

GIS I: ArcMap Introduction

Fall 2006 Workshop



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www.ku.edu/~adrsa/

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Introduction

This is an introductory level, instructor-led workshop. This hands-on session will teach you how to get around in ArcMap, along with some foundational geographic information systems (GIS) concepts. Work through step-by-step exercises in ArcMap, and look at how ArcCatalog can help you manage spatial data. Become familiar with navigational tools, and explore data from both the spatial and tabular side. Customize and save data settings and displays, and learn to prepare data for presentation, i.e how to make a simple map.

Objectives

- Use ArcCatalog
- Add and remove data in ArcMap
- Navigate (zoom, pan, etc.)
- Learn about format of geographic data
- Turn layers off and on
- Change layer order
- Display data by particular attributes
- Label features
- Use Identify tool
- Save work as map document
- Set view projection
- Set display/ distance units
- Measure distances
- Select a record from the attribute table, manually and by performing a query
- Select features by location, i.e. relationship to features in other layers
- Lay out/ format data for presentation

More Information

KU GIS Day is November 15. Get details on the student competition, find a schedule and register at: <http://www.lib.ku.edu/gis/>.

The datasets that accompany ArcGIS, or 'ESRI Data and Maps' are now available online at http://gis.lib.ku.edu/esri_data_maps.shtml. The PDF software manuals, or 'ESRI Digital Books' are also available via the Web at http://gis.lib.ku.edu/esri_dig_books.shtml.

All workshops offered through Information Services are free to KU students, staff, faculty, and approved affiliates. To learn more about or register for workshops, receive announcements of upcoming workshops, and track workshops you attend, visit the KU Libraries Instruction Web site at www.lib.ku.edu/instruction.

Upcoming GIS Workshops (www2.ku.edu/~workshops)

- **GIS I: Finding GIS Data on the Web**, Oct. 26
- **GIS II: Mapping Your Data**, Oct. 31

Getting Additional Help

Online Tutorials- Learn GIS at your own pace through virtual tutorials. ESRI online tutorials are available free to KU-affiliates and can be used by individuals or classes. See a list of courses at: www.kars.ku.edu/user/vc_courses.shtml and email or call (data@ku.edu, mickey@ku.edu or 864-1238, 864-0454) to register for one or more.

GIS and Data Lab - 105 Anschutz Library

Hours (while KU is in session): Mon-Thurs **9AM-8PM**, Fri **9AM-5PM**, Sat/Sun **1PM-5PM**

Contact: data@ku.edu or 864-1238 (Rhonda Houser), 864-7777 (Mickey Waxman)



More information: www.lib.ku.edu/gis

Copy Workshop Data

- To copy workshop data from network drive to hard drive, click on Start (button) → Programs → ArcGIS → Data
- Click once on the folder called **gis1**
- Under **File and Folder Tasks**, choose '**Copy this folder**'
- Make sure **c:\wutemp** is selected as file destination
- Click on '**Copy**'

Explore ArcCatalog

- Click on Start Menu → Programs → ArcGIS → **ArcCatalog**

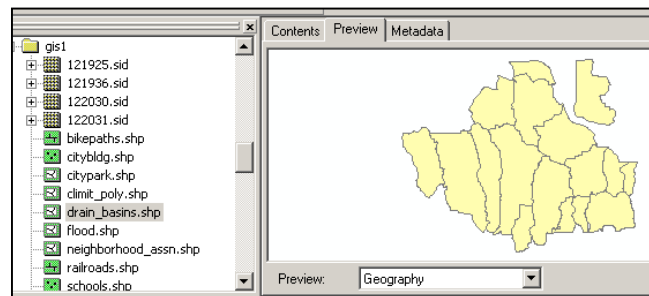
ArcGIS is a suite of software that includes  **ArcMap**,  **ArcCatalog**, and **ArcToolbox**,  among other modules. ArcCatalog is for data management; ArcMap is primarily for displaying and working with data, and ArcToolbox is for data conversion and manipulation.

