Getting Started with GIS (for ArcGIS 10.1)

Much of the information provided in this tutorial can be found with example data and video tutorials here:
http://training.esri.com/gateway/index.cfm?fa=catalog.webCourseDetail&courseid=2500

Summarized by Kim Ness, 12/4/2012

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I. After reading this, you will be able to:

1. Define GIS.
2. Differentiate between vector and raster data.
3. Navigate a GIS map.
4. Use tools to access feature information.

II. **Definitions**:

1. **Attribute Query=** Request for features based on values in the attribute table. The three basic components of an attribute query are the attribute field, operator, and attribute value.
2. **Feature=**A representation of a real-world object on a GIS map
3. **Geographic Coordinates=**A measurement of a location on the earth's surface expressed in degrees of latitude and longitude.
4. **GIS=**Acronym for geographic information system. An integrated system of data, software, hardware, people and workflows used to answer questions, make decisions, and provide tools to create, share, and use geographic information.
5. **Layer=**References GIS data that represents real world features. The layer creates a symbol to represent the collection of these features. The features in a layer have the same theme, geometry, and set of attributes.
6. **Location Query=**Request for features based on the location and spatial relationship to other features. The three basic components of a location query are the layer containing features to select, the location relationship, and the layer containing the related features.
7. **Metadata=**Information that describes the content, quality, condition, origin, and other characteristics of data.
8. **Raster=**A data model that defines surfaces as an array of equally sized cells arranged in rows and columns. Each cell contains an attribute or measurement value. A raster's origin, cell size, and relative cell location are used to determine the location of the cells and raster on the earth.
9. **Scale=**Relationship between the size of a feature on a map and the actual size of that feature in the real world. Scales can be expressed as a ratio or an equivalence.
10. **Vector=**A data model that represents geographic features as points, polylines, and polygons. Attributes are associated with each vector feature, as opposed to a raster data model, which associates attributes with grid cells. Vector data uses pairs of geographic coordinates to determine the location of the features on the earth.

III. How a GIS Works

- Whether you search an address on the Internet or map fire truck routes, you can use a GIS to get the information you need. GIS provides tools to create, share, and use geographic information with others. For example, you can locate addresses for each of your customers, share this information with your co-workers, and work together to build a customer profile.
- The functionality and versatility of a GIS depends on the system itself. A GIS integrates ***hardware, software, data, people, and workflows*** into its comprehensive package.

IV. What is GIS data?

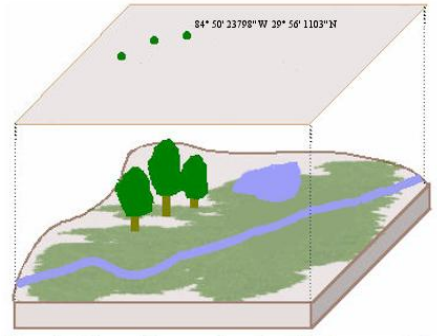
- Trees, buildings, streets, and lakes are examples of real-world objects. When using a GIS, these objects are referred to as features. How would you represent these features in a map? What about something that is harder to visualize, such as rainfall? There are 2 main types of geographic data: VECTOR and RASTER data.

1. Vector Data:

Used to define objects with distinct boundaries, such as roads, parks, and land parcels. In order to accurately represent these objects, a GIS provides different geometries to use depending on the object you are trying to represent. The three geometries are points, polylines, and polygons.

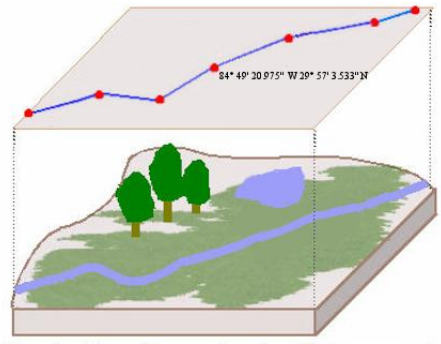
POINTS:

Points are defined by a single location. This image illustrates the points used to represent trees. Each point has a longitude and latitude location (also referred to as geographic coordinates) that defines the precise location of the feature on the earth. This image provides an example of the geographic coordinates for one of the tree points.



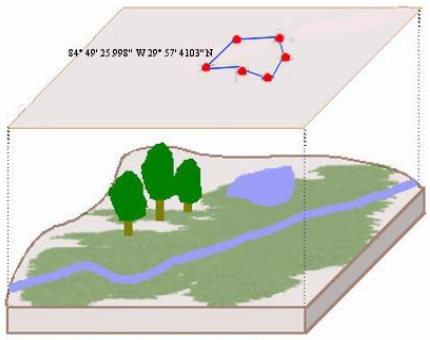
POLYLINES:

Polylines are defined by two or more locations that are connected with lines. This image illustrates the polyline used to represent the river. Each location has a longitude and latitude (also referred to as geographic coordinates) that defines the precise location of the river on the earth. This image provides an example of the geographic coordinates for one of the polyline locations.



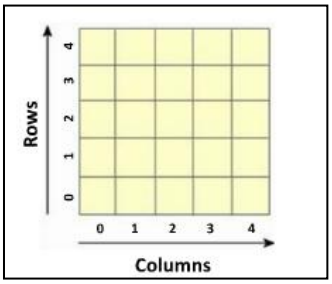
POLYGONS:

Polygons are defined using multiple locations that are connected and closed. This image illustrates a polygon used to represent the lake. Each location has a longitude and latitude (aslo referred to as geographic coordinates) that defines the precise location of the lake on the earth. This image provides an example of the geographic coordinates for one of the polygon locations.

