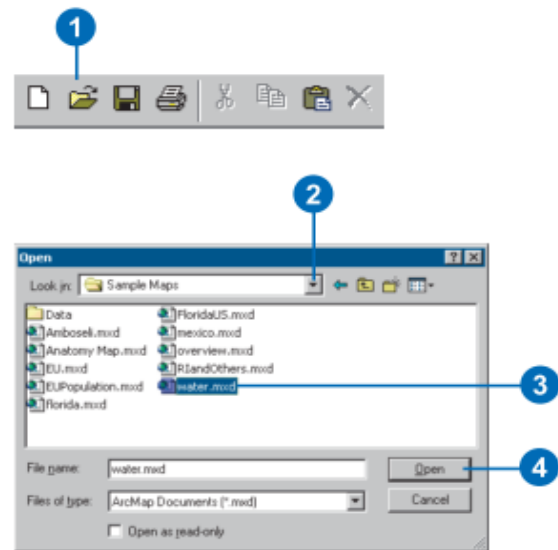


The ArcMap Window



Opening a Map from ArcMap

1. Click the Open button on the Standard toolbar.
2. Click the Look in dropdown arrow and navigate to the folder that contains the map.
3. Click the map you want to open.
4. Click Open.



Opening a Map from ArcCatalog

1. Start ArcCatalog if it isn't already running.
2. In ArcCatalog, navigate to the folder that contains your map.
3. Click the Thumbnails button to look at the maps the folder contains.
4. Double-click the map to open it in ArcMap.

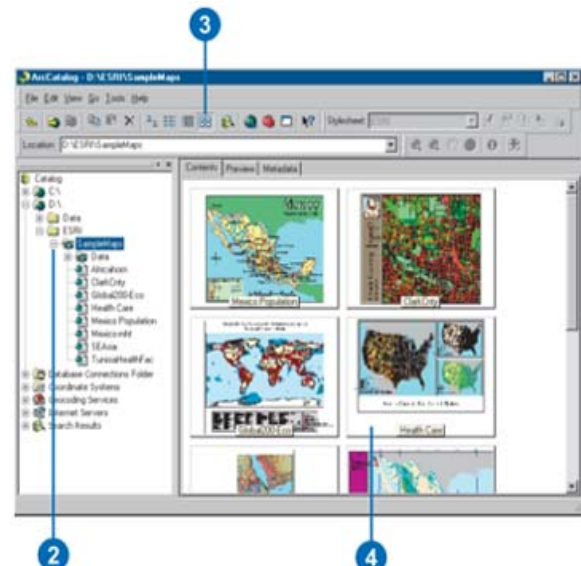


Table of Contents (TOC): Every map has a table of contents. It shows what layers the map contains and also how the map presents the geographic features in those layers. Some maps display all the layers in one data frame. Others, such as those with insets and overviews, will have more than one data frame. The TOC shows how the layers are organized into data frames. When viewing a map, you'll use the TOC primarily to turn layers on and off. As you begin building your own maps, you'll find that the TOC is the focal point for many tasks, such as adding and deleting layers and determining how to draw layers. You can choose to display the table of contents with the Display, Source, or Selection tabs.

The table of contents lists all the layers on the map and shows what the features in each layer

represent. The check box next to each layer indicates whether it is currently turned on or off, that is, whether it is currently drawn on the map or not. The order of layers within the table of contents is also important; the layers at the top draw on top of those below them. Thus, you'll put the layers that form the background of your map, such as the ocean, at the bottom of the table of contents.

Layers in the table of contents can be further organized into data frames. A data frame simply groups, in a separate frame, the layers that you want to display together. You always get a data frame when you create a map; it's listed at the top of the table of contents as "Layers", but you can change the name to something more meaningful if you like. For many of the maps you make, you won't need to think much more about data frames; you'll just add layers to your map and, depending on how you order them in the table of contents, some layers will draw on top of others. You will want to think more about data frames—and adding additional ones—when you want to compare layers side by side or create insets and overviews that highlight a particular location or attribute.

Showing the Table of Contents

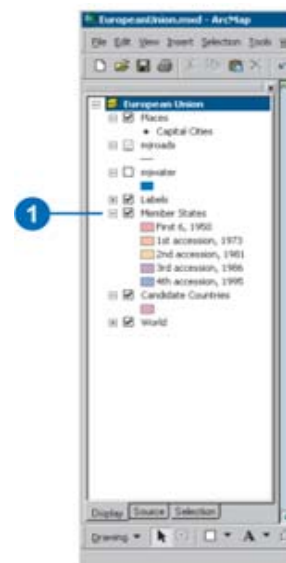
1. Click Window on the Main menu.
2. Click Table Of Contents



Turning a Layer On or Off

1. In the table of contents, check the box next to the layer's name.

The layer should appear on your map. If you can't see the layer, it may be hidden by another layer or display only at a particular scale.



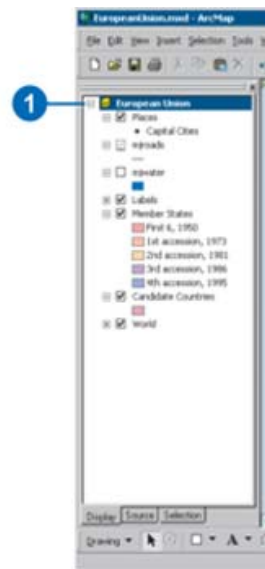
Showing a Layers LEGEND

1. Click the plus or minus sign to the left of the layer name in the table of contents to show or hide its legend.



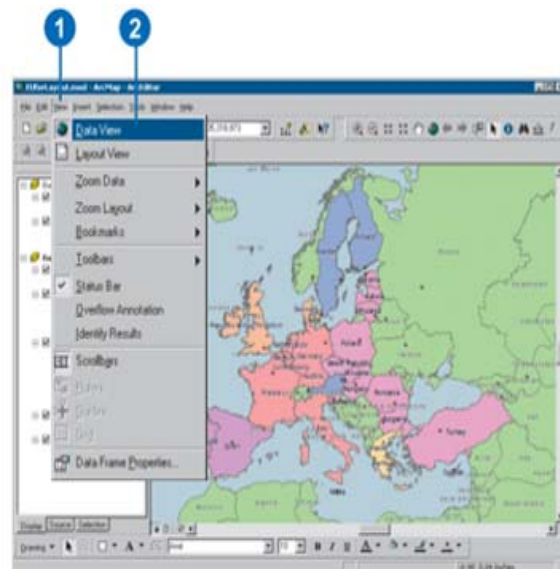
Showing the content of a Data Frame

1. Click the plus or minus sign to the left of the data frame in the table of contents to show or hide the list of layers it contains.



Switching to Data View

1. Click the View menu on the Standard toolbar.
2. Click Data View. The ArcMap window displays the active data frame.



Data View and Layout View: ArcMap provides two different ways to view a map: data view and layout view. Each view lets you look at and interact with the map in a specific way. When you want to browse the geographic data on your map, choose data view. Data view is an all-purpose view for exploring, displaying, and querying the data on your map. This view hides all the map elements on the layout—such as titles, North arrows, and scalebars—and lets you focus on the data in a single data frame, for instance, to do editing or analysis. When you’re preparing your map to hang on the wall, put in a report, or publish on the Web, you’ll want to work with it in layout view. Layout view is for laying out your map. In layout view, you’ll see a virtual page upon which you can place and arrange map elements. In layout view, you can do almost everything you can in data view, plus design your map.

Switching to Layout View

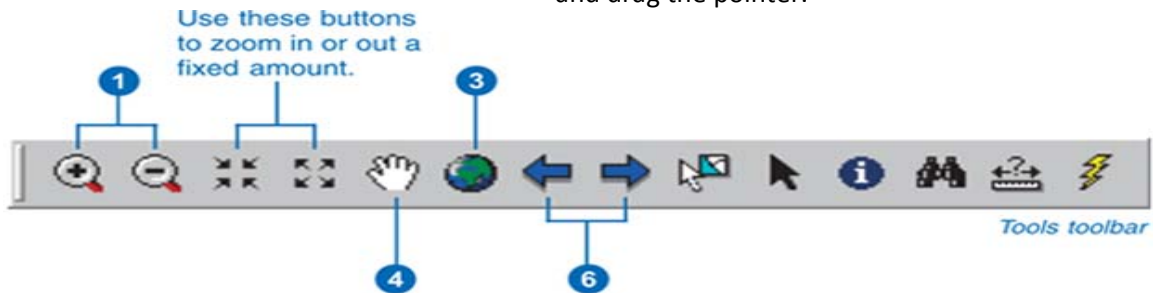
1. Click the View menu on the Standard toolbar.
2. Click Layout View. The ArcMap window displays the entire map



You can also use these buttons to quickly switch between the data and layout view.

Zooming in or out

1. Click the Zoom In or Zoom Out button on the Tools toolbar.
2. Move the mouse pointer over the map & click once to zoom around a point. Or click and drag a rectangle defining the area you want to zoom in or out on.



Zooming to the full extent of the data

3. Click the Full Extent button on the Tools toolbar.

Panning

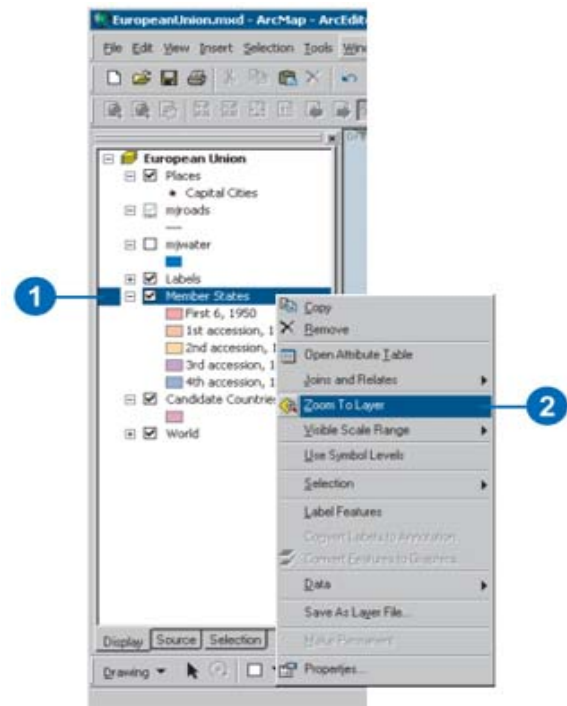
4. Click the Pan button on the Tools toolbar.
5. Move the mouse pointer over the map display and click and drag the pointer.

Moving back or forward on display

6. Click the Back or Forward Extent buttons on the Tools toolbar.

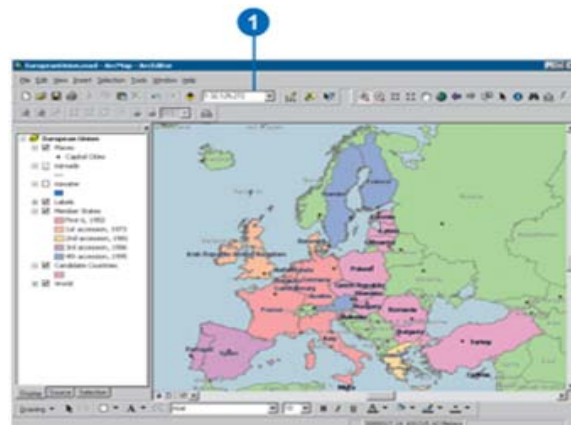
Zooming to the extent of a layer

1. Right-click the layers you want to zoom to.
2. Click Zoom To Layer.



Zooming to specific scale

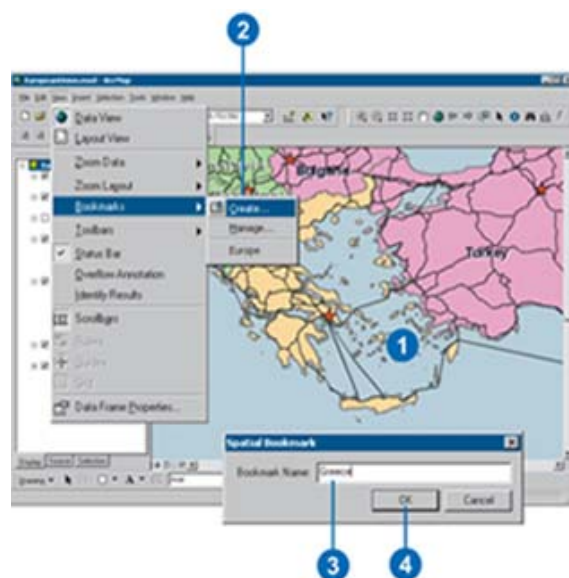
1. Type the desired scale on the Standard toolbar.



Spatial Bookmark: A spatial bookmark identifies a particular geographic location that you want to save and refer to later. For example, you might create a spatial bookmark that identifies a study area. That way, as you pan and zoom around your map, you can easily return to the study area by accessing the bookmark. You can also use spatial bookmarks to highlight areas on your map you want others to see. You can create a spatial bookmark at any time. As a shortcut, you can also create bookmarks when you find and identify map features. Spatial bookmarks, however, can only be defined on spatial data; they can't be defined on an area of the page in layout view. Each data frame on your map maintains its own list of bookmarks. In layout view, the list reflects the bookmarks of the active data frame.

Creating a Spatial bookmark

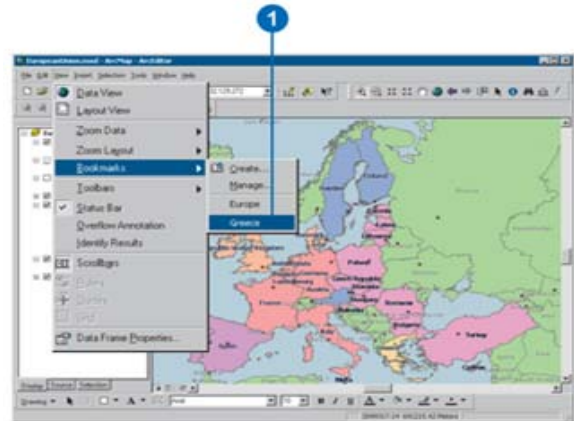
1. Pan and zoom the map to the area for which you want to create a bookmark.
2. Click the Bookmarks menu, and click Create.
3. Type a name for the bookmark.
4. Click OK.



Using a Spatial bookmark

1. Click the Bookmarks menu, and click the name of the bookmark you want to use.

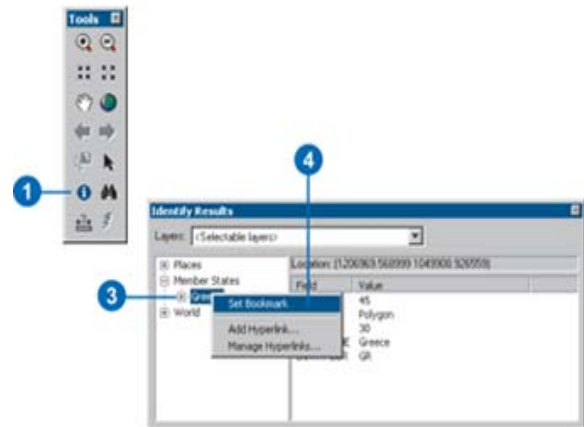
The bookmarked display appears.



Creating spatial bookmark using Identify dialog box

1. Click the Identify button on the Tool toolbar.
2. Click the mouse pointer over the map feature to identify.
3. Right-click the identified feature in the Identify Results dialog box.
4. Click Set Bookmark.

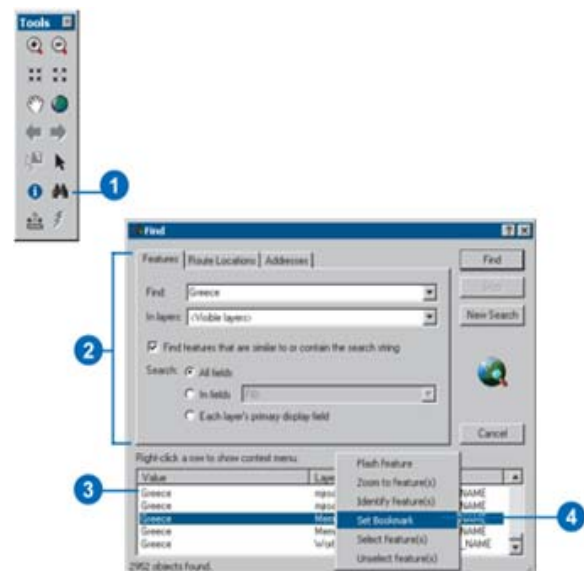
The bookmark is named after the feature.



Creating spatial bookmark from Find dialog box

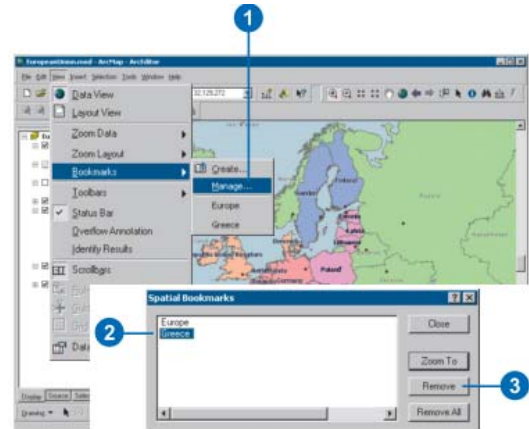
1. Click the Find button on the Tools toolbar.
2. Fill in the dialog box to find the features you want.
3. Right-click the Value in the Find Results list.
4. Click Set Bookmark.

The bookmark is named after the feature.



Removing a Spatial bookmark

1. Click the Bookmarks menu, and click Manage.
2. Click a bookmark.
3. Click Remove.

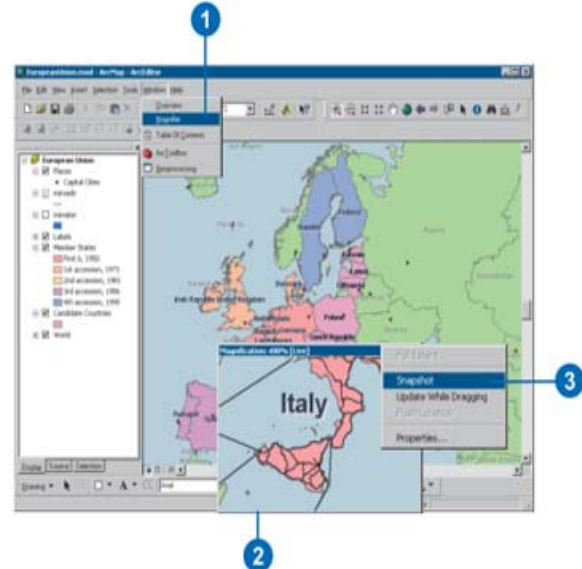


Opening a Magnifier Window

1. Click the Window menu and click Magnifier.

You must be viewing the map in data view to display a magnifier window.

2. When the magnifier window appears, drag it over the data to see a magnified view.
3. Right-click the title bar and click Snapshot to lock the view.

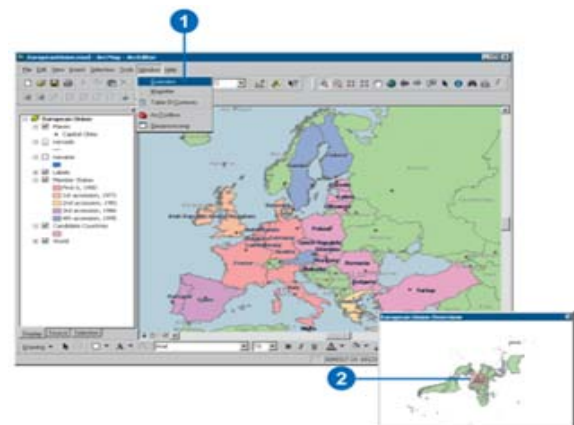


Opening an Overview Window

1. Click the Window menu and click Overview.

You must be viewing the map in data view to display an overview window.

2. Drag, shrink, or expand the box in the overview window to change the map display in the active data frame.

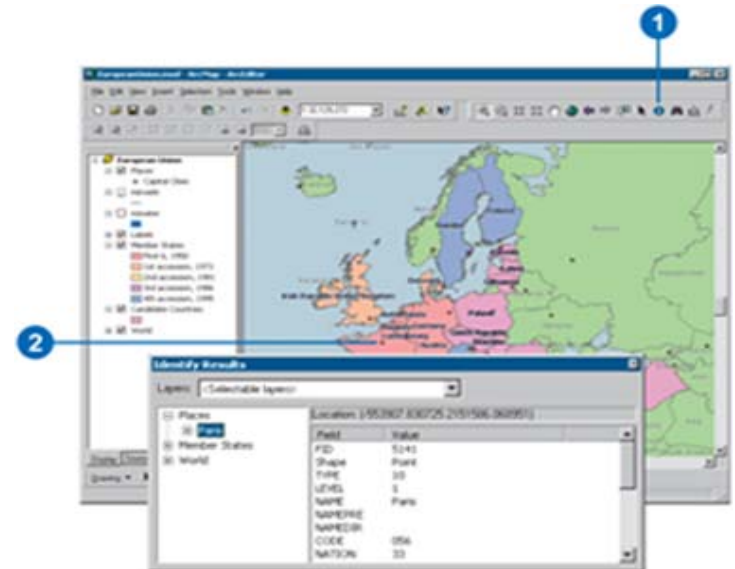


Exploring Data on a Map: Sometimes just looking at a map isn't enough. You need to query data to solve problems. ArcMap lets you explore the data on the map and get the information you need. You can point at features to find out what they are, find features that have a particular characteristic or attribute, examine all the attributes of a particular layer, and measure distances on the map. MapTips also provide a quick way to browse map features. Like ToolTips for toolbar buttons, MapTips pop up as you pause the mouse pointer over a feature.

Identifying features by pointing at them

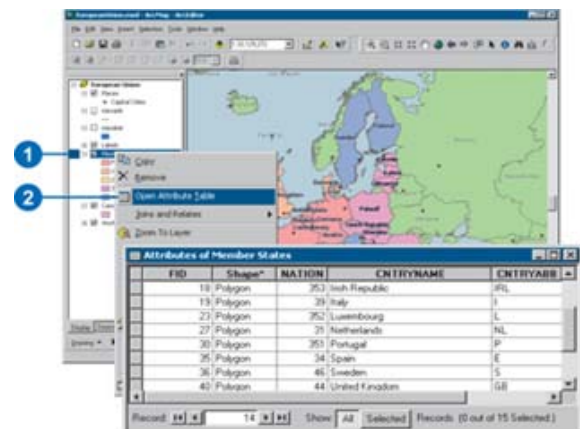
1. Click the Identify button on the Tools toolbar.
2. Click the mouse pointer over the map feature you want to identify.

The features in all visible layers under the pointer will be identified.



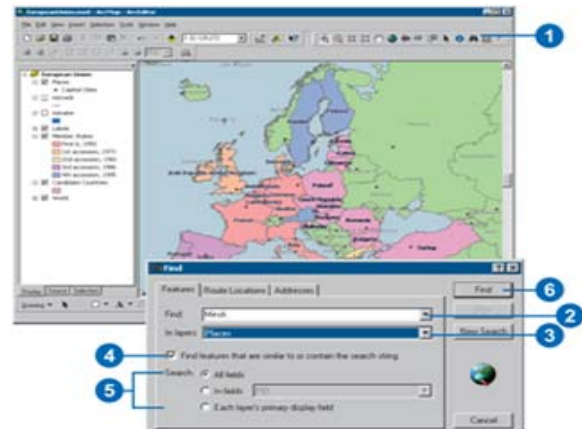
Viewing a layer's attribute table

1. In the table of contents, right click the layer for which you want to display the attribute table.
2. Click Open Attribute Table.



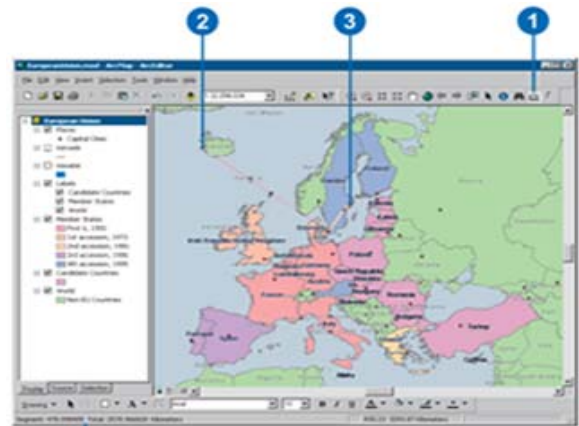
Finding features with particular attributes

1. Click the Find button on the Tools toolbar.
2. Type the string you want to find in the Find text box.
3. Click the In layers dropdown arrow and click the layer you want to search.
4. Uncheck Find features that are similar to or contain the search string if the string must match exactly.
5. Search for the string in all fields, in a specific field, or in the primary display field.
6. Click Find.



Measuring Distance

1. Click the Measure button on the Tools toolbar.
2. Use the mouse pointer to draw a line representing the distance you want to measure. The line can have more than one line segment.
3. Double-click to end the line.



Getting Help: A quick way to learn what ArcMap can do is to get help about the buttons and menu commands you see on the interface. After clicking the What's This? button, you can click an item in the window to display a popup description of it. Sometimes a dialog box will also have a Help button on the bottom; clicking it opens a Help topic with detailed information about the task you're trying to accomplish. Much of the information in this book is available in the ArcGIS Desktop Help system. The Help topics are organized around the main tasks you want to complete as well as the concepts behind the tasks. You can look up general Help topics in the Help Contents. You can search the Index for specific tasks and issues. You can also use the Find tab to look up Help topics that have specific words or phrases.

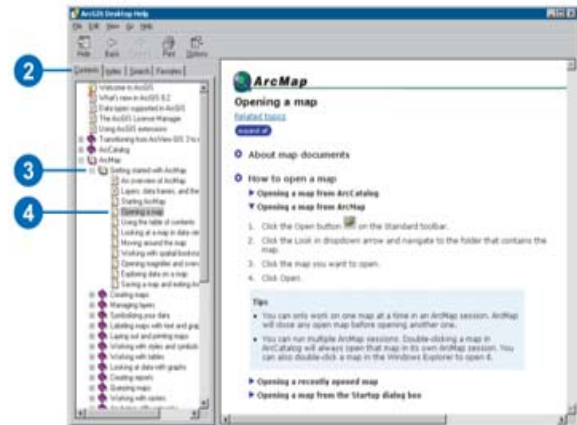
Tips for buttons and menus: When you pause the mouse pointer over a button, the button's name appears in a small box called a ToolTip. When you position the mouse pointer over a button or menu command, a description of what it does appears in the status bar.

Using the Help Contents to get Help

1. Click the Help menu and click ArcGIS Desktop Help.
2. Click the Contents tab.
3. Double-click a book to see a list of the topics in that category.

Double-clicking an open book closes its list.

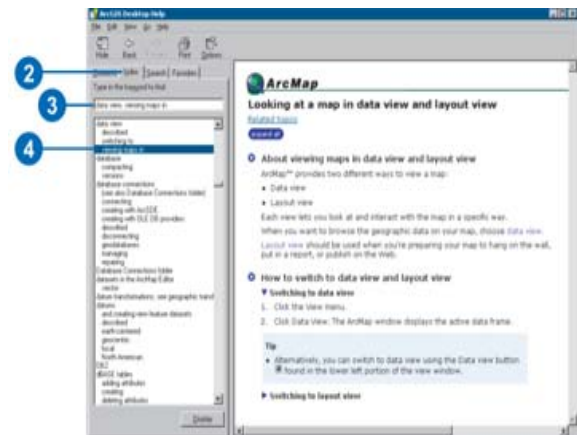
4. Click the topic you want to read.



Searching the Index for help

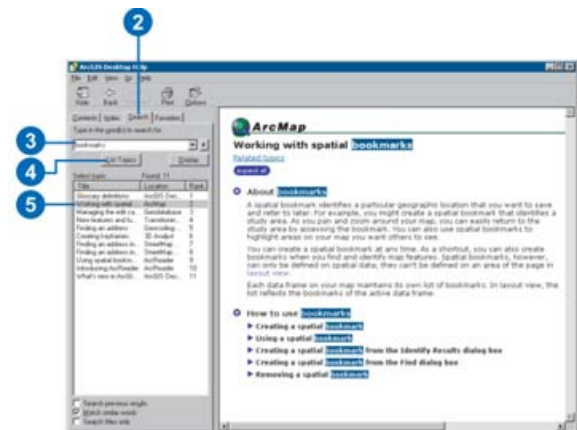
1. Click the Help menu and click ArcGIS Desktop Help.
2. Click the Index tab.
3. Type the subject about which you want information.
4. Double-click the topic you want to read.

If several topics are related to your selection, the Topics Found dialog box appears. Simply double-click the topic you want to read.



Finding Help topics containing specific word

1. Click the Help menu and click ArcGIS Desktop Help.
2. Click the Search tab.
3. Type the word that should be contained in the topics you want to find.
4. Click List Topics.
5. Double-click the topic you want to read.

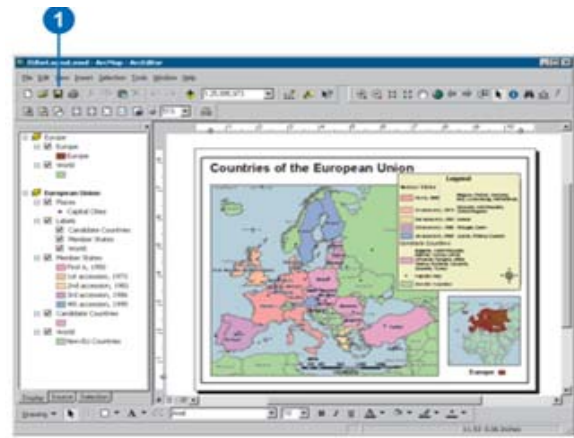


Saving a Map and Exiting ArcMap: After you finish working on a map, you can save it and exit ArcMap. You save a map as a document and store it on your hard disk. If you haven't saved the map before, you'll need to name it, preferably with a name that adequately describes its contents. ArcMap automatically appends a file extension (.mxd) to your map document name. The data displayed on a map is not saved with it. Map layers reference the data sources in your GIS database. This helps to keep map documents relatively small in size. So if you plan to distribute your map to others, they'll need access to both the map document and the data your map references. In general, it's a good idea to save your map periodically while editing it just in case something unexpected happens.

Saving a Map

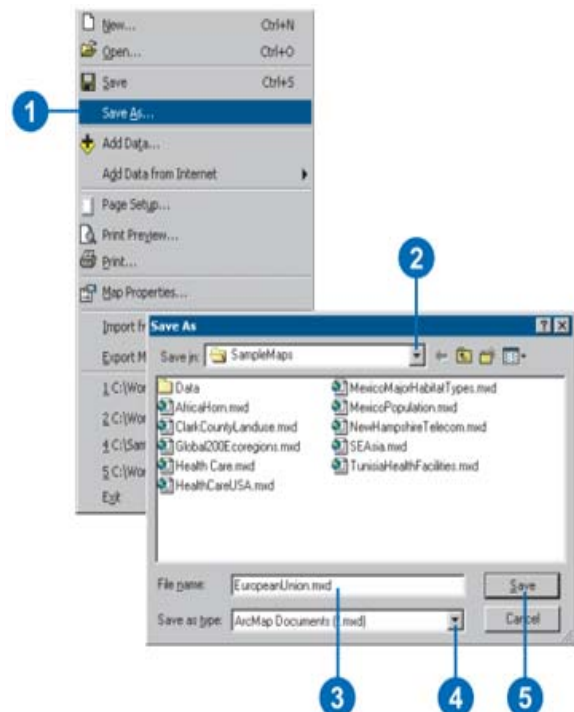
1. Click the Save button on the Standard toolbar.

If you haven't saved the map before, you'll need to provide a name for it.



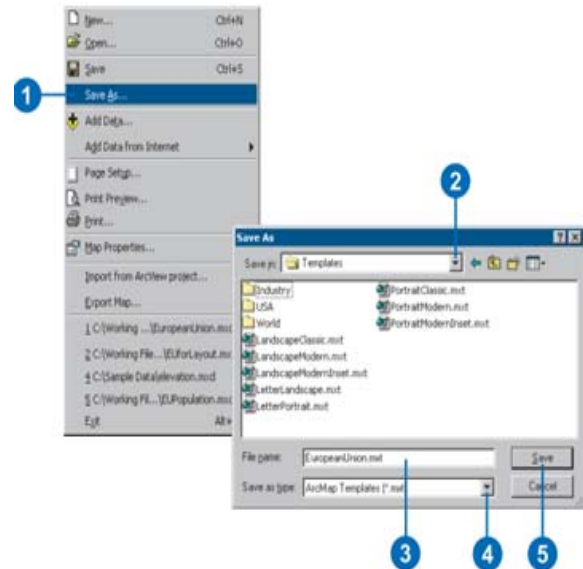
Saving a map as new map

1. Click the File menu and click Save As.
2. Navigate to the location to save the map document.
3. Type a filename.
4. Click the Save as type dropdown arrow and click ArcMap Documents.
5. Click Save.



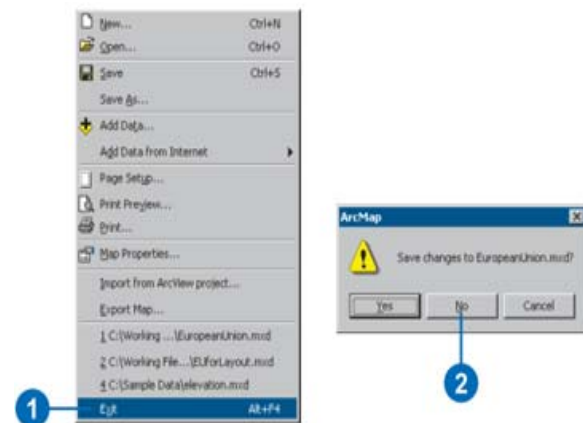
Saving a map as a map template

1. Click the File menu and click Save As.
2. Navigate to the location to save the map template.
3. Type a filename.
4. Click the Save as type dropdown arrow and click ArcMap Template.
5. Click Save.



Exiting ArcMap

1. Click the File menu and click Exit.
2. Click Yes to save any changes, No to discard any changes, or Cancel to continue working on your map.



Module III

Displaying Data

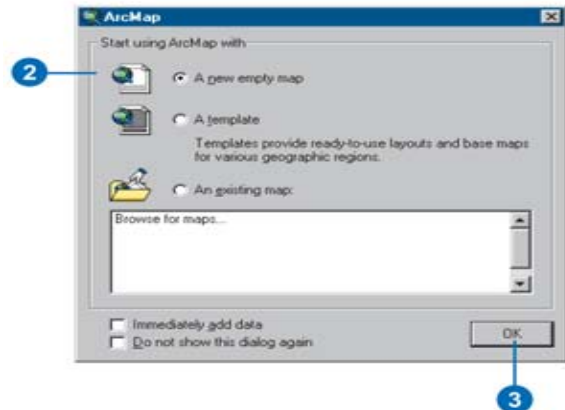
The first step to creating a map is to locate the data you want to put on it. Finding data may be as simple as using ArcCatalog to browse your organization's GIS database or the spatial data distributed with ArcMap.

In this Module, you'll learn how to:

- Creating a new map
 - Adding layers
 - Adding shapefiles
 - Adding data from the Internet
 - Creating and adding a new feature class
 - About coordinate systems
 - Specifying a coordinate system
 - Referencing data on a map
-

Creating a New Map from Startup Dialog Box

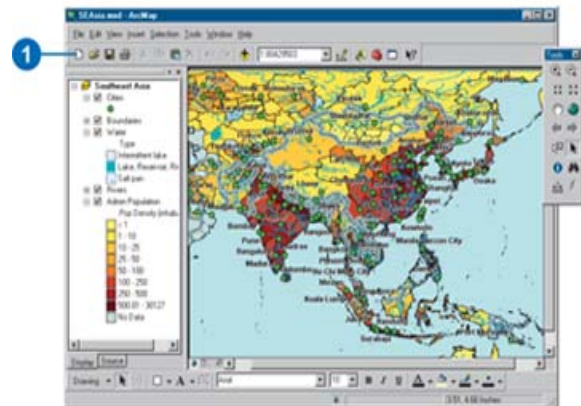
1. Start ArcMap.
2. Click to create a new empty map, create a map from a template, or browse for an existing map.
3. Click OK.



Creating a New Empty Map

1. Click the New button on the Standard toolbar to create a new empty map.

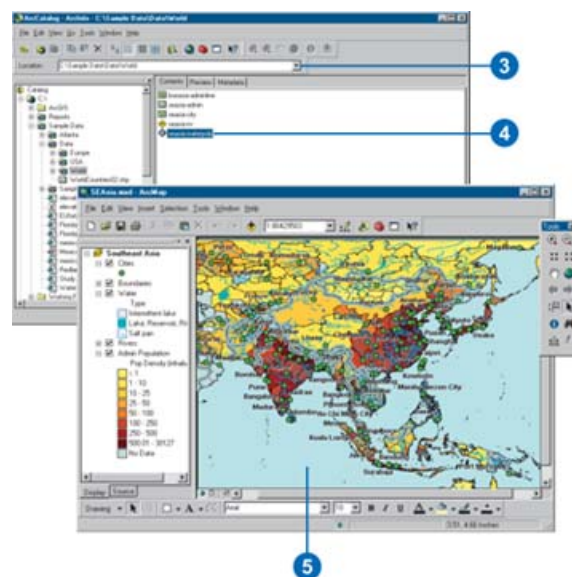
If you have a map open already, you'll be prompted to save your changes.



Adding a Layer from ArcCatalog

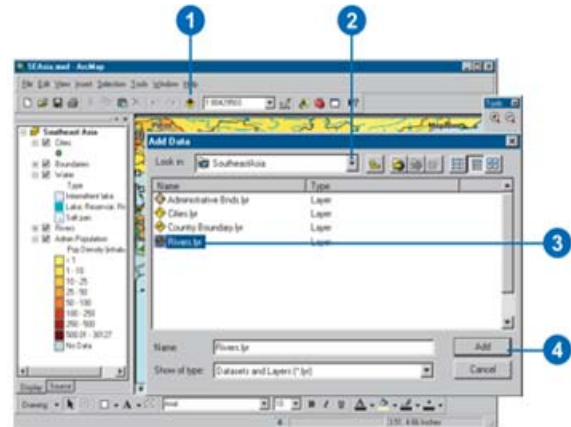
1. Start ArcCatalog from the Start menu.
2. Arrange the ArcCatalog and ArcMap windows so you can see both on the screen.
3. Navigate to the layer you want to add to the map.
4. Click and drag the layer from ArcCatalog.
5. Drop the layer over the map display in ArcMap.

The layer is copied to the map. Any subsequent edits made to the layer on disk will not be reflected on this map.



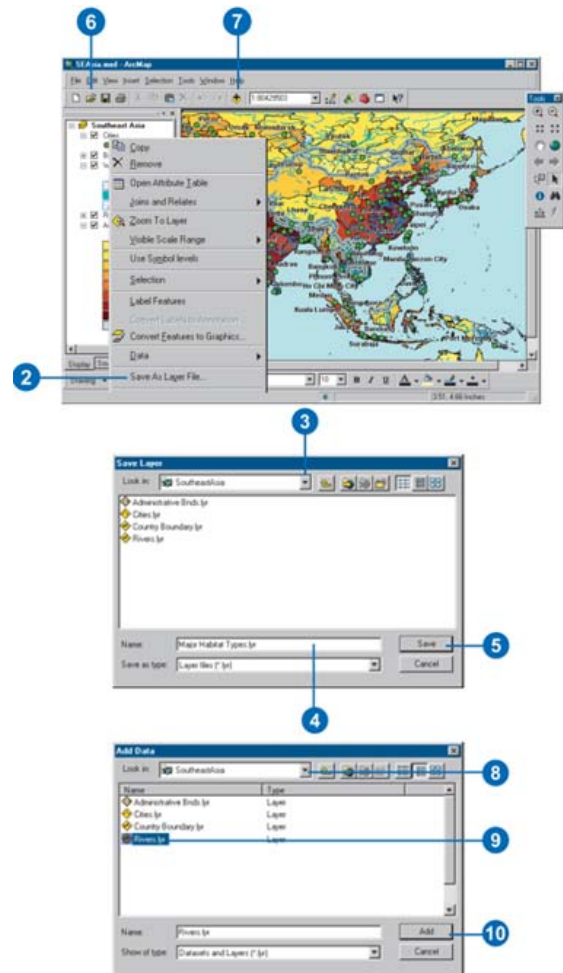
Adding Layer from the Add Data Button

1. Click the Add Data button on the Standard toolbar.
2. Click the Look in dropdown arrow and navigate to the folder that contains the layer.
3. Click the layer.
4. Click Add.
The new layer appears on your map.