In ArcCatalog, users can create, preview, delete, etc. files and metadata. In ArcMap, users can display data, create, query and edit features and attributes, perform analysis of features and more. ArcToolbox allows conversions, model building, spatial analysis and statistics and more in-depth work with data.

- Navigate to **c:\wutemp** and double-click on the **gis1** folder
- In left-hand window where data layers are listed, click once on the **drain_basins** data layer

ArcCatalog shows information such as format, source, map display (tabular and spatial), and projection. ArcCatalog is your 'file manager' for ArcGIS. ArcCatalog shows files by GIS format and file type, different from the way files appear in Windows Explorer.

- Click on the 'Preview' tab at bottom of window to display the 'Geography' and 'Table' components of the drain basin data.



What type of shape is used to represent drainage basins in Lawrence?

How many polygons (drainage basins) are there?

- Click on the 'Metadata' tab for information such as data source, date created, geographic coordinate system used, etc.
- Click on the 'Spatial' tab

What is the coordinate system used for this layer?


What are the units of measurement for this layer (meters, feet, etc.)?

- Click on the 'Attributes' tab

What types of information come with the layer? (look at column headings in attribute table)



Note you can add layers to ArcMap by dragging and dropping from ArcCatalog.

Explore ArcMap

- Click on the globe  next to the red toolbox to **launch ArcMap from ArcCatalog**

GIS data may come from various sources, including the following:

- User creates from sampling, surveys, known locations, based on reference data, etc.
- User generates from other data such as latitude/longitude coordinates, geo-referenced tabular data, data created in GPS unit, etc.
- User obtains from local, state or federal government, academic/ research institution, non-profit, individual, etc.


- Close ArcCatalog
- Click OK to start in ArcMap with a new empty map (if such message appears)
- Maximize ArcMap (click on  middle button, top right corner)
- Find your toolbar 



Add Data


Aerial Photos (Basemap) Layer


- Click on the 'Add Data' button  to bring data layers into ArcMap
- Navigate to: **c:\ wutemp\ gis1**
- Add the raster layer (aerial photo): **121925.sid**
- Click on layer title (file highlighted in blue) and click on 'Add'

What are raster data?


- Click 'OK' for any messages that appear about building pyramids or about spatial reference
- Double-click on the photo name in the table of contents.
- Click on the **Source** tab, and scroll down to note the lack of coordinate system information. The photo may be in a particular geographic projection or coordinate system, but this reference information was not recorded in the dataset, and so does not appear on the **Source** tab.
- Click Cancel
- Click on the 'Add Data' button 
- Hold down the **Ctrl** key while clicking on (selecting) each of the three remaining aerial photos to add them all at once: **121936.sid, 122030.sid, 122031.sid**
- Click on 'Add'

- Click on 'Full Extent' button  to see entire area covered by the air photos
- Click on the 'Precise Zoom In' tool  then click, hold and drag a box around an area on the map that you want to see closer

To deactivate current tool being used or switch to another tool, click on the Select Elements button  (default tool or cursor) or click on another tool


- Click on the 'Previous Extent' button  to return to the last zoom
- Find Jayhawk Boulevard, Strong Hall, South Park, or where you work or live on campus
- Click on the 'Window' menu and choose 'Magnifier' to bring up a magnification window
- Move the window by clicking/ dragging the top blue bar
- To change magnification level, right-click on the blue bar and choose 'Properties'
- Close the 'Magnifier' window
- Turn one air photo **on** or **off** by clicking in the box next to the layer title (to remove checkmark)
- Turn all layers **on** (make them draw)

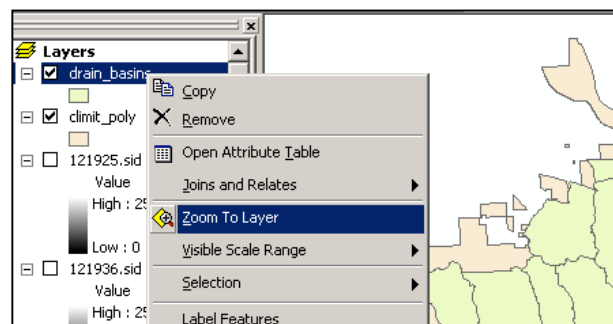
City Limits Layer

- Click on the 'Add Data' button  to bring in more layers
- Navigate to: **c:\ wutemp\ gis1**
- Select the vector layer for city limits: **CityLimits.shp**
- Click on 'Add'
- Right-click on layer title and choose 'Zoom to Layer'
- Turn this layer on if not already

What is vector data format?