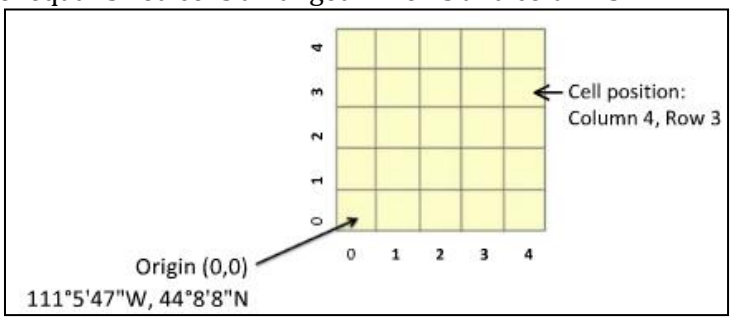


2. Raster Data:

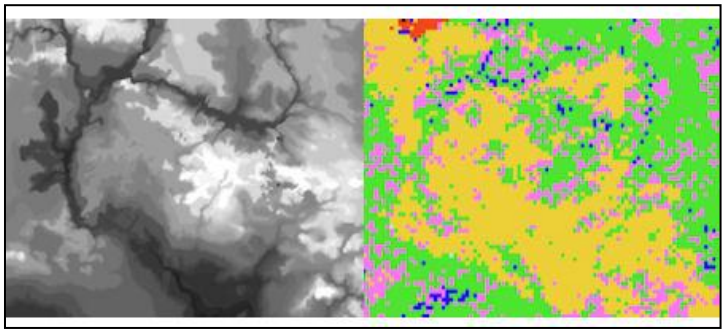
Not every object or phenomena has distinct boundaries. Precipitation, heat from a forest fire, and satellite imagery are all examples of features and phenomena with a continuous surface, without a defined outline. A continuous surface describes a surface where every location has a value, and every value could be unique; for example, elevation. A GIS represents this information using a **raster** data model. Look at figures a-d to understand what raster data is.



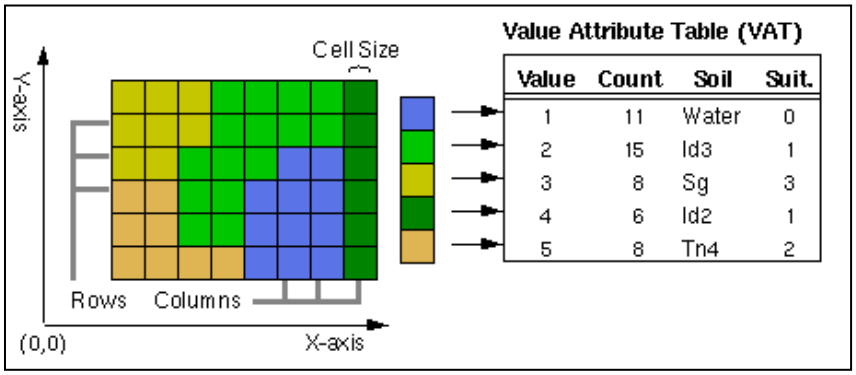
a. A raster is made up of equal-sized cells arranged in rows and columns.



b. The raster has an origin (real-world location). A GIS uses the origin, relative cell location, and cell size to determine the location of the cells on the earth.



c. Each cell in a raster stores a value. The value can represent a continuous measurement such as elevation or a discrete value such as land cover.



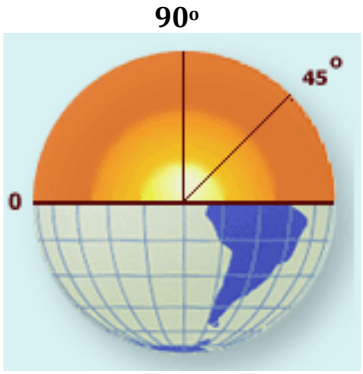
d. Discrete rasters can have values that represent a code for a particular category. In this case cells with the same value are counted and stored in the raster's value attribute table (VAT).

V. Refresher on Coordinates

Definitions from the National Atlas Map: see this link to understand latitude and longitude. See this link:
http://www.nationalatlas.gov/articles/mapping/a_latlong.html

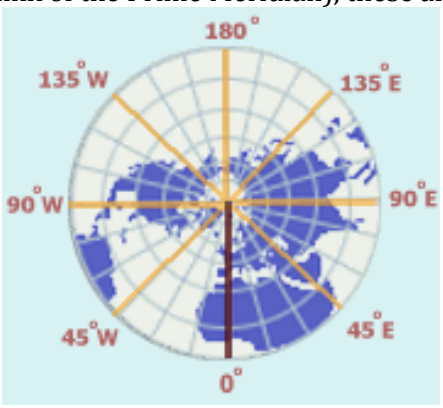
1. Latitude:

- Lines of equal distance apart and parallel to the Equator. Degrees are only 0° to 90° in the northern hemisphere and 0° to (-90°) in the southern hemisphere.



2. Longitude

- Also called meridians (think of the Prime Meridian), these are lines that the poles.



3. How should Bad River staff enter their GPS coordinates?

GPS coordinates (latitude and longitude) on a globe (3D surface) are transferred to flat maps (a plane) via a mathematical formula called a *Projection* http://www.connect.net/jbanta/FAQ.html.

We use *Projections* to convert 3D latitude and longitude to 2D flat surface maps. Consider cutting a globe into pieces and stretching it to fit on a flat surface.