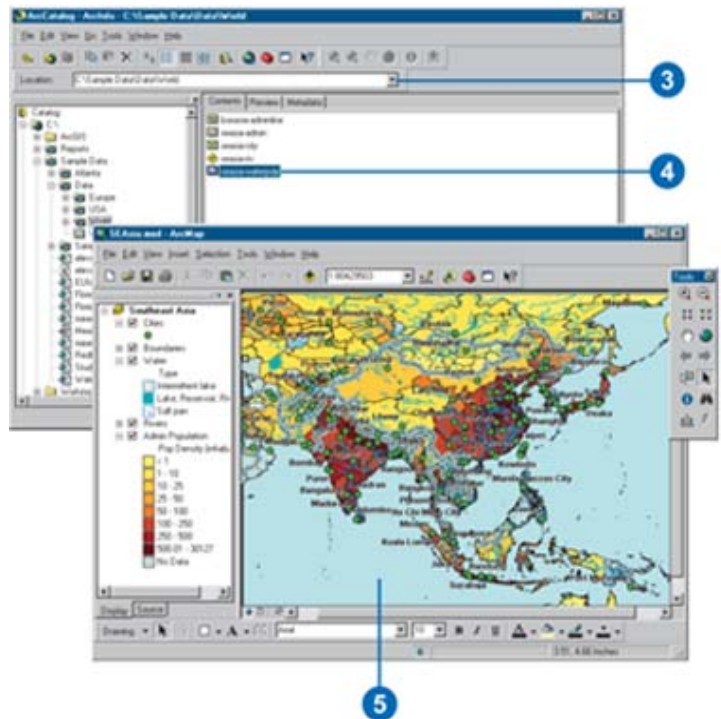
Adding a Layer from another Map

1. Open the map that contains the layer you want to copy.
2. In the table of contents, right click the layer and click Save As Layer File.
3. Click the Look in dropdown arrow and navigate to the folder where you want to save the layer.
4. Type a name for the layer.
5. Click Save.
6. Click the Open button on the Standard toolbar to open the map you want to add the layer to.
7. Click the Add Data button.
8. Click the Look in dropdown arrow and navigate to the folder that contains the layer.
9. Click the layer.
10. Click Add.



Adding Data from ArcCatalog

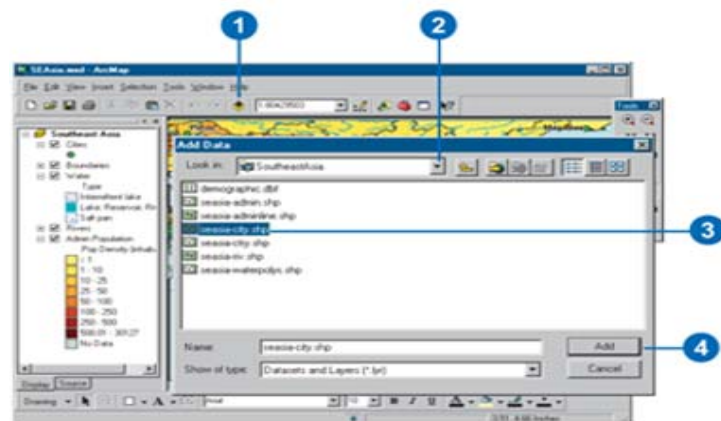
1. Start ArcCatalog from the Start menu.
2. Arrange the ArcCatalog and ArcMap windows so that you can see both on the screen.
3. Navigate to the data source you want to add to the map.
4. Click and drag the data source from ArcCatalog.
5. Drop the data source over the map display in ArcMap. ArcMap creates a new layer on the map that references the data source.



Adding Data in ArcMap

1. Click the Add Data button on the Standard toolbar.
2. Click the Look in dropdown arrow and navigate to the folder that contains the data source.
3. Click the data source.
4. Click Add.

ArcMap creates a new layer on the map that references the data source.

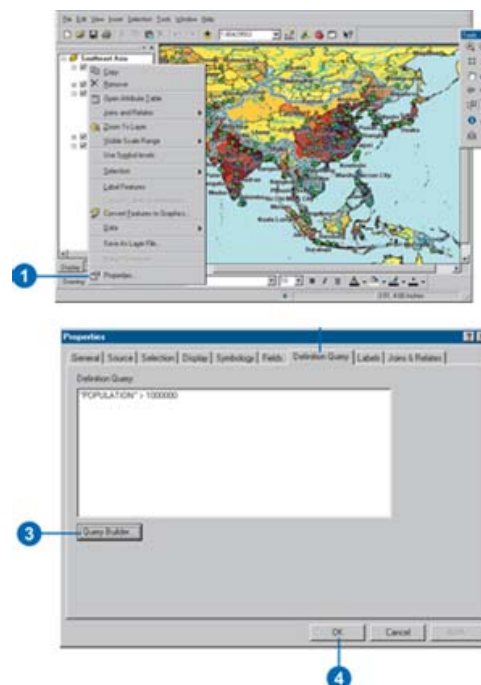


Displaying a Subset of the Features

1. In the table of contents, right click the layer and click Properties.
2. Click the Definition Query tab.
3. Type an expression or click Query Builder.

The Query Builder lets you create an expression to identify the particular features in the layer you want to display. For example, you might choose to display only those cities with a population greater than 1,000,000.

4. Click OK.



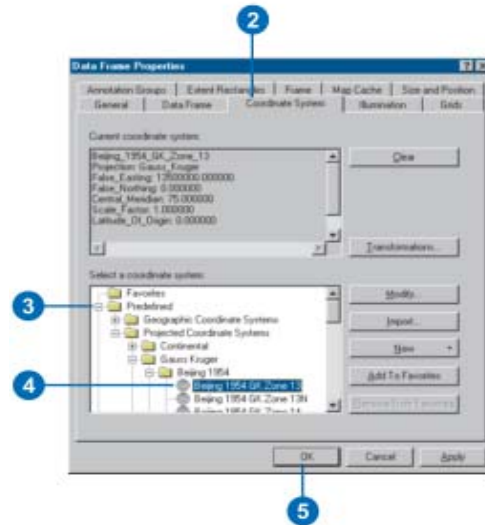
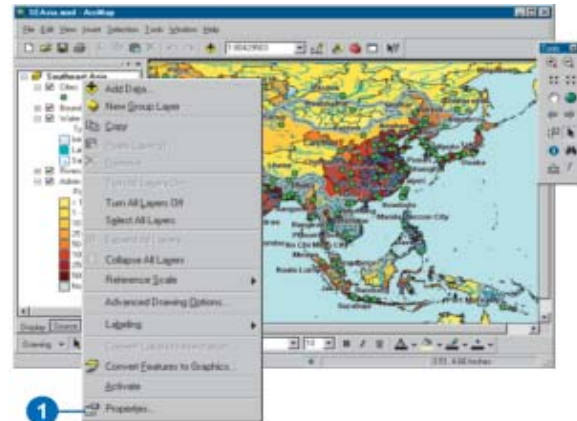
Specifying a coordinate system: *If all the data you want to display on your map is stored in the same coordinate system, you can just add it to a map and not consider whether the layers will overlay properly; they will. If, however, you've collected data from a variety of sources, you'll need to know what coordinate system each dataset uses to ensure ArcMap can display them together. When you add a layer to an empty data frame, that layer sets the coordinate system for the data frame; you can change it later if necessary. As you add subsequent layers, they are automatically transformed to the data frame's coordinate system as long as there's enough information associated with the layer's data source to determine its current coordinate system. If there isn't enough information, ArcMap will be unable to align the data and display it correctly. In this case, you'll have to supply the necessary coordinate system information yourself.*

For coverages, shapefiles, and rasters, it's stored on disk in a separate file named after the data source but with a .prj file extension (for example, streets.prj). These files are optional files; thus you may still need to define the coordinate system for one of these data sources. You can create a .prj file with ArcCatalog. If no coordinate system information is associated with a data source, ArcMap will examine the coordinate values to see if they fall within the range: -180 to 180 for x-values and -90 to 90 for y-values. If they do, ArcMap assumes that these are geographic coordinates of latitude and longitude. If the values are not in this range, ArcMap simply treats the values as planar x,y coordinates.

Displaying data with a predefined coordinate system

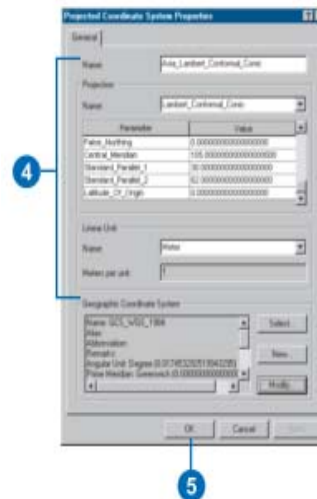
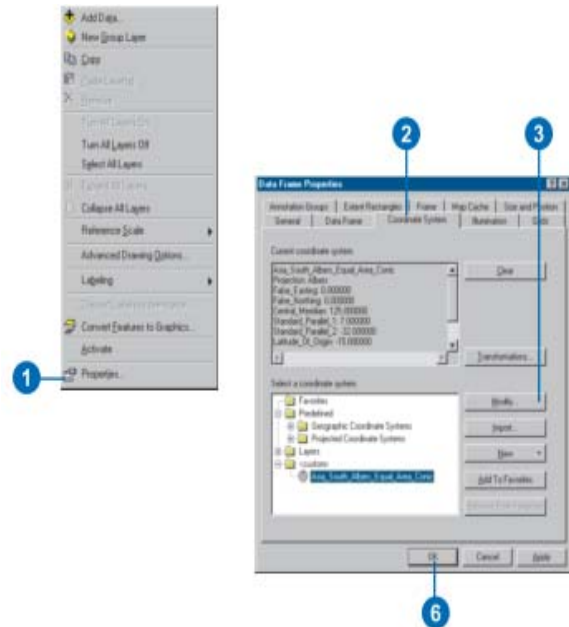
1. Right-click the data frame that you want to set the coordinate system of and click Properties.
2. Click the Coordinate System tab.
3. Double-click Predefined.
4. Navigate through the folders until you find the coordinate system you want and click it.
5. Click OK.

All layers in the data frame will now be displayed with that coordinate system.



Modifying the parameters of a coordinate system

1. Right-click the data frame whose coordinate system you want to modify and click Properties.
2. Click the Coordinate System tab.
3. Click Modify.
4. Adjust the coordinate system properties as appropriate.
5. Click OK.
6. Click OK on the Data Frame Properties dialog box.

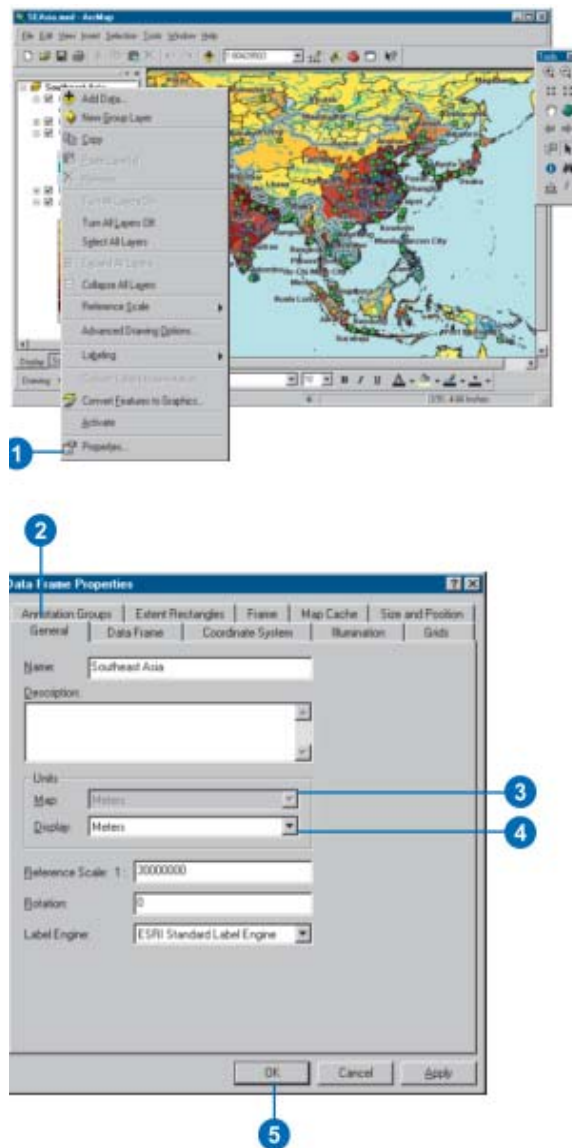


Setting the units for reporting lengths and displaying coordinates

1. Right-click the data frame and click Properties.
2. Click the General tab.
3. Click the Map dropdown arrow and click the appropriate units.

The map units option is only available when your data has no coordinate system information associated with it.

4. Click the Display dropdown arrow and click the appropriate units.
5. Click OK



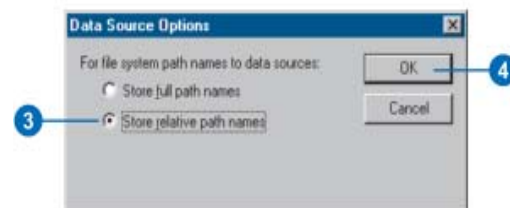
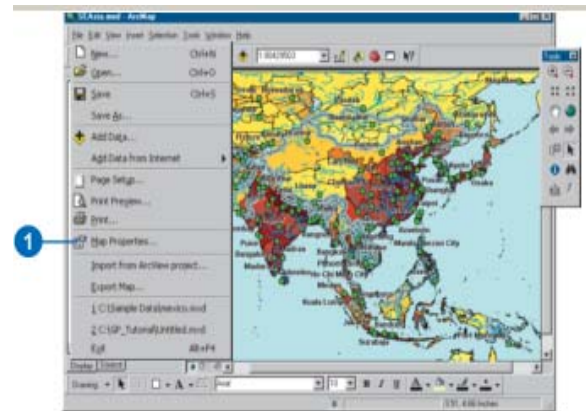
Referencing data on a map: When you add a layer to your map, ArcMap references the data source the layer is based on. When you save the map, the data references are stored with it. The next time you open your map, ArcMap locates the data based on the references. If ArcMap can't find a data source, you'll need to either locate the data source yourself or ignore the reference, in which case the layer won't be drawn. If you plan on distributing your maps to others, they'll need access to the data referenced on it. If they have access to the data—for example, data stored on a server—they can simply update the references to the data if necessary. If they don't have access to the data, you'll probably have to distribute the data with your map. To help make it easier to distribute data with your map, ArcMap allows you to store relative pathnames to data sources referenced on a map. This lets you, for example, distribute your map and data in the same directory. The references stored in the map are correct regardless of where they are placed on disk.

Repairing and updating data links: When you first open a map, ArcMap searches for the data

referenced by the layers on the map. If it can't find the data—for example, because the data has been moved—the layer won't display. You can immediately tell which layers on your map have broken links because you'll see a red exclamation mark next to their names in the table of contents. If you know the new location of the data, you can repair the link. You can also update the link to a layer's data source. You might want to do this when, for example, you want to retain the layer's display properties but use an updated attribute table.

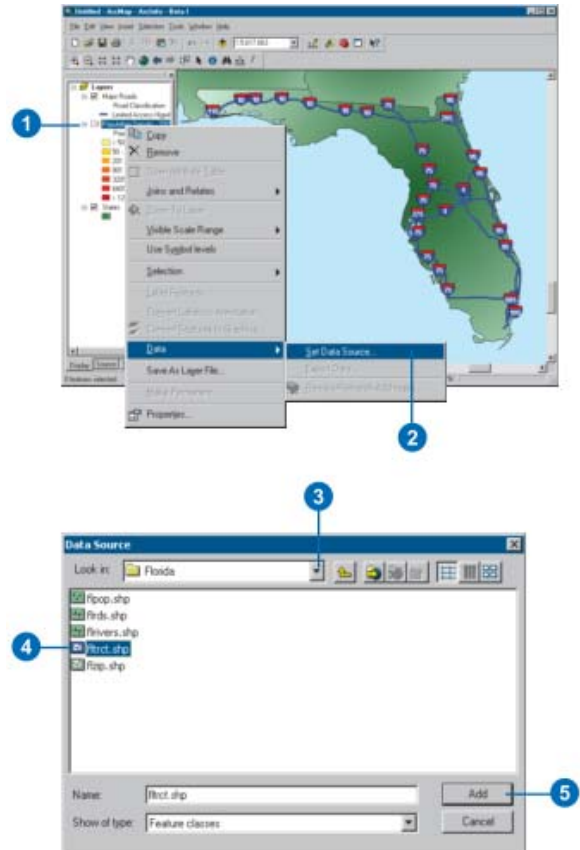
Storing relative pathnames to data

1. Click the File menu and click Document Properties.
2. Click Data Source Options.
3. Click Store relative path names.
4. Click OK.
5. Click OK on the Document Properties dialog box.



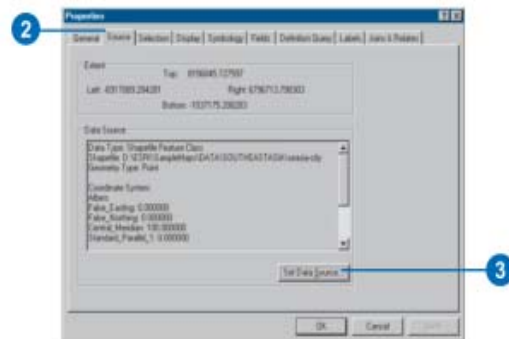
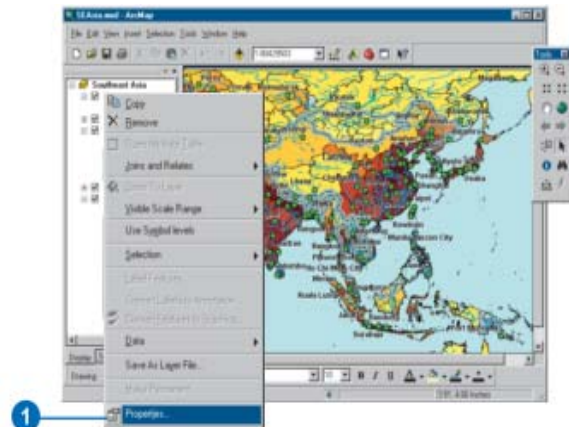
Repairing broken data source links

1. Locate the layer with the broken link in the table of contents. It will have a red exclamation mark next to it.
2. Right-click the layer, point to Data, and click Repair Data Source.
3. Click the Look in dropdown arrow and navigate to the location of the data source.
4. Click the data source.
5. Click the Add button. The link to the data source is now updated.



Updating a link to a data source

1. In the table of contents, rightclick the layer and click Properties.
2. Click the Source tab.
3. Click Set Data Source.
4. Click the Look in dropdown arrow and navigate to the data source.
5. Click the data source.
6. Click Add.



Module IV

Working with Layers

You can think of a layer as a specific way to display and work with geographic data. Layers exist within maps and can be saved independently of maps in a database or as a layer file (.lyr). In fact, many organizations save layers for their staff to access rather than providing direct access to the organization's geographic data. This helps to ensure that those accessing the data are viewing the same information.

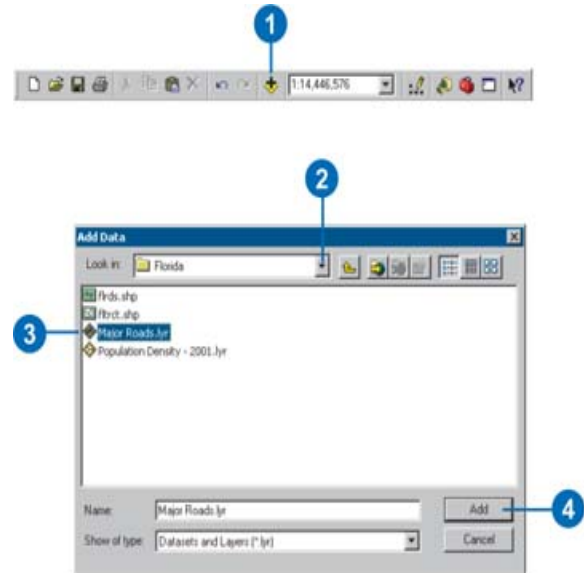
In this Module, you'll learn how to:

- Adding layers
 - Changing a layer's text
 - About the drawing order
 - Copying layers
 - Removing layers from the map
 - Grouping layers
 - Saving a layer to disk
 - Accessing layer properties
 - Displaying a layer at specific scales
 - Creating a transparent layer
 - Changing the appearance of the table of contents
 - Using data frames to organize layers
-

Adding a layer file in ArcMap

1. Click the File menu and click Add Data, or click the Add Data button on the Standard toolbar.
2. Click the Look in dropdown arrow and navigate to the folder containing your layer file.
3. Click the layer file.
4. Click Add.

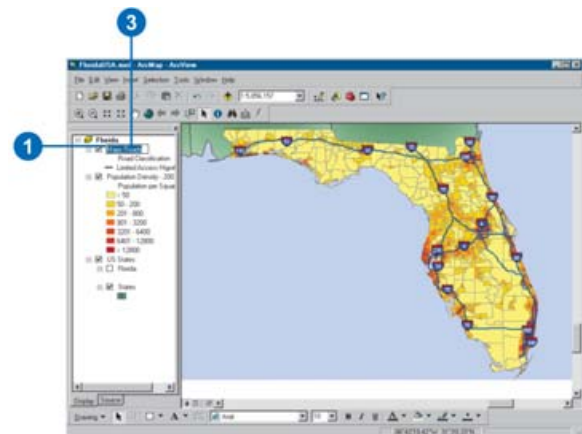
ArcMap adds the layer to your table of contents using the special properties it was saved with.



Changing the name of a layer

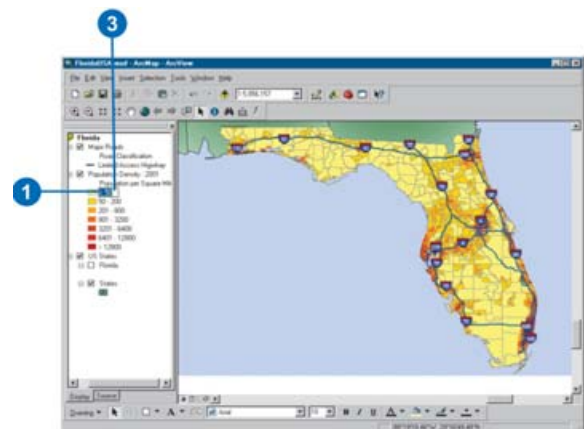
1. In the table of contents, click the layer to select it.
2. Click again over the name. This will highlight the name and allow you to change it.
3. Type the new name and press Enter.

NOTE: This does not change the actual filename.



Changing the map feature label

1. In the table of contents, click the text you want to change.
2. Click again over the text string. This will highlight the string and allow you to change it.
3. Type the new description and press Enter

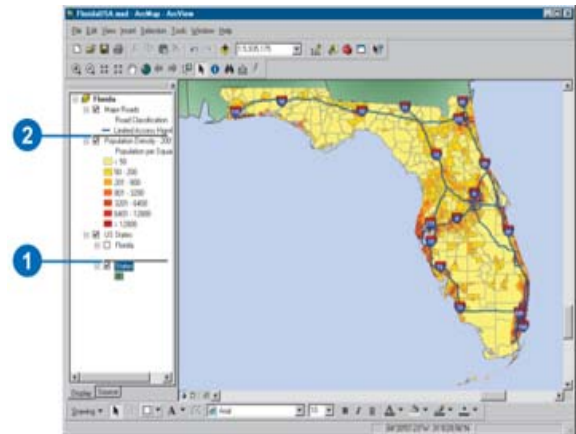


Moving a layer to change its drawing order

1. In the table of contents, click and drag the layer up or down.

A black bar indicates where the layer will be placed. This bar indents to reflect the position in the layer hierarchy where the drop will occur.

2. Release the mouse pointer to drop the layer in its new position.

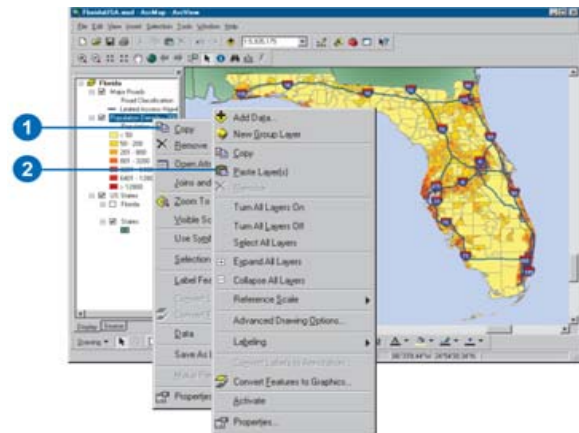


Copying a layer between data frames

1. Right-click the layer or layers you want to copy to another data frame and click Copy.
2. Right-click the data frame you want to copy the layer or layers into and click Paste Layer(s).

You can also drag and drop a layer from one data frame to another.

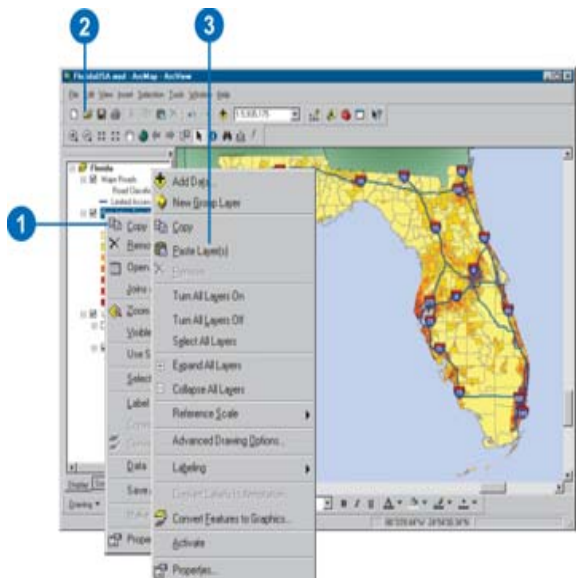
If you want to move your layer instead of copying it while you drag and drop, hold down the Ctrl key when you drop the layer.



Copying a layer to another map

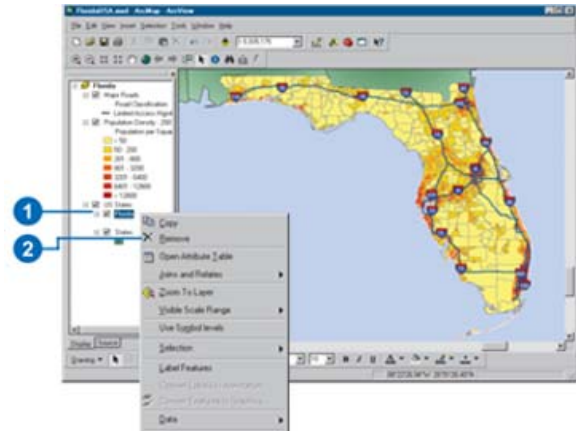
1. Right-click the layer or layers you want to copy to another data frame and click Copy.
2. Click the Open button on the Standard toolbar and open the map you want to copy the layer or layers into.
3. Right-click the data frame you want to copy the layer into and click Paste Layer(s).

If you don't want to close your original map, open another ArcMap session



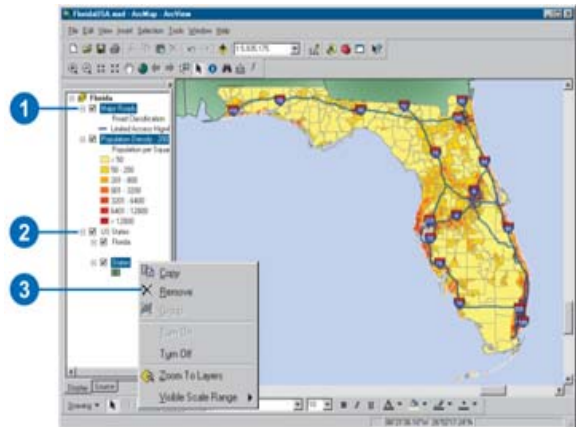
Removing a layer

1. In the table of contents, right click the layer or layers you want to remove.
2. Click Remove.



Removing Several Layers

1. In the table of contents, click the first layer you want to remove.
2. Hold down the Shift or Ctrl key and click to select additional layers.
3. Right-click the selection and click Remove.



Creating a Group Layer

1. Right-click the data frame in which you want to create a group layer.
2. Click New Group Layer.

A new group layer appears in the table of contents.

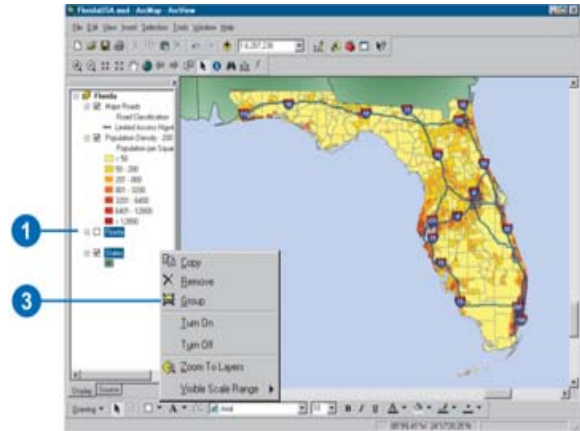


Grouping Layers: When you want to work with several layers as one layer, you gather them together into a group layer. For example, suppose you have two layers on a map representing railroads and highways. You might choose to group these layers together and name the resulting layer “transportation networks”. A group layer appears and acts like an individual layer in the table of contents. Turning off a group layer turns off all its component layers. The properties of the group layer override any conflicting properties of its constituent layers.

Grouping layers in the table of contents

1. Hold the Ctrl key and highlight multiple layers in the table of contents.
2. Right-click one of the chosen layers.
3. Click Group.

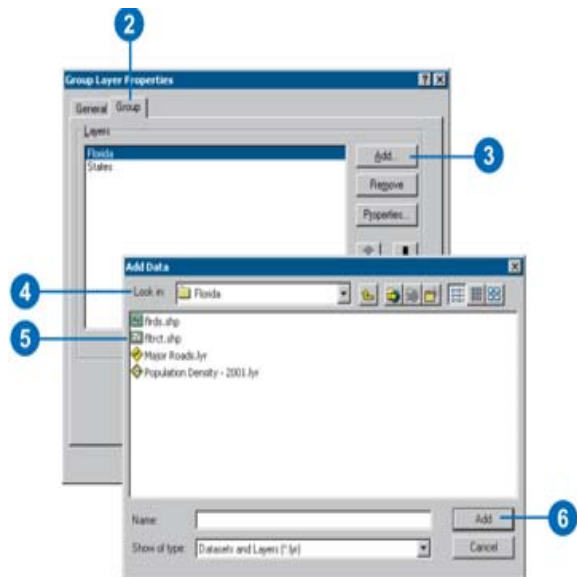
A new group layer appears in the table of contents containing the selected layers.



Adding layers to a group layer

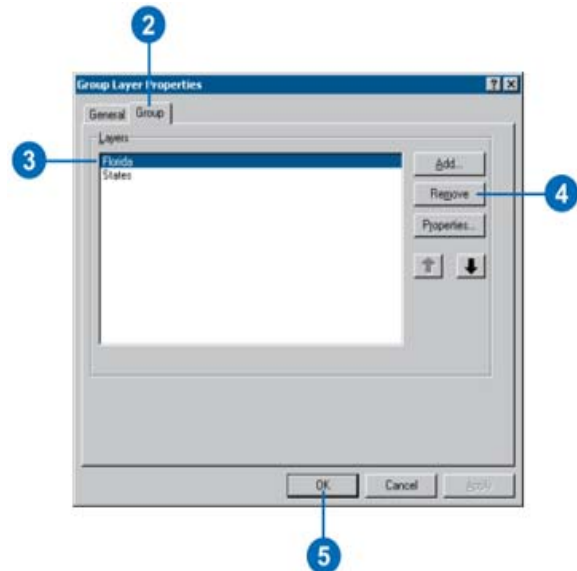
1. Double-click the group layer in the table of contents to display its properties.
2. Click the Group tab.
3. Click Add.
4. Click the Look in dropdown arrow and navigate to the data source you want to add to the group.
5. Click the data source.
6. Click Add.

Tip: If the layer you want to add to a group is already on the map, you can drag and drop it in the group.



Removing a layer from group layer

1. Double-click the group layer in the table of contents to display its properties.
2. Click the Group tab.
3. Click the layer that you want to remove.
4. Click Remove.
5. Click OK.

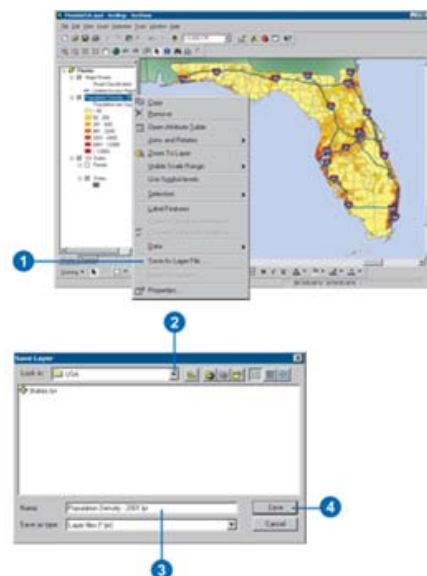


Saving a Layer to Disk: One of the main features of a layer is that it can exist as a file in your GIS database. This makes it easy for others to access the layers you've built. When you save a layer to disk, you save everything about the layer. When you add the layer to another map, it will draw exactly as it was saved. This is very convenient when others at your organization need to make maps but don't know how to represent or access the data in your database. All they need to do is add the layer

Passing layers to others: Don't forget, the layer file is just a link to the actual data source. So if you are passing the layer to others, be sure they also have the data referred to in the layer.

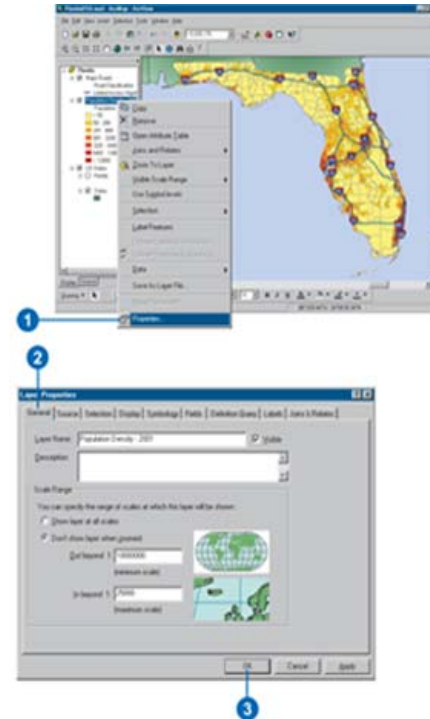
Saving a layer to disk

1. In the table of contents, right click the layer and click Save As Layer File.
2. Click the Look in dropdown arrow and navigate to the location where you want to save the layer.
3. Optionally, change the layer name.
4. Click Save



Displaying layer properties

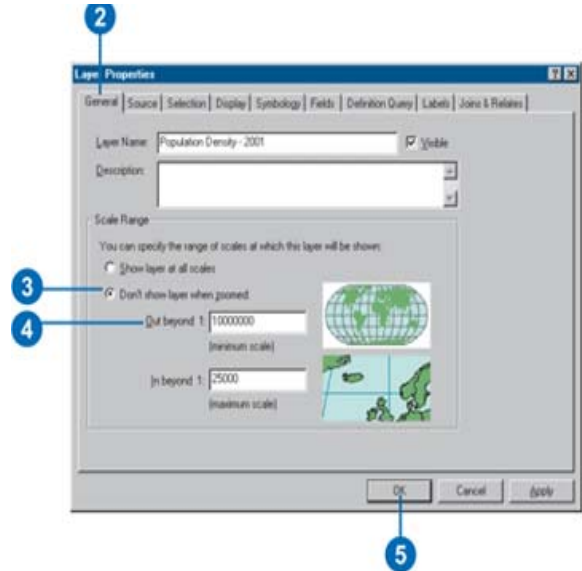
1. In the table of contents, right click the layer and click Properties.
2. Click the tab containing the properties you want to adjust.
3. When finished, click OK.



Displaying a layer at specific scales: To help you automatically display layers at the appropriate scale, you can set a layer's visible scale range to define the range of scales at which ArcMap draws the layer. Whenever the scale of the data frame is outside the layer's visible scale range, the layer won't draw. In this way, you can control how the map looks at various scales. For example, you can hide a detailed layer that might otherwise clutter your map when you zoom out. You can also progressively display more detailed layers as you zoom in on an area, that is, as the scale of the data frame gets larger. Setting a visible scale range is especially useful if you are creating a map for others to use because it makes browsing the map easier.

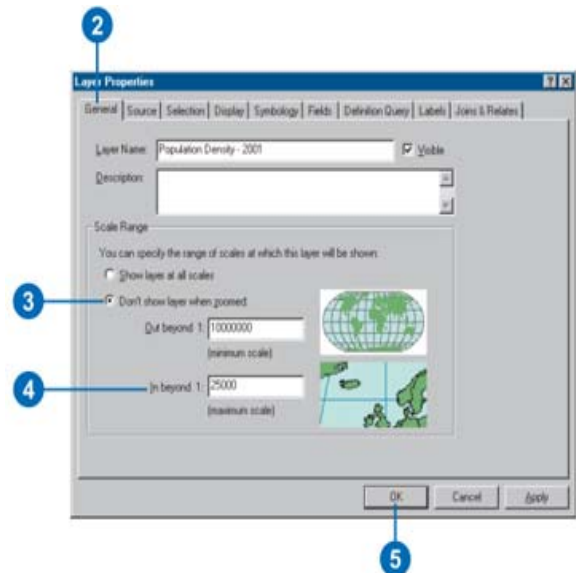
Setting the minimum visible scale for a layer

1. Right-click the layer in the table of contents and click Properties.
2. Click the General tab.
3. Click Don't show layer when zoomed.
4. Type a minimum scale for the layer.
If you zoom out beyond this scale, the layer will not be visible.
5. Click OK.



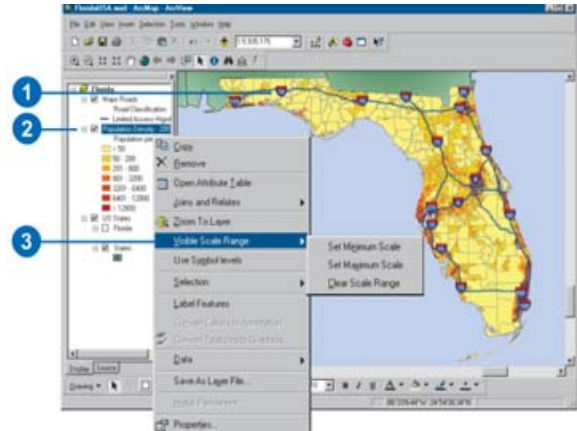
Setting the maximum visible scale for a layer

1. Right-click the layer in the table of contents and click Properties.
2. Click the General tab.
3. Click Don't show layer when zoomed.
4. Type a maximum scale for the layer.
If you zoom in beyond this scale, the layer will not be visible.
5. Click OK.



Setting a visible scale based on the current scale

1. Adjust the data frame display to the appropriate scale.
2. Right-click the layer for which you want to set a visible scale.
3. Point to Visible Scale Range and click Set Maximum Scale or Set Minimum Scale.



Clearing a layer's visible scale

1. Right-click the layer for which you want to clear a visible scale range.
2. Point to Visible Scale Range and click Clear Scale Range.