Drainage Basins Layer

- Click on the 'Add Data' button 
- Navigate to: **c:\ wutemp\ gis1**
- Select the vector layer showing drainage basins: **drain_basins.shp**
- Click on 'Add'
- Zoom to the extent of this layer (right-click)




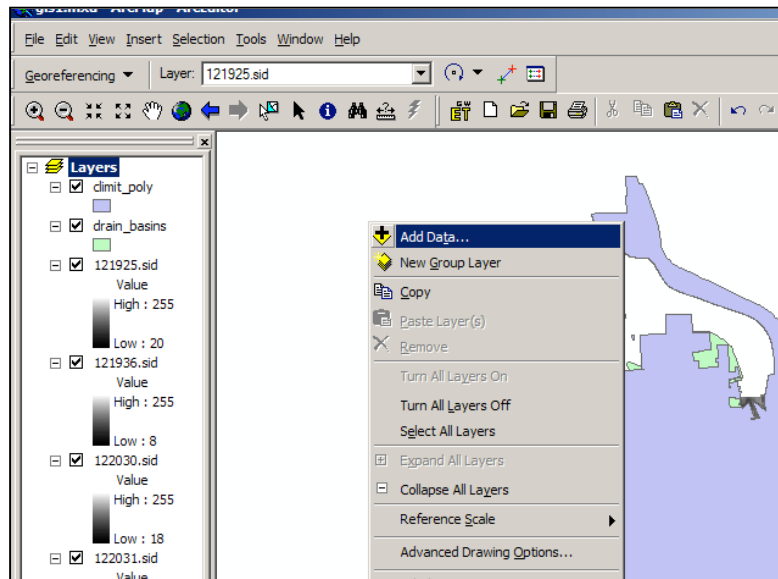
- Turn this layer on, if not already


Data are layered one on top of the other in the view (stacked out toward you), according to their order in table of contents (left-hand listing of data layers). Most recent layers added will be on top, with point layers over line layers and line layers over polygon layers.

- Change layer order: click on **drain_basins** layer title, hold and drag layer below the **city limits** layer
- Drag **drain_basins** layer back to top in table of contents
- Click on 'Identify' tool . This tool brings up associated attribute information for a feature (point, line or polygon) that you click on. By default, **information is shown for top layer**.
- Choose drain basin as the target layer
- Click inside one of the drainage basins
- Close the 'Identify' tool window


Water Bodies Layer

- Right-click somewhere in the mapping view (data frame), and choose  'Add Data'
- Navigate to: **c:\ wutemp\ gis1**
- Select the vector layer for water bodies: **water.shp**
- Click on 'Add'
- Right-click on layer title and choose 'Zoom to Layer'
- Turn on only water bodies and aerial photos



- Click on the 'Pan' tool  then click, hold and drag map to move
- Also, use scroll bars at bottom and right to move around on map

City Parks Layer

- Click on the 'Add Data' button 
- Navigate to: **c:\ wutemp\ gis1**
- Select the vector layer for parks: **parcs.shp**
- Click on 'Add'
- Right-click on layer title and choose 'Zoom to Layer'

- Turn this layer on if not already
- Remove **parks** layer: by right-click on layer title and choose '**Remove**' (this does not delete data from hard disk)
- Add **parks** layer back in
- Turn on only this layer
- Right-click on **parks** layer title and choose 'Zoom to Layer'
- Right-click on **parks** layer to select, and choose 'Open Attribute Table' to view tabular data

What types of information are given for parks?
(use scroll bar to see all field/ column headings)



- Close the parks attribute table

What is the basic format of geographic data?