Most of the files I found use *NAD83 UTM 15*. The break-down of this Projection system is:

- "NAD" = North American Datum and "83" = 1983 : Latitude and longitude were measured in 1983 to minimize the distortion of distances, and sizes for North America. *There are others such as the World Geodetic System 1984, which minimizes the distortion for the entire world.*
- "UTM 15" = Universal Transverse Mercator, Zone 15: this represents the 15th slice of the 60 slices around the world. Each slice is 6°, and minimizes the distortion for the areas covered by the UTM Zone. See the USGS help document: http://egsc.usgs.gov/isb/pubs/factsheets/fs07701.html#grid

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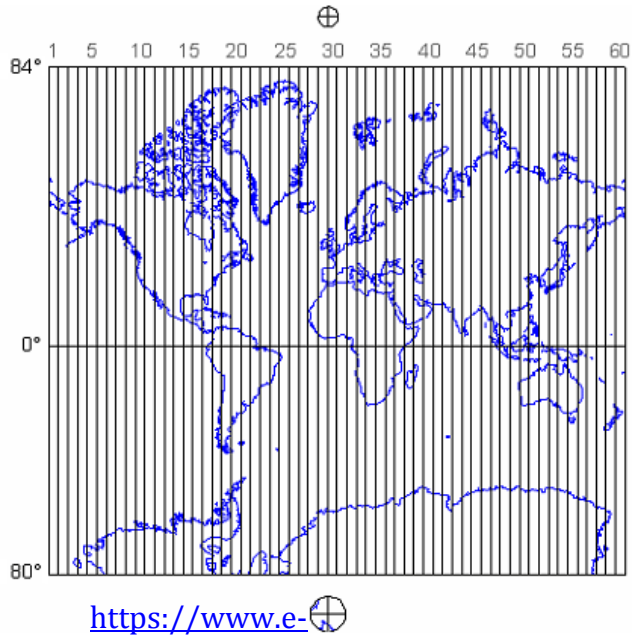


https://www.e-education.psu.edu/natureofgeoinfo/book/export/html/1695

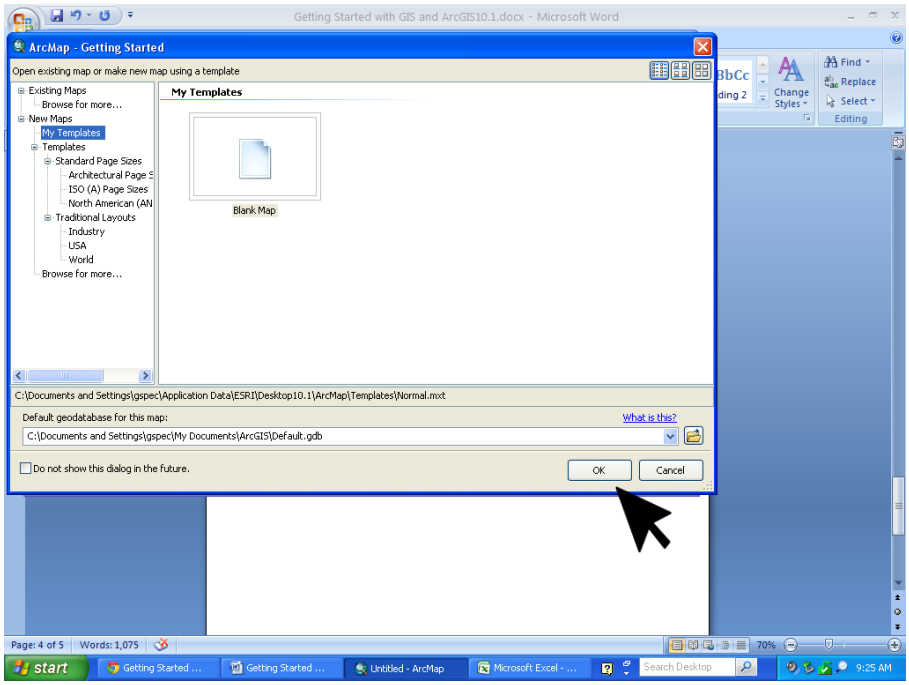
4. "Why don't my GPS lat/longs match my existing lat/longs?"
(*http://www.uvm.edu/giv/resources/WGS84_NAD83.pdf*)

"Almost certainly because your GPS receiver is set to output lat/long values referenced to a different datum than your existing lat/long values. GPS receivers calculate their locations referenced to the WGS84 datum. Most GPS receivers by default display WGS84 lat/long values. Most existing mapping data reference a local (non-WGS84) datum. Most GPS receivers have built-in datum transform software, and can be configured to output referenced to whatever datum the user requires."