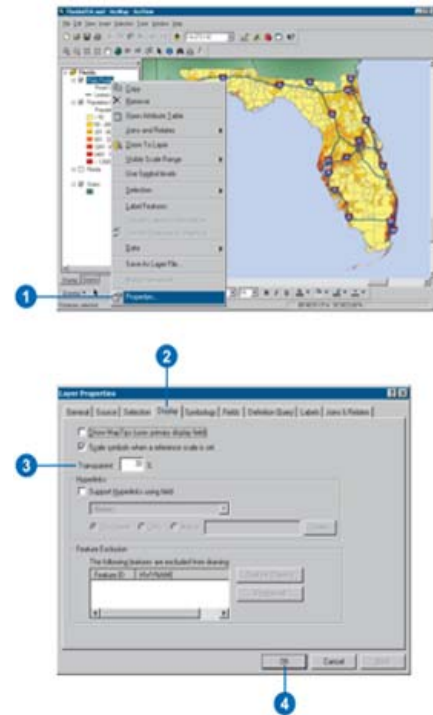
Creating a transparent layer: Giving a layer transparency is an easy way to show varying and overlapping information. One situation in which transparency might be useful is if you needed to see the information displayed in two overlapping polygon layers. Similarly, another use is to allow you to see an image under a polygon layer.

Changing a layer's source data: The properties saved within a layer file can be applied to other data sources at times. This data needs to be in the same format with the same attribute information. You might do this when using updated census data, for example. This data will be in the same format; therefore, the data should display using the same layer properties as the previous data. You might also change source data to allow for a consistent presentation between counties using data with the same table and feature classes.

Setting the layer's transparency

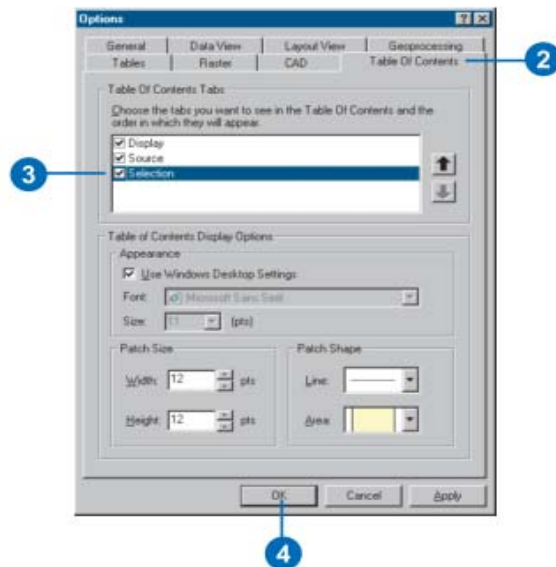
1. Right-click the layer and click Properties.
2. Click the Display tab.
3. Enter the transparency value, in percent, you wish this layer to be displayed with.
4. Click OK.

If you are uncertain how transparent you want the layer, click Apply before OK, and keep changing the transparency value before you close the Properties dialog box.



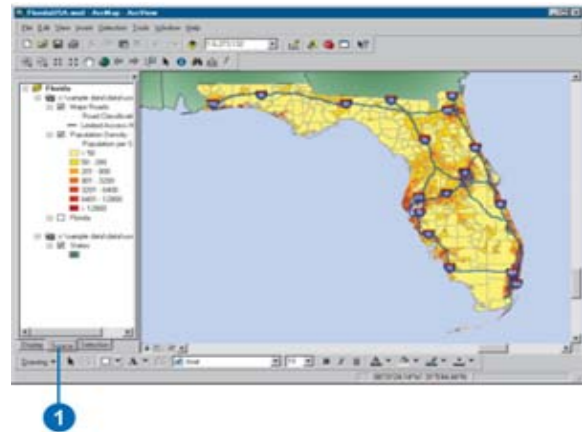
Showing the Display, Source, and Selection tabs

1. Click the Tools menu on the Standard toolbar and click Options.
2. Click the Table Of Contents tab.
3. Check the boxes to show the Display, Source, and Selection tabs.
4. Click OK.



Viewing the data source in the table of contents

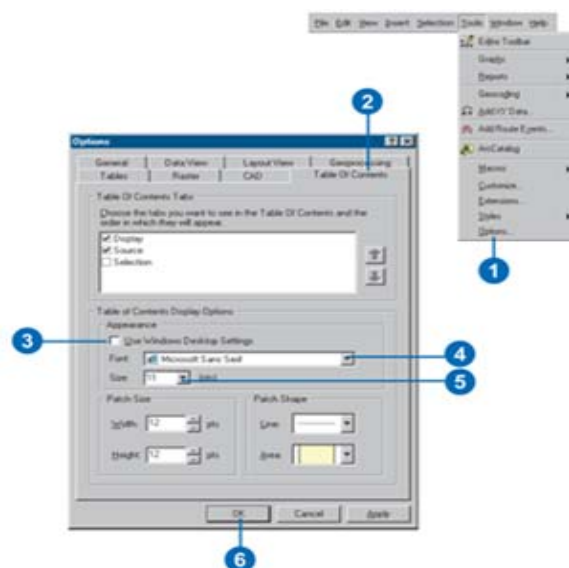
1. Click the Source tab in the table of contents.



Changing the appearance of the table of contents: You can adjust the look of the table of contents to suit your needs. For example, you might change the text size and font so it makes a greater visual impact or is easier to read. You also might want to change the shape of the lines and patches that represent the features on a map. The table of contents has three tabs at the bottom, a Display tab, Source tab, and a Selection tab. The Display tab shows the drawing order of the layers and allows you to change the order. The Source tab sorts layers by where they're stored on disk. The Selection tab shows a list of the layers in the active data frame and lets you check the ones you want to make selectable. Seeing the Source tab is useful during editing, when you edit all layers in a given folder or database. If you're not planning on using your map for editing, you can hide the Source tab. You can't change the drawing order of layers from the Source tab.

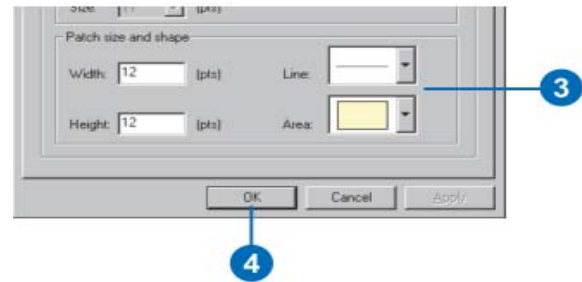
Setting the text font for layers

1. Click the Tools menu on the Standard toolbar and click Options.
2. Click the Table Of Contents tab.
3. Uncheck Use Windows Desktop Settings.
4. Click the Font dropdown arrow and click the font you want to use.
5. Click the Size dropdown arrow and click the font size.
6. Click OK.



Setting the line and patch for layer symbology

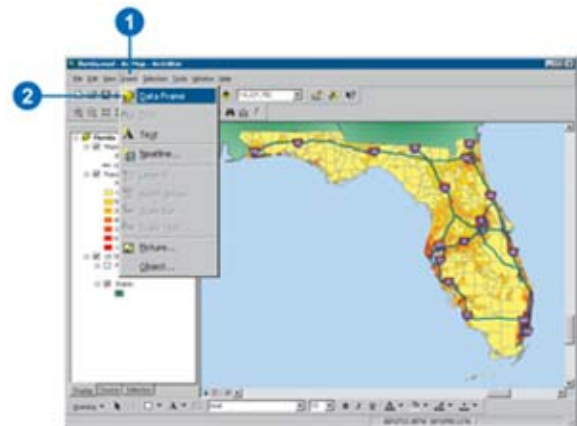
1. Click the Tools menu on the Standard toolbar and click Options.
2. Click the Table Of Contents tab.
3. Click the Line or Area dropdown arrow and click the appropriate shape.
4. Click OK.



Adding a data frame

1. Click the Insert menu.
2. Click Data Frame.

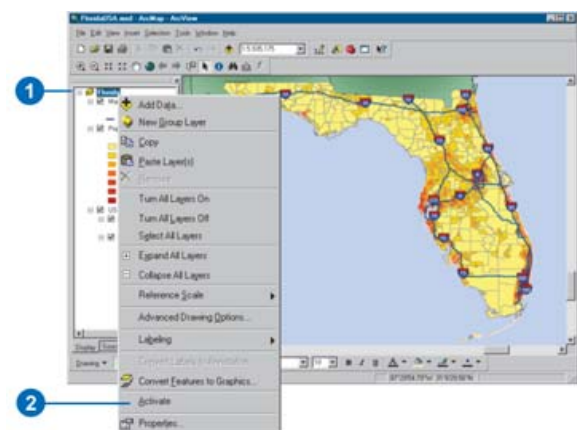
The new data frame will appear in the table of contents and in the center of the layout when in layout view



Making a data frame active

1. Right-click the data frame in the table of contents.
2. Click Activate.

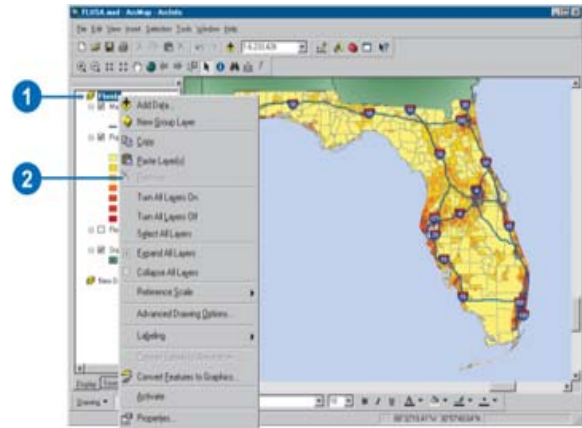
You can also click the frame in layout view to activate it.



Removing a data frame

1. Right-click the data frame in the table of contents that you want to remove.
2. Click Remove.

In layout view, you can select the data frame and press the Delete key on the keyboard.



Module V

Symbolizing Features

Choosing how to represent your data on a map may be the most important mapmaking decision. How you represent your data determines what your map communicates. On some maps, you might simply want to show where things are. The easiest way to do this is to draw all the features in a layer with the same symbol. On other maps, you might draw features based on an attribute value or characteristic that identifies them. For example, you could map roads by type to get a better sense of traffic patterns.

In general, you can draw map features:

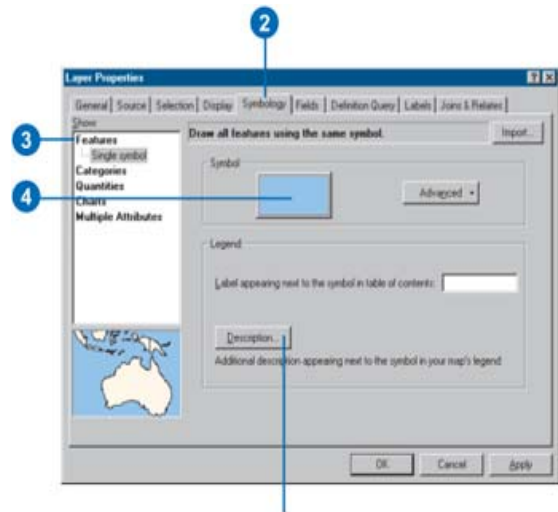
- With a single symbol
- To show a category such as a type (unique values)
- To represent a quantity such as population (graduated color or symbol, and dot density maps)
- To show multiple attributes

In this Module, you'll learn how to:

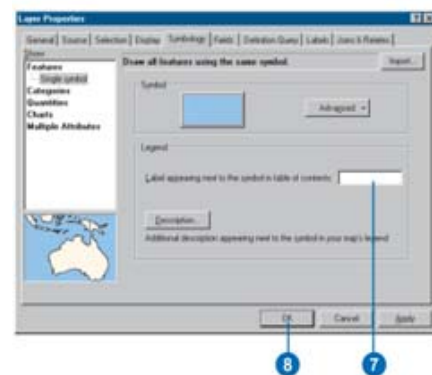
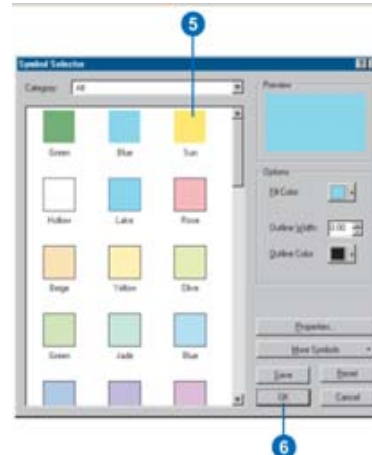
- Drawing all features with one symbol
 - Drawing features to show categories
 - Managing categories
 - Ways to map quantitative data
 - Standard classification schemes
 - Setting a classification
 - Representing quantity with color, graduated or proportional symbols, and charts
 - Drawing features to show multiple attributes
 - Working with advanced symbolization
-

Drawing a layer using a single symbol

1. In the table of contents, right click the layer you want to draw with a single symbol and click Properties.
2. Click the Symbology tab.
3. Click Features.
 - Because Single symbol is the only option, ArcMap automatically selects it.
4. Click the Symbol button to change the symbol.
5. In the Symbol Selector dialog box, click a new symbol or change specific properties of the symbol.
6. Click OK on the Symbol Selector dialog box.
7. Type a label for the feature. The label appears next to the symbol in the table of contents.
8. Click OK

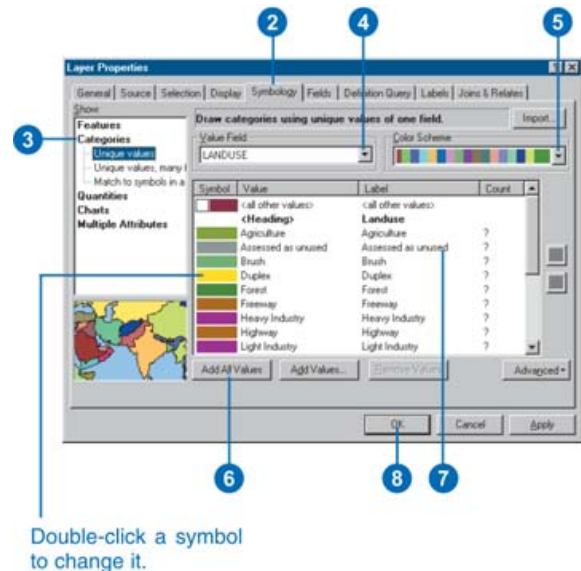


Click Description if you want an additional description of your layer to appear in your legend. You can press the Ctrl and Enter keys together in the Description for Legend dialog box to insert a line break in your description. For more information on working with legends, see Chapter 15, 'Laying out and printing maps'.



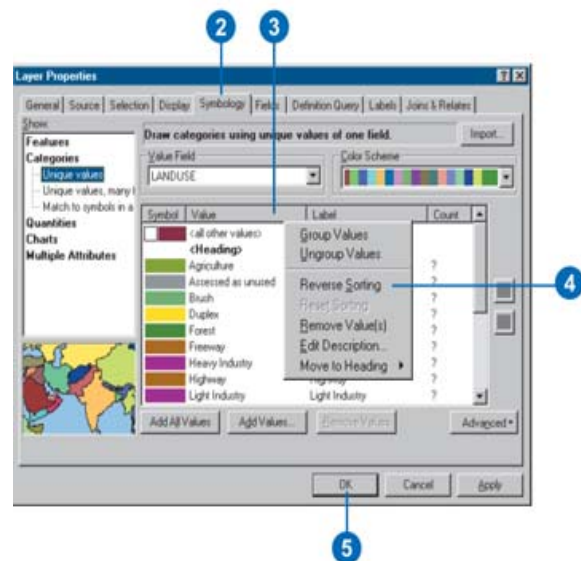
Drawing a layer showing unique values

1. In the table of contents, right click the layer you want to draw showing unique values and click Properties.
2. Click the Symbology tab.
3. Click Categories.
- ArcMap automatically selects the Unique values option.
4. Click the Value Field dropdown arrow and click the field that contains the values you want to map.
5. Click the Color Scheme dropdown arrow and click a color scheme.
6. Click Add All Values.
- This adds all unique values to the list.
Alternatively, click the Add Values button to choose which unique values to display.
7. If you want to edit the default label so more descriptive labels appear in your legend and the table of contents, click a label in the Label column and type the label you want.
8. Click OK.



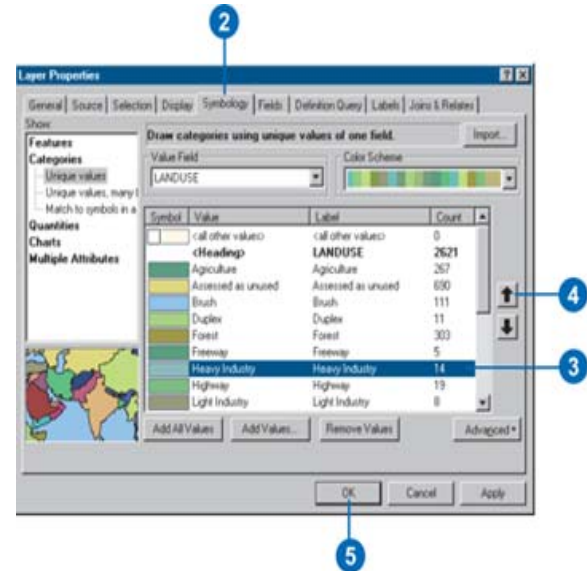
Reversing the sort of unique values

1. In the table of contents, rightclick the layer whose unique values you want to sort and click Properties.
2. Click the Symbology tab.
3. Click the Value column to show a context menu.
4. Click Reverse Sorting to reverse the alphanumeric sorting of the entire list of classes.
5. Click OK.



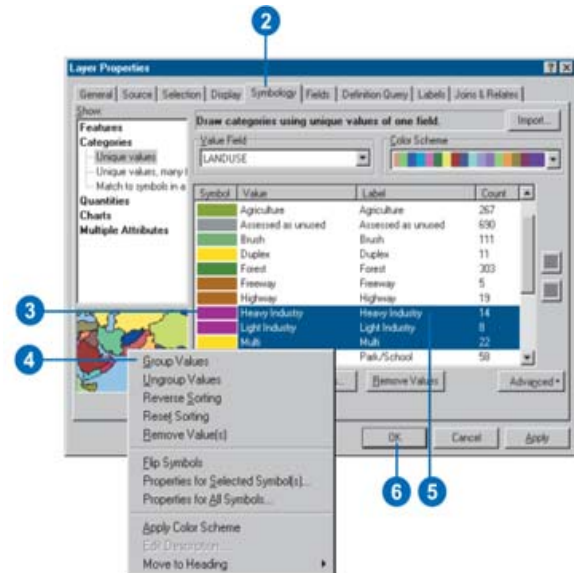
Ordering unique values

1. In the table of contents, rightclick the layer whose unique values you want to reorder and click Properties.
2. Click the Symbology tab.
3. Click the value you want to move up or down in the list.
4. Use the up and down arrows to either promote or demote the value in the list.
5. Click OK.



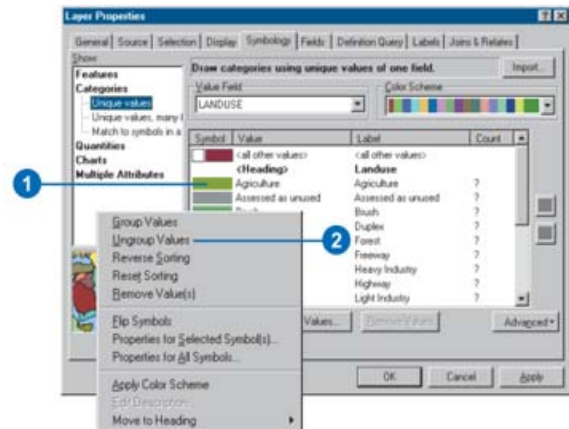
Combining two or more categories into one

1. In the table of contents, rightclick the layer drawn with unique values you want to combine categories for and click Properties.
2. Click the Symbology tab.
If you don't already see categories in the scrolling list, follow the steps for 'Drawing a layer showing unique values' earlier in this chapter.
3. Click the first of the values you want to combine. Hold down the Shift or Ctrl key and click the additional values that you want to combine.
4. Right-click over the values and click Group Values. The selected values will now be combined into one category.
5. If you want more descriptive labels to appear in your legend and the table of contents, click a label in the Label column and type the label you want.
6. Click OK.



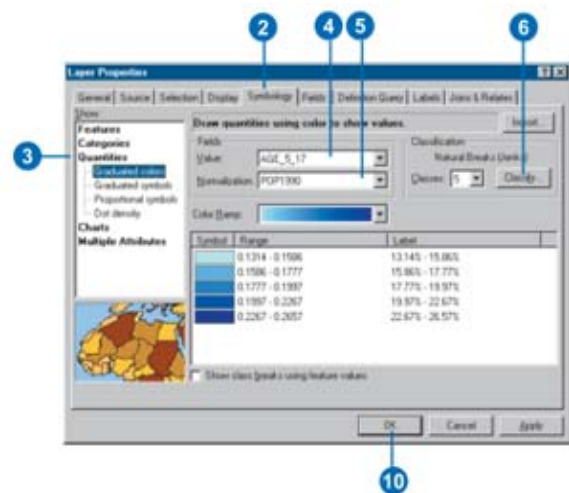
Ungrouping combined categories

1. Right-click a combined category in the scrolling list.
2. Click Ungroup Values.
The symbols for each of the ungrouped values are the same as when they were grouped



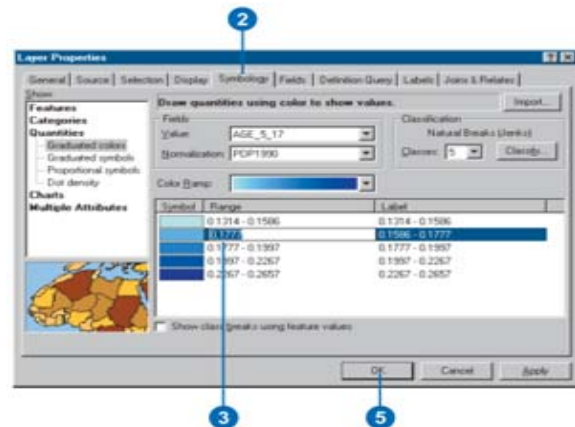
Setting a standard classification method

1. In the table of contents, rightclick the layer that shows a quantitative value for which you want to change the classification.
2. Click the Symbology tab.
3. Click Quantities.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field.
ArcMap divides this field into the Value to create a ratio.
6. Click Classify.
7. Click the Method dropdown arrow and click the classification method you want.
8. Click the Classes dropdown arrow and click the number of classes you want to display.
9. Click OK on the Classification dialog box.
10. Click OK on the Layer Properties dialog box.



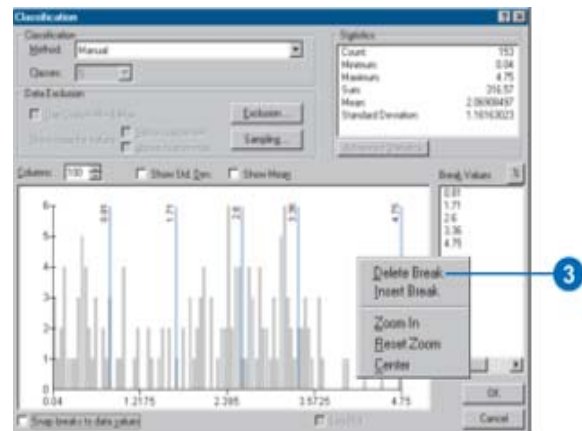
Inserting your own class breaks and setting a range

1. In the table of contents, rightclick the layer for which you want to set class breaks and click Properties.
2. Click the Symbology tab.
If you have not already set a classification method, follow the steps in 'Setting a standard classification method' earlier in this chapter.
3. Click the Range you want to edit.
Make sure to click the Range, not the Label.
4. Type a new value. This sets the upper value of the range.
5. Click OK



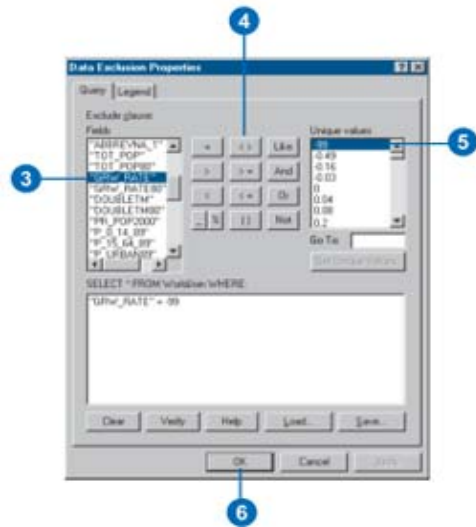
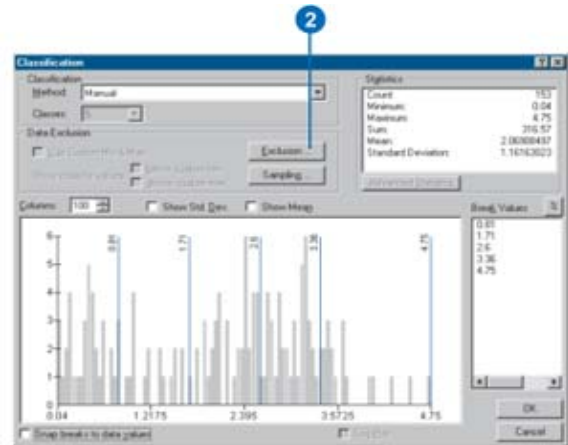
Deleting a class break

1. Click Classify from the Symbology tab of the Layer Properties dialog box.
2. Click the class break you want to delete.
The selected break is highlighted.
3. Right-click over the histogram and click Delete Break.



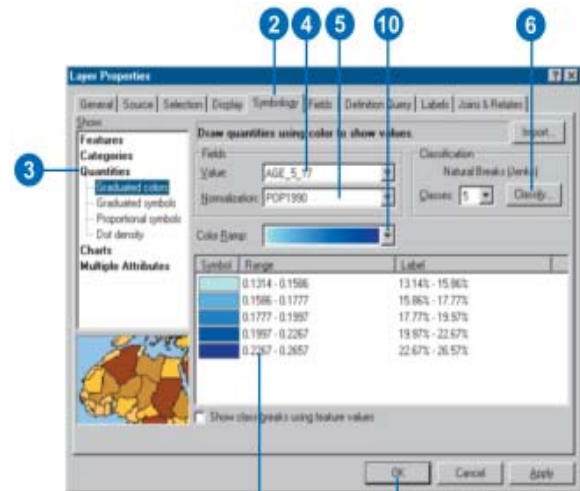
Excluding features from the classification

1. Click Classify from the Symbology tab of the Layer Properties dialog box.
2. Click Exclusion.
3. Double-click the field you're using to draw the layer.
4. Click an operator.
5. Click Get Unique Values and double-click the value you want to exclude.
6. Click OK to execute the expression and exclude values.

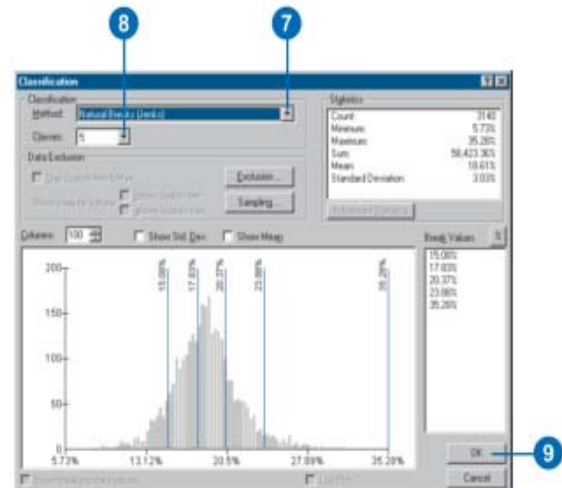


Symbolizing data with graduated colors

1. In the table of contents, rightclick the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities.
- ArcMap automatically selects Graduated colors.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field.
- ArcMap divides this field into the Value to create a ratio.
6. Click Classify.
7. Click the Method dropdown arrow and click the classification method you want.
8. Click the Classes dropdown arrow and click the number of classes you want to display.
9. Click OK on the Classification dialog box.
10. Click the Color Ramp dropdown arrow and click a ramp to display the data with.
11. Click OK on the Layer Properties dialog box.

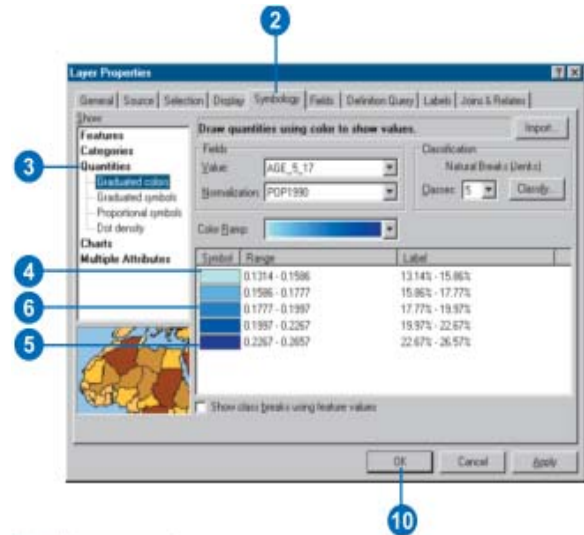


Right-click a class to see additional options, such as sorting and number formatting.



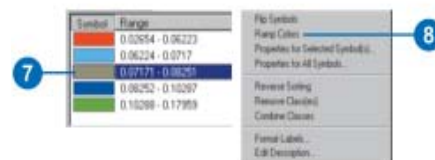
Creating your own color ramp for a layer

1. In the table of contents, rightclick the layer that shows a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities.
4. Double-click the top symbol in the list and set the start color for the ramp.
5. Double-click the bottom symbol and set the end color.
6. Optionally, double-click any middle symbol to set its color. This lets you create a multipart color ramp.
7. Click all the middle symbols you've set the color of.
8. Right-click a symbol and click Ramp Colors.
9. Optionally, if you want to use the new color ramp on another layer, right-click the Color Ramp dropdown and click Save to style to save your new ramp to your default style.
10. Click OK.



Symbol	Range
[Red]	0.02654 - 0.06223
[Orange]	0.06224 - 0.0717
[Yellow]	0.07171 - 0.08251
[Green]	0.08252 - 0.10287
[Dark Green]	0.10288 - 0.17959

Appearance after the top, middle, and bottom colors have been set.



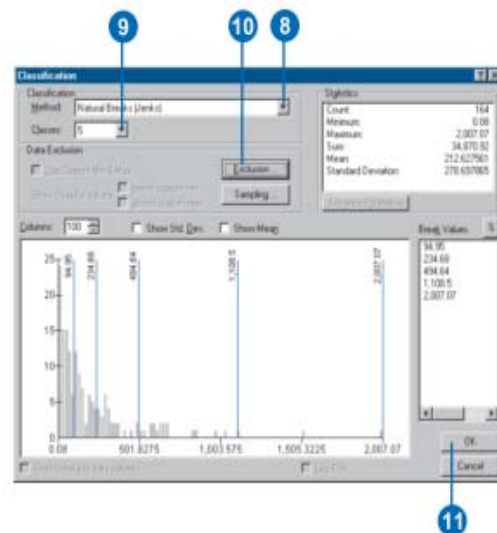
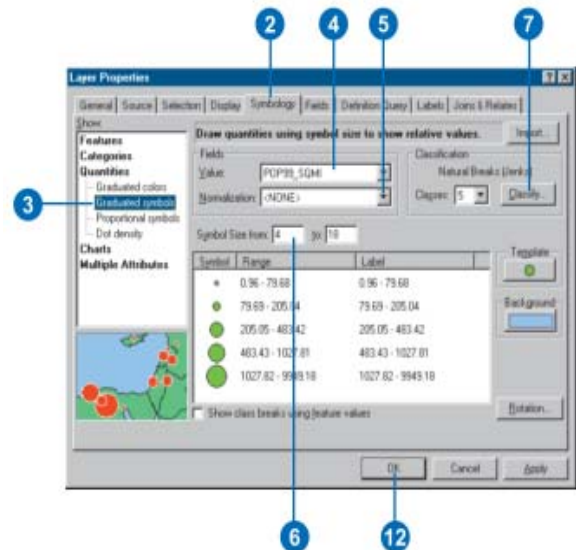
Symbol	Range
[Red]	0.02654 - 0.06223
[Orange]	0.06224 - 0.0717
[Yellow]	0.07171 - 0.08251
[Green]	0.08252 - 0.10287
[Dark Green]	0.10288 - 0.17959

Resulting ramp goes from red to yellow to green.



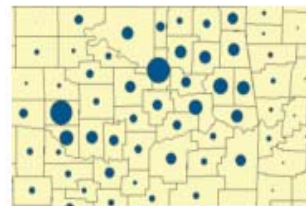
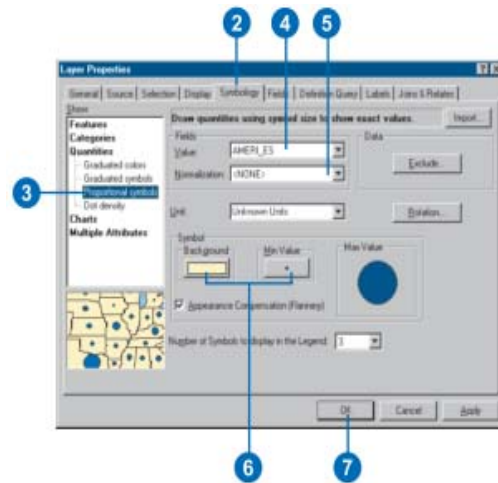
Representing quantity with graduated symbols

1. In the table of contents, rightclick the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Graduated symbols.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field. ArcMap divides this field into the Value to create a ratio.
6. Type the minimum and maximum symbol sizes.
7. Click Classify.
8. Click the Method dropdown arrow and click the classification method you want.
9. Click the Classes dropdown arrow and click the number of classes you want.
10. Optionally, click Exclusion to remove unwanted values from the classification (for example, null values or extreme outliers).
11. Click OK on the Classification dialog box.
12. Click OK on the Layer Properties dialog box.

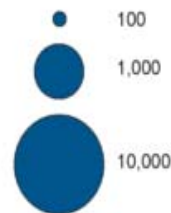


Representing quantity with proportional symbols

1. In the table of contents, rightclick the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Proportional symbols.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field.
ArcMap divides this field into the Value to create a ratio.
6. Optionally, click Background and Min Value to change the symbol properties and background of the proportional symbols.
7. Click OK.



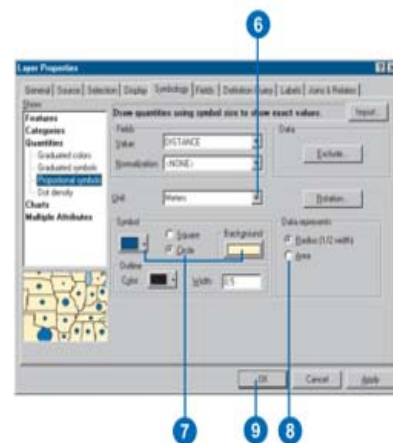
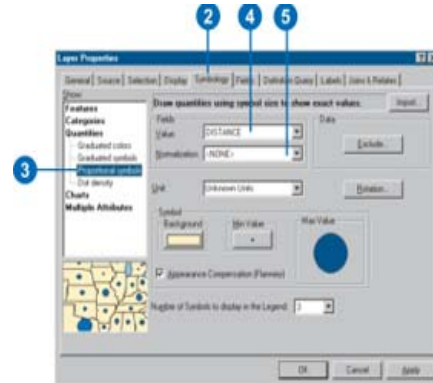
How the proportional symbols appear on your map when the Background is yellow with a black outline and the Min Value symbol is blue with a black outline



Proportional symbols appear in the legend and table of contents as a stack of progressively larger blue circles.

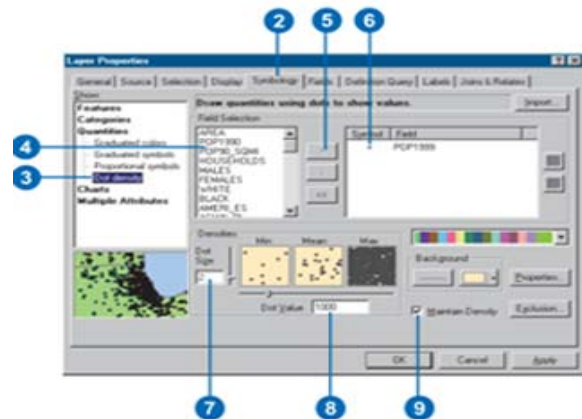
Representing quantity with proportional symbol as values are measurement on a map

1. In the table of contents, rightclick the layer you want to draw showing a quantitative value and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Proportional symbols.
4. Click the Value dropdown arrow and click the field that contains the quantitative value you want to map.
5. To normalize the data, click the Normalization dropdown arrow and click a field.
6. Click the Unit dropdown arrow and click a unit.
7. Click Square or Circle as the symbol. Optionally, change the color of the symbol and click Background to change the background of the proportional symbols.
8. Click Radius or Area. For example, click Radius if your data represents the distance an earthquake was felt from its epicenter. Click Area if the value represents an area.
9. Click OK.

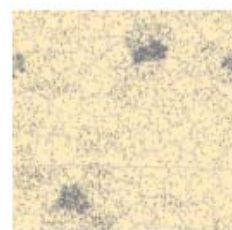
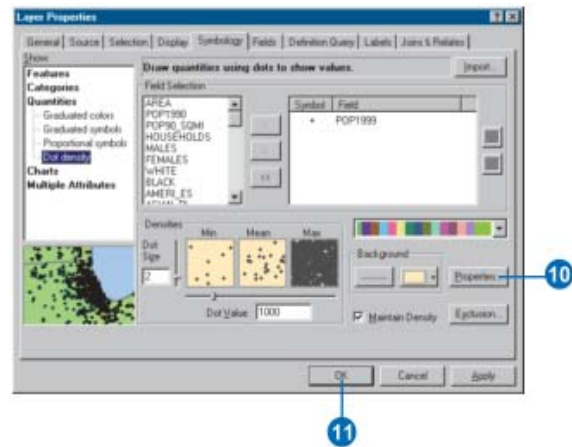


Drawing a dot density map

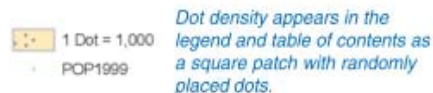
1. In the table of contents, rightclick the layer you want to draw showing a quantitative value using dot densities and click Properties.
2. Click the Symbology tab.
3. Click Quantities and click Dot density.
4. Click the field or fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.



6. Double-click a dot symbol in the field list to change its properties.
7. Type the dot size or click the slider to adjust the size.
8. Type the dot value or click the slider to adjust the value.
9. Check Maintain Density to preserve the dot density.
10. Optionally, click Properties to set the dot placement options and use Masking.
11. Click OK



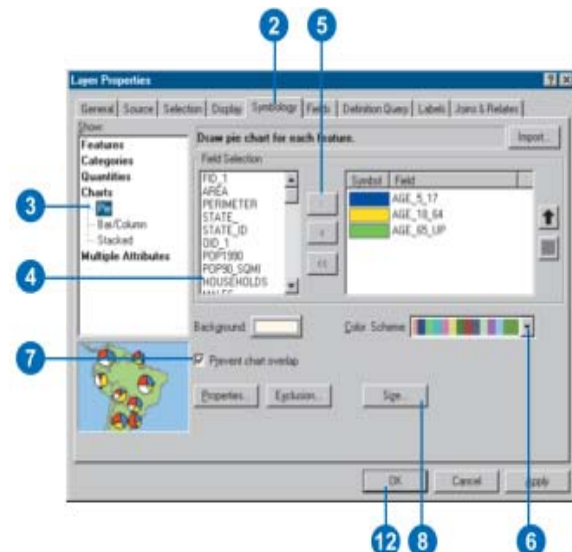
How the dot density map appears when the dots are black and the Background has a gray county boundary outline and a sand background



Dot density appears in the legend and table of contents as a square patch with randomly placed dots.