The screenshot shows a map with several green polygons representing parks. An attribute table titled 'Attributes of citypark' is overlaid on the map. The table has four columns: CITYPARK, CITYPARK_I, PARKNAME, and CLASSIF. The data rows are as follows:

CITYPARK	CITYPARK_I	PARKNAME	CLASSIF
21	4		community
2	1	Riverfront Park	community
3	2	Maple Grove Cemetery	cemetery
4	250	future park (undeveloped)	future
5	1	future park (undeveloped)	future
6	1	Martin Park	community
7	1	future park (undeveloped)	future
8	1	future park (undeveloped)	future
9	1	Burcham Park	community
10	1	future park (undeveloped)	future

Streets Layer

- Click on the 'Add Data' button 
- Navigate to: **c:\ wutemp\ gis1**
- Select the vector layer delineating streets: **streets.shp**
- Click on 'Add'
- Turn off all other layers
- Right-click on **streets** layer title and choose 'Zoom to Layer'
- Turn on all layers
- Click on 'Full Extent' button  to see total area covered by data layers

Which layer covers the largest geographic area?

What is the geographic area covered/shown by most of the layers?

- Click on the **Source** tab at the bottom of the table of contents, for a listing of data layers by where they are saved. The **Display** tab shows layers by drawing order, while the **Source** tab shows layers by their storage location. The **Selection** tab gives access to all selections options (zoom to selected features, switch selection, etc.) by right-clicking on a specific layer. Make sure **Display** tab is always showing for this exercise.

Change How Data Display

ArcMap applies a **default display scheme** to data layers (i.e. the colors, classes and patterns used to display data). These **settings are dynamic** and can be changed so that data are displayed using the information in the attribute table or with a certain color, line thickness, or particular symbol.

- Turn off (uncheck box for) every other vector layer except the one being edited below so changes are apparent. Leave aerial photos (raster data) on as a base map.

City Limits Layer

- Zoom to the extent of this layer (right-click)
- Double-click on the title (next to check box) of the **city limits** layer in the table of contents, to bring up the 'Layer Properties' window
- Click on the **Source** tab and look in the 'Data Source' box; note the 'Shapefile' (actual file location and file name) and the 'Geometry Type' (polygon)
- On the **Symbology** tab, click on the box of color near 'Symbol'
- Under Options, change 'Fill Color' to **No Color** and set 'Outline Width' and 'Outline Color'
- Click OK and OK again

Water Bodies Layer


- Double-click on the title of the **water** layer
- Click on the **General** tab and type a name for the layer
- Click Apply (notice the layer name change)
- On the **Symbology** tab, click on the box of color near 'Symbol'
- Choose a color scheme from the left or under Options set 'Fill Color,' 'Outline Width' and 'Outline Color'
- Click OK
- Click on the **Display** tab and set the transparency level at 40 to 60% so layers underneath can be seen
- Click OK



Streets Layer

- Double-click on the title of the **streets** layer
- Click on the **Source** tab and look in the 'Data Source' box

What type of geometry is used to represent streets?

- On the **Symbology** tab, click on the button with the line
- Choose a line scheme from the left or under Options, set 'Color' and 'Width'
- Click OK
- Click on the **Labels** tab and make sure 'Label field' is set to **Name**, so any labels added to identify streets use data from the **Name** column (in attribute table)
- Click OK
- Right-click on the **streets** layer title and choose 'Label features'
- Click on 'Fixed Zoom In' tool  to zoom in (closer) at regular intervals

What happens to street names as you zoom closer?

Parks Layer

- Double-click on the title of the **parks** layer
- Click on the **Symbology** tab
- In the 'Show' box click on 'Categories' and select 'Unique Values'
- Change the 'Value Field' to **CLASSIFICA** (type of park)
- Click 'Add All Values'
- Click OK

Drainage Basins Layer

- Double-click on the title of the **drain_basins** layer
- Click on the **General** tab and type a layer name
- Click on the **Symbology** tab
- Under Options, change 'Fill Color' to **No Color** and set 'Outline Width' and 'Outline Color'
- Click OK

Save Settings and Data as One File


- Choose File → Save As and save map document in **c:\wutemp** as **mymap.mxd**

You can save existing data, settings, display schemes, etc. as **ONE** file. Map document files end with .mxd and do not store actual data layers, but references to those layers and settings for data and the data frame. Map document files cannot be opened on other computer unless the data are in the same location.