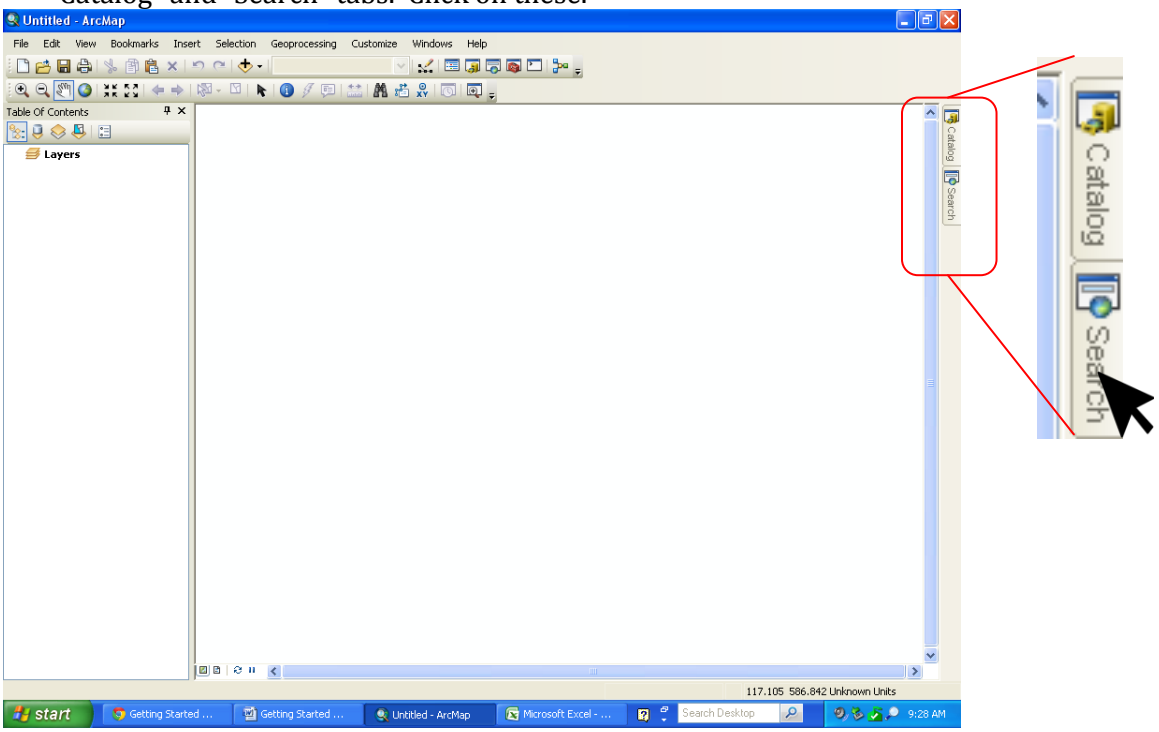
VI. Using ArcMap 10.1

1. Open ArcMap

- (Click on Start menu, choose All Programs > ArcGIS > ArcMap.In the ArcMap - Getting Started window, click Browse for more (located on the left side of the window, under Existing Maps).

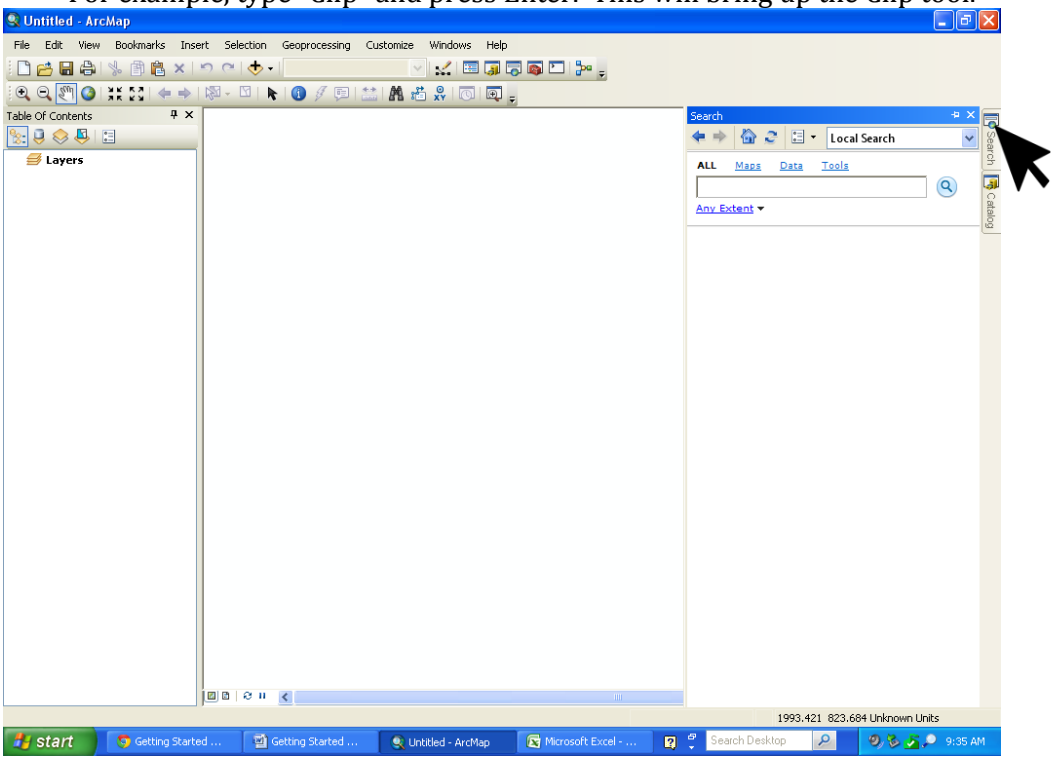


- Start a blank map, (or navigate to where your previous map is located). This is what a blank ArcMap document (with extension .mxd) looks like this. Notice on the RIGHT-side of page "Catalog" and "Search" tabs. Click on these.