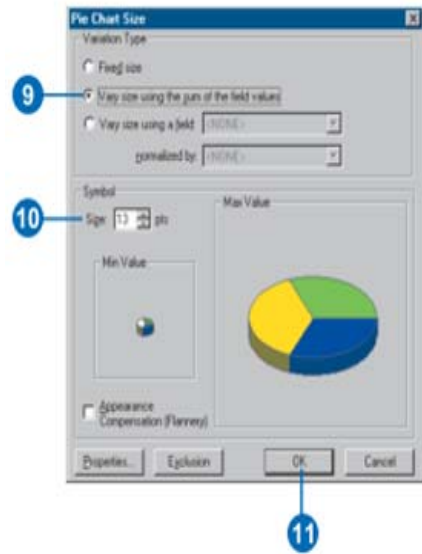
Drawing pie charts

1. In the table of contents, rightclick the layer you want to draw showing quantitative values with charts and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Pie.
4. Click the fields under Field Selection that contain the quantitative values that you want to map.
Choosing more than one field shows the relationship to the whole.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use or double-



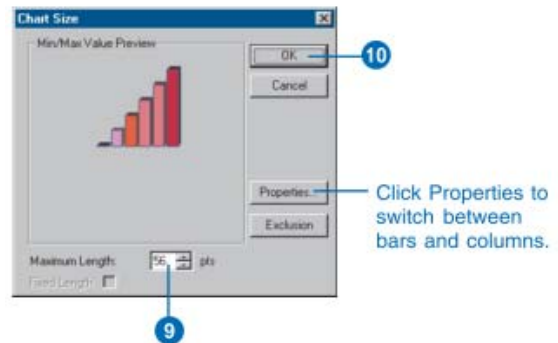
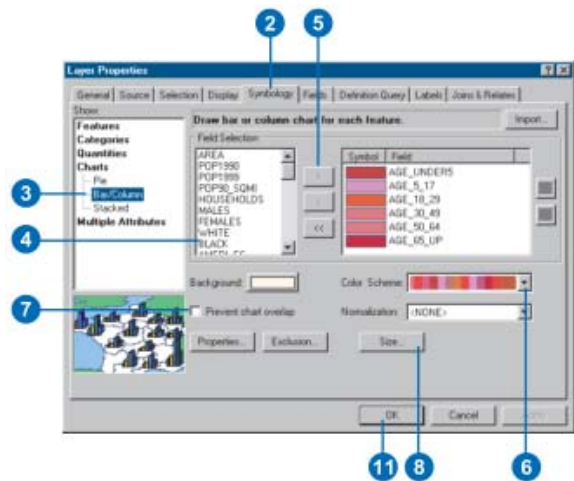
click a symbol in the list to change its properties.

7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Click the Variation Type you want. You can either draw all pies the same size or vary the size based on the sum of the attributes or a particular attribute value.
10. Type a size or click the arrows to set the size.
11. Click OK.
12. Click OK.



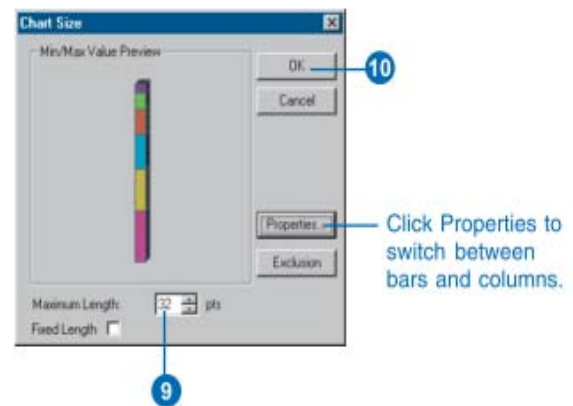
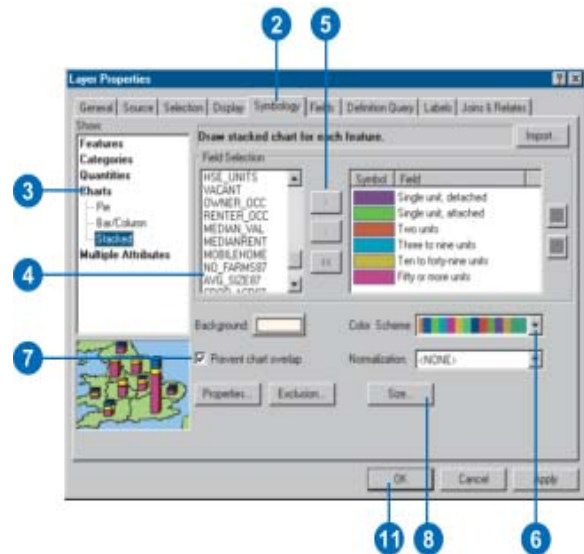
Drawing bar or column charts

1. In the table of contents, rightclick the layer you want to draw showing quantitative values with bar or column charts and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Bar/ Column.
4. Click one or more fields under Field Selection that contain the quantitative values that you want to map.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use.
You can double-click an individual symbol in the list to change its properties.
7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Type a maximum length or click the arrows to set the length.
10. Click OK.
11. Click OK.



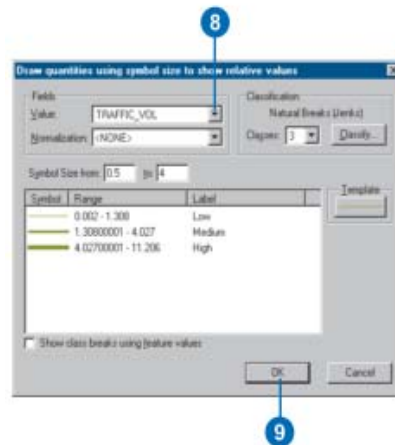
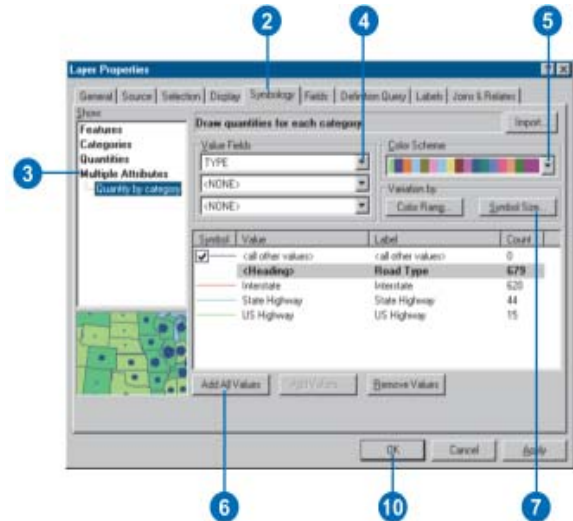
Drawing stacked charts

1. In the table of contents, rightclick the layer you want to draw showing quantitative values with stacked charts and click Properties.
2. Click the Symbology tab.
3. Click Charts and click Stacked.
4. Click the fields under Field Selection that contain the quantitative values that you want to map.
Choosing more than one field shows the relationship to the whole.
5. Click the arrow button to add fields to the field list.
6. Click the Color Scheme dropdown arrow and click the colors you want to use. You can double-click an individual symbol in the list to change its properties.
7. Check the box to prevent the charts from overlapping.
8. Click Size.
9. Type a maximum length or click the arrows to set the length.
10. Click OK.
11. Click OK.



Drawing a layer to show both categories and quantities

1. In the table of contents, rightclick the layer you want to draw showing multiple attributes and click Properties.
2. Click the Symbology tab.
3. Click Multiple Attributes.
ArcMap automatically selects Quantity by category.
4. Click the first Value Fields dropdown arrow and click the field that contains the values you want to map.
5. Click the Color Scheme dropdown arrow and click a color scheme.
6. Click Add All Values.
7. Click Symbol Size or Color Ramp, depending on how you want to symbolize the quantitative value. This example shows Symbol Size.
8. Click the Value dropdown arrow and click the quantitative value you want to map. Set other options as described in the 'Representing quantity' sections of this chapter.
9. Click OK.
10. Click OK.



Module VI

Working with Labels

Labeling is the process of placing descriptive text onto or next to features on your map. In ArcGIS, labeling refers specifically to the process of automatically generating and placing descriptive text for map features. A label is a piece of text on the map that is derived from one or more feature attributes. Labels are not selectable, and you cannot edit the display properties of individual labels. Labeling is useful to add descriptive text to your map for many features. Labeling can be a fast way to add text to your map, and it avoids you having to add text for each feature manually. In addition, ArcMap labeling dynamically generates and places text for you. This can be useful if your data is expected to change or you are creating maps at different scales.

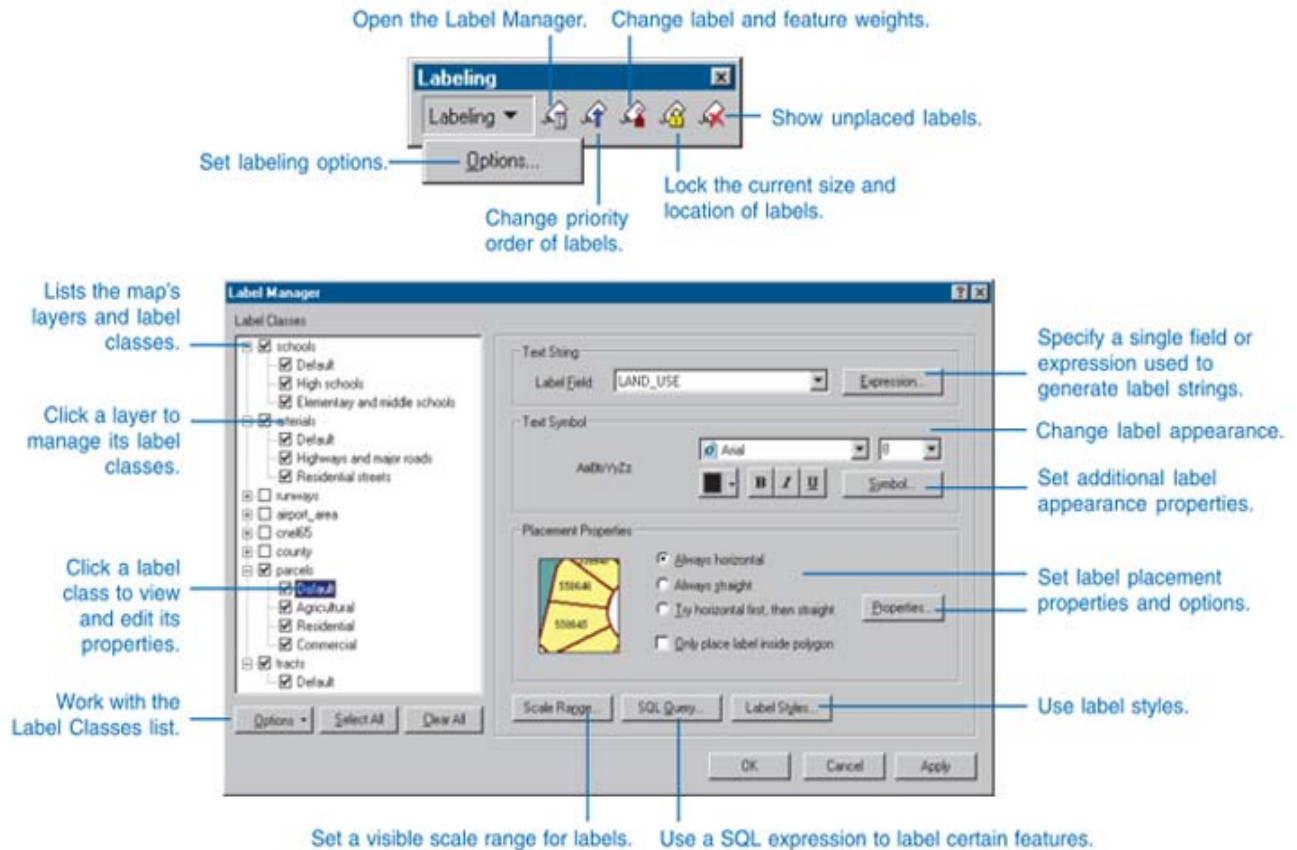
Annotation is an alternative to labeling. If you only want to add descriptive text for a few features, if you want to reuse your text and make it appear in the same place all the time, or if you do not have attributed features, it will be better to add your text as annotation. Labeling your features is a good way to create annotation.

In this Module, you'll learn how to:

- Use label manager
 - Labeling based on attribute table
 - Building label classes from symbology classes
 - Build label expression
 - Examples of label expression
-

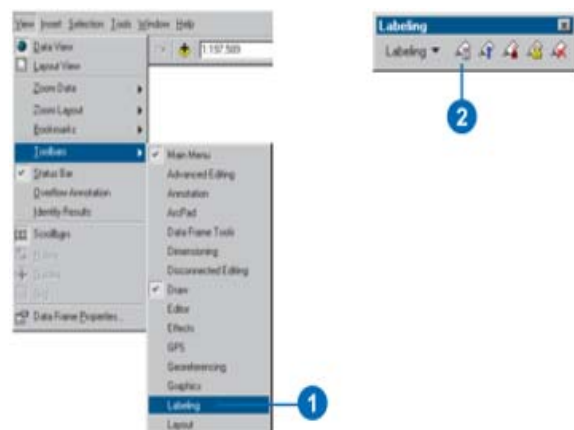
The Labeling toolbar and the Label Manager

The Labeling toolbar is where you start labeling in ArcMap. From here you can control the labeling process and open the Label Manager, which lets you view and change labeling properties for all the labels in your map.



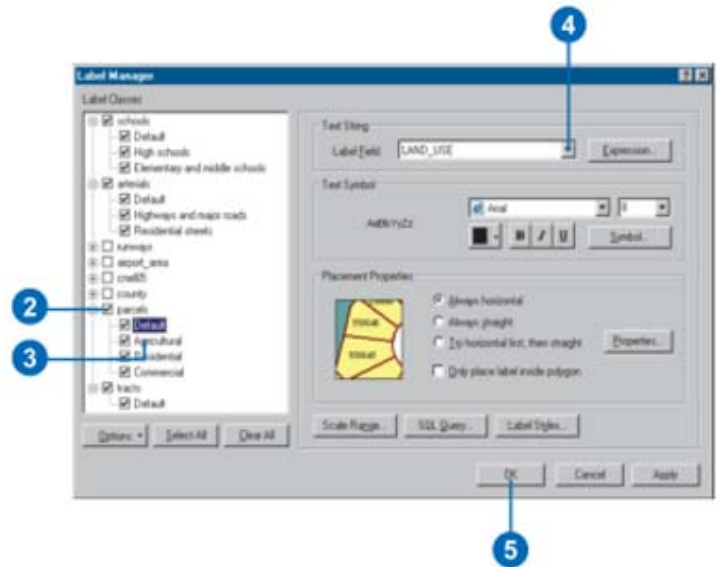
Adding the Labeling toolbar and opening the Label Manager

1. Click the View menu, point to Toolbars, and click Labeling.
2. Click the Label Manager button



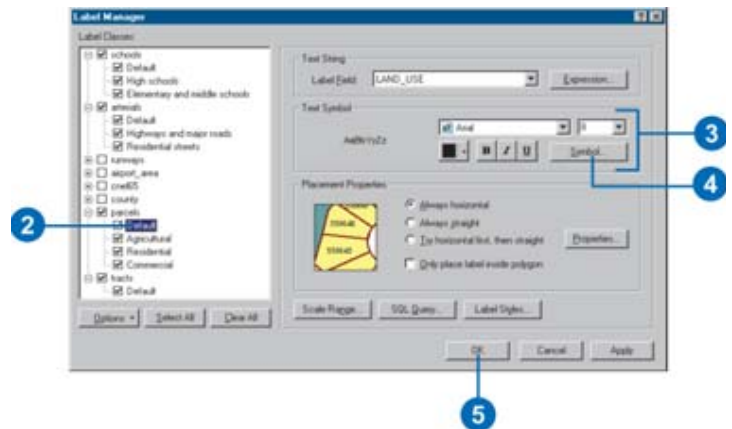
Using the Label Manager

1. Open the Label Manager by clicking the Label Manager button on the Labeling toolbar.
2. Check the box next to the layer you want to label.
3. Choose a label class under the layer.
4. Click the Label Field dropdown arrow and click the attribute field you want to use as a label.
5. Click OK.



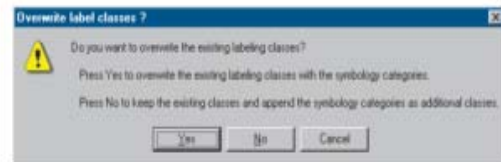
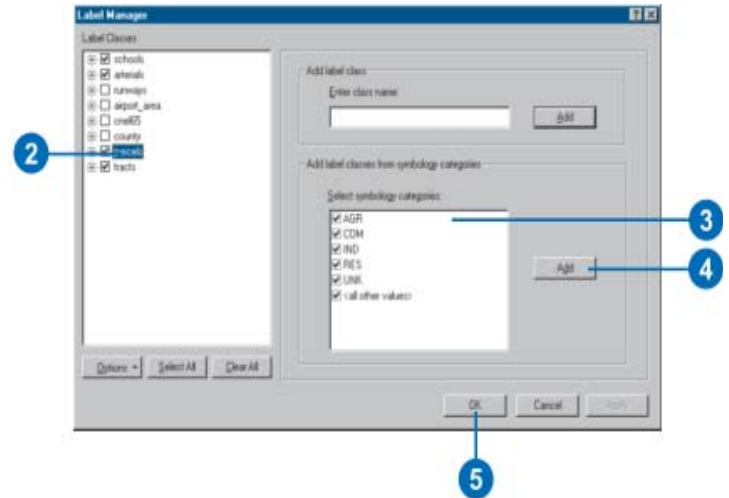
Changing label symbols

1. Open the Label Manager.
2. Click a label class in the Label Classes list.
3. Click the buttons and dropdown menus in the Text Symbol box to set the font, size, color, or other symbol properties of your labels.
4. Optionally, click the Symbol button to change other properties or to choose an existing text symbol for your labels.
5. Click OK



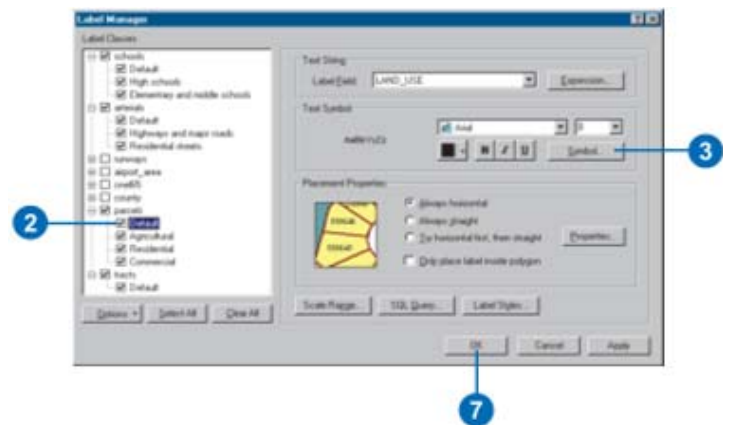
Building label classes from symbology classes

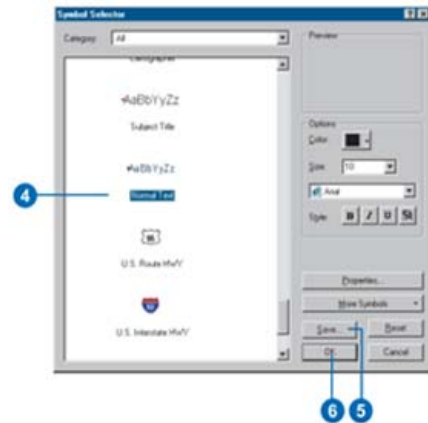
1. Open the Label Manager.
2. Click a layer in the Label Classes list.
3. In the Select symbology categories box, check the box next to the symbology class you want to use to make a new label class.
4. Click the Add button.
5. Click Yes or No on the Overwrite label classes dialog box, depending on what you want to do with your existing label classes.
6. Click OK



Using label styles

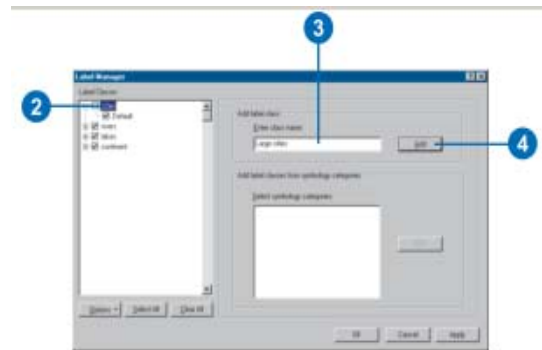
1. Open the Label Manager.
2. Click a label class in the Label Classes list.
3. Click the Symbol button.
4. Click a standard label style from the left pane of the Symbol Selector dialog box.
5. Optionally, modify the properties of a label style and click Save to save your new symbol in your personal style folder.
6. Click OK on the Symbol Selector dialog box.
7. Click OK on the Label Manager dialog box





Using label classes to label features from the same layer differently

1. Open the Label Manager.
2. Click the layer in the Label Classes box for which you want to create label classes.
3. Type a name for your new label class in the Enter label name box.
4. Click Add.
5. Uncheck the Default label class to avoid labeling some features twice.
6. Right-click the new label class in the Label Classes list and click SQL Query.
7. Click the operators to build an expression that identifies the subset of features you want to label.
8. Click OK.
9. Click the Label Field dropdown arrow and click the attribute field you want to use as a label.
10. Click the buttons and dropdown menus to define the symbol and placement properties of your labels.
11. Repeat steps 2 through 10 if you want to create additional label classes.
12. Click OK



In this example, cities with a population greater than 1,000,000 will be labeled.

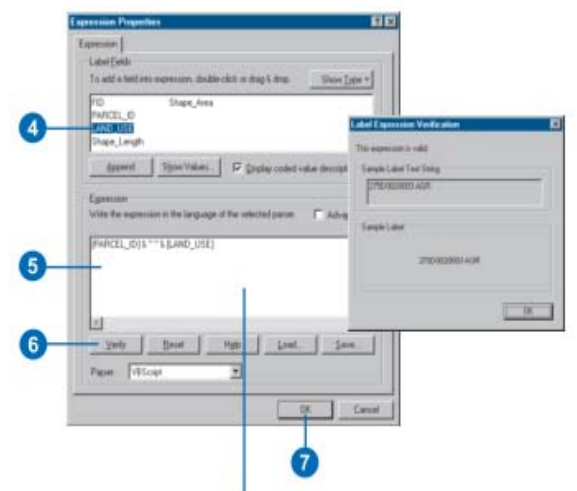
Labeling based on a single attribute field

1. Open the Label Manager.
2. Click a label class in the Label Classes list.
3. Click the Label Field dropdown arrow and click the field you want to use as a label.
4. Click OK.



Labeling based on multiple attribute fields

1. Open the Label Manager.
2. Click a label class in Label Classes list.
3. Click Expression.
4. Click a label field and click Append to use the text of that field in your labels.
5. Optionally, use the Expression box to add additional characters you want to appear in your labels or add VBScript or JScript functions to format your labels.
6. Click Verify to make sure that there are no syntax errors and to preview your label string. Close the Label Expression Verification dialog box.
7. Click OK.
8. Click OK.



To create stacked text, use the VBScript constant, `vbNewLine`, between the field names—`[PARCEL_ID]` & `vbNewLine` & `[LAND_USE]`. You can also click the Help button for more information on syntax and building label expressions.

Building label expressions

About label expressions: You can use label expressions to adjust the formatting of your labels. In addition to inserting characters and scripting functions, you can also use ArcGIS formatting tags in label expressions. These are special characters that you can use to change the appearance of all or part of your labels. For example, you might use the bold formatting tag to make the first line bold in a stacked, multiline label.

A label expression is limited to a single line of code, unless you check the Advanced box on the Label Expression dialog box. Checking the Advanced box allows you to enter a function containing programming logic and spanning multiple lines of code. See 'Specifying the text of labels' earlier in this chapter for more information on applying label expressions.

Examples are shown below for common uses of VBScript functions as well as ArcGIS formatting tags in label expressions. In addition, a complete reference of the ArcGIS formatting tags is provided.

Examples of label expressions

The following are examples of label expressions:

Use the VBScript & operator to concatenate strings. For example, this expression creates a label where the value of the PARCELNO field is preceded by the text "Parcel no: ": "Parcel no: " & [PARCELNO]

To control how decimal numbers are displayed, use the VBScript Round function. For example, this expression displays a field called Area rounded to one decimal place: Round ([AREA], 1)

To convert your text labels to all uppercase or lowercase, use the VBScript UCase and LCase functions. For example, this expression makes a Name field all lowercase: LCase ([NAME])

To create stacked text, use the VBScript vbNewLine or vbCrLf constants between the field names: "Name: " & [NAME] & vbNewLine & [ADDRESS_1] & vbNewLine & [ADDRESS_2]

Use the VBScript format functions to format your labels. For example, this expression displays the label as currency: "Occupancy Revenue: " & FormatCurrency ([MAXIMUM_OC] * [RATE])

This VBScript function labels cities with their name only if their population exceeds 250,000:

```
Function FindLabel ([NAME], [POPULATION])
    if ([POPULATION] > 250000) then
        FindLabel = [NAME]
    end if
End Function
```

ArcGIS text formatting tags: Labels will be drawn using the symbol specified in the Label Manager or on the Labels tab of the Layer Properties dialog box. You can modify or override the appearance of this symbol for particular portions of the expression by inserting ArcMap text formatting tags into the expression as text strings. This lets you create mixed-format labels where, for example, one field in a

label is underlined. You can even use tags with curved text. The tags that you can use are listed in the table below. Acceptable values for Color (RGB) are red, green, blue = 0–255, and acceptable values for Color (CMYK) are cyan, magenta, yellow, black = 0–100; missing color attributes are assumed to be 0. The defaults are 0 percent for Character spacing (no adjustment), 100 percent for Character width (regular width) and Word spacing (regular spacing), and 0 points for Line leading (no adjustment).

Formatting action	Tag syntax
Font	"<FNT name='Arial' size='18'>" & [LABELFIELD] & "</FNT>" "<FNT name='Arial' scale='200'>" & [LABELFIELD] & "</FNT>"
Color (RGB)	"<CLR red='255' green='255' blue='255'>" & [LABELFIELD] & "</CLR>"
Color (CMYK)	"<CLR cyan='100' magenta='100' yellow='100' black='100'>" & [LABELFIELD] & "</CLR>"
Bold	"<BOL>" & [LABELFIELD] & "</BOL>"
Italic	"<ITA>" & [LABELFIELD] & "</ITA>"
Underline	"<UND>" & [LABELFIELD] & "</UND>"
All capitals	"<ACP>" & [LABELFIELD] & "</ACP>"
Small capitals	"<SCP>" & [LABELFIELD] & "</SCP>"
Superscript	"^{" & [LABELFIELD] & "}"
Subscript	"_{" & [LABELFIELD] & "}"
Character spacing	"<CHR spacing='25'>" & [LABELFIELD] & "</CHR>"
Character width	"<CHR width='150'>" & [LABELFIELD] & "</CHR>"
Word spacing	"<WRD spacing='150'>" & [LABELFIELD] & "</WRD>"
Line leading	"<LIN leading='12'>" & [LABELFIELD] & "</LIN>"
Un-Bold	"<_BOL>" & [LABELFIELD] & "</_BOL>"
Un-Italic	"<_ITA>" & [LABELFIELD] & "</_ITA>"
Un-Underline	"<_UND>" & [LABELFIELD] & "</_UND>"
Un-Superscript	"<_SUP>" & [LABELFIELD] & "</_SUP>"
Un-Subscript	"<_SUB>" & [LABELFIELD] & "</_SUB>"

Tag syntax

The following syntax rules apply to tags in label expressions.

Just like other static text in label expressions, formatting tags must be surrounded by double quotes and concatenated to other parts of the expression using the & operator:

"<BOL>" & [LABELFIELD] & "</BOL>"

Tags are not interpreted by VBScript/JScript. Instead, they are passed on to the ArcMap framework as plain text, to be dynamically formatted as they are drawn. You don't need to quote tags included inside quoted strings:

"Current <BOL>status</BOL> of parcel: " & [LABELFIELD]

The ArcMap text formatting tags follow Extensible markup language (XML) syntax rules. Each start tag must be accompanied by an end tag. Tags can be nested, but you must close the inner tag before closing an outer tag:

"<BOL><UND>" & [LABELFIELD] & "</UND></BOL>"

The case of tag pairs must match exactly. So <BOL>...</BOL> is valid, as is <bol>...</bol>, but <Bol>...</bol> is invalid.

In label expressions, tag attributes must be surrounded either by single quotes (as shown in the table above) or by two sets of double quotes. The following expression is equivalent to the FNT entry in the table:

"<FNT name=""Arial"" size=""18"">" & [LABELFIELD]& "</FNT>" & and < are special characters and are not valid in your text if formatting tags are used. Use the equivalent character codes & and < instead. For example, this expression displays the values of the label field inside < > characters: "<ITA><" & [LABELFIELD] & "></ITA>"

If you have special characters embedded in the values of the label field, you can replace them dynamically using a simple label script:

```
Function FindLabel ([LABELFIELD])
    NewString = Replace([LABELFIELD], "&", "&amp;")
    FindLabel = "<ITA>" & NewString & "</ITA>"
End Function
```

Formatting tags can be embedded in the values of the field you use to label a layer's features, whether or not you use a label expression. In this way, you can change the format of any portion of a particular value in a label field. In order to embed formatting tags, the label field must be of string type. Tags and tag attributes

used in field values do not need to be surrounded by quotes, so the following are valid values for a label field:

<ITA>Rochester</ITA>

<FNT size='18'>C</FNT>olorado

Tags aren't recognized by the table of contents, Attribute table window, or Identify Results window, so tags added to field values appear unformatted as raw text in these windows. For more information on working with formatting tags, see 'Using text formatting tags' in this chapter.

Module VII

Working with Tables

A table is a database component that contains a series of rows and columns, where each row, or record, represents a geographic feature—such as a parcel, power pole, highway, or lake—and each column, or field, describes a particular attribute of the feature—such as its length, depth, cost, and so on.

In this Module, you'll learn how to:

- Elements of a table
 - Opening a layer's attribute table
 - Loading existing tabular data onto a map
 - Arranging columns
 - Controlling a table's appearance
 - Locating and viewing records
 - Sorting records
 - Selecting records
 - Adding table with x,y coordinates
 - Exporting records
 - Summarizing data
 - Adding and deleting fields
 - Editing attributes
 - Making field calculations
 - About joining attribute tables
 - Joining attribute tables
 - Relating attribute tables
-

Working with tables: A table is a database component that contains a series of rows and columns, where each row, or record, represents a geographic feature—such as a parcel, power pole, highway, or lake—and each column, or field, describes a particular attribute of the feature—such as its length, depth, cost, and so on. Tables are stored in a database—for example, INFO™, Microsoft Access, dBASE®, FoxPro®, Oracle®, and SQL Server™.

You'll typically use tables in ArcMap to inspect the attributes of geographic features. From a table, you can identify features with particular attributes and select them on the map. Over time, you might also update the attributes to reflect changes to geographic features.

Tables can also store information related to features such as warehouse inventories, monthly sales figures, and maintenance records. By joining this information to your spatial data, you can uncover new patterns and relationships that were not apparent before. For example, you might see which stores have the top monthly sales figures, what roads require maintenance in the near future, or where the largest number of endangered species is located.

Elements of a table

Columns or fields.

NAME	COUNTRY	CONTINENT	POPULATION	SQKM_ADMIN
Dac Lac	Vietnam	Asia	1174010	18336.211
Dadra and Nagar Haveli	India	Asia	146584	468.958
Daga	Bhutan	Asia	40220	1052.873
Dahuk	Iraq	Asia	443959	9912.903
Daman & Diu	India	Asia	107437	130.738
Darhan	Mongolia	Asia	88600	251.074
Dayr az Zawr	Syria	Asia	621876	27235.260
Delhi	India	Asia	9924474	1303.114
Dhaka	Bangladesh	Asia	36365932	31262.400
Dhawalagiri	Nepal	Asia	529003	8298.877
Dhi Qar	Iraq	Asia	975393	14037.630
Dimashq	Syria	Asia	3089555	18181.971
Diyala	Iraq	Asia	929035	18230.381
Diyarbakir	Turkey	Asia	1188608	14740.640
Dnepropetrovsk	Ukraine	Europe	398727	31721.480
Donetsk	Ukraine	Europe	5475559	26620.520
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	3386.422
Domod	Mongolia	Asia	91911	118099.500

Rows or records.

Record: 14 | 16 | Show: All Selected | Records: (0 out of 842 Selected) | Options

Move to first record.

Previous record.

Current record.

Next record.

Move to last record.

Number of records. An * indicates total not yet determined.

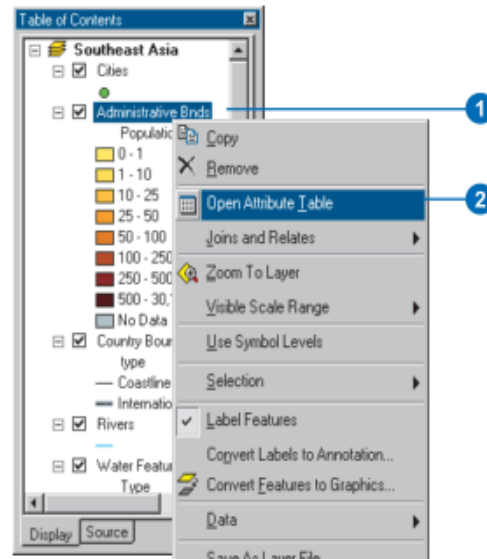
Click to find and replace records, select records by attributes, add fields, change the highlight color, add the table to the layout, export the table, and open related tables.

Opening a layer's attribute table: To explore the attributes of a layer on a map, open its attribute table. Once open, you can select features and find features with particular attributes.

You can open more than one table at a time. For example, you can view an attribute table of administrative boundaries and, at the same time, view the attribute table for cities.

Opening a layer's attribute table

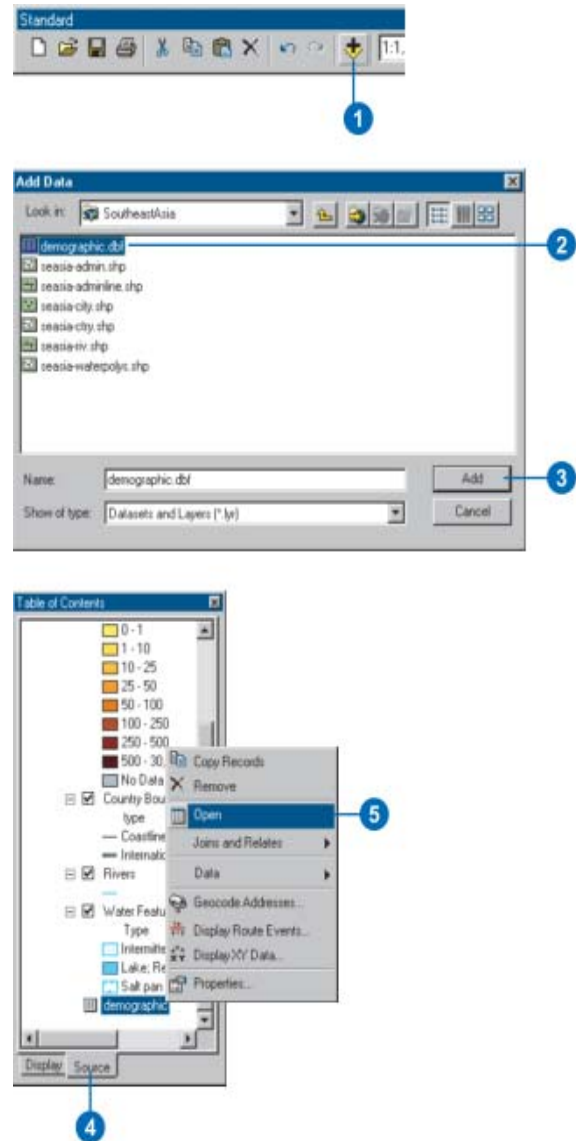
1. In the table of contents, rightclick the layer for which you want to display a table.
2. Click Open Attribute Table. The layer's attribute table opens.



NAME	COUNTRY	CONTINENT	POPULATION	SQEM ADMIN
Dao Lac	Vietnam	Asia	1174010	1836.211
Dadra and Nagar Haveli	India	Asia	146564	468.958
Daga	Bhutan	Asia	40220	1052.873
Dahuk	Iraq	Asia	443959	9912.903
Daman & Diu	India	Asia	107437	130.738
Darhan	Mongolia	Asia	88600	251.674
Diyar al Zaur	Syria	Asia	621876	2729.260
Delhi	India	Asia	9504474	1303.114
Dhaka	Bangladesh	Asia	36369592	31262.490
Dhawalagiri	Nepal	Asia	629003	8298.877
Dhu Qar	Iraq	Asia	375393	14037.630
Dmanisiq	Syria	Asia	3099555	18181.971
Diyala	Iraq	Asia	629005	18230.381
Diyarbakir	Turkey	Asia	1188608	14740.640
Dnepropetrovsk	Ukraine	Europe	3998727	31721.480
Dnestrsk	Ukraine	Europe	5479559	28620.530
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	3386.422
Donod	Mongolia	Asia	91911	118099.500

Loading existing tabular data onto a map

1. Click the Add Data button.
2. Navigate to the table you want to add and click it.
3. Click Add.
4. Click the Source tab at the bottom of the table of contents.
5. Right-click the table and click Open.



Changing a column's width

1. Position the mouse pointer at the edge of the column you want to resize.
The pointer's icon changes.
2. Click and drag the column's edge to the desired width.
A black line indicates where the edge of the column will be located.
3. Drop the edge of the column.
The column is resized.

1

NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Dac Lac	Vietnam	Asia	1174010	18336.211
Dadra and Nagar Haveli	India	Asia	146584	468.958
Dagaj	Bhutan	Asia	40220	1852.873
Dahuk	Iraq	Asia	443959	9912.903
Daman & Diu	India	Asia	107437	130.728
Darhan	Mongolia	Asia	88600	251.074
Dajr al Zawr	Syria	Asia	621676	27235.260
Delhi	India	Asia	9924474	1303.114
Dhaka	Bangladesh	Asia	36385932	31262.400
Dhawalagiri	Nepal	Asia	529003	6298.877
Dhi Qar	Iraq	Asia	975283	14037.630
Dimachq	Syria	Asia	3089555	18181.871
Diyala	Iraq	Asia	829035	18230.381
Diyarbakir	Turkey	Asia	1188608	14740.640
Dnepropetrovsk	Ukraine	Europe	3986727	31721.480
Dnietzk	Ukraine	Europe	5479559	28620.520
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	2386.422
Dornod	Mongolia	Asia	91911	118095.5

3

NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Dac Lac	Vietnam	Asia	1174010	18336.211
Dadra and Nagar Haveli	India	Asia	146584	468.958
Dagaj	Bhutan	Asia	40220	1852.873
Dahuk	Iraq	Asia	443959	9912.903
Daman & Diu	India	Asia	107437	130.728
Darhan	Mongolia	Asia	88600	251.074
Dajr al Zawr	Syria	Asia	621676	27235.260
Delhi	India	Asia	9924474	1303.114
Dhaka	Bangladesh	Asia	36385932	31262.400
Dhawalagiri	Nepal	Asia	529003	6298.877
Dhi Qar	Iraq	Asia	975283	14037.630
Dimachq	Syria	Asia	3089555	18181.871
Diyala	Iraq	Asia	829035	18230.381
Diyarbakir	Turkey	Asia	1188608	14740.640
Dnepropetrovsk	Ukraine	Europe	3986727	31721.480
Dnietzk	Ukraine	Europe	5479559	28620.520
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	2386.422
Dornod	Mongolia	Asia	91911	118095.5

Changing a column's position

1. Click the heading of the column you want to move.
2. Click and drag the column's heading.

A red line indicates where the column will be positioned.

3. Drop the column.

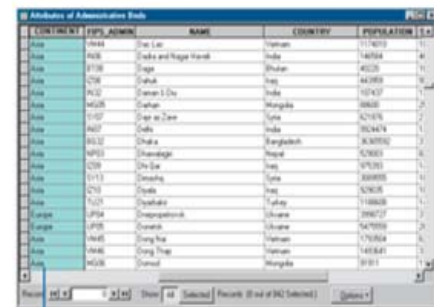
After you drop it, the column appears in the new position.