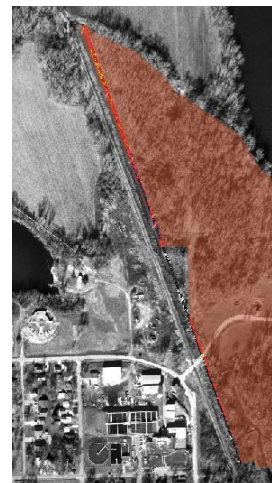
- Choose File → New to close this map file
- Click OK
- Now open your saved map file by choosing File → Open
- Navigate to c:\wutemp, where your map document file is stored. This file includes paths to the location of the actual data layers, which may be elsewhere.
- Highlight the name of your map file and click Open
- As you work, choose **File → Save** to save changes

Compare View Projections

- Choose **View → Data Frame Properties** (or right-click in the View)
- Click on the **Coordinate System** tab and in the 'Select a Coordinate System' box choose:
Predefined → Projected Coordinate Systems → State Plane → NAD 1983 (feet)
NAD 1983 StatePlane Kansas North FIPS 1501 (Feet)
- Click OK
- Choose **View → Data Frame Properties** again
- On the **General** tab, change Display Units to **Meters**

- Click OK
- Find and zoom into Burcham Park (near the river)
- Click on the  Measure Tool to measure the west (left) perimeter of this park from SW to NW side
- Click and drag to start measuring; double-click to stop
- Distance is simultaneously displayed at the bottom left of the data frame
- Write down the total distance _____ m (State Plane)


- Choose **View → Data Frame Properties**
- On the **Coordinate System** tab, in the 'Select a Coordinate System' box choose:
 - Predefined → Projected Coordinate Systems → UTM → NAD 1983 → **NAD 1983 UTM Zone 14N**
- Click OK
- Zoom into Burcham Park again if necessary
- Use the Measure Tool again to measure the same side of the park
- Write down the total distance _____ m (UTM)



Projections affect **distance, area, direction or shape** (or a combination of these). Depending on the scope and scale of a dataset or project and level of accuracy required, using different projections might clearly make a difference in distance (or other parameters).

How wide is the Kansas River at the downtown bridge?

How long is the path that loops around the 'Train Park' at 6th and Kentucky streets?

What is the real name of this park? (use  Identify tool)

- Change the projection back to Kansas State Plane North by following the directions at the beginning of this section
- Find the map scale at the top of the data frame; ArcMap uses the **map units** to determine the correct scale of your view
- Locate Memorial Stadium and Potter Lake and note the scale at which you can first identify them

Determine which parks are within the Broken Arrow drainage basin


Label Drainage Basins

- Turn off all layers except **drainage basins** and **parks**
- To set the field (or column heading from attribute table) used to label the features in a layer, double-click on **drainage basin** layer title to bring up 'Layer Properties'
- Click on **Labels** tab and choose **BASIN** in the drop-down box for Label Field
- Click OK
- Right click on the **drain_basins** layer title in table of contents and choose **Label Features** (repeat this if you want to remove labels)

Highlight 'Broken Arrow' drainage basin:

- Right-click on **drainage basin** layer in table of contents, and choose 'Open Attribute Table'
- Right-click on the 'Basin' column name and choose 'Sort Ascending' to alphabetize drainage basin names

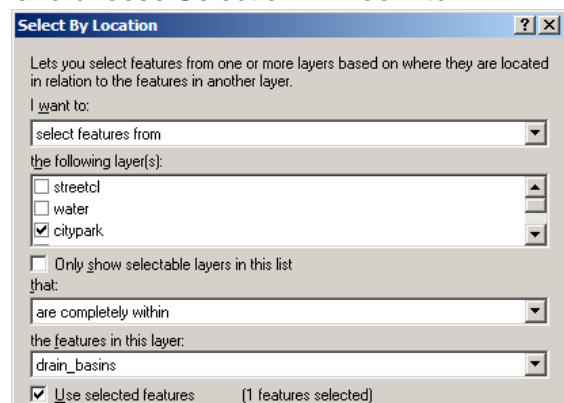
Note other available sorting options.