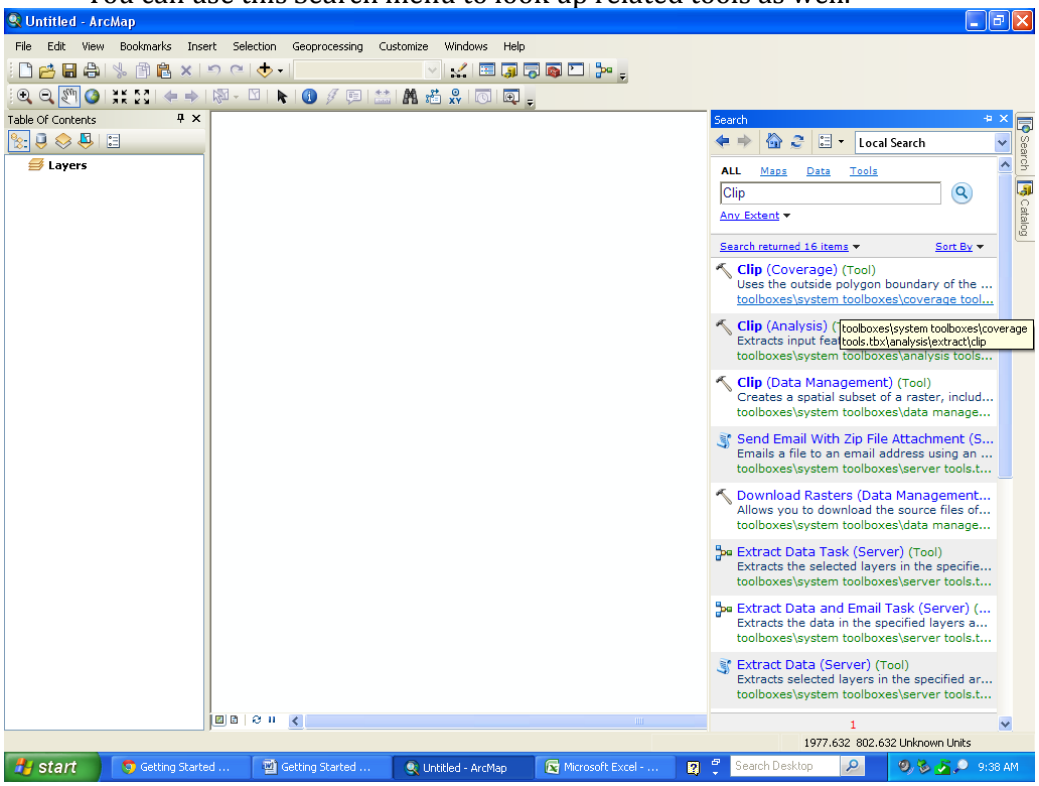


2. Using the Search bar for finding tools.

- Open the Search bar. You can use this Search bar to search for tools, or help documents. For example, type “Clip” and press Enter. This will bring up the Clip tool.

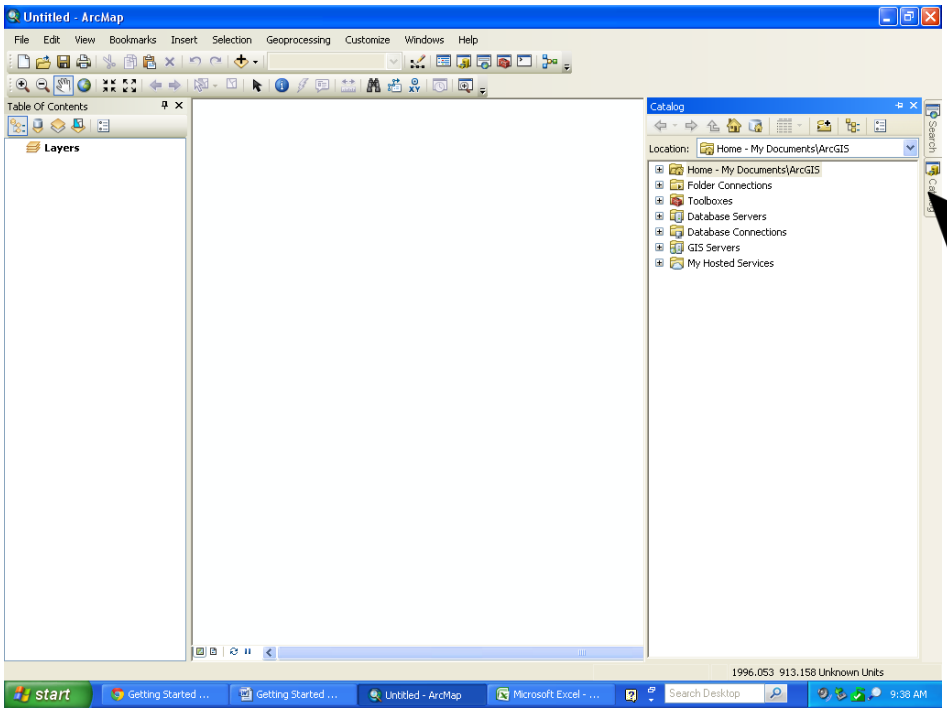


- You can use this Search menu to look up related tools as well.