NAME	COUNTRY	CONTINENT	POPULATION	SGEM ADMIN
Dac Lac	Vietnam	Asia	1174010	10336 211
Dada and Naga Haveli	India	Asia	146584	468 958
Daga	Bhutan	Asia	40220	1052 873
Dahuk	Iraq	Asia	443959	9912 903
Daman & Diu	India	Asia	107437	130 738
Dahan	Mongolia	Asia	88600	251 074
Dajr al Zawr	Syria	Asia	621876	27235 260
Delhi	India	Asia	9924474	1303 114
Dhaka	Bangladesh	Asia	36389992	31262 400
Dhawalagiri	Nepal	Asia	529003	8298 877
Dhi Qar	Iraq	Asia	975303	14037 630
Dimashq	Syria	Asia	3089595	18181 371
Diyala	Iraq	Asia	829035	18230 381
Diyarbakir	Turkey	Asia	1188608	14740 640
Dnepropetrovsk	Ukraine	Europe	3998727	31721 480
Dnestrsk	Ukraine	Europe	5479559	26620 520
Dong Nai	Vietnam	Asia	1792504	6248 294
Dong Thap	Vietnam	Asia	1493641	3386 422
Donod	Mongolia	Asia	91911	118099 5

NAME	CONTINENT	COUNTRY	POPULATION	SGEM ADMIN
Dac Lac	Asia	Vietnam	1174010	10336 211
Dada and Naga Haveli	Asia	India	146584	468 958
Daga	Asia	Bhutan	40220	1052 873
Dahuk	Asia	Iraq	443959	9912 903
Daman & Diu	Asia	India	107437	130 738
Dahan	Asia	Mongolia	88600	251 074
Dajr al Zawr	Asia	Syria	621876	27235 260
Delhi	Asia	India	9924474	1303 114
Dhaka	Asia	Bangladesh	36389992	31262 400
Dhawalagiri	Asia	Nepal	529003	8298 877
Dhi Qar	Asia	Iraq	975303	14037 630
Dimashq	Asia	Syria	3089595	18181 371
Diyala	Asia	Iraq	829035	18230 381
Diyarbakir	Asia	Turkey	1188608	14740 640
Dnepropetrovsk	Europe	Ukraine	3998727	31721 480
Dnestrsk	Europe	Ukraine	5479559	26620 520
Dong Nai	Asia	Vietnam	1792504	6248 294
Dong Thap	Asia	Vietnam	1493641	3386 422
Donod	Asia	Mongolia	91911	118099 5

Freezing a column

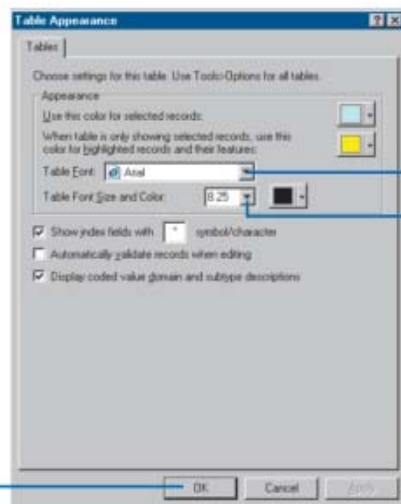
1. Click the heading of the column(s) you want to freeze.
2. Right-click the selected column's heading and click Freeze/Unfreeze Column to freeze the column.
The column is now frozen.



The column has been frozen.

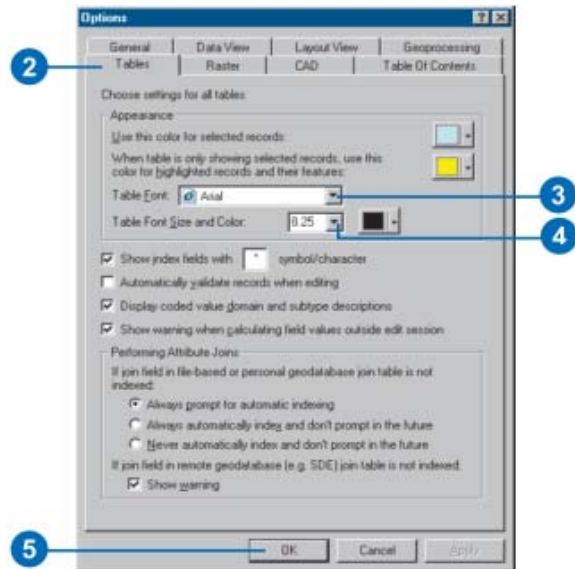
Setting the text font and size for a table

1. On the table window, click Options and click Appearance.
2. Click the Table Font dropdown arrow and click the font you want to use.
3. Click the Table Font Size dropdown arrow and click a point size.
4. Click OK.



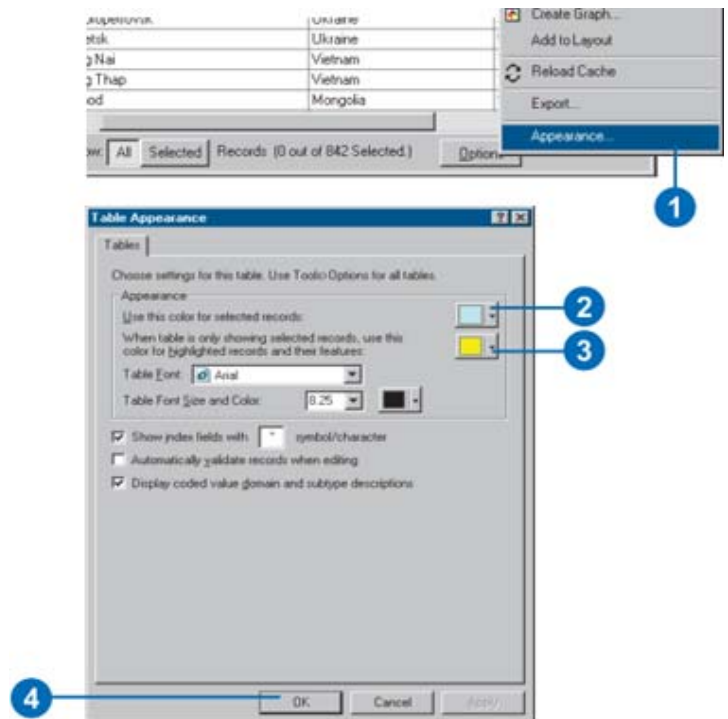
Setting the default text font and size for all tables

1. Click the Tools menu and click Options.
2. Click the Tables tab.
3. Click the Table Font dropdown arrow and click the font you want to use.
4. Click the Table Font Size dropdown arrow and click a point size.
5. Click OK.



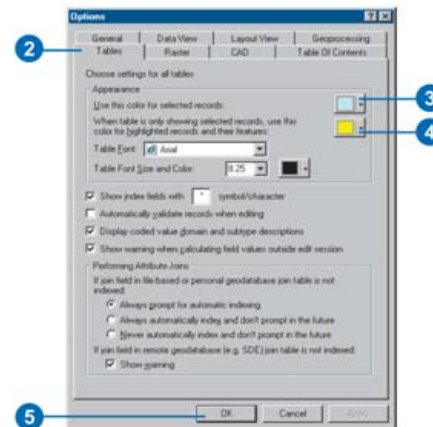
Setting the selection and highlight color for a table

1. On the table window, click Options and click Appearance.
2. Click the selected records dropdown arrow and click the color you want to use.
3. Click the highlighted records dropdown arrow and click the color you want to use.
4. Click OK



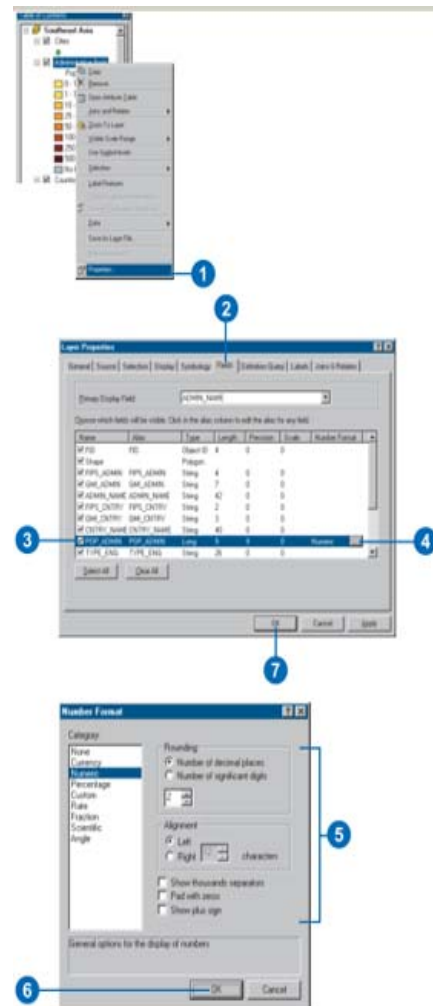
Setting the default selection and highlight color for all tables

1. Click the Tools menu and click Options.
2. Click the Tables tab.
3. Click the selected records dropdown arrow and click the color you want to use.
4. Click the highlighted records dropdown arrow and click the color you want to use.
5. Click OK.



Formatting numeric fields

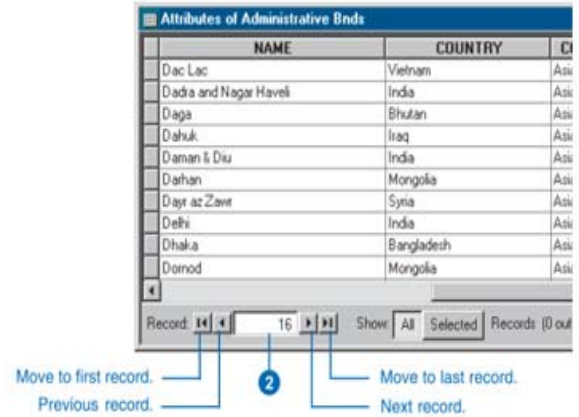
1. Right-click the layer or table in the table of contents and click Properties.
2. Click the Fields tab.
3. Click a numeric field in the list.
4. Click the button in the Number Format column. Only numeric fields have this button.
5. Set the number of decimal places, alignment, and so on.
6. Click OK on the Number Format dialog box.
7. Click OK when finished.



Moving to a specific record number

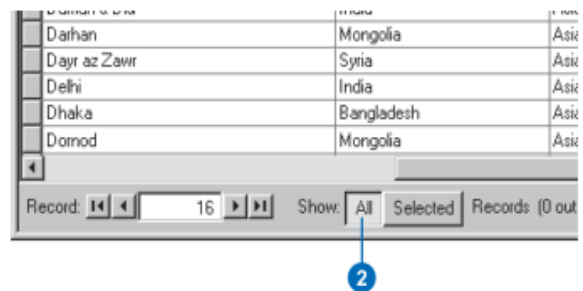
1. Open the table.
2. Type the number of the record you want to move to and press Enter.

The table scrolls to the record



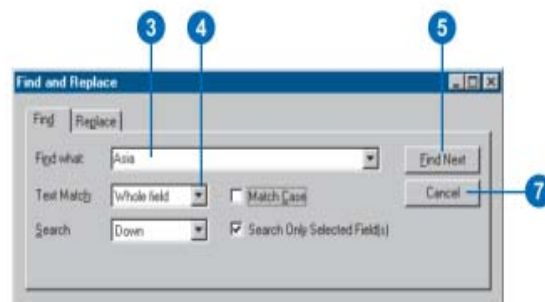
Viewing all or only the selected records

1. Open the table.
2. Click Show All to view all records or click Show Selected to view only the selected ones.



Finding records with particular attribute values

1. Click the heading of the column that contains the text for which you want to search.
2. Click Options and click Find & Replace.
3. Type the text you want to find in the Find what text box.
4. Click the Text Match dropdown arrow and click the type of search you want.
5. Click Find Next.
The first record found containing your text is selected.
6. If you want to find another record containing the same text, click Find Next again.
7. Click Cancel to close the dialog box.



Sorting records by one column

1. Click the heading of the column whose values you want to use to sort the records.
2. Right-click the selected column's heading and click Sort Ascending or Sort Descending.

The table's records are sorted.

NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Dac Lac	Vietnam	Asia	11741	
Dadra and Nagar Havel	India	Asia	1465	
Dage	Bhutan	Asia	4025	
Dahuk	Iraq	Asia	4439	
Daman & Diu	India	Asia	10741	
Darhan	Mongolia	Asia	9892	
Dar el Zaur	Syria	Asia	6219	
Delhi	India	Asia	99244	
Dhaka	Bangladesh	Asia	3630	
Dhawalagiri	Nepal	Asia	62902	6230.917
Dhi Qar	Iraq	Asia	97520	14037.630
Dimashiq	Syria	Asia	306999	19181.971
Diyala	Iraq	Asia	62635	10230.381
Diyarbakir	Turkey	Asia	118860	14740.640
Dnepropetrovsk	Ukraine	Europe	398727	31721.490
Dneshik	Ukraine	Europe	947899	26620.520
Dong Nai	Vietnam	Asia	179394	6248.254
Dong Thap	Vietnam	Asia	149341	3386.422
Dorod	Mongolia	Asia	8191	118099.5

NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Bagnal	Nepal	Asia	742622	10713.620
Samarkand	Uzbekistan	Asia	2396775	16484.620
Cagayan Valley	Philippines	Asia	2341000	26293.721
Ahaz	Malaysia	Asia	2328434	19394.980
Southern	Sri Lanka	Asia	2323388	9906.203
Ha Bac	Vietnam	Asia	2311962	4741.386
Hangyongbukto	North Korea	Asia	2284713	16348.358
Hu Tay	Vietnam	Asia	2259421	1394.277
Vinh Phu	Vietnam	Asia	2256495	4698.190
Fergana	Uzbekistan	Asia	2242864	6721.428
Domburgilaya oblast'	Russia	Europe	2228836	9379.258
Tasog'halisi	South Korea	Asia	2228443	454.393
Jarkypa	Nepal	Asia	2217995	3708.168
Domburgilaya oblast'	Russia	Asia	2208219	117327.202
Almaty	Kazakhstan	Asia	2183695	104087.102
Ha Noi	Vietnam	Asia	2187289	1307.020
Hwanghae-rando	North Korea	Asia	2181196	8231.963
Lumbini	Nepal	Asia	2179072	9609.160
Jambi	Indonesia	Asia	2166717	46381.898

The records are sorted according to the selected column's values.

Sorting records by more than one column

1. Rearrange the table's columns so the column whose values will be sorted first appears to the left of the column whose values will be sorted second.
2. Click the heading of the first column you want to use to sort the records.
3. Press the Ctrl key on the keyboard and click the second column's heading.
4. Repeat step 3 until you've selected all columns that will be used to sort the table's records.
5. Right-click a selected column heading and click Sort Ascending or Sort Descending.

The table's records are sorted

NAME	COUNTRY	CONTINENT	POPULATION	SQEM_ADMIN
Dac Lac	Vietnam	Asia	117401	
Dadra and Nagar Haveli	India	Asia	146564	
Dage	Shatan	Asia	40220	
Dhaka	Bag	Asia	44396	
Daman & Diu	India	Asia	107433	
Dafhan	Morgida	Asia	98600	
Daj az Zene	Yene	Asia	621878	
Daha	India	Asia	76244	
Dhaka	Bargladesh	Asia	363658	
Dharmadiga	Nepal	Asia	529079	
Dhu Gar	Bag	Asia	576203	14037.630
Dhoshag	Yene	Asia	3069996	18191.571
Dhaha	Bag	Asia	526026	18230.381
Diyahbali	Tubur	Asia	1186608	14740.640
Dinesapatnank	Ukraine	Europe	2994737	31721.480
Dionatit	Ukraine	Europe	5479969	28620.530
Dong Nai	Vietnam	Asia	1792664	6249.264
Dong Thap	Vietnam	Asia	1493641	3396.422
Dromad	Morgida	Asia	91911	118099.6

NAME	COUNTRY	CONTINENT	POPULATION	SQEM_ADMIN
Dhenal	Bargladesh	Asia	821781	6330.440
Dhagang	Bargladesh	Asia	14746629	41969.570
Dhapha	Bargladesh	Asia	26295363	34193.799
Dhaha	Bargladesh	Asia	31312663	21771.020
Dhaka	Bargladesh	Asia	36365662	31362.480
Dhaha	Shatan	Asia	18989	1796.959
Ha	Shatan	Asia	23711	1729.476
Bunhang	Shatan	Asia	33622	2773.234
Tangia	Shatan	Asia	36967	1836.534
Dage	Shatan	Asia	40220	1062.673
Funaha	Shatan	Asia	47676	4436.967
Femagatal	Shatan	Asia	52688	523.437
Lhantaha	Shatan	Asia	56226	2867.930
Fam	Shatan	Asia	59804	1717.670
Shangang	Shatan	Asia	63190	2381.362
Wangd Phoshang	Shatan	Asia	66890	4364.049
Tianghu	Shatan	Asia	76891	1630.109
Sandap Jonghha	Shatan	Asia	103820	2097.943
Morga	Shatan	Asia	103897	1630.243

The records are sorted first by the left column's values, then by the right column's values.

Interactively selecting records

1. Open the attribute table for a layer on your map.
2. Click the leftmost column in the table adjacent to the record you want to select.
To select consecutive records, you can click and drag the mouse.
3. Press and hold the Ctrl key while clicking additional records

2

NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Dac Lac	Vietnam	Asia	1174010	10336.211
Dadra and Nagar Haveli	India	Asia	146584	460.950
Dage	Bhutan	Asia	40220	1052.073
Dahuk	Iraq	Asia	443993	9912.903
Daman & Diu	India	Asia	107437	130.736
Darhan	Mongolia	Asia	88600	251.074
Dayr az Zawr	Syria	Asia	621676	27226.260
Dehli	India	Asia	9924474	1303.114
Dhaka	Bangladesh	Asia	36365932	31262.400
Dhawalagiri	Nepal	Asia	529003	8298.877
Dhi Qar	Iraq	Asia	975393	14037.630
Dinashiq	Syria	Asia	3089995	18181.971
Diyala	Iraq	Asia	929035	18230.381
Diyaliba	Turkey	Asia	1188908	14740.640
Dnepropetrovsk	Ukraine	Europe	3980727	31721.480
Donetsk	Ukraine	Europe	5479999	28620.520
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	3386.422
Donoed	Mongolia	Asia	91911	118099.5

3

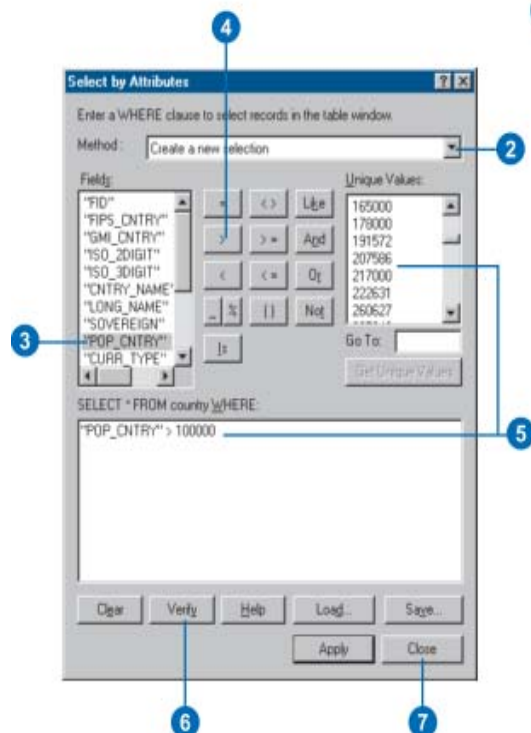
NAME	COUNTRY	CONTINENT	POPULATION	SQKM ADMIN
Dac Lac	Vietnam	Asia	1174010	10336.211
Dadra and Nagar Haveli	India	Asia	146584	460.950
Dage	Bhutan	Asia	40220	1052.073
Dahuk	Iraq	Asia	443993	9912.903
Daman & Diu	India	Asia	107437	130.736
Darhan	Mongolia	Asia	88600	251.074
Dayr az Zawr	Syria	Asia	621676	27226.260
Dehli	India	Asia	9924474	1303.114
Dhaka	Bangladesh	Asia	36365932	31262.400
Dhawalagiri	Nepal	Asia	529003	8298.877
Dhi Qar	Iraq	Asia	975393	14037.630
Dinashiq	Syria	Asia	3089995	18181.971
Diyala	Iraq	Asia	929035	18230.381
Diyaliba	Turkey	Asia	1188908	14740.640
Dnepropetrovsk	Ukraine	Europe	3980727	31721.480
Donetsk	Ukraine	Europe	5479999	28620.520
Dong Nai	Vietnam	Asia	1793504	6248.254
Dong Thap	Vietnam	Asia	1493641	3386.422
Donoed	Mongolia	Asia	91911	118099.5

Selected records are highlighted in the table and on the map.

Selecting records by attributes

1. Click Options in the table you want to query and click Select By Attributes.
2. Click the Method dropdown arrow and click the selection procedure you want to use.
3. Double-click the field from which you want to select.
4. Click the logical operator you want to use.
5. Click the Get Unique Values button, then scroll to and double-click the value in the Unique Values list you want to select. Alternatively, you can type a value directly into the text box.
6. Click Verify to verify your selection.
7. Click Close.

Your selection is highlighted in the table. Use Apply if you intend to run more than one query or if you want to check your results before closing the Select By Attributes dialog box.



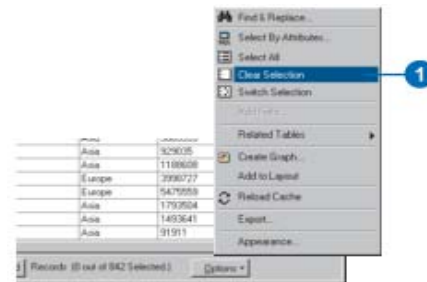
Selecting all records

1. Click Options in the table and click Select All.



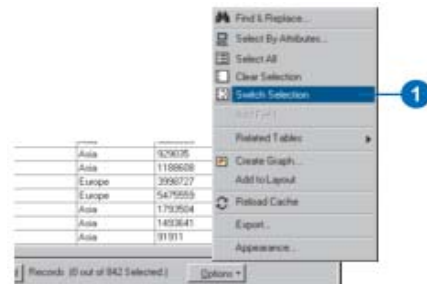
Clearing the selected set

1. Click Options in the table and click Clear Selection.



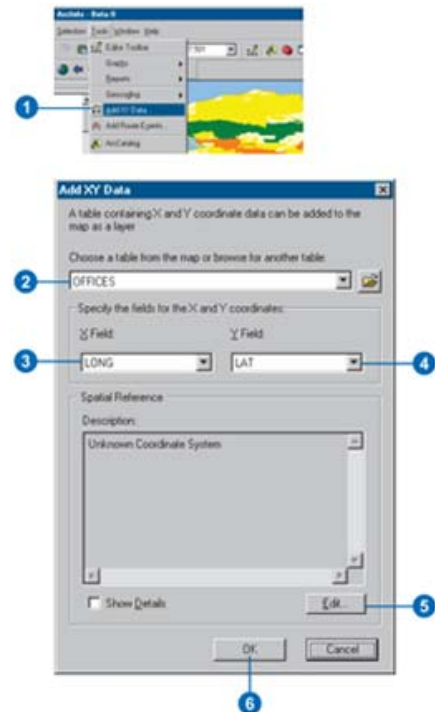
Switching the selected set

1. Click Options in the table and click Switch Selection.



Adding a table with x,y coordinates

1. Click Tools on the Main menu and click Add XY Data.
2. Click the table dropdown arrow and click a table that contains x,y coordinate data. If the table is not on the map, click the Browse button to access it from disk.
3. Click the X Field dropdown arrow and click the field containing x coordinate values.
4. Click the Y Field dropdown arrow and click the field containing y coordinate values.
5. Click Edit to define the coordinate system and units represented in the x and y fields. The x,y coordinates will be automatically transformed to match the coordinate system of the data frame.
6. Click OK.

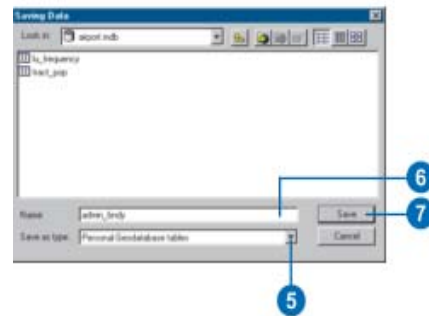
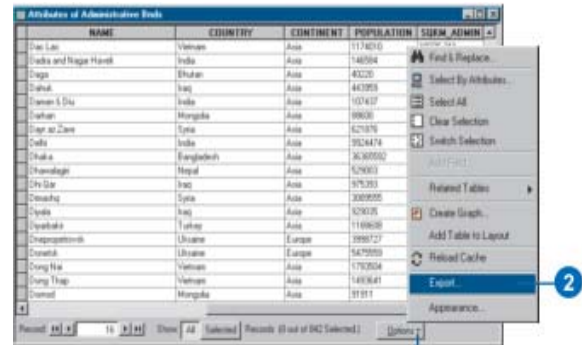


Exporting records

1. Click Options in the table you want to export.
2. Click Export.
3. In the Export Data dialog box, click the Export dropdown arrow to choose to export Selected records or All records.

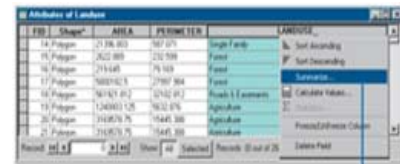
This option is only available if records are selected in the table you want to export.

4. Click the Browse button and navigate to the folder or geodatabase in which you want to place the exported data.
5. Click the Save as type dropdown arrow and click the format to which you want to export the data. For example, click Personal Geodatabase tables.
6. Type a name for the exported table.
7. Click Save.
8. Click OK.



Summarizing data in a field

1. Right-click the field heading of the field you want to summarize and click Summarize.
2. Check the box next to the summary statistics you want to include in the output table.
3. Type the name and location of the output table you want to create or click the Browse button and navigate to a workspace.
4. Click OK.
5. Click Yes when prompted to add the new table to your map

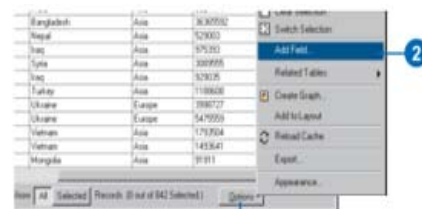


LANDUSE	Count_LANDUSE	Avg_AREA	Sum_AREA
0 Agriculture	263	11482.24719	3030763.528
1 Forested in wood	680	2824.81392	1920706.873
2 Bush	111	12426.19384	1379288.49
3 Drylake	15	49621.76184	46768.376
4 Forest	383	38868.61957	14891584.572
5 Farming	18	7397.828	134068.94
6 Power Industry	14	13230.376	185233.26
7 Highway	19	64338.88842	1222374.888
8 Light Industry	8	118775.81825	950172.182

The new output table contains one record for each unique land use value and a field for each summary statistic you selected.

Adding a field to a table

1. Click Options in the table you want to add a field to.
2. Click Add Field.
3. Type a name for the field.
4. Click the Type dropdown arrow and click the field type.
5. Set any other field properties, such as a field alias, as necessary.
6. Click OK.



Deleting a field from a table

1. In the table window, right-click over the field header of the field you want to delete.
2. Click Delete Field.
3. Click Yes to confirm the deletion.

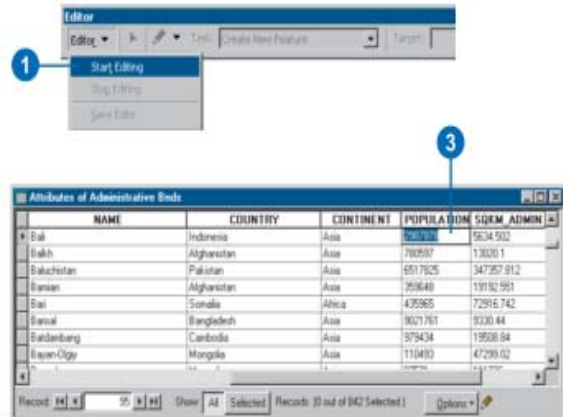
Deleting a field cannot be undone.



Editing text in records

1. If you haven't started an edit session, click the Editor menu on the Editor toolbar and click Start Editing.
2. Open the table you want to edit.
3. Click the cell containing the attribute value you want to change.
4. Type the values and press Enter.

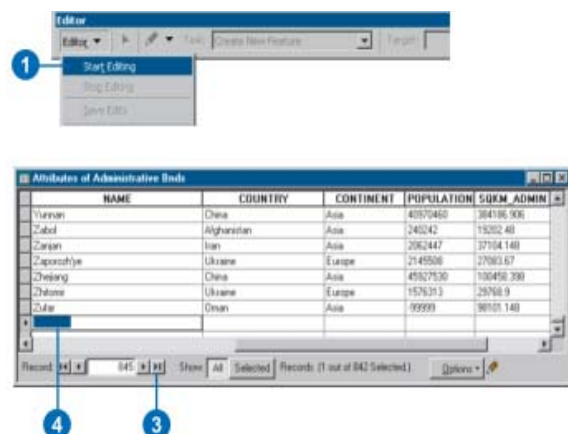
The table is updated.



Adding new records

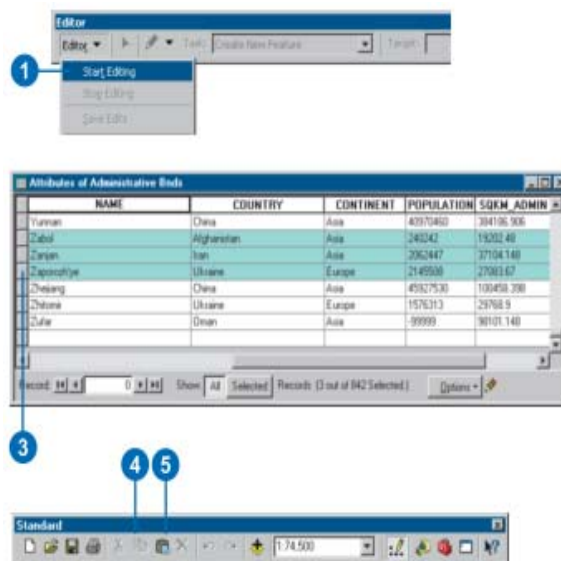
1. If you haven't started an edit session, click the Editor menu on the Editor toolbar and click Start Editing.
2. Open the table you want to edit.
3. Click Move to end of table.
4. Click a cell in the last, empty record and type in a new value.

NOTE: Use these steps to add new records to tables that don't have associated geographic features. If you want to add features to your shapefile or geodatabase, use the Create New Feature task on the Editor toolbar.



Copying and pasting records

1. If you haven't started an edit session, click the Editor menu on the Editor toolbar and click Start Editing.
2. Open the table you want to edit.
3. Select the records you want to copy. Press and hold the Ctrl key while clicking to select more than one record.
4. Click Copy on the Standard toolbar.
5. Click Paste on the Standard toolbar. The new records are added at the end of the table.

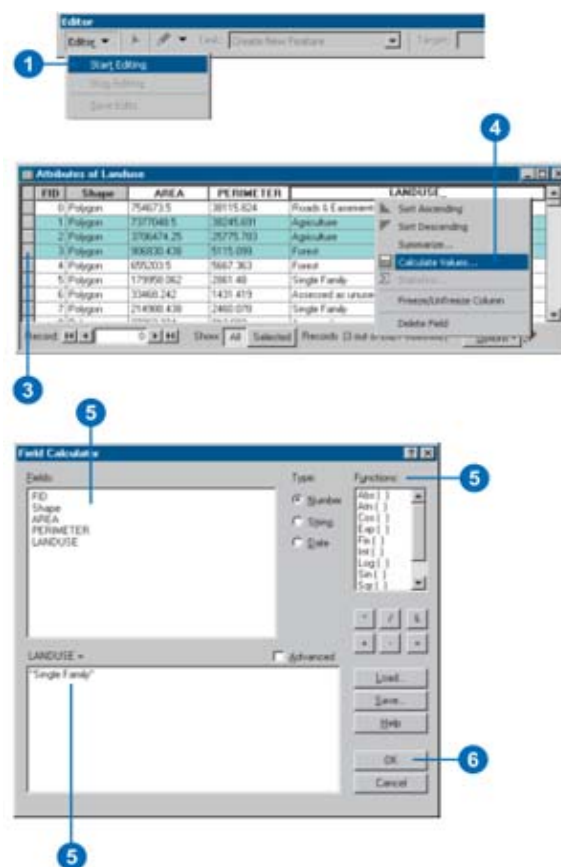


Making simple field calculations

1. If you haven't started an edit session, click the Editor menu on the Editor toolbar and click Start Editing.

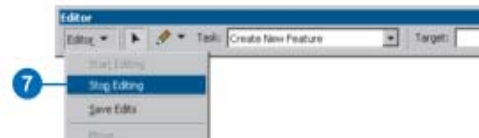
You can make calculations without being in an edit session; however, in that case, there is no way to undo the results.

2. Open the table you want to edit.
3. Select the records you want to update. If you don't select any, the calculation will be applied to all records.
4. Right-click the field heading for which you want to make a calculation and click Calculate Values.
5. Use the Fields list and Functions to build a calculation expression. You can also edit the expression in the text area below. Alternatively, you can just type in a value to set the field to. In this example, the string "Single Family" is used.



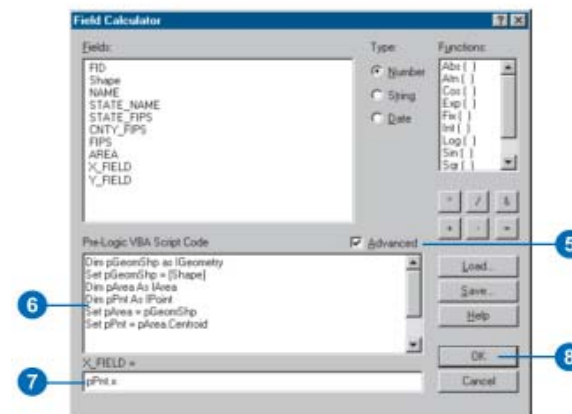
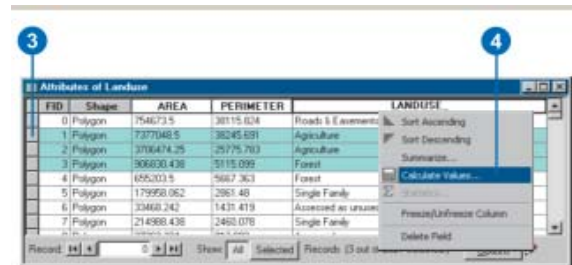
NOTE: Use double quotes when calculating strings.

6. Click OK.
7. Don't forget to end your edit session. Click the Editor menu and click Stop Editing.



Making advanced field calculations

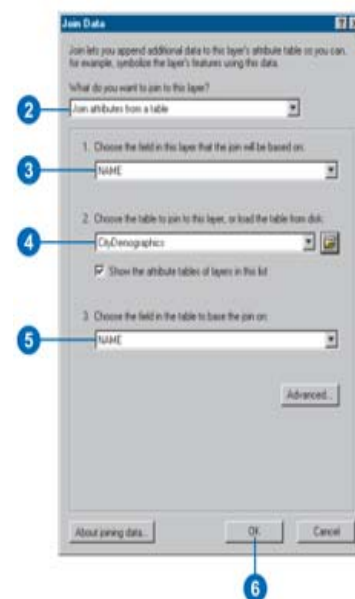
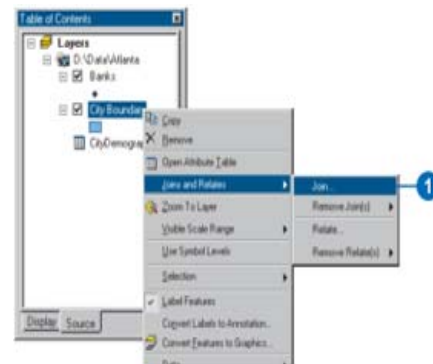
1. If you haven't started an edit session, click the Editor menu on the Editor toolbar and click Start Editing.
You can make calculations without being in an edit session; however, in that case, there is no way to undo the results.
2. Open the table you want to edit.
3. Select the records you want to update. If you don't select any, the calculation will be applied to all records.
4. Right-click the field heading for which you want to make a calculation and click Calculate Values.
5. Check Advanced.
6. Type VBA statements in the first text box.
The VBA statements can include ArcMap methods. The VBA code shown in the figure gets the x coordinate of the centroid of each polygon in the layer and writes it out to a field called X_FIELD.
7. Type the variable or value that is to be written to the selected records.
8. Click OK.



Joining the attributes in one table to another

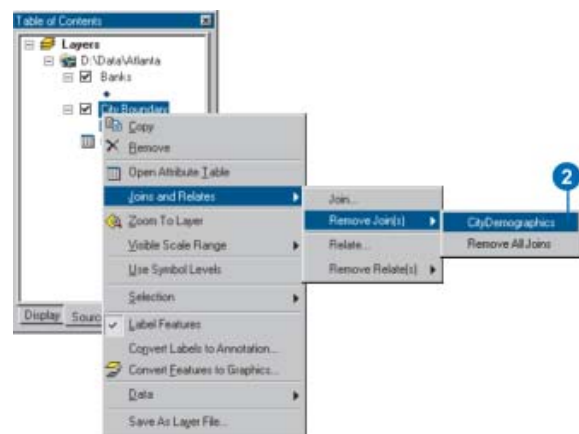
1. Right-click the layer or table you want to join, point to Joins and Relates, and click Join.
2. Click the first dropdown arrow and click Join attributes from a table.
3. Click the second dropdown arrow and click the field name in the layer that the join will be based on.
4. Click the third dropdown arrow to choose the table to join to the layer. If the table is not currently part of the map, click the Browse button to search for it on disk.
5. Click the fourth dropdown arrow and click the field in the table to base the join on.
6. Click OK.

The attributes of the table are appended to the layer's attribute table



Removing a joined table

1. Right-click the layer containing a join you want to remove and point to Joins and Relates.
2. Point to Remove Join(s) and click the join you want to remove



Managing joined tables

1. Right-click a layer or table in the table of contents and click Properties.
2. Click the Joins & Relates tab.

All the joins for the layer or table are listed on the left side of the dialog box. You can add new joins or remove existing ones.



All joins for the layer or table are listed here.

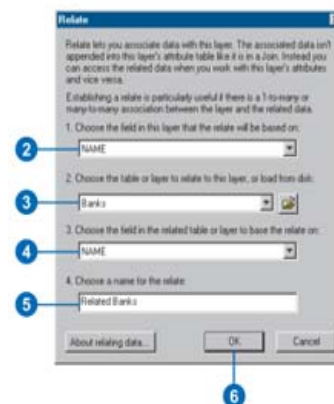
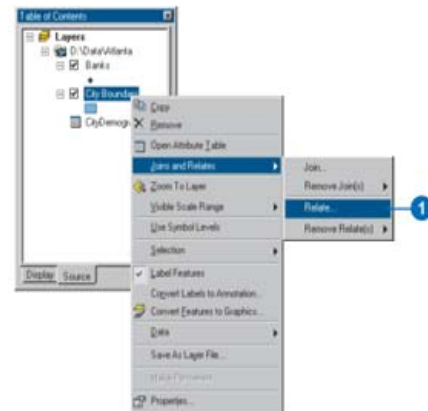
Relating the attributes in one table to another

1. Right-click the layer you want to relate, point to Joins and Relates, and click Relate.
2. Click the first dropdown arrow and click the field in the layer, the relate will be based on.
3. Click the second dropdown arrow and click the table or layer to relate to, or load the table from disk.
4. Click the third dropdown arrow and click the field in the related table to base the relate on.
5. Type a name for the relate.

You'll use this name to access the related data.

6. Click OK.

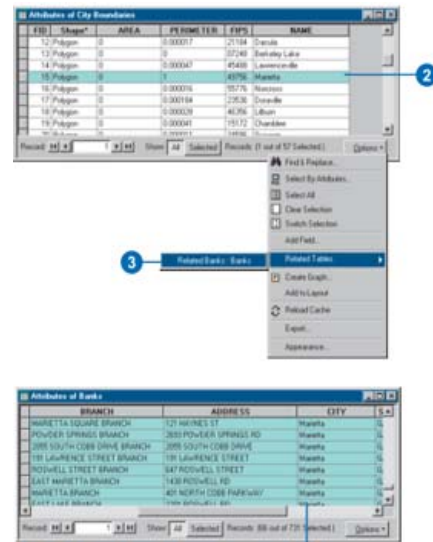
The relate is now established between the two tables. The next topic discusses how to access records using the relate.