- Select '**Broken Arrow**' basin by clicking on the arrow at the far left of this record with the Pointer tool 

How many records are selected? (look at bottom of attribute table)

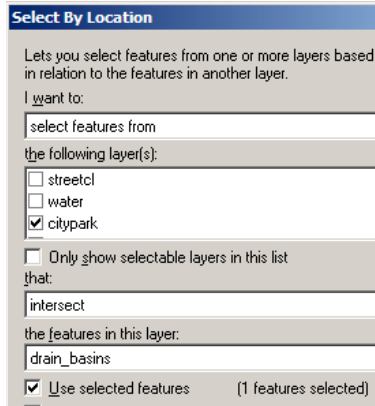
- Toggle between the 'Selected' and 'All' buttons to see highlighted record or all records
- Close the table, making sure the '**Broken Arrow**' basin is selected (highlighted)
- Zoom in to this drainage basin; right-click on layer and choose Selection → Zoom to Selected Features
- Choose **Selection → Select by Location** (select by relationship to features in other layers)
- Complete the phrase:

I want to: **select features from**
the following layers: **Parks**
that: **are completely within**
the features in this layer: **Drainage Basins**



- Make sure the **boxes are checked** next to 'Use selected features'
- Hit Apply and Close
- Zoom in to the selected parks manually, or right-click on **parks** layer and choose Selection → Zoom to Selected Features

How many parks are inside the Broken Arrow drainage basin? Which ones? (use identify tool or look in parks table)



- Go through the ‘Select by Location’ process again to find out how many and **which parks intersect** with the boundaries of the **Broken Arrow** drainage basin
- To generate a spreadsheet of these selected parks, open the parks attribute table
- Hit the ‘Options’ button at bottom left and **Export...** to copy selected table records into a .dbf file.
- Click ‘Yes’ to add the table to ArcMap, and open it to confirm the export worked (tables are added to the Source tab at bottom of Table of Contents)

Calculate average acres per type of park

- Right-click on the parks layer and open the attribute table
- Right-click on the CLASSIFICA column and choose ‘Summarize’ to figure the average size by type of park (community, neighborhood, etc.)
- Under ACRES, check the box next to ‘Average’
- Save the output table in c:\wutemp
- Click OK and Yes to add the table in

Attributes of type_acres				
	OID	CLASSIFICA	Count_CLASSIFICA	Average_ACRES
▶	0		4	0.8124
	1	cemetery	2	38.0011
	2	community	21	132.9167
	3	future	15	26.0915
	4	neighborhood park/play lot	32	4.6003

Find ‘community’ parks

- Choose Selection → Clear Selected Features to clear any previously highlighted features
- Open the attribute table of the **City Parks** layer (right-click on layer)
- Hit the ‘Options’ button and choose **‘Select by Attributes’**
- Use the ‘Create a new selection’ method
- **Double-click** on field name (CLASSIFICATION); **Single-click** on operator (=)
- Click ‘Get Unique Value’ button to display values from the table


- **Double-click** on field value (community) to complete the equation: "CLASSIFICATION" = 'community'
- Click on 'Apply' and 'Close' to see selected parks

Community parks are highlighted in the table (note number of records selected at bottom)

- Move and/or minimize the table to see the community parks highlighted

Format Data for Presentation

You can format data for presentation as a digital or print map by making a Map Layout. Make a map in **either portrait or landscape format**, showing the 'Broken Arrow' drainage basin (labeled), streets (labeled), and parks.


- Zoom in (if not already) to the **Broken Arrow** drainage basin
- Choose **View → Layout View** (toggle between Data and Layout view with icons at bottom left )

Data view navigation tools allow you to zoom in, out, etc. to the data layers you are using.