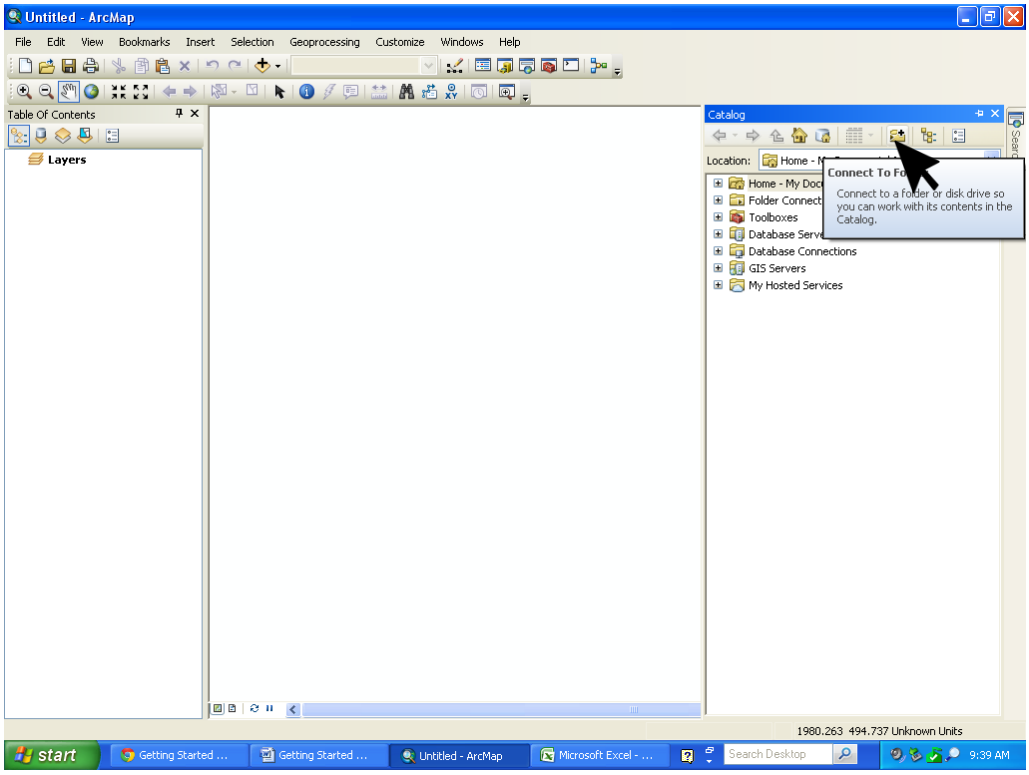


3. Connecting to a folder using ArcCatalog.

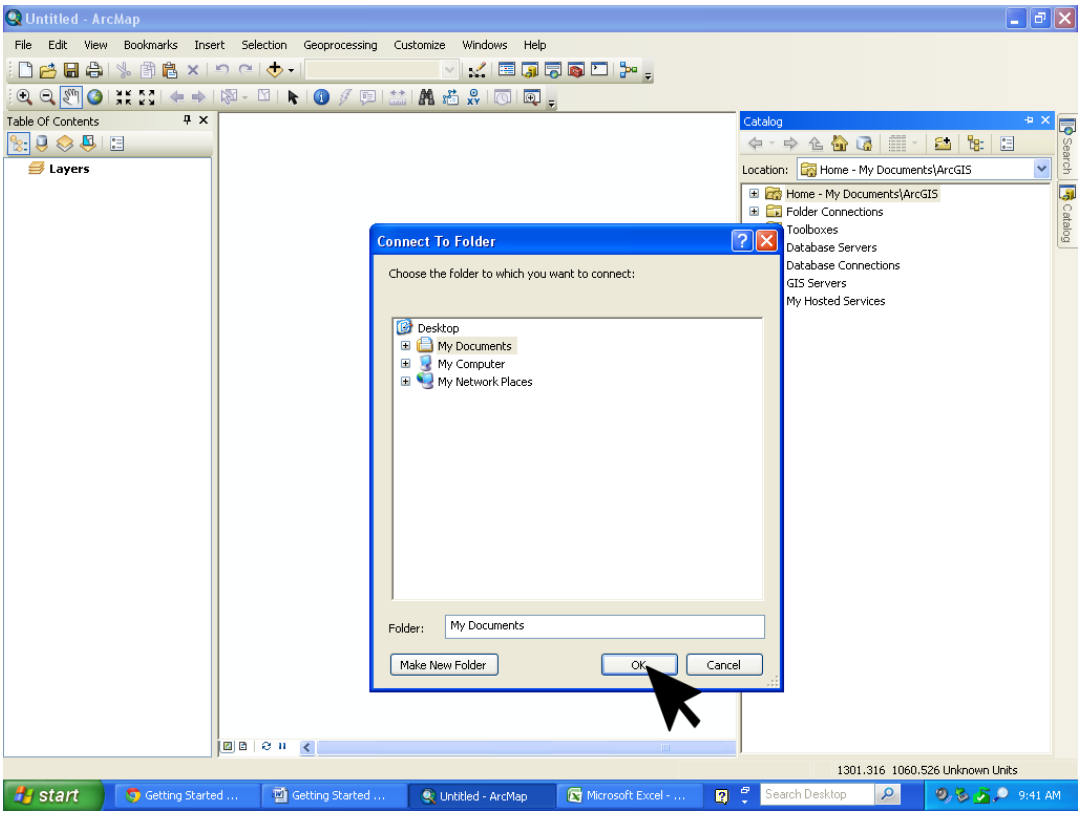
- Click on the "Catalog" tab. This will open up ArcGIS Catalog. This is a major difference from ArcGIS 9.3.1 in that you can have Catalog open at the same time and edit your data.



- Connect to a folder. YOU NEED TO DO THIS to find your data. Find the icon  to connect to the folder.