Accessing related records

1. Open the attribute table for which you've set up a relate.
2. Select the records in the table for which you want to display related records.
3. Click Options, point to Related Tables, and click the name of the relate you want to access.

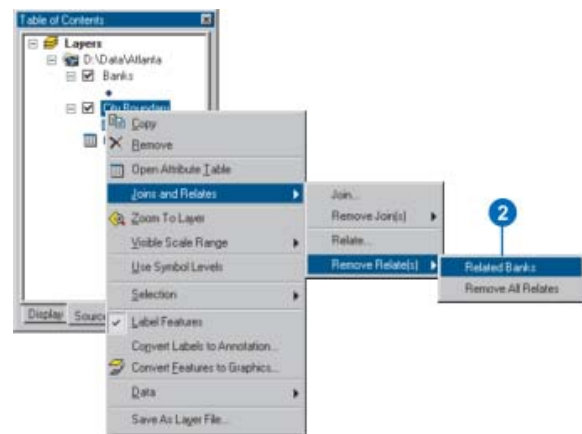
The related table displays with the related records selected



All banks in the city of Marietta are selected.

Removing a related table

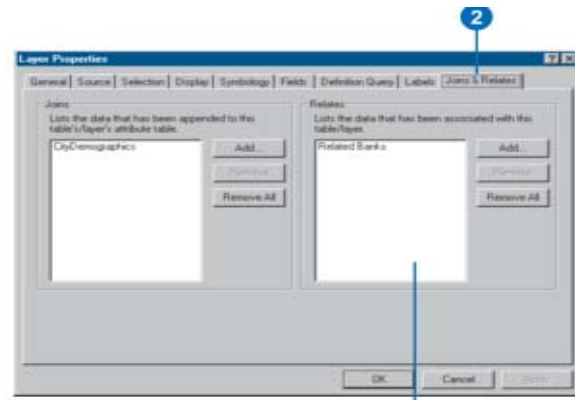
1. Right-click the layer containing a relate you want to remove and point to Joins and Relates.
2. Point to Remove Relate(s) and click the relate you want to remove.



Managing related tables

1. Right-click a layer or table in the table of contents and click Properties.
2. Click the Joins & Relates tab.

All the relates for the layer or table are listed on the right side of the dialog box. You can add new relates or remove existing ones.



All relates for the layer or table are listed here.

Module VIII

Querying Maps

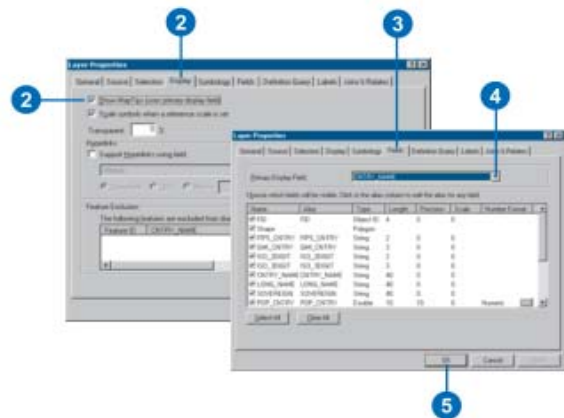
Maps convey a great deal of information. You can learn a lot about an area just by looking at a map. Yet, sometimes those things that are most interesting and revealing are not immediately apparent by looking at a map. You can begin to discover new spatial relationships when you start asking questions such as: Where is...? Where's the closest? What's inside? And What intersects?

In this Module, you'll learn how to:

- Displaying MapTips
 - Identifying features
 - Hyperlinking
 - Selecting features interactively
 - Selecting features by searching with a SQL expression
 - Building a SQL expression
-

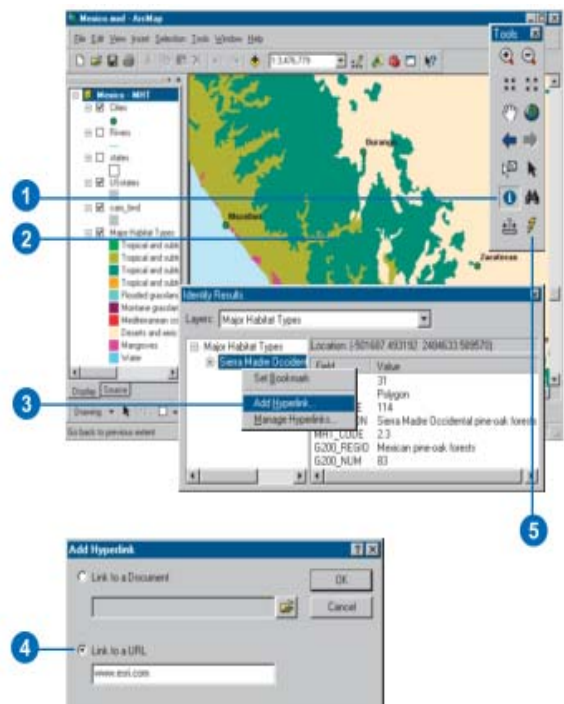
Displaying MapTips

1. In the table of contents, rightclick the layer for which you want to display MapTips and click Properties.
2. Click the Display tab and check Show MapTips.
3. Click the Fields tab.
4. Click the Primary Display Field dropdown arrow and click the attribute field you want to display as the MapTip.
5. Click OK.
6. Move the mouse pointer over a feature to see the MapTip.



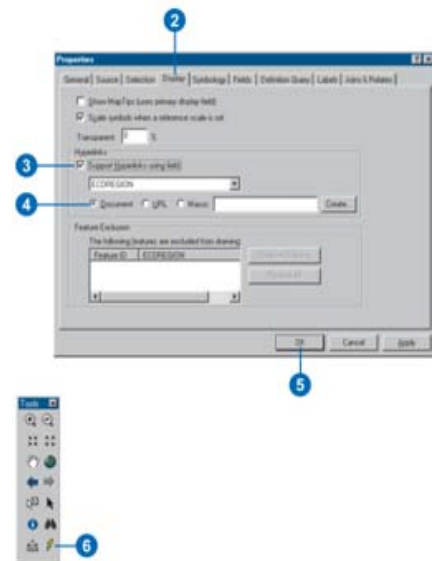
Creating and accessing hyperlinks stored in a layer file or ArcMap document

1. Click the Identify button on the Tools toolbar.
2. Click a feature.
3. In the Identify Results window, right-click the feature you want to set a hyperlink for and click Add Hyperlink.
4. To add a hyperlink to a Web page, click Link to a URL and type a URL. To link to a document, click Link to a Document and type a pathname to the document.
5. Click the Hyperlink tool on the Tools toolbar and click a feature.



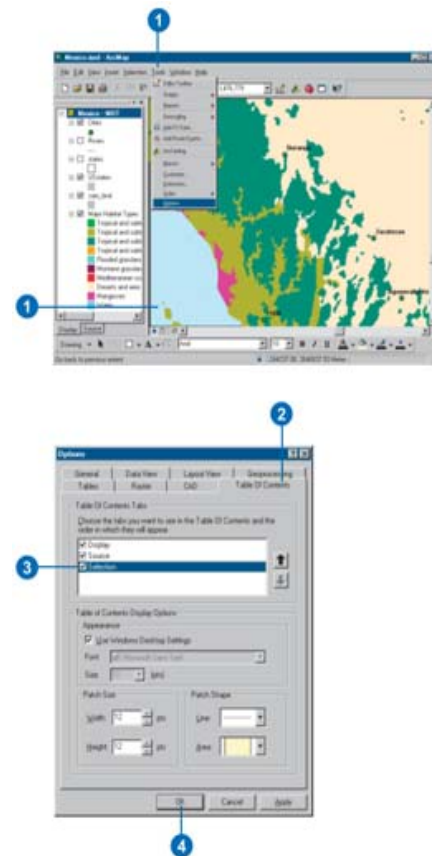
Using an attribute field as a hyperlink

1. In the table of contents, rightclick the layer containing a field with hyperlinks and click Properties.
2. Click the Display tab.
3. Check Support Hyperlinks using field. Click the dropdown arrow and click a field.
4. Click Document or URL.
5. Click OK.
6. On the Tools toolbar, click the Hyperlink button.
7. Move the mouse pointer over a feature and click to display the hyperlink.



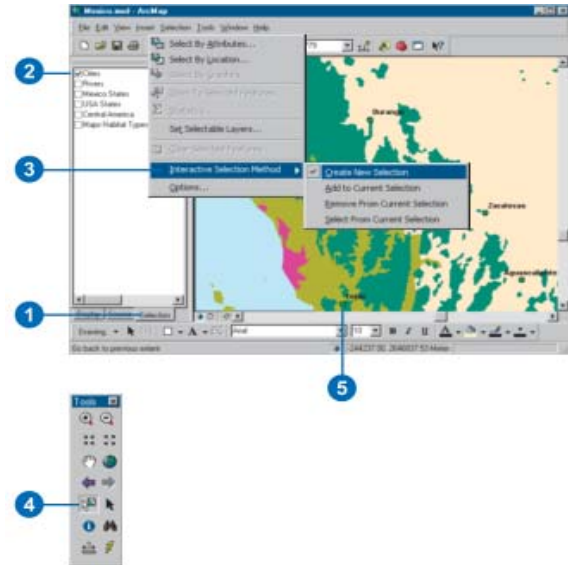
Making the Selection tab visible

1. Click Tools on the Main Menu and click Options.
2. Click the Table Of Contents tab.
3. In the Table Of Contents tab options, check the Selection box.
4. Click OK



Selecting a feature by clicking it in the map

1. Click the Selection tab in the table of contents.
2. Click the layers you want to select from.
3. Click Selection, point to Interactive Selection Method, then click Create New Selection.
4. Click the Select Features tool.
5. Click the feature you want to select.
6. To select additional features, hold down the Shift key while clicking the features.



To remove a feature from the selected set, click the Selection menu, point to Interactive Selection Method, and click Remove From Current Selection. Click a selected feature and it is deselected.

Select features by dragging a box

1. Click the Selection tab in the table of contents.
2. Click the layers you want to select from.
3. Click Selection in the Main Menu, point to Interactive Selection Method, then click Create New Selection.
4. Click Selection in the Main Menu and click Options.
5. Specify how you'd like to select features with the box and click OK.
6. Click the Select Features button.
7. Click and drag a box around the features you want to select.
8. To select additional features, hold down the Shift key as you drag the box.



To remove a feature from the selected set, click the Selection menu, point to Interactive Selection Method, and click Remove From Current Selection. Drag a box around the features you want to deselect.

Module IX

GPS and Georeferencing

To **georeference** something means to define its existence in physical space. That is, establishing its location in terms of map projections or coordinate systems. The term is used both when establishing the relation between raster or vector images and coordinates but also when determining the spatial location of other geographical features. Examples would include establishing the correct position of an satellite image within a map or finding the geographical coordinates of a place name or street address. This procedure is thus imperative to data modeling in the field of geographic information systems (GIS) and other cartographic methods. When data from different sources need to be combined and then used in a GIS application, it becomes essential to have a common referencing system.

In this Module, you'll learn how to:

- GPS field Survey
 - Creating Waypoints
 - Creating Tracks
 - About georeferencing
 - Aligning the raster with control point
 - Transforming the raster
 - Interpreting the root mean square error
 - Resampling the raster datasets
 - Raster rectification
 - Georeferencing a raster dataset
 - Hands-on exercises
-

GPS Field Survey

For this survey, you will use Magellan Triton 400 handheld GPS. You will record some point feature (office, mosque, ATM etc) and line feature (road, canal, telephone line, sewerage line etc). You can also capture Ground Control Point with GPS for next exercise of how to perform georeferencing. As you will go outside of a building or shaded area, your GPS will get information from available satellite at this point. You will see battery icon at the upper left corner of the GPS screen that denotes Battery (Power) strength and in the upper right corner's bar indicate the strength of satellite signals. At indoor, it remains deemed (light red color), which means there is no satellite signal and at outdoor, after some time, it will show green colored bar, which means GPS is receiving signal from sufficient number of Satellites (at least 4) to fix a position on the ground.



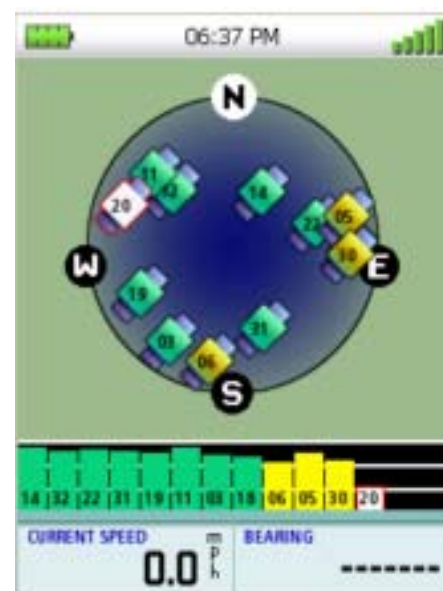
Magellan Triton

- A Backlight Button
- B Power Button
- C Zoom - (Zoom out) Button
- D Zoom + (Zoom in) Button
- E ENTER Button / Cursor Control
- F PAGE / GO TO Button
- G Esc (Escape) Button
- H Menu Button
- I SD Card Slot (under protective rubber cover)

Satellite Status Screen

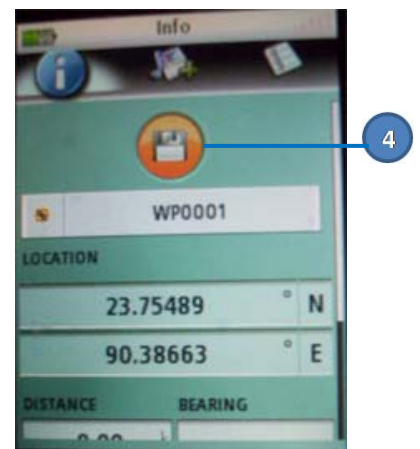
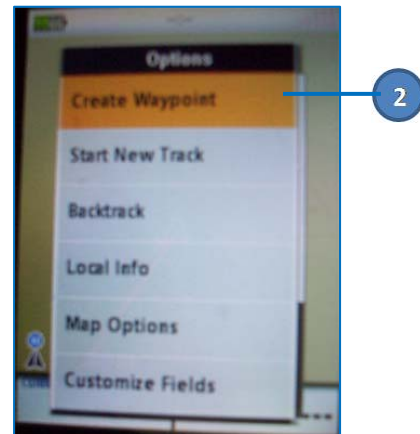
Using PAGE / GO TO button, you can navigate to satellite status screen. The Satellite Status Screen graphically displays the satellites and their signal strength that is being used to compute your location. This screen shows when you are getting strong, weak, or poor signal reception. Green satellite icons represent satellites that are being used to compute your position while yellow (good), white (medium), and red (poor) icons show signal strengths of other available satellites. Signal levels are also represented at the bottom of the screen as colored bars.

The numbers indicate the GPS satellite ID.



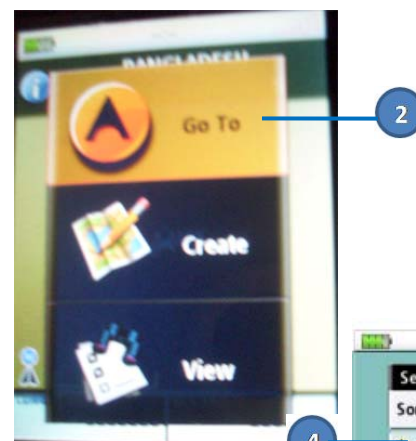
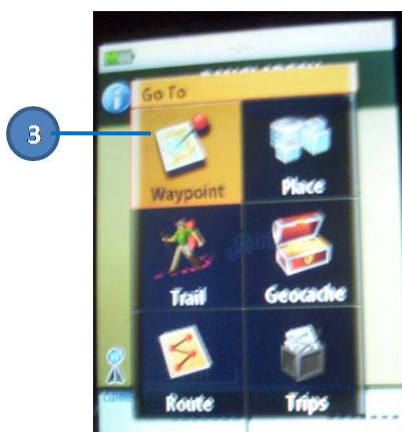
Creating Waypoints

1. Press ENTER.
2. Select Create Waypoint to capture point feature or POI (Point of Interest)
3. Edit the waypoint as desired. Use the cursor control UP or DOWN to highlight the field you want to edit and press ENTER. Use the cursor control LEFT or RIGHT to select the page you want to edit. (Available pages are Information, Media, and Alerts.)
4. When the edits, if any, are done, use the cursor control UP or DOWN to highlight the save to disk button (highlighted in the screen to the right). Press ENTER



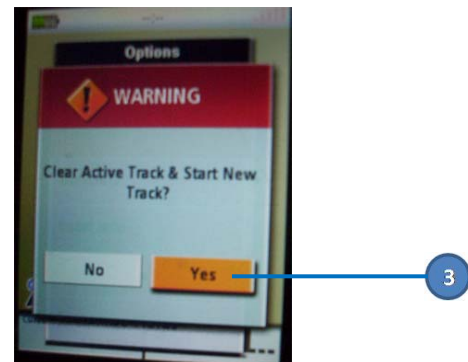
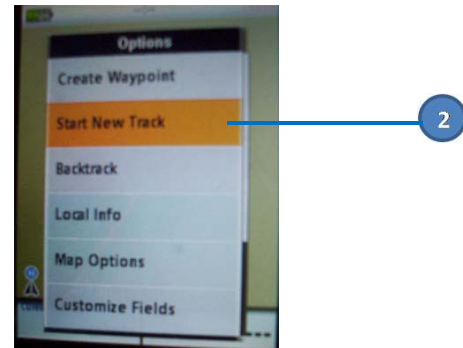
Viewing a saved Waypoint

1. From the Map screen, press MENU.
2. Select Go To.
3. Select Waypoint
4. You will get a list of waypoint (s) if there are existing saved waypoints.



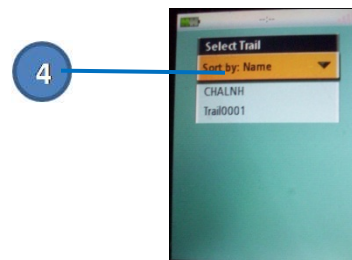
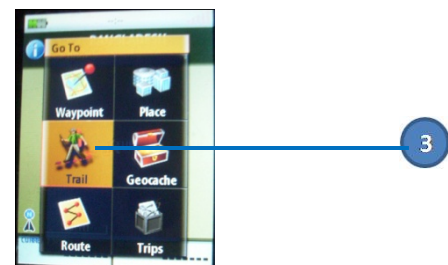
Creating Track (Line feature)

1. Press ENTER.
2. Select Start New Track to capture line feature.
3. Click Yes as you will be asked for Clear Active Track & Start New Track. Now start walking along the alignment of the feature you want to capture. There are two options for fixing coordinates automatically **by distance** or **by time**. As we will take both point and line features using the same GPS, it is better to choose option **by distance**. If we select 10m interval, then GPS will store coordinates after each 10m traveling to draw the track/path/trail.
4. After finishing your travel again Press ENTER and choose save track from the menu to store your alignment.



Viewing a saved Track

1. From the Map screen, press MENU.
2. Select Go To.
3. Select Trail
4. You will get a list of Trail (s) if there are existing saved Trails.



About Georeferencing

Raster data is commonly obtained by scanning maps or collecting aerial photographs and satellite images. Scanned map datasets don't normally contain spatial reference information (either embedded in the file or as a separate file). With aerial photography and satellite imagery, sometimes the locational information delivered with them is inadequate and the data does not align properly with other data you may have. Thus, to use some raster datasets in conjunction with your other spatial data, you may need to align, or georeference, to a map coordinate system. A map coordinate system is defined using a map projection (a method by which the curved surface of the earth is portrayed on a flat surface).

When you georeference your raster dataset, you define its location using map coordinates and assign a coordinate system. Georeferencing raster data allows it to be viewed, queried, and analyzed with other geographic data

The general steps for georeferencing a raster dataset are:

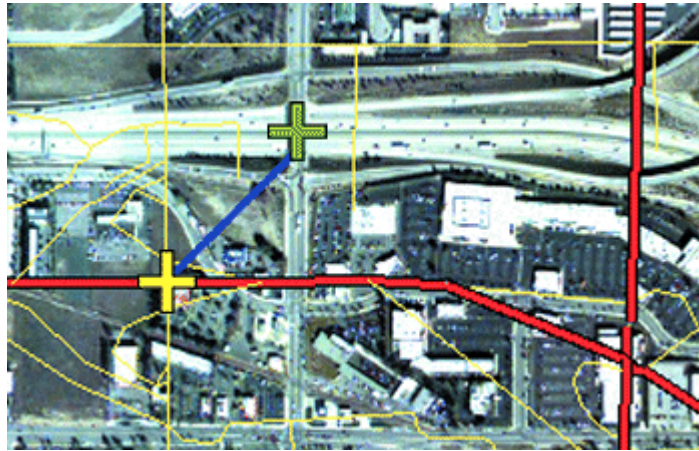
1. Add the raster dataset that you want to align with your projected data in ArcMap.
2. Add control points that link known raster dataset positions to known positions in map coordinates.
3. Save the georeferencing information when you're satisfied with the alignment (also referred to as registration).
4. Optionally, permanently transform the raster dataset.

Aligning the Raster with Control Point

Generally, you will georeference your raster dataset using existing spatial data (target data), such as a vector feature class, that resides in the desired map coordinate system. The process involves identifying a series of ground control points—known x,y coordinates—that link locations on the raster dataset with locations in the spatially referenced data (target data). Control points are locations that can be accurately identified on the raster dataset and in real-world coordinates. There are many different types of features that can be used as identifiable locations, such as road or stream intersections, the mouth of a stream, the corner of a building etc.

The control points are used to build a polynomial transformation that will convert the raster dataset from its existing location to the spatially correct location. The connection between one control point on the raster dataset (the from point) and the corresponding control point on the aligned target data (the to point) is a link.

The example below shows a from control point (yellow cross) placed on the vector target data at a street crossing and the associated control point (green cross) placed on the raster dataset. The associated link is represented by the blue line joining the control points.



The number of links you need to create depends on the complexity of the transformation you plan to use to transform the raster dataset to map coordinates. However, adding more links will not necessarily yield a better registration. If possible, you should spread out the links over the entire raster dataset rather than concentrating them in one area. Typically, having at least one link near each corner of the raster dataset and a few throughout the interior produces the best results.

Generally, the greater the overlap between the raster dataset and target data, the better the alignment results because you'll have more widely spaced points with which to georeference the raster dataset. For example, if your target data only occupies one-quarter of the area of your raster dataset, the points you could use to align the raster dataset would be confined to that area of overlap. Thus, the areas outside the overlap area are not likely to be properly aligned.

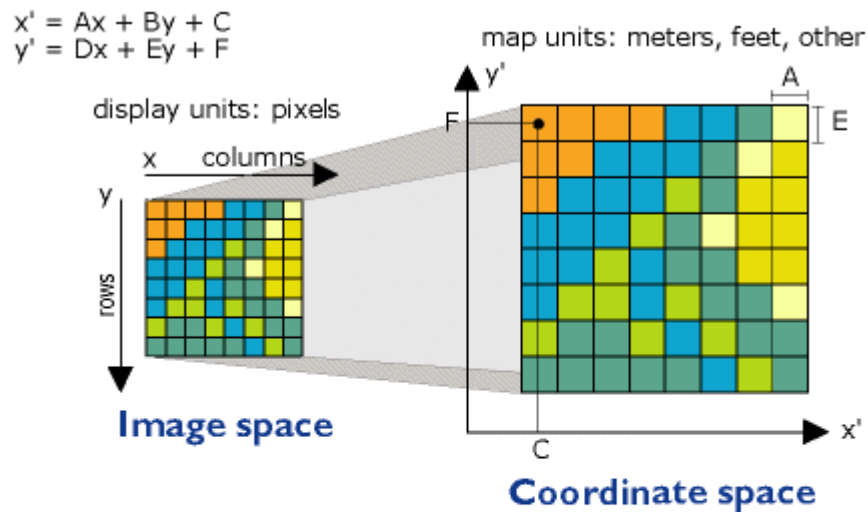
Keep in mind that your georeferenced data is only as accurate as the data to which it was aligned. To minimize errors, you should georeference to data that is at the highest resolution and largest scale for your needs.

Transforming the Raster

When you've created enough links, you can transform—or warp—the raster dataset to permanently match the map coordinates of the target data. You have the choice of using a polynomial, spline, or adjust transformation to determine the correct map coordinate location for each cell in the raster.

The polynomial transformation uses a polynomial that is built upon control points and a least square fitting (LSF) algorithm. It is optimized for global accuracy but does not guarantee local accuracy. The polynomial transformation yields two formulas: one for computing the output x-coordinate for an input (x,y) location and one for computing the y-coordinate for an input (x,y) location. The goal of the least-square fit is to derive a general formula that can be applied to all points, usually at the expense of slight movement of the to positions of the control points. The number of the noncorrelated control points required for this method must be 3 for a first order, 6 for a second order, and 10 for a third order. The first-order polynomial transformation is commonly used to georeference an image.

Below is the equation to transform a raster dataset using the affine (1st order) polynomial transformation. You can see how six parameters define how a raster's rows and columns transform onto map coordinates.



x is column count in image space.
 y is row count in image space.
 x' is horizontal value in coordinate space.
 y' is vertical value in coordinate space.

A is width of cell in map units.
 B is a rotation term.
 C is the x' value of the center of upper-right cell.
 D is a rotation term.
 E is negative of height of cell in map units.
 F is the y' value of the center of upper-right cell.

Interpreting the root mean square error

When the general formula is derived and applied to the control point, a measure of the error—the residual error—is returned. The error is the difference between where the from point ended up as opposed to the actual location that was specified—the to point position. The total error is computed by taking the root mean square (RMS) sum of all the residuals to compute the RMS error. This value describes how consistent the transformation is between the different control points (links). When the error is particularly large, you may want to remove and add control points to adjust the error.

Although the RMS error is a good assessment of the accuracy of the transformation, don't confuse a low RMS error with an accurate registration. For example, the transformation may still contain significant errors due to a poorly entered control point. The more control points of equal quality used, the more accurately the polynomial can convert the input data to output coordinates. Typically, the adjust and spline transformations give an RMS of near zero or zero; however, this does not mean that the image will be perfectly georeferenced.

Resampling the raster dataset

When you rectify or transform a raster dataset, project it, resample it, convert the raster dataset from one projection to another, or change the cell size, you are performing a geometric transformation. Geometric transformation is the process of changing the geometry of a raster dataset from one coordinate space to another. Types of geometric transformations include rubber sheeting (usually used for georeferencing), projection (using the projection information to transform the data from one projection to another), translation (shifting all the coordinates equally), rotation (rotating all the coordinates by some angle), and changing the cell size of the dataset.

After the geometric transformation is applied to the input raster, the cell centers of the input raster rarely line up with the cell centers on the output raster; however, values need to be assigned to the centers.

Although you might think each cell in a raster dataset is transformed to its new map coordinate location, the process actually works in reverse. During georeferencing, a matrix of empty cells is computed using the map coordinates. Then, each empty cell is given a value based on the resampling process.

The three most common resampling techniques are nearest neighbor assignment, bilinear interpolation, and cubic convolution. These techniques assign a value to each empty cell by examining the cells in the ungeoreferenced raster dataset

Nearest neighbor assignment is the fastest resampling technique and is appropriate for categorical or thematic data, since it does not alter the value of the input cells. Once the location of the cell's center on the output raster dataset is located on the input raster, nearest neighbor assignment determines the location of the closest cell center on the input raster and assigns the value of that cell to the cell on the output raster.

The nearest neighbor assignment does not change any of the values of cells from the input raster dataset. The value 2 in the input raster will always be the value 2 in the output raster; it will never be 2.2 or 3. Since the output cell values remain the same, nearest neighbor assignment should be used for nominal or ordinal data where each value represents a class, member, or classification—this may be categorical data such as a land-use, soil, or forest type.

Bilinear interpolation uses the value of the four nearest input cell centers to determine the value of the output raster. The new value for the output cell is a weighted average of these four values, adjusted to account for their distance from the center of the output cell in the input raster. This interpolation method results in a smoother-looking surface than can be obtained using nearest neighbor.

Cubic convolution is similar to bilinear interpolation, except the weighted average is calculated from the 16 nearest input cell centers and their values. Cubic convolution will have a tendency to sharpen the data more than bilinear interpolation since more cells are involved in the calculation of the output value. Therefore, this resampling method is often used when resampling imagery, such as aerial photography and satellite imagery.

Bilinear interpolation or cubic convolution should not be used on categorical data since the categories will not be maintained in the output raster dataset. However, all three techniques can be applied to continuous data, with nearest neighbor producing a blocky output, bilinear interpolation producing smoother results, and cubic convolution producing the sharpest results.

Should you rectify your raster

You can permanently transform your raster dataset after georeferencing it by using the Rectify command on the Georeferencing toolbar or by using the Warp tool. You can also store the transformation information separately in a new file using the Update Georeferencing command on the Georeferencing toolbar

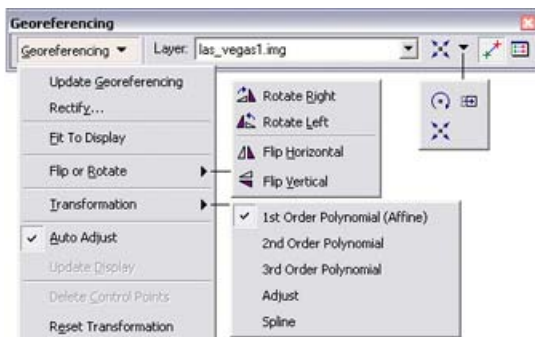
Rectifying or warping will create a new raster dataset that is georeferenced using the map coordinates and the spatial reference. You can save this as a GRID, IMG, TIFF, BMP, GIF, JPEG, JPEG 2000, or PNG format. ArcGIS doesn't require you to permanently transform your raster dataset to display it with other spatial data; however, you should choose to if you plan to perform analysis with it or want to use it with another software package that doesn't recognize the external georeferencing information created in the world file

Updating the georeferencing will store the transformation information in external files—it will not create a new raster dataset, which is what happens when you permanently transform your raster dataset.

Georeferencing a raster dataset

Method A: Using Referenced Dataset

1. Start ArcMap.
2. Add the layers residing in map coordinates and the raster dataset you want to georeference.
3. In the table of contents, right-click a target layer (the referenced dataset) and click Zoom to Layer.
4. From the Georeferencing toolbar, click the Layer drop-down arrow and click the raster layer you want to georeference.




Georeferencing toolbar buttons and their functions

Button	Name	Function
	Rotate	Rotates the source layer.
	Shift	Shifts the source layer.
	Scale	Rescales the source layer.
	Add Control Points	Allows you to select control points from a layer and add them to the map.
	View Link Table	Shows links and errors in tabular form.

- Click Georeferencing and click Fit To Display.

This will display the raster dataset in the same area as the target layers. You can also use the Shift and Rotate tools to move the raster dataset as needed. To see all the datasets, you may have to adjust their order in the table of contents.

- Click the Add Control Points tool  to add control points.
- To add a link, click the mouse pointer on a known location on the raster dataset, then on a known location on the data in map coordinates (the referenced data).

You may find it useful to add your links in a Magnification window. When working with two raster datasets, you may want to open the Effects toolbar and adjust the transparency or turn layers on and off in the table of contents to view each image as you add your links.

- Add enough links for the type of transformation.

You need a minimum of three links for a spline or 1st-order polynomial (affine), six links for a 2nd-order polynomial, and ten links for an affine or 3rd-order polynomial.



- Click View Link Table  to evaluate the transformation.

You can examine the residual error for each link and the RMS error. If you're satisfied with the registration, you can stop entering links.

- Click Georeferencing and click Update Georeferencing to save the transformation information with the raster dataset.

This creates a new file with the same name as the raster dataset but with an .aux.xml file extension. It also creates a world file for some of the file formats, including .tif and .img files.

Method B: Using Specific X,Y Map Coordinates

- Click View Link Table  on the Georeferencing toolbar.
- Click the Add Control Points tool .
- Click the mouse over the known location in the unreferenced image to add the first coordinate in the link.
- Right-click the image and click Input X and Y.
- Enter the reference coordinates on the Enter Coordinates dialog box.
- Click OK.

Hands-on exercise using method B

Collection of Satellite Image

Google Earth (GE) is a very good source for high resolution image. It is free so far. For this georeferencing exercise, a portion of Dhaka City is saved from GE and then four distinct locations are identified for control points. These control points (CP) can also be managed from GPS field survey. For Example, the following image is showing four control points like GCP1...GCP4. But you are advised to select by your own choice. Now open an excel file and put the for CP to convert Degree-Minute-Second to Degree Decimal

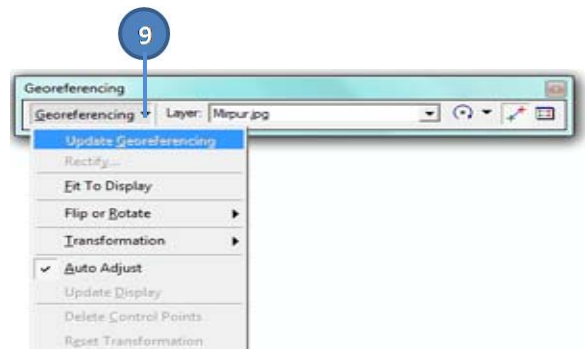
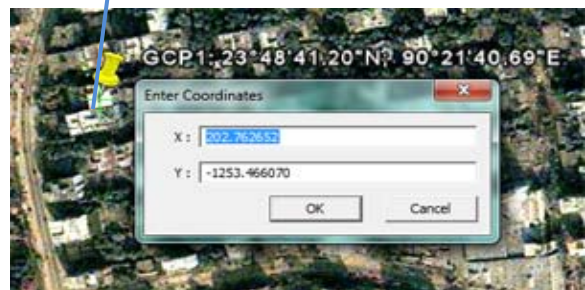
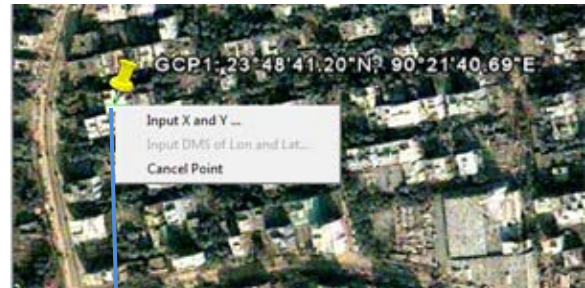
GCP	X			Y			X	Y
	D	M	S	D	M	S		
1	90	21	40.69	23	48	41.2	90.3613	23.81144
2	90	22	14.19	23	48	50.92	90.37061	23.81414
3	90	22	24.81	23	48	24.68	90.37356	23.80686
4	90	21	47.66	23	48	16.63	90.36324	23.80462



If you want to do georeferencing for images other than Google Earth, which you have purchased or collected from RS datasets providers, you could also get CP from GE. Other sources of CP are GPS survey or already georeferenced vector or raster datasets.

1. Now open the image to be georeferenced in ArcGIS using Add Data button.
2. Identify at least four control points on the image
3. Find corresponding locations on GE and get Lat/Lon for those locations; if Lat/Lon is in DMS, convert it to degree decimal with excel spreadsheet [follow the example given in previous page. The Lat/Lon of those CPs can also be taken from GPS field Survey or from already georeferenced Vector/Raster data of the same area.
4. Open georeferencing tool bar if it is not already there by clicking view – toolbars – georeferencing
5. Click Add Control Points button from Georeferencing Tool Bar
6. Click the Cross Hair at the first CP and then right click first and then left click on the option Input X and Y... to enter the value of X (lon) and Y (lat), which you have got from GE or GPS field survey.
7. Follow step 5-6 for the rest of the CPs.
8. After entering the values of all CPs, click View Link Table button to open table of entered CPs and check Residual and RRMS error to ensure the quality of CPs and adjust accordingly, if needed by deleting and entering new CPs.
9. Click Georeferencing combo box and select Update Georeferencing to associate lat/lon information with the image.
10. Georeferencing is done.

Now you can exercise Method A for georeferencing.



Module X

Map Layout and Printing

Before you begin to symbolize data for a map, you'll need to think about how you want the map to look when it's printed or published.

You should consider questions such as:

- Will the map stand alone, or will it be part of a series of maps that share a similar design?
- What size will the printed version of the map be?
- How will the page be oriented?
- How many data frames will the map have?
- Will the map have other map elements such as a title, a North arrow, and a legend?
- Will the map contain graphs or reports to complement the geographic view of the data?
- How will scale be indicated on the map?
- How will the map elements be organized?

In this Module, you'll learn how to:

- About map templates
 - Starting a map from a template
 - Saving a map as a template
 - Setting up the page
 - Using rulers, guides, and grids
 - Adding data frames
 - Adding map elements related to data frames
 - Creating grids and graticules
 - Adding other map elements
 - Printing a map
 - Exporting a map
-

Map Outputs

Laying out and printing maps:

You should consider questions such as:

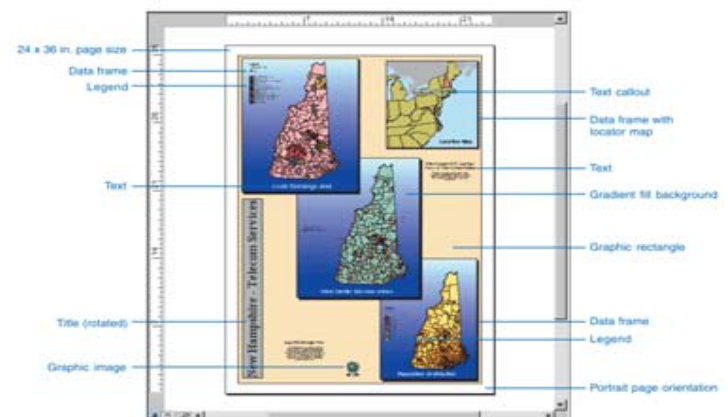
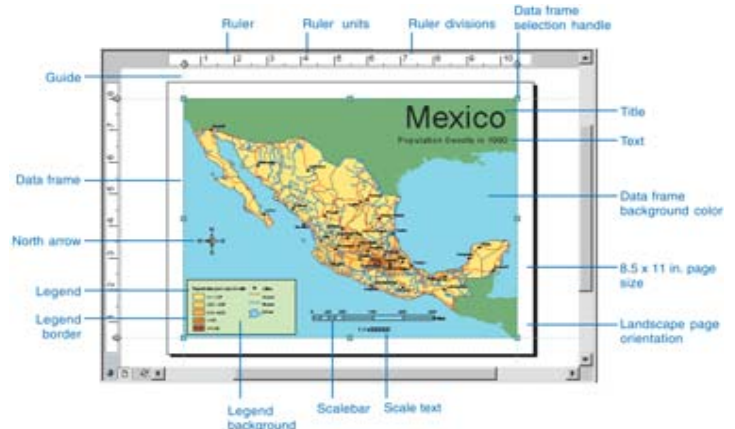
- Will the map stand alone, or will it be part of a series of maps that share a similar design?
- What size will the printed version of the map be?
- How will the page be oriented?
- How many data frames will the map have?
- Will the map have other map elements such as a title, a North arrow, and a legend?
- Will the map contain graphs or reports to complement the geographic view of the data?
- How will scale be indicated on the map?
- How will the map elements be organized on the page?

The shape and orientation of the geographic features you're depicting may influence the size and shape of the data frame on the map as well as the orientation of the map on the page.

Aesthetic criteria, limitations of the media that you use to reproduce the map, and the number and size of other elements that you add to the map will bear upon your choice of page size and orientation.

In addition to a data frame, most maps contain one or more other map elements. These include titles, North arrows, legends, scale bars, scale text, graphs, reports, text labels, and graphics.