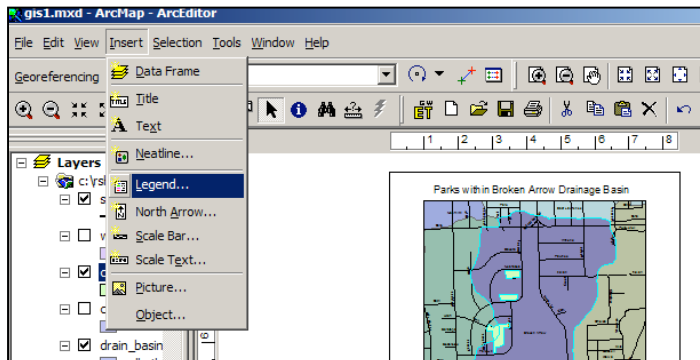


Layout view tools allow you to zoom in, out, etc. from the layout page or surface, which does not change the level of zoom or focus by which data are displayed.



- Use both toolbars to explore the layout view
- Choose **View → Zoom Layout → Zoom to Whole Page** to see entire layout
- Right click in the layout view and choose 'Page and Print Setup' to change settings such as page orientation
- Toggle back to the data view by clicking on the globe icon 
- Open the selected parks DBF table you generated
- Hit the 'Options' button and choose 'Add Table to Layout' to bring this table into your map

Try some of the following options from the 'Insert' menu to customize your map:

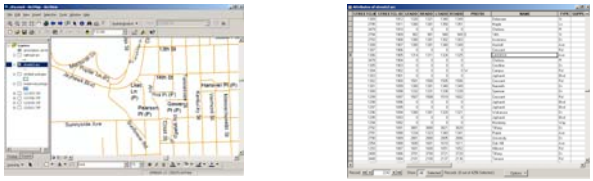


- **Insert → Legend** ...use the forward/backward arrows to add/remove layers to appear in the legend (key); keep the **streets, parks and drainage basin** layers in this legend; click Next and choose other settings; click Finish when done
- **Insert → North Arrow** ...follow prompts

- **Insert** → **Scale Bar...** follow prompts
- **Insert** → **Title...** follow prompts
- Click, hold and drag to **move** elements around
- Click and hold mouse over corner of layout element until double-headed arrow appears; resize element by dragging in or out
- Double-click on object to **edit** layout elements (scale, legend, etc.)
- Choose **File** → **Export Map...** to export layout as one image; this image can be inserted into a Word document, PowerPoint presentation or poster, or used in other programs

Note: Please complete a workshop evaluation. An online evaluation is linked from the internet browser 'Favorites' menu.

Definitions

Term	Definition
drainage basin	area of land that drains water, sediment, dissolved materials to a common outlet at some point along a stream channel.
geographic data	includes locations and descriptions of geographic features, or spatial and attribute information. 
geographic information systems (GIS)	system comprised of spatial data and software in which user can display and manipulate layers of information correctly located in relation to geographic coordinates.
large-scale map	area on ground represented by large area on map (1:2,500); large-scale maps usually show more detail than small-scale maps.
latitude and longitude	spherical reference system used to measure locations on Earth's surface; latitude measures angles in a north-south direction, and longitude measures angles in the east-west direction (from www.esri.com).
map projections	describe ways to represent areas on the Earth's surface (three-dimensional) on a flat surface such as a map; imagine trying to wrap a piece of paper around a globe; all projections distort shape, area, distance or direction to some extent.
map scale	dimensions of a map compared to the dimensions of the Earth, usually expressed as a ratio between a distance on the map and a distance on the Earth; for instance, a scale of 1:24,000 means 1 unit of distance on the map equals 24,000 units on the ground.
raster	type of spatial data in which features are represented by cells (or pixels) with same value and cells are organized in a grid of rows and columns; raster format is appropriate for data that vary continuously over space such as elevation; images and grids are types of raster data.
small-scale map	area on the ground is represented by a small area on the map (1:1,000,000); small-scale maps usually show less detail, but cover larger areas.
vector	type of spatial data in which features are represented by points, lines or polygons; coordinate-based structure (XY or latitude-longitude) commonly used to represent linear features; coverages and shapefiles are types of vector data.

Last Update: 10/25/2006