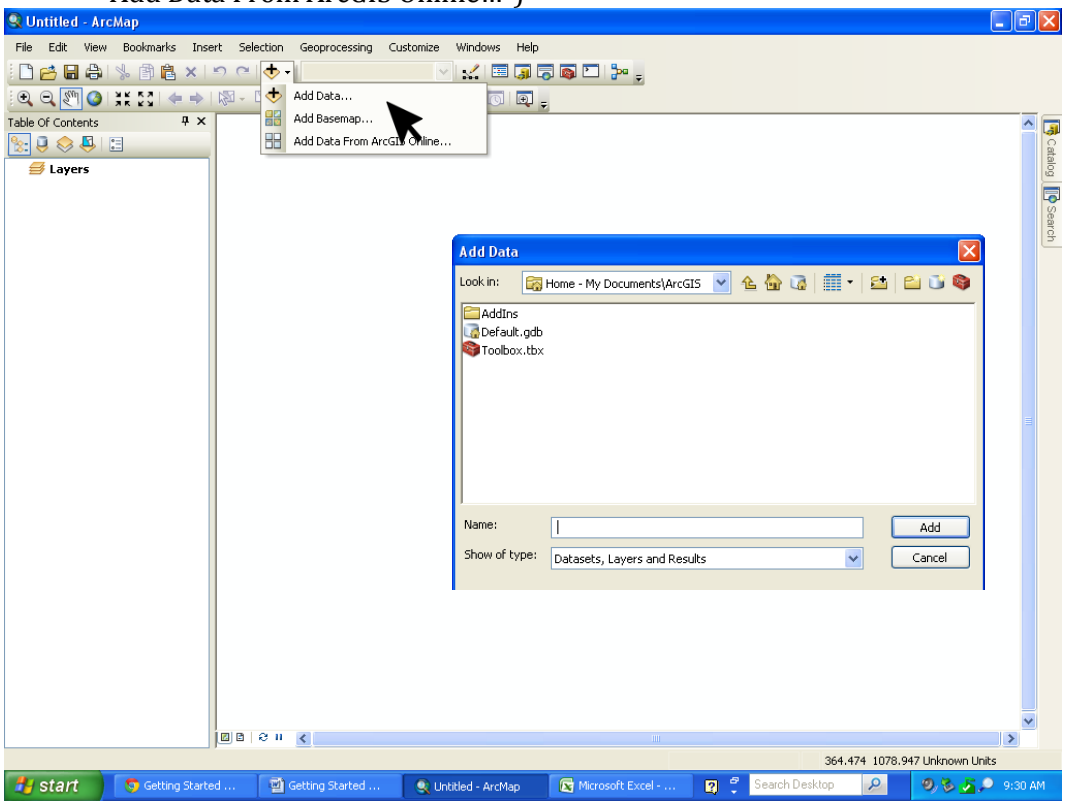


- Navigate to where your data are and click OK.



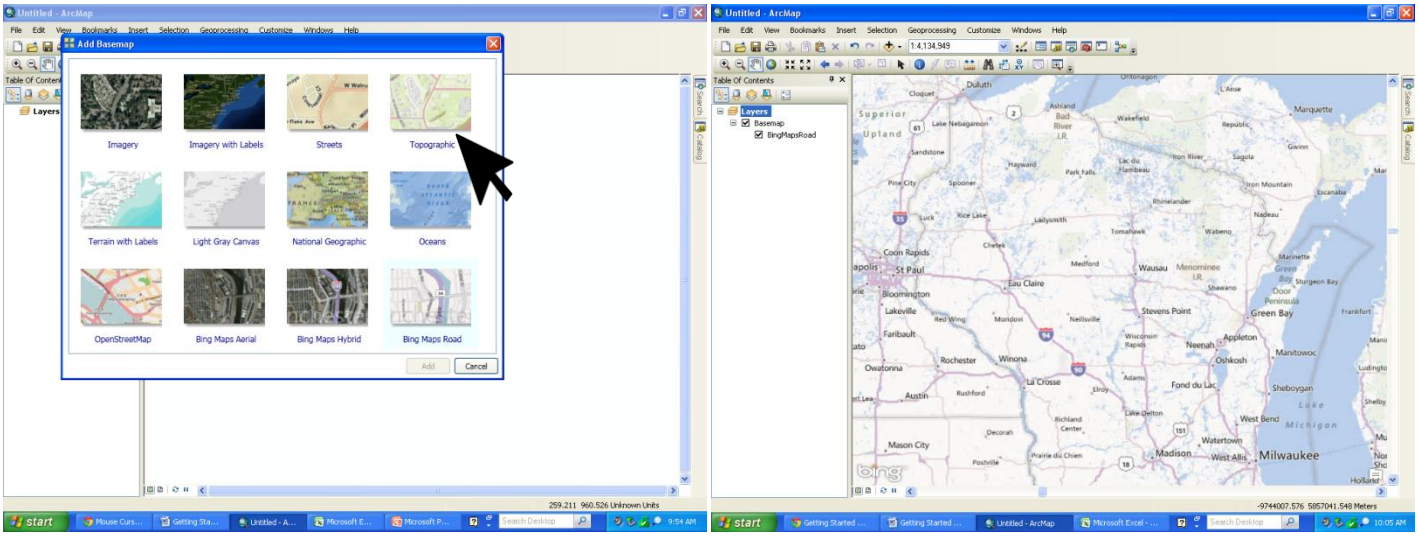
4. Find and add data.

- Navigate to where your are data located. You can also add free data ("Add Basemap" or "Add Data From ArcGIS Online…")