About map templates: If you are creating a series of maps and it is important that they have the same look and feel, you can use a map template to standardize the layout. If the series contains the same background data, you can include that data in the template. Using a template can save you time since you don't have to manually reproduce the common parts of the maps. You can also use the map templates that come with ArcMap to quickly make a decent looking map, with a minimal amount of layout work on your part. Just choose a template that has the look you want, add your data, and make

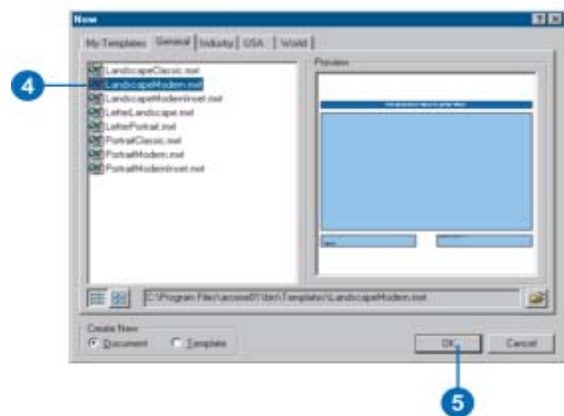
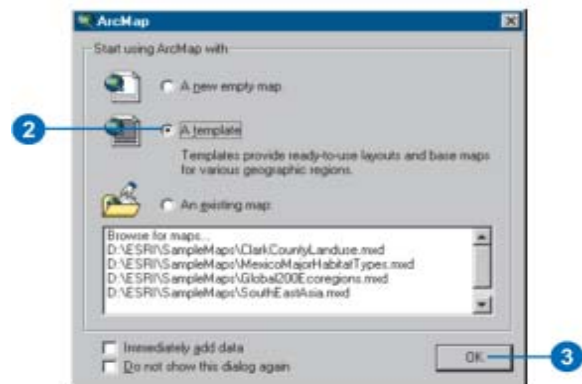


whatever changes you want, and your map is done.

Starting a map from a template: Map templates make it easy to reuse the same layout or even the same data on a series of maps. You can use the templates that come with ArcMap to make maps quickly—all you need to do is add data, a title, and any other supporting information that you choose. When you open a template, you get a new untitled ArcMap document plus any layout or data that's saved in the template.

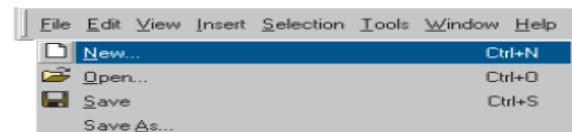
Opening a template when you first start ArcMap

1. Start ArcMap.
2. Click Start using ArcMap with A template.
3. Click OK.
4. Click a template.
5. Click OK.



Opening a new template while in ArcMap

1. Click File and click New.
2. Click a template and click OK.



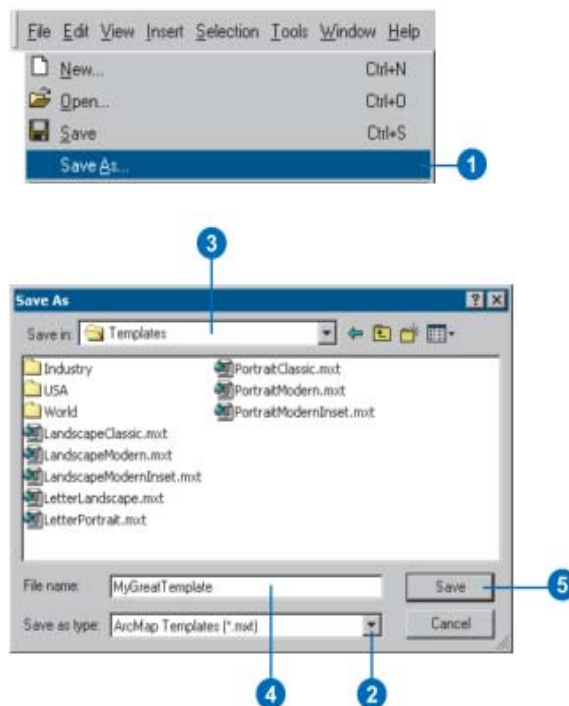
Saving a map as a template: If you create a map that you'd like to use as a template, or if you modify an existing template and want to use it again, you can save it as a template. You can save a map template anywhere on your network. When you want to use the template, you can open it from ArcCatalog or ArcMap. If you save a template in the ArcMap Templates folder (by default in the folder `\Bin\ Templates` where you've installed ArcGIS), it will show up in the list of templates on the New map

document dialog box. You can also create subfolders in this folder, and they'll show up as separate tabs on this dialog box—when you click each tab you'll see the templates in that folder. If you work with many different templates, this is a great way to organize them.

Saving a template

1. Click File and click Save As.
2. Click the Save as type dropdown arrow and click ArcMap Templates.
3. Navigate to the folder where you want the template saved.
4. Type a name for the new template.
5. Click Save.

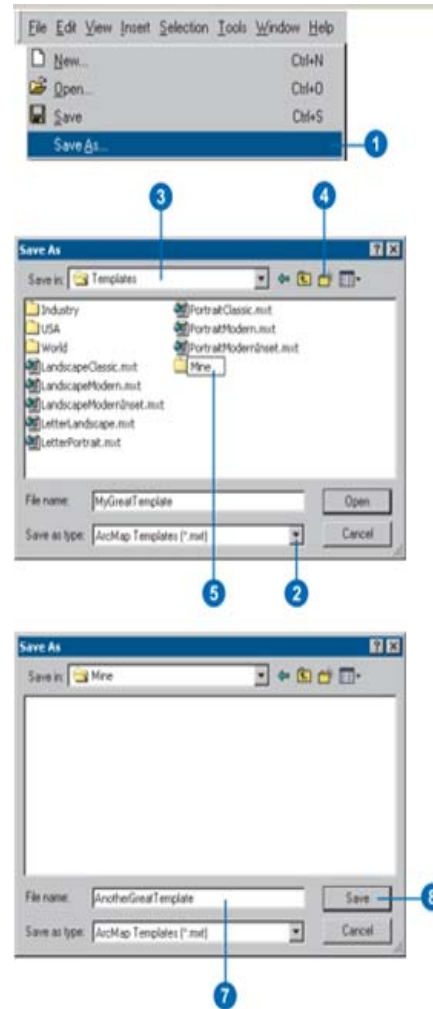
NOTE: You can only save a map as a template if your map was built using Normal.mxt as the base template. If it wasn't, click the Edit menu and click Select All Elements while in layout view. Then copy and paste the elements into a new empty map. Then you can save the new map as a template



Saving a template so it will appear in a new tab

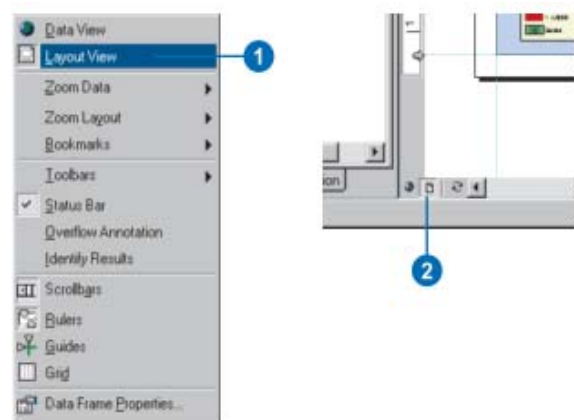
1. Click File and click Save As.
2. Click the dropdown arrow and click ArcMap Templates.
3. Navigate to the Templates folder.
4. Click the New Folder button.
5. Type the name of the new folder—this name will appear on the New map document dialog box as a tab.
6. Double-click the new folder.
7. Type the name of the new template.
8. Click Save.

Next time you start a map from a template, you'll see a new tab with your template on the New map document dialog box



Switching to layout view

1. Click View and click Layout View.
OR
Click the Layout View button on the bottom left corner of the map display area.



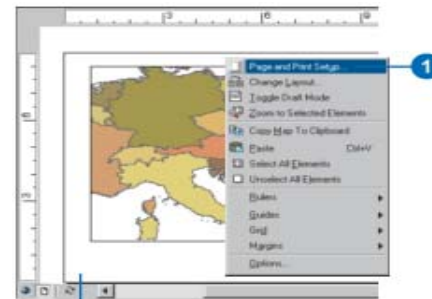
Setting up the page size and printer properties

1. Right-click the virtual page and click Page and Print Setup.

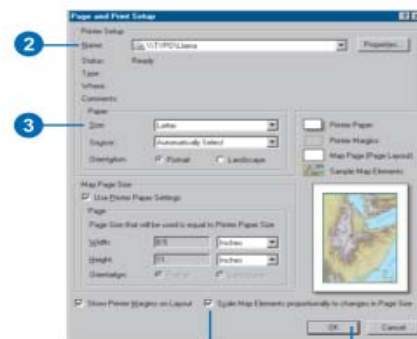
You can also open the Page and Print Setup dialog box from the File menu or the Print dialog box

2. Click the Name dropdown narrow and click the printer you want to use.
3. Click the Paper Size dropdown arrow and click the page size that's right for your map.
4. Click OK.

Because the Use Printer Paper Settings box is checked, the map Width and Height text boxes are updated with the new page size, and the Page Orientation is set accordingly



Right-click outside the selected data frames to get the Page context menu.



Check to automatically rescale map elements when you change the page size.

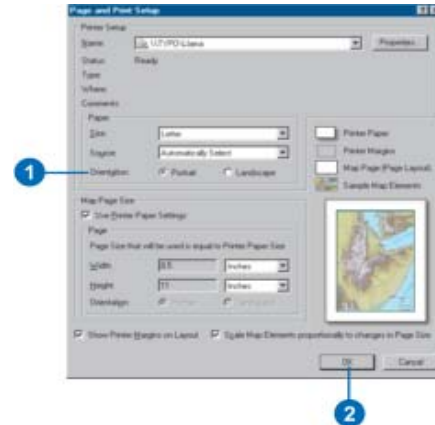
Making the map page size independent of the system printer

1. Uncheck Use Printer Paper Settings on the Page and Print Setup dialog box.
2. Click the Standard Sizes dropdown arrow and click the page size that's right for your map.
3. Optionally, to define a custom page size, type the page size for your map in the Width and Height text boxes.
4. Click OK.



Setting the page orientation

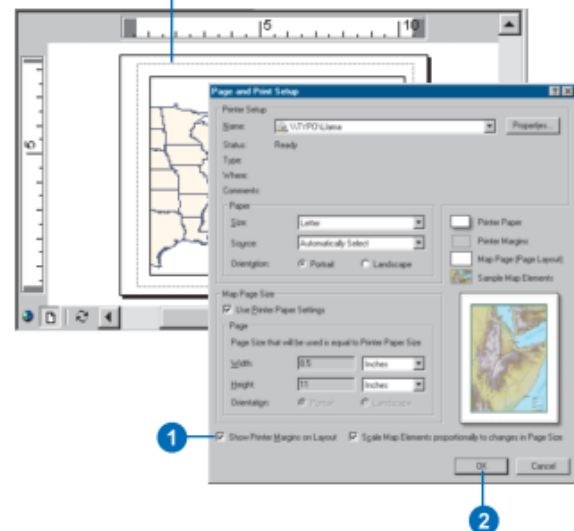
1. On the Page and Print Setup dialog box, click a Paper or Page Orientation (Landscape or Portrait) to set the page orientation.
2. Click OK.



Showing or hiding printer margins

1. Check Show Printer Margins on Layout in the Page and Print Setup dialog box.
2. Click OK.

Printer margins shown by light gray dotted line



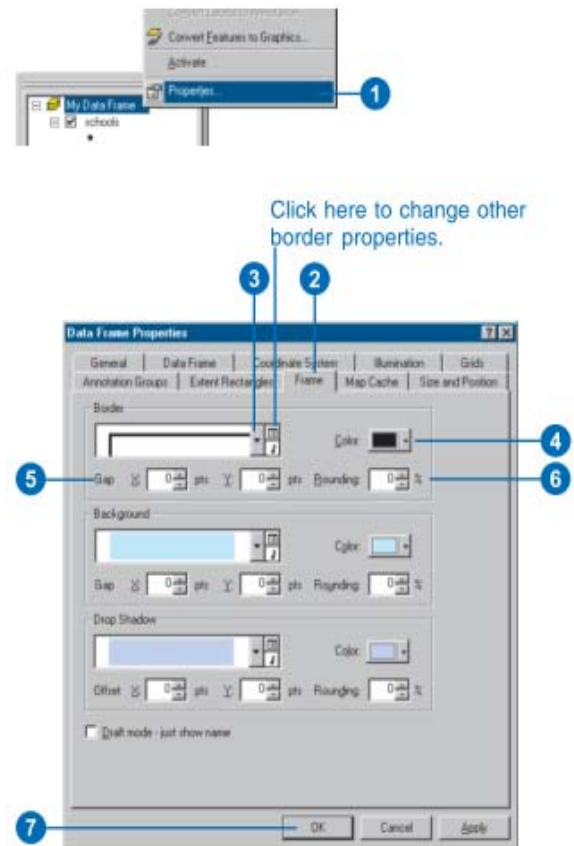
Renaming a data frame

1. Click the data frame in the table of contents.
2. Wait a moment, then click the data frame a second time.
3. Type a new name for the data frame.



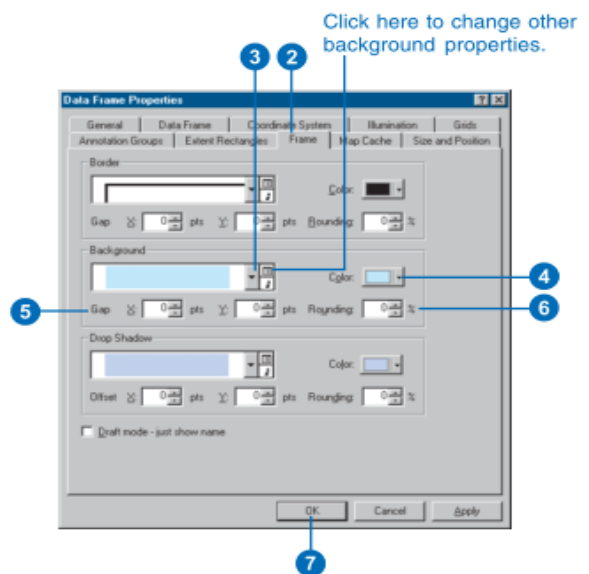
Adding a border to a data frame

1. In the table of contents, rightclick the data frame and click Properties.
2. Click the Frame tab.
3. Click the Border dropdown arrow and click a symbol.
4. Click the Color dropdown arrow and click a color.
5. Type an X and Y gap to offset the border from the edge of the data frame.
6. Type a Rounding percentage to round the corners of the border.
7. Click OK.



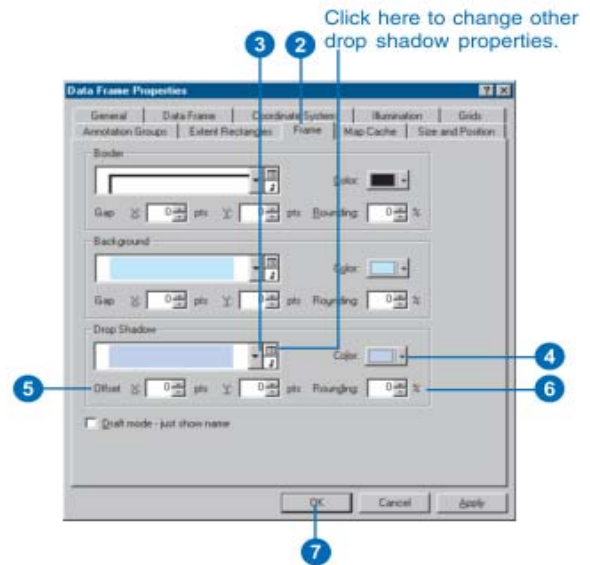
Adding a background to a data frame

1. In the table of contents, rightclick the data frame and click Properties.
2. Click the Frame tab.
3. Click the Background dropdown arrow and click a background.
4. Click the Color dropdown arrow and click a color.
5. Type an X and Y gap to offset the background from the edge of the data frame.
6. Type a Rounding percentage to round the corners of the background.
7. Click OK.



Adding a drop shadow to a data frame

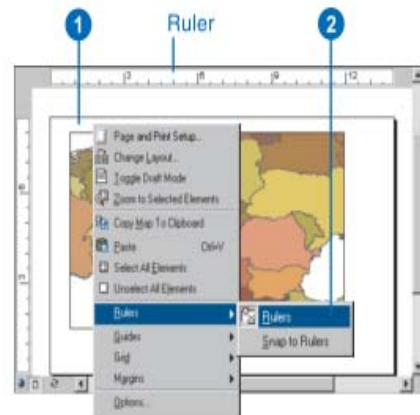
1. In the table of contents, rightclick the data frame and click Properties.
2. Click the Frame tab.
3. Click the Drop Shadow dropdown arrow and click a drop shadow.
4. Click the Color dropdown arrow and click a color.
5. Type an X and Y offset to shift the drop shadow away from the border of the data frame.
6. Type a Rounding percentage to round the corners of the drop shadow.
7. Click OK



Turning rulers on and off

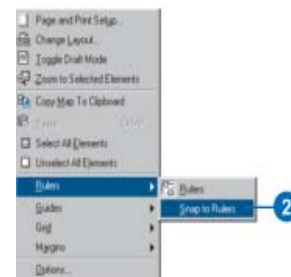
1. Right-click the page.
2. Point to Rulers and click Rulers.

The rulers are on by default.



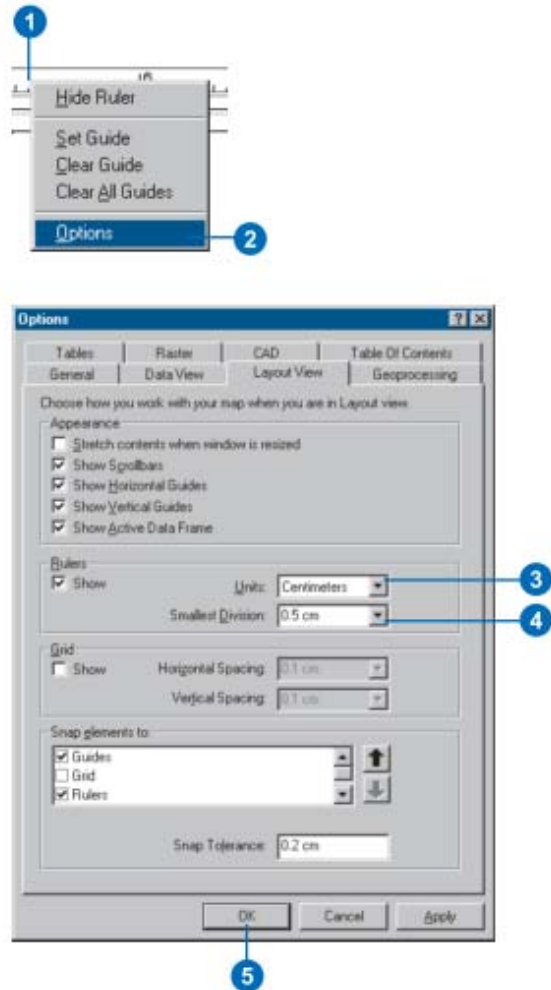
Snapping to rulers

1. Right-click the page.
2. Point to Rulers and click Snap to Rulers.



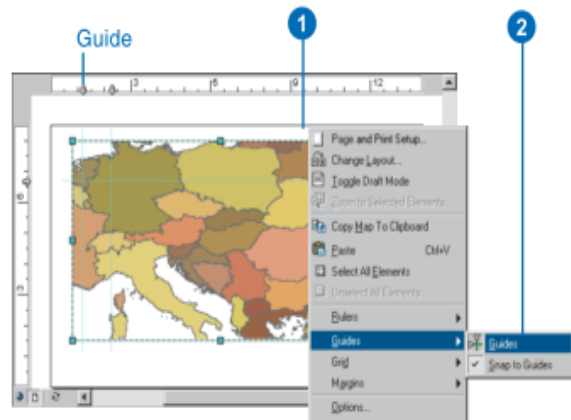
Setting the units and divisions on rulers

1. Right-click the ruler.
2. Click Options.
If the ruler is not showing in your layout view, then click Tools on the Main menu, click Options, and click the Layout View tab.
3. Click the Units dropdown arrow and click a unit of measure.
4. Click the Smallest Division dropdown arrow and click the size of the smallest division.
5. Click OK.



Turning guides on and off

1. Right-click the page.
2. Point to Guides and click Guides.



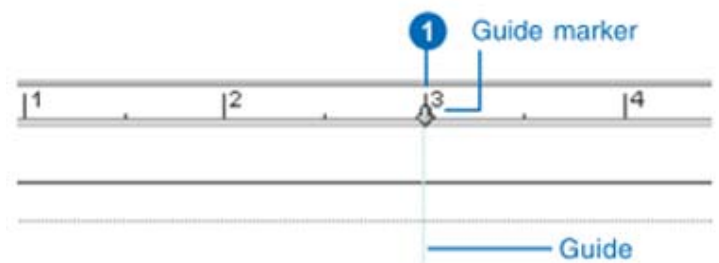
Snapping to guides

1. Right-click the page.
2. Point to Guides and click Snap to Guides.
When you move map elements to the vicinity of a guide, the map element will snap to the guide.



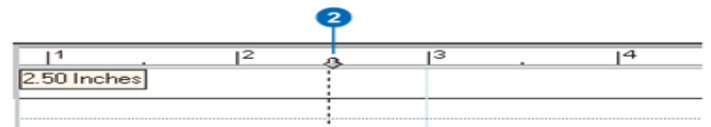
Adding a guide

1. Click the ruler at the location where you want to add a guide. It doesn't have to be exact, because you can move the guide.



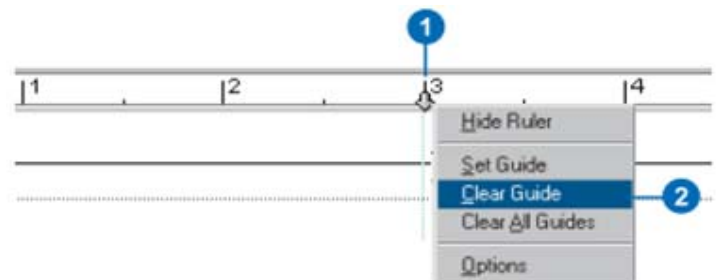
Moving a guide

1. Point to a guide marker on the ruler. Your pointer will change.
2. Click and drag the guide marker to a new location on the ruler.
The guide appears with a dotted line until you release the mouse button.



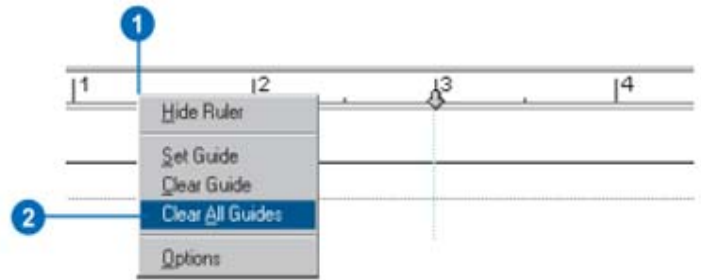
Removing a guide

1. Point to a guide marker on the ruler. Your pointer will change.
2. Right-click the guide marker and click Clear Guide.



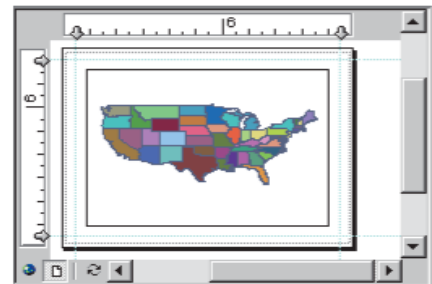
Removing all guides from a ruler

1. Right-click the ruler.
2. Click Clear All Guides. All of the guides are removed from the ruler.



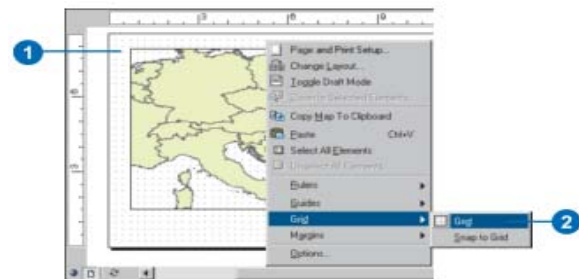
Using guides to define a map's margins

1. Click the rulers to add guides where you want the map's margins to be.
2. Optionally, move the guides to fine-tune their position



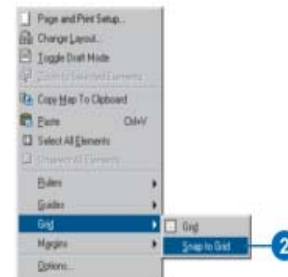
Turning the grid on and off

1. Right-click the page.
2. Point to Grid and click Grid.



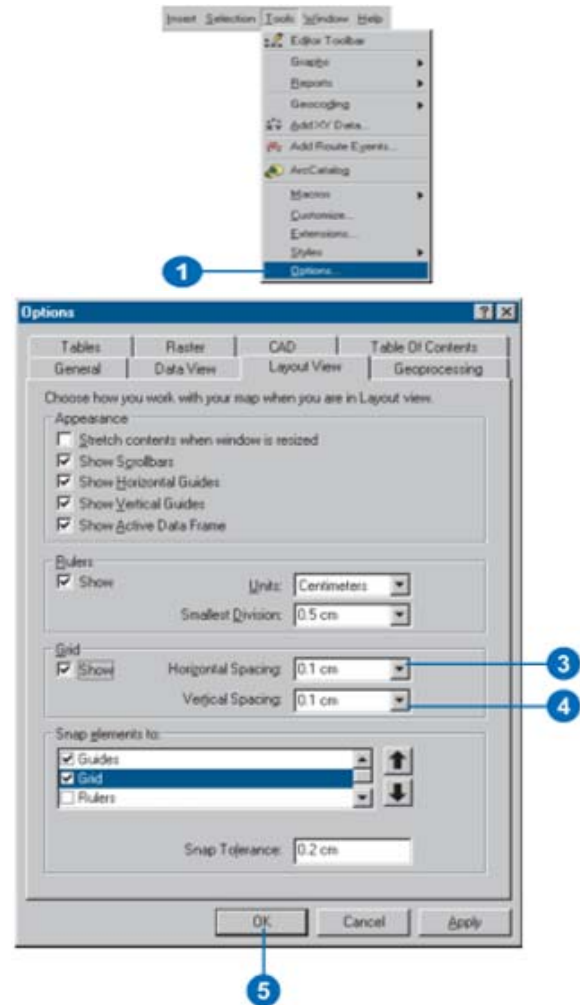
Snapping to the grid

1. Right-click the page.
2. Point to Grid and click Snap to Grid.



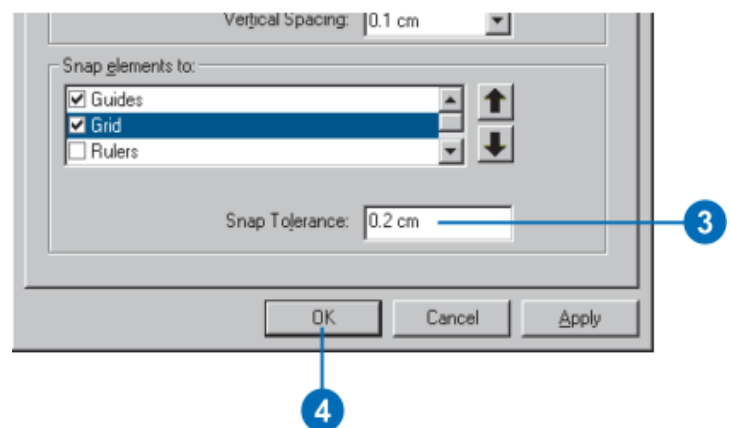
Changing the grid size

1. Click Tools and click Options.
2. Click the Layout View tab on the Options dialog box. The Options dialog box appears.
3. Click the Horizontal Spacing dropdown arrow and click a number of units to specify the horizontal spacing of the snapping grid.
4. Click the Vertical Spacing dropdown arrow and click a number of units to specify the vertical spacing of the snapping grid.
5. Click OK



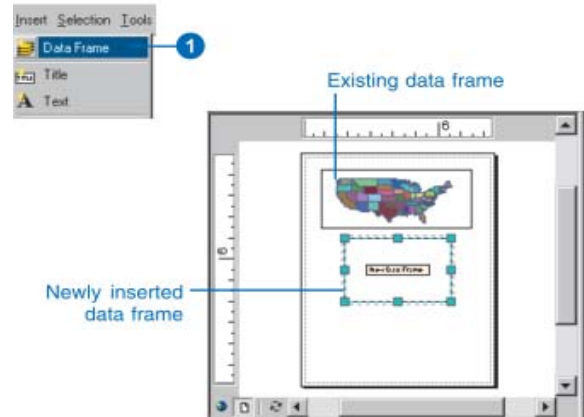
Changing the snapping tolerance

1. Right-click the page.
2. Click Options.
3. Type a number of units for the snapping tolerance.
4. Click OK.



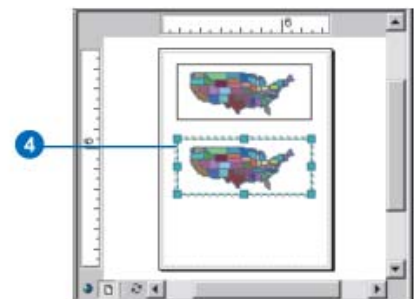
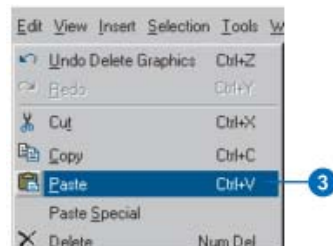
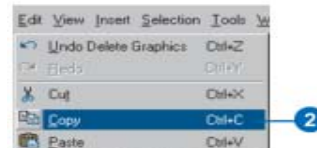
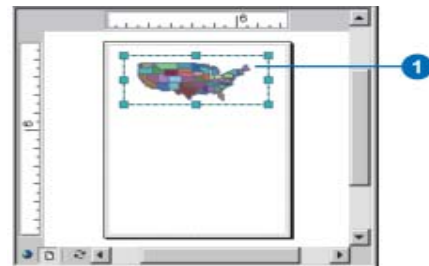
Adding a new data frame to a map

1. Click Insert on the Main menu and click Data Frame. You can add any data to the new data frame.



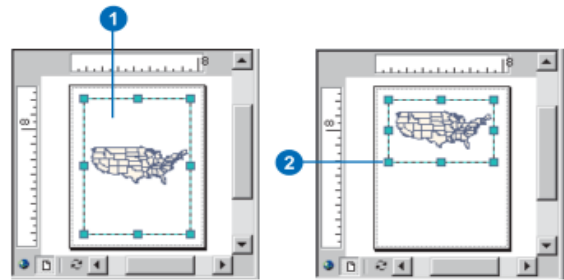
Duplicating a data frame

1. In Layout View, click the data frame to select it.
2. Click Edit and click Copy.
3. Click Edit and click Paste.
4. Click the copy, located on top of the original data frame, and drag it to a new place on the page.



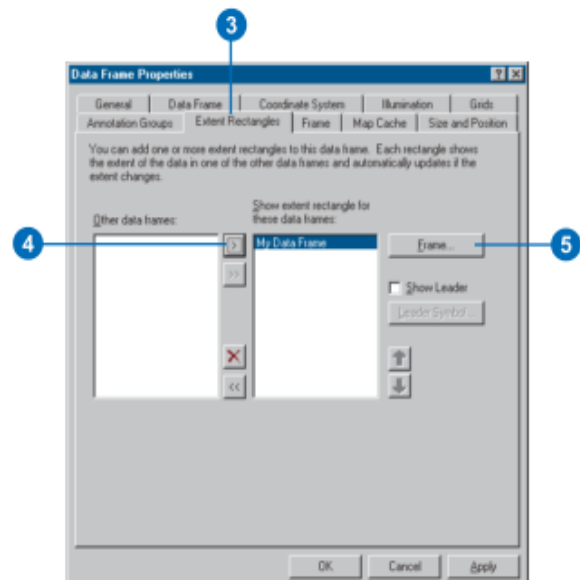
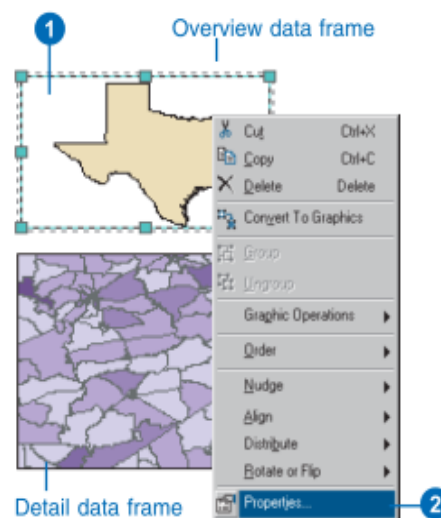
Resizing a data frame

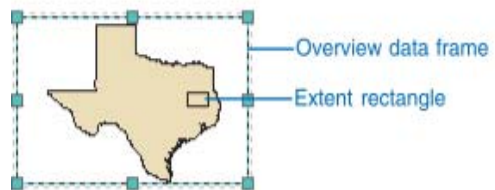
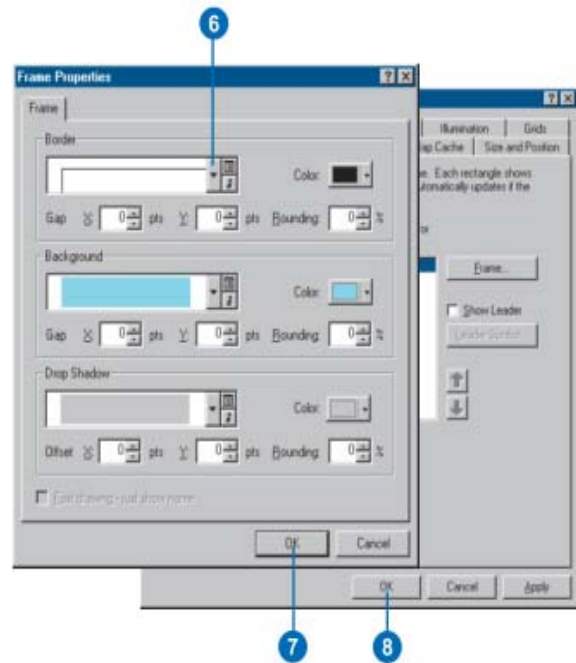
1. Click the data frame to select it.
2. Click a selection handle and drag it to change the size of the data frame. Hold Shift while resizing to maintain a 1:1 size ratio.



Using one data frame to show the location of another

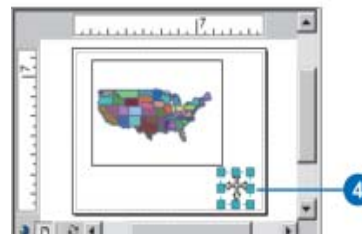
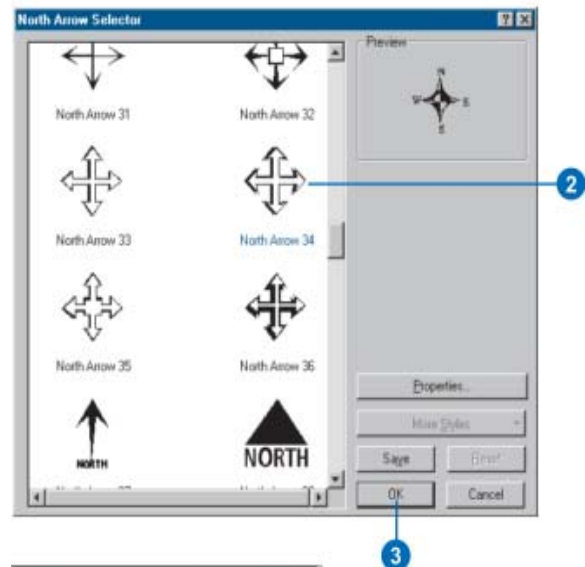
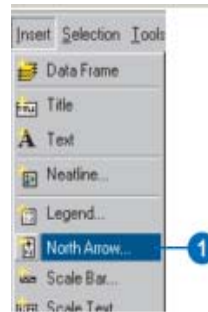
1. Click the overview data frame to select it.
2. Right-click the overview data frame and click Properties.
3. Click the Extent Rectangles tab.
4. Click the detail data frame (in this case called My Data Frame) in the Other data frames list and click the right arrow button to send it to the Show extent rectangle for these data frames list.
5. Click Frame to choose a border for the extent rectangle
6. Click the Border dropdown arrow and click a border.
7. Click OK on the Frame Properties dialog box.
8. Click OK on the Data Frame Properties dialog box.





Adding a North arrow

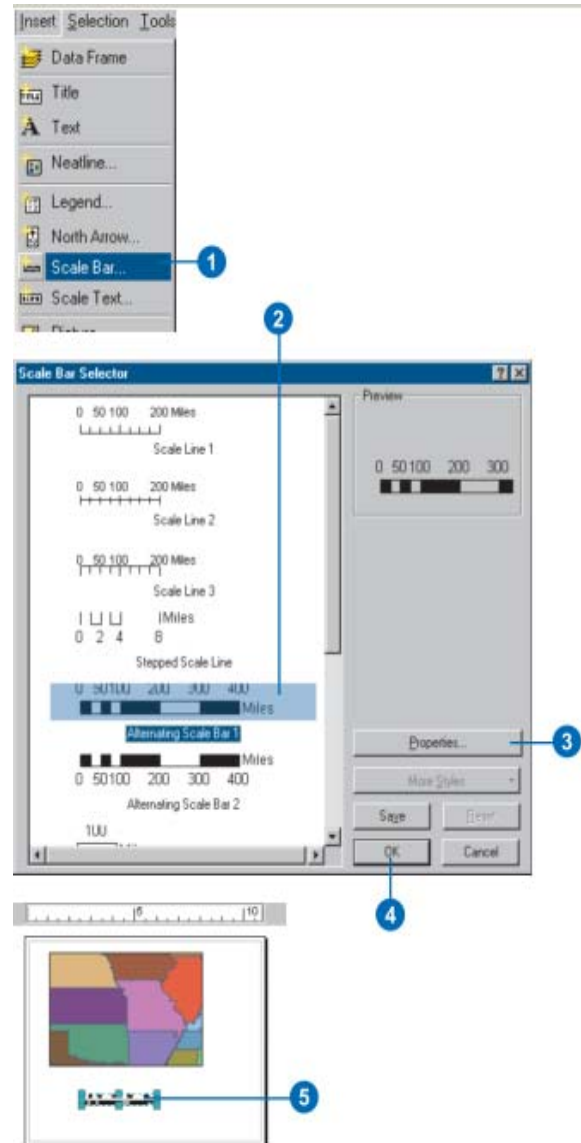
1. Click Insert and click North Arrow.
2. Click a North arrow.
3. Click OK.
4. Click and drag the North arrow into place on your map.
5. Optionally, resize the North arrow by clicking and dragging a selection handle.



Adding a scale bar

1. Click Insert and click Scale Bar.
2. Click a scale bar.
3. Optionally, click Properties to modify the scale bar's properties.
4. Click OK.
5. Click and drag the scale bar into place on your map.
6. Optionally, resize the Scale bar by clicking and dragging a selection handle.

If you resize the width, the distance measures along the scale bar are recalculated. If you resize the height, the height of the bar is altered and the text size is altered accordingly.



Customizing a scale bar's scale and units

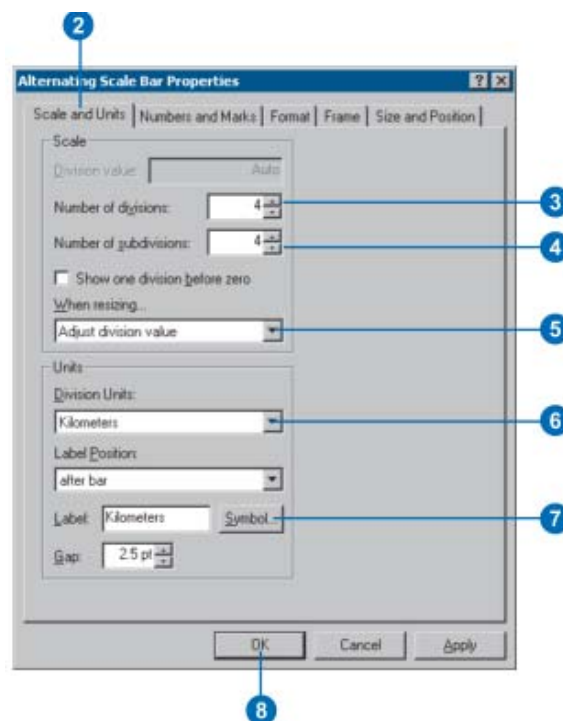
1. Right-click the scale bar and click Properties.
2. Click the Scale and Units tab.
3. Click the arrow buttons to set the Number of divisions.
4. Click the arrow buttons to set the Number of subdivisions.
5. Click the When resizing dropdown arrow and click how you want the scale bar to respond when the map scale changes.

Adjust division value—the division value will vary with the map scale. The number of divisions and the width of the scale bar remain constant.

Adjust number of divisions—the number of divisions will vary with the map scale. The division value and the width of the scale bar remain constant.

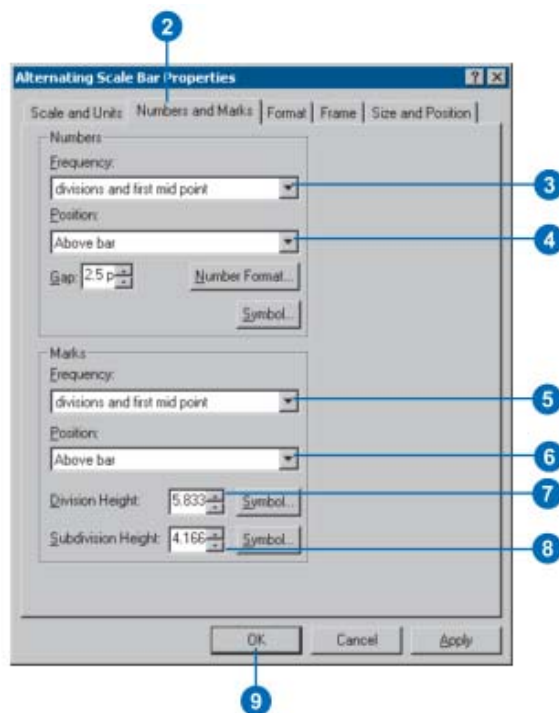
Adjust width—the width of the scale bar will vary with the map scale. The division value and number of divisions remain constant.

6. Choose the units for the scale bar.
7. Click Symbol and choose a text style for the scale bar labels.
8. Click OK.



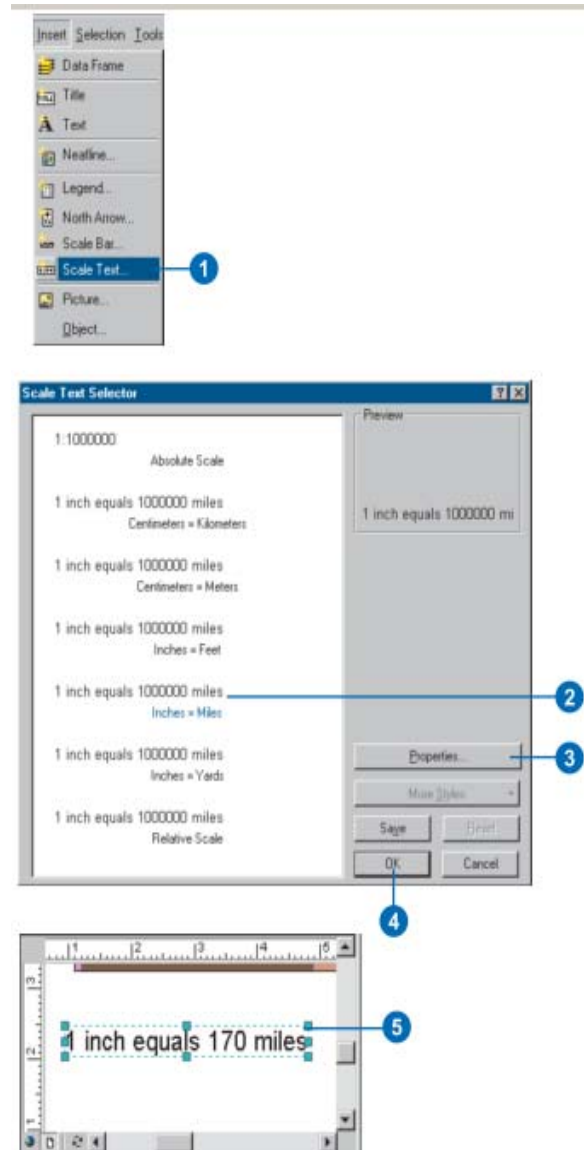
Customizing a scale bar's numbers and marks

1. Right-click the scale bar and click Properties.
2. Click the Numbers and Marks tab.
3. Click the Numbers Frequency dropdown arrow to choose where along the bar to place the numbers.
4. Click the Numbers Position dropdown arrow to choose where to place numbers relative to the bar.
5. Click the Marks Frequency dropdown arrow to choose where along the bar to place tic marks.
6. Click the Marks Position dropdown arrow to choose where to place tic marks relative to the bar.
7. Click the Division Height arrow buttons to increase or decrease the height of division tic marks.
8. Click the Subdivision Height arrow buttons to increase or decrease the height of subdivision tic marks.
9. Click OK.



Adding scale text

1. Click Insert and click Scale Text.
2. Click a sample of the style of scale text to add to the map.
3. Optionally, click Properties to customize the scale text.
4. Click OK.
5. Click and drag the scale text into position on your map.
6. Optionally, resize the scale text by clicking and dragging a selection handle



Adding a legend

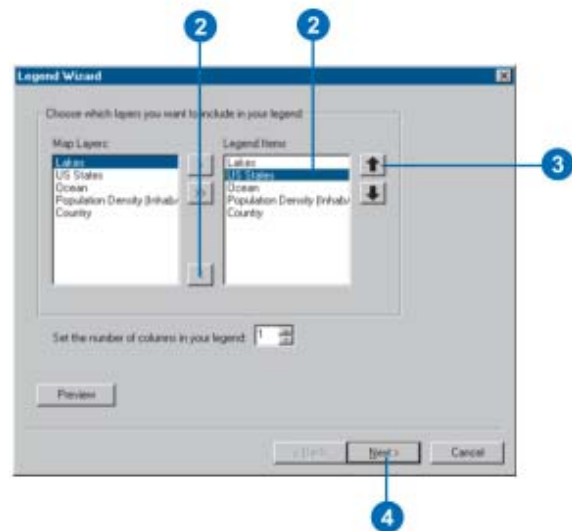
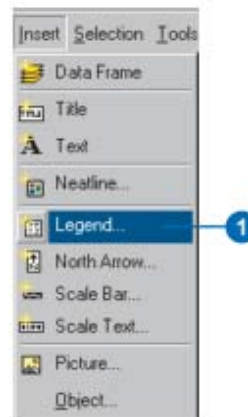
1. Click Insert and click Legend.

The Legend Wizard appears. If you don't see it, enable the Legend Wizard as described in the tip to the left.

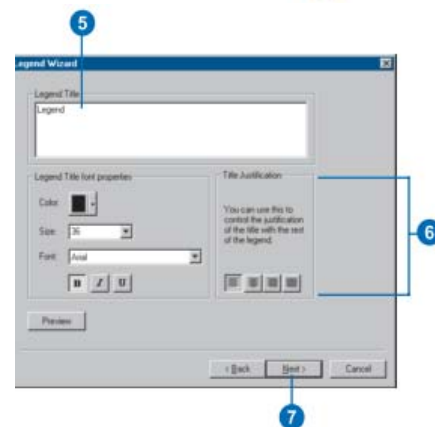
2. By default, all the layers on the map will appear as legend items in the legend.

To remove a legend item, click it, and then click the left arrow button.

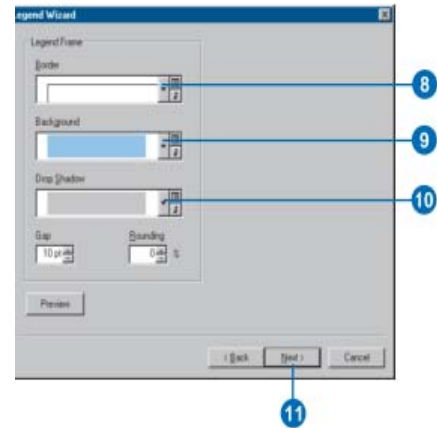
3. Use the up and down arrow buttons to order the legend items.
4. Click Next.



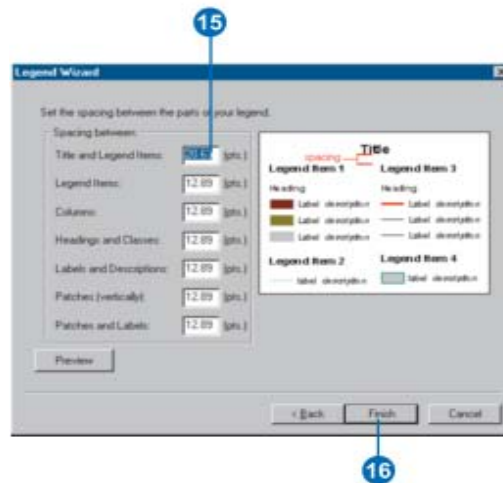
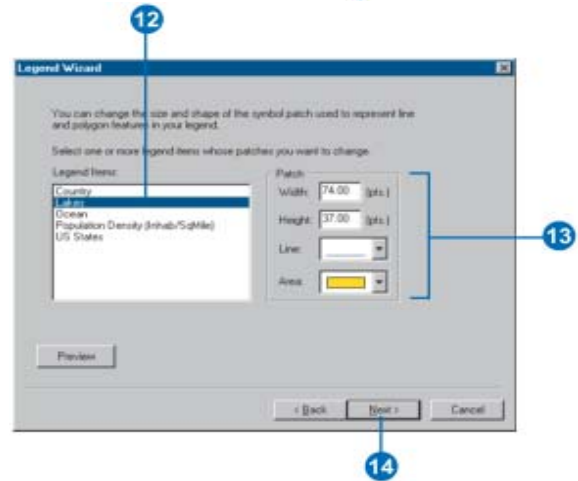
5. Type a title for the legend.
6. Set the text color, size, and font as desired.
7. Click Next.



8. Click the Border dropdown arrow and click a border.
9. Click the Background dropdown arrow and click a background.
10. Click the Drop Shadow dropdown arrow and click a drop shadow.
11. Click Next

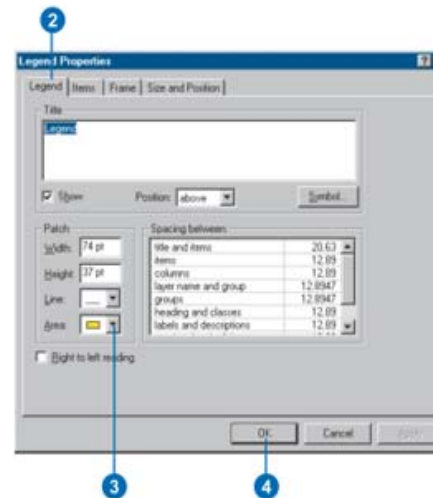
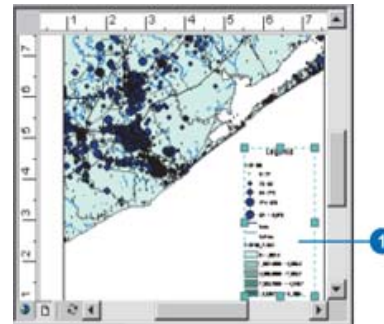


12. Click a Legend Item in the list to modify the symbol patch.
13. Set the Patch properties as desired.
14. Click Next.
15. Set the Spacing between legend elements by typing a value into the appropriate box.
16. Click Finish.



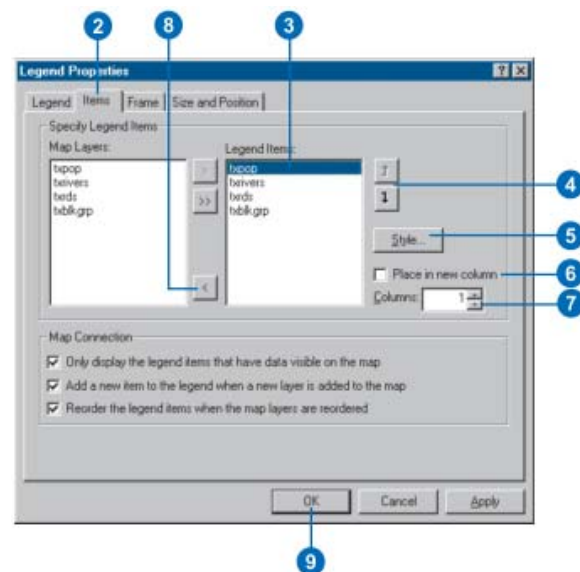
Changing the patches in a legend

1. Double-click the legend on the map to open the Legend Properties dialog box.
2. Click the Legend tab.
3. Click the dropdown arrow to select a new patch shape.
4. Click OK.



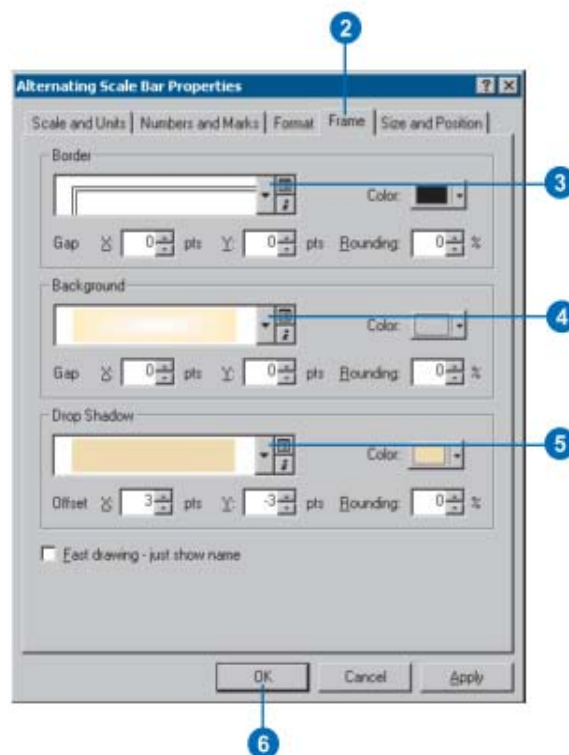
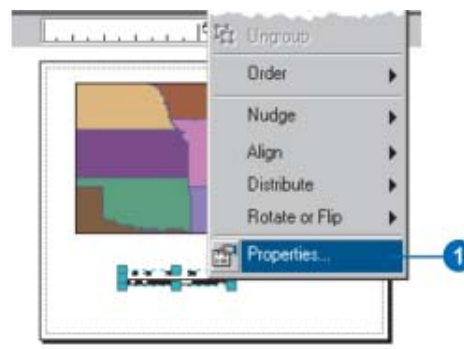
Changing the items in a legend

1. Right-click the legend on the map and click Properties.
2. Click the Items tab.
3. Click a legend item in the Legend Items list.
4. Click the up and down arrows to move the item up or down in the legend.
5. Optionally, click Style and change the Item's style in the legend.
6. Optionally, check Place in new column to place the highlighted item in a new column.
7. Optionally, change the number of columns in the legend for the highlighted legend item by clicking the up and down arrow keys.
8. Optionally, remove an item from the legend by clicking it and clicking the left arrow key.
9. Click OK.



Framing a map element

1. Right-click the element on the map and click Properties.
2. Click the Frame tab.
3. Click the Border dropdown arrow and click a border.
4. Click the Background dropdown arrow and click a background.
5. Click the Drop Shadow dropdown arrow and click a drop shadow.
6. Click OK.



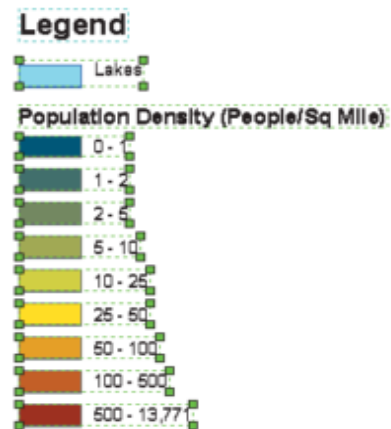
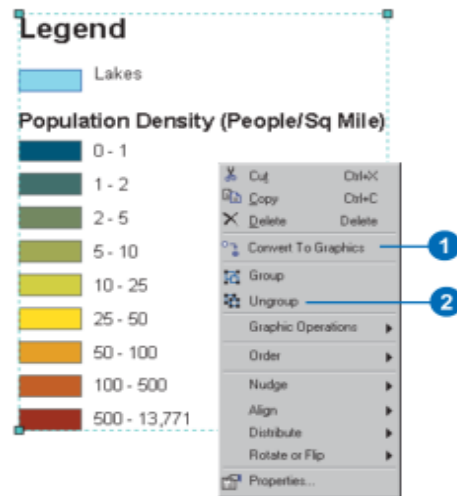
Converting map elements to simple graphics

1. Right-click an element, such as a legend, and click Convert To Graphics.

The element is now a grouped graphic.

2. Right-click the graphic and click Ungroup.

The individual graphics that comprise the map element can now be edited separately



After ungrouping, you can edit the individual graphic elements.

Adding a graticule

1. In the table of contents, double-click the data frame for which you want to add a graticule.
2. Click the Grids tab on the Data Frame Properties dialog box.
3. Click New Grid.

The Grids and Graticules Wizard should appear. If not, see the tip to the left.

4. Click Graticule.
5. Type a name for the new grid.
6. Click Next.
7. Click an Appearance option.
8. Type the Intervals you want.
9. Click Next.

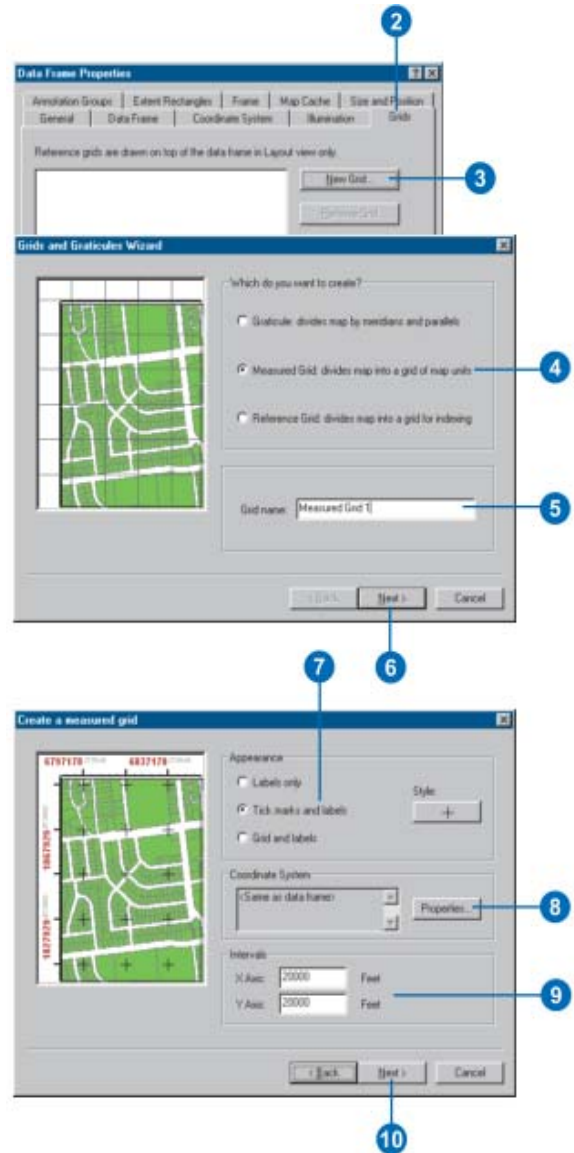


10. Check the Axes you want and set how they should appear.
11. Click the Font button beside Text Style to set the text style.
12. Click Next.
13. Click the Graticule Border you want.
14. Check Place a border outside the grid.
15. Click to specify whether the graticule is static or updates with changes to the data frame.
16. Click Finish.



Adding a measured grid

1. In the table of contents, double-click the data frame you want to add a measured grid to.
2. Click the Grids tab on the Data Frame Properties dialog box.
3. Click New Grid.
4. The Grids and Graticules Wizard should appear. If not, see the tip to the left.
5. Click Measured Grid.
6. Type a name for the new grid.
7. Click Next.
8. Click an Appearance option.
9. Click Properties to set a coordinate system for the grid that differs from that of the data frame.
10. Type the Intervals you want.



11. Check the Axes you want and set how they should appear.
12. Click the Font button beside Text Style to set the text style.
13. Click Next.
14. Click the Measured Grid Border you want.
15. Check Place a border outside the grid.
16. Click to specify whether the measured grid is static or updates with changes to the data frame.
17. Click Finish.

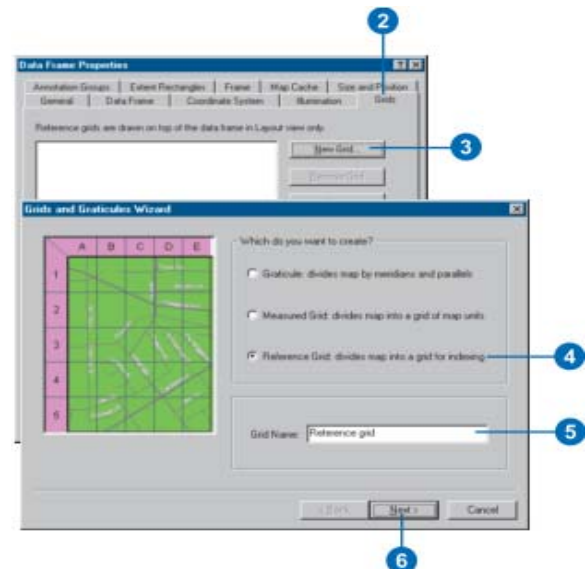


Adding a reference grid

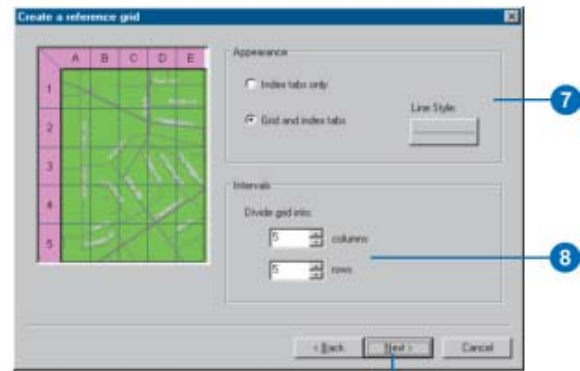
1. In the table of contents, double-click the data frame you want to add a reference grid to.
2. Click the Grids tab on the Data Frame Properties dialog box.
3. Click New Grid.

The Grids and Graticules Wizard should appear. If not, see the tip to the left.

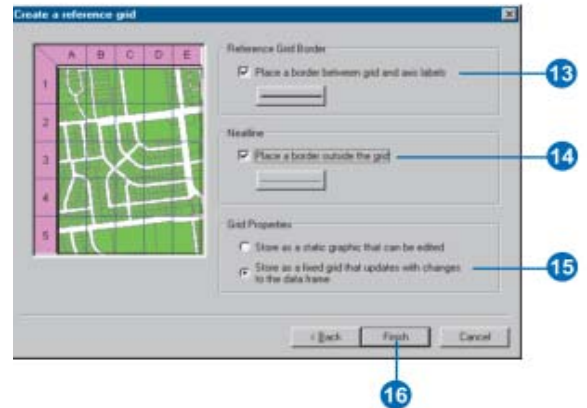
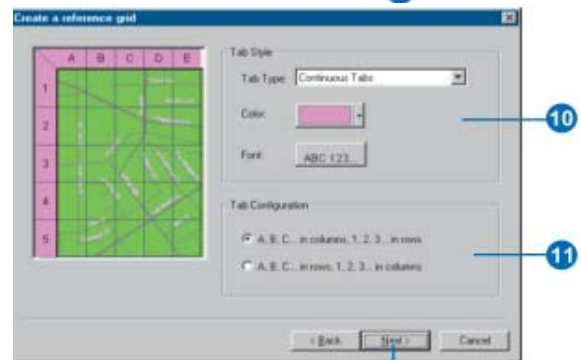
4. Click Reference Grid.
5. Type a name for the new grid.
6. Click Next.



7. Click an Appearance option.
8. Type the Intervals you want.
9. Click Next.

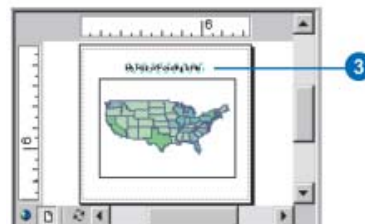


10. Set the Tab Style.
11. Set the Tab Configuration.
12. Click Next.
13. Check Place a border between grid and axis labels.
14. Check Place a border outside the grid.
15. Click to specify whether the graticule is static or updates with changes to the data frame.
16. Click Finish.



Adding a title

1. Click Insert and click Title.
2. Type a title for the map.
3. Click and drag the title into place on your map.
4. Optionally, modify the appearance of the title text

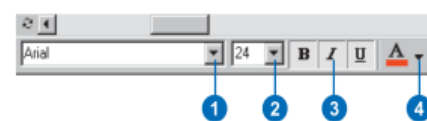


Modifying a title

1. With the title selected, click the Font dropdown arrow and click a font in the Draw toolbar.
2. Click the Font Size dropdown arrow and click a font size.
3. Click Bold, Italic, or Underline to change the style of the text.
4. Click the Text Color dropdown arrow and click a color



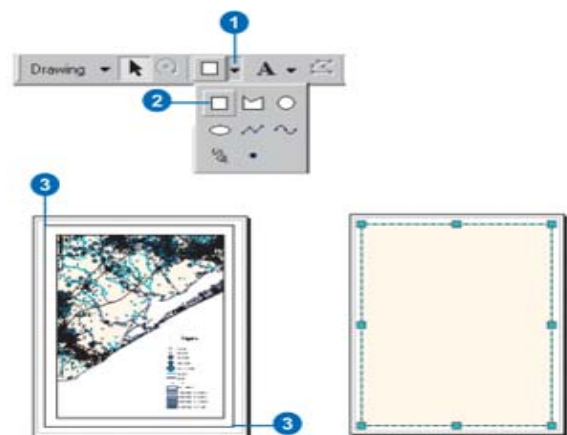
My Map of Housing Units



Adding a graphic element

1. Click the graphics dropdown arrow on the Draw toolbar.
2. Click the New Rectangle button.
3. Click the map and drag a box where you want the rectangle.

The graphic element appears on the map



Applying color to a graphic element

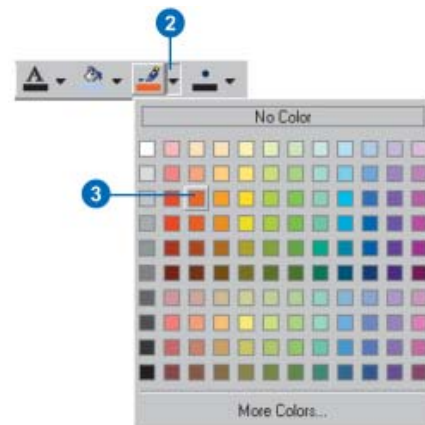
1. Click a graphic element to select it.
2. Click the Fill Color dropdown arrow on the Draw toolbar.
3. Click a color.

The fill color is applied to the graphic element.



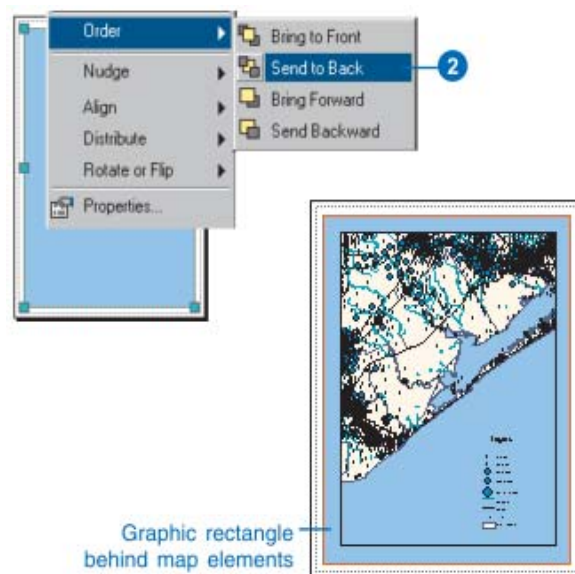
Applying a line color to a graphic element

1. Click a graphic element to select it.
 2. Click the Line Color dropdown arrow on the Draw toolbar.
 3. Click a color.
- The line color is applied to the graphic element.



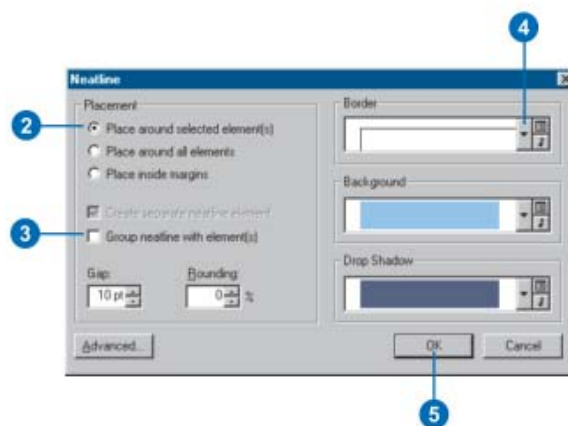
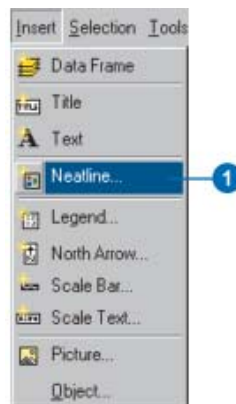
Placing a graphic element behind other elements

1. Click the graphic element to select it.
2. Right-click the graphic element, point to Order, and click Send to Back.



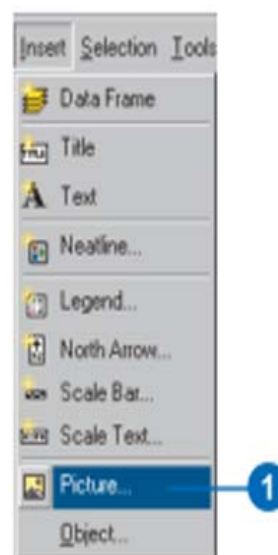
Adding a neatline

1. Click the Insert menu and click Neatline.
2. Click the Placement option you want.
3. Check Group neatline with element(s) if you want to group the elements with the neatline.
4. Click the Border dropdown arrow and click the type of neatline you want.
5. Click OK

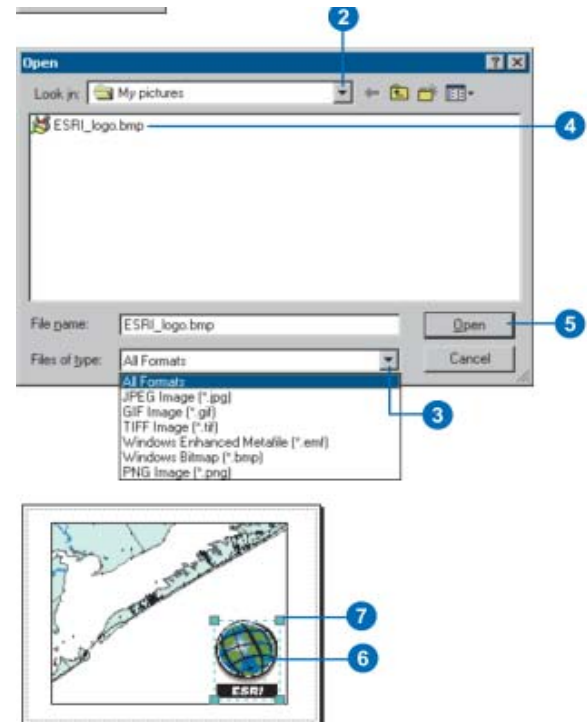


Adding a picture

1. Click Insert and click Picture.

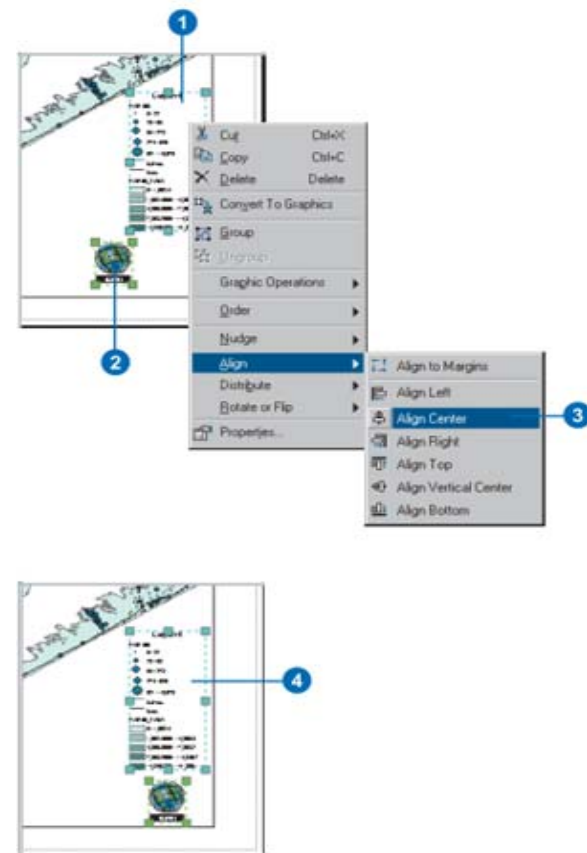


2. Navigate to the folder that contains the picture.
3. Optionally, select the type of picture that you want to add.
4. Click the picture that you want to add.
5. Click Open.
6. Click and drag the picture into position on your map.
7. Optionally, resize the picture by clicking a selection handle and dragging it.



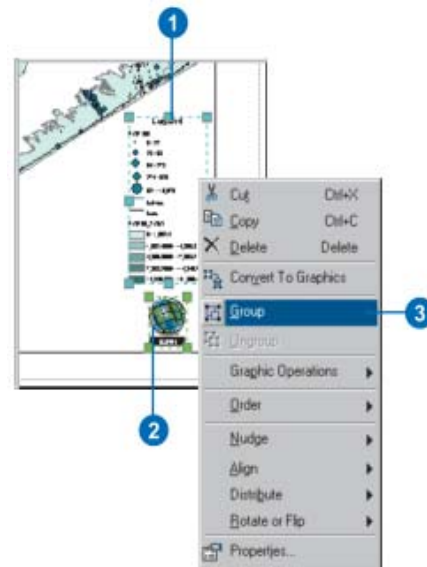
Aligning map elements

1. Click one of the map elements to select it.
2. Hold the Shift key and click the other map element. Now both elements are selected.
3. Right-click one of the selected elements, point to Align, and click Align Center.
4. Click the aligned map elements and drag them into position on your map



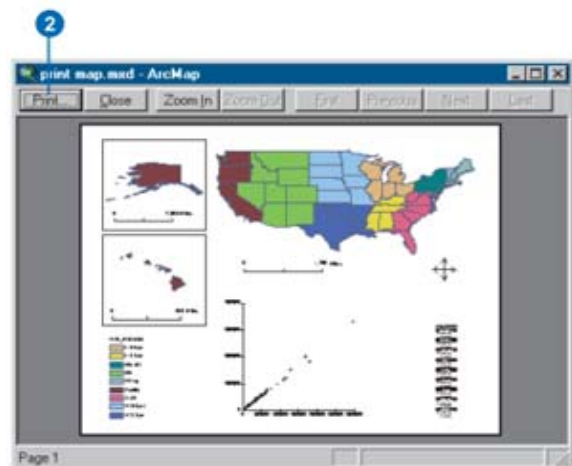
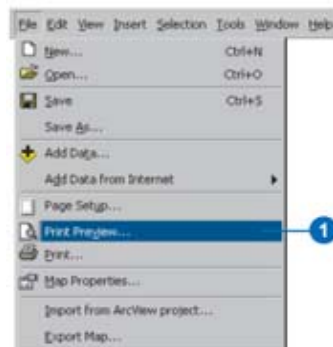
Grouping map elements

1. Click one of the map elements to select it.
2. Hold the Shift key and click the other map element.
Now both elements are selected.
3. Right-click one of the selected elements and click Group.

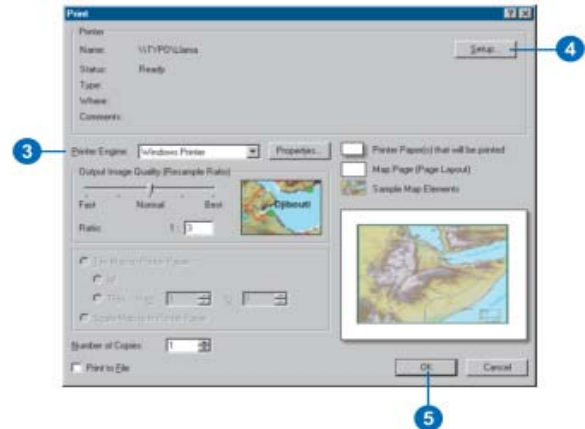


Previewing and printing a map

1. Click File and click Print Preview.
2. Examine the preview. If it looks right, click Print.



3. Verify that you're printing to the correct printer with the printer engine you want.
4. Optionally, click the Setup button to display the Page and Print Setup dialog box and choose another printer engine. Click OK.
5. Click OK.



Changing the layout

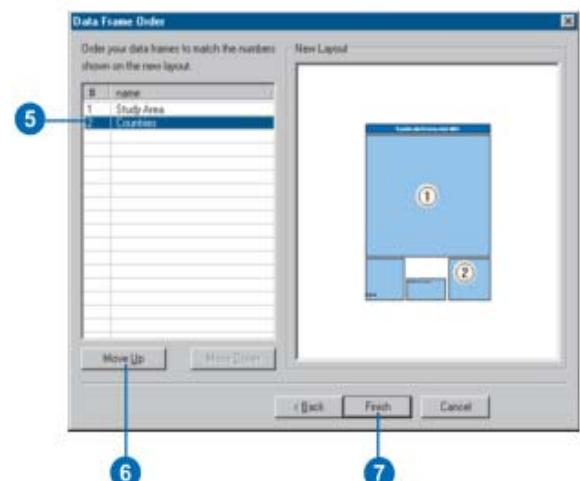
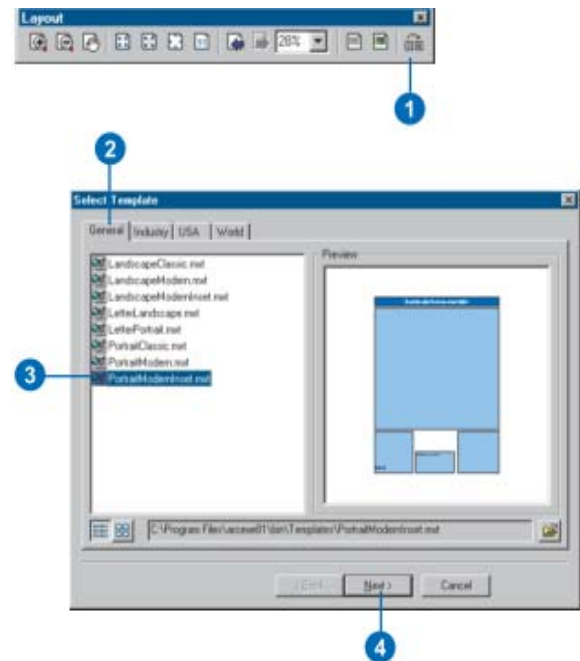
1. Click the Change Layout tool on the Layout toolbar.
2. Click the tab containing the template you want to use to change the layout.
3. Click the template you want to use.
4. Click Finish if the number of data frames on the map matches the number of data frames in the template.

Click Next if the number of data frames on the map doesn't match the number of data frames in the template and proceed to the next step to arrange the data frames on the map.

5. Click the data frame you want to position on the map.
6. Click Move Up or Move Down to change its position in the list.

Order the data frames to position them appropriately on the layout. If your map has more data frames than the template provides space for, the extra data frames will be positioned at the lower-left corner of the map.

7. Click Finish



Exporting a map

1. Click File and click Export Map.
2. Navigate to where you want to save the export file.
3. Click the Save as type dropdown arrow and click the type of file that you want to export.
4. Type a name for the export file.
5. Optionally, click the arrow to expand the Options and set the parameters for the file type that you chose.
6. Click Save