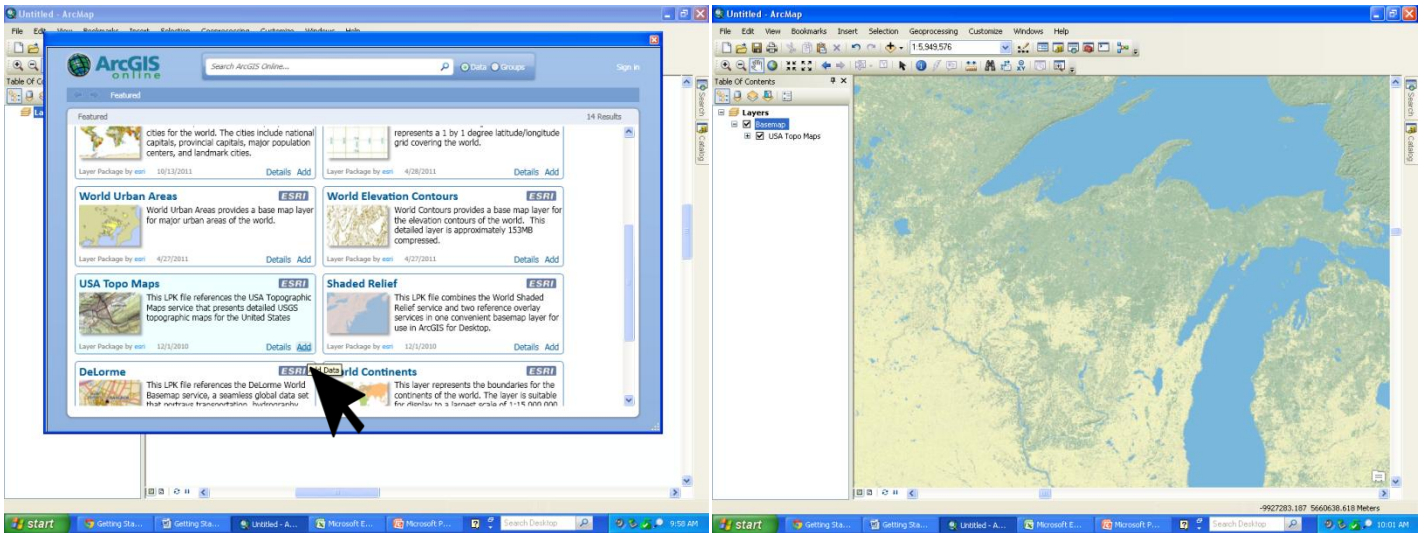
- Basemap layers and ArcGIS Online layers are free. I decided to add the Bing Roads Map layer (A), which displays the roads from Bing for the entire world (B)

A B

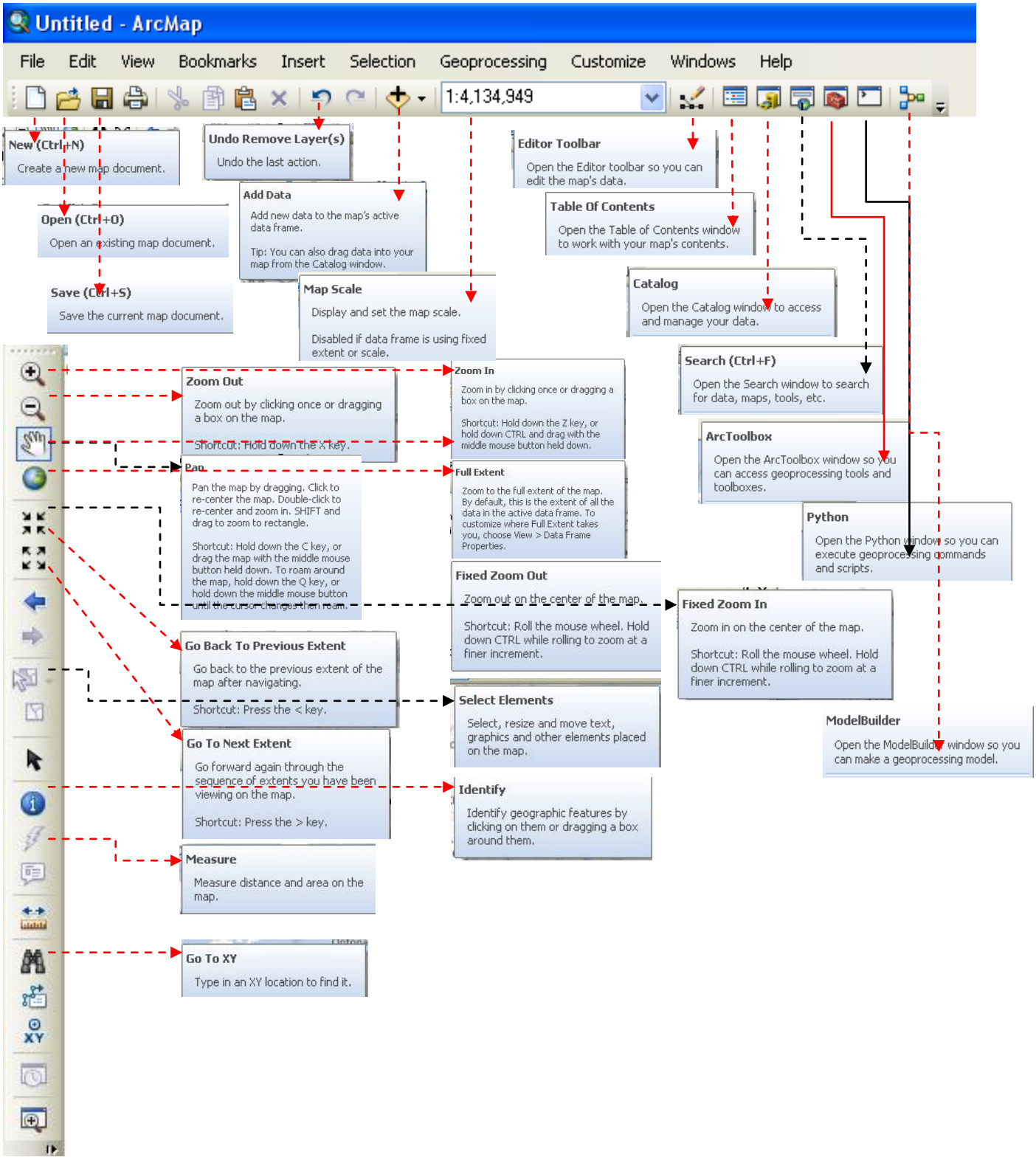


- Layers from ArcGIS Online are also free. These layers are out-of-the-box themes of gis data. Scroll through layers available and read through descriptions. I added the USGS Topo Maps (US Geological Topographic Quadrangles) (A). Click on "Add" and the layer will populate in your ArcMap mapping session (B). ***Zoom in closer and you will see additional roads appear at different zoom scales.*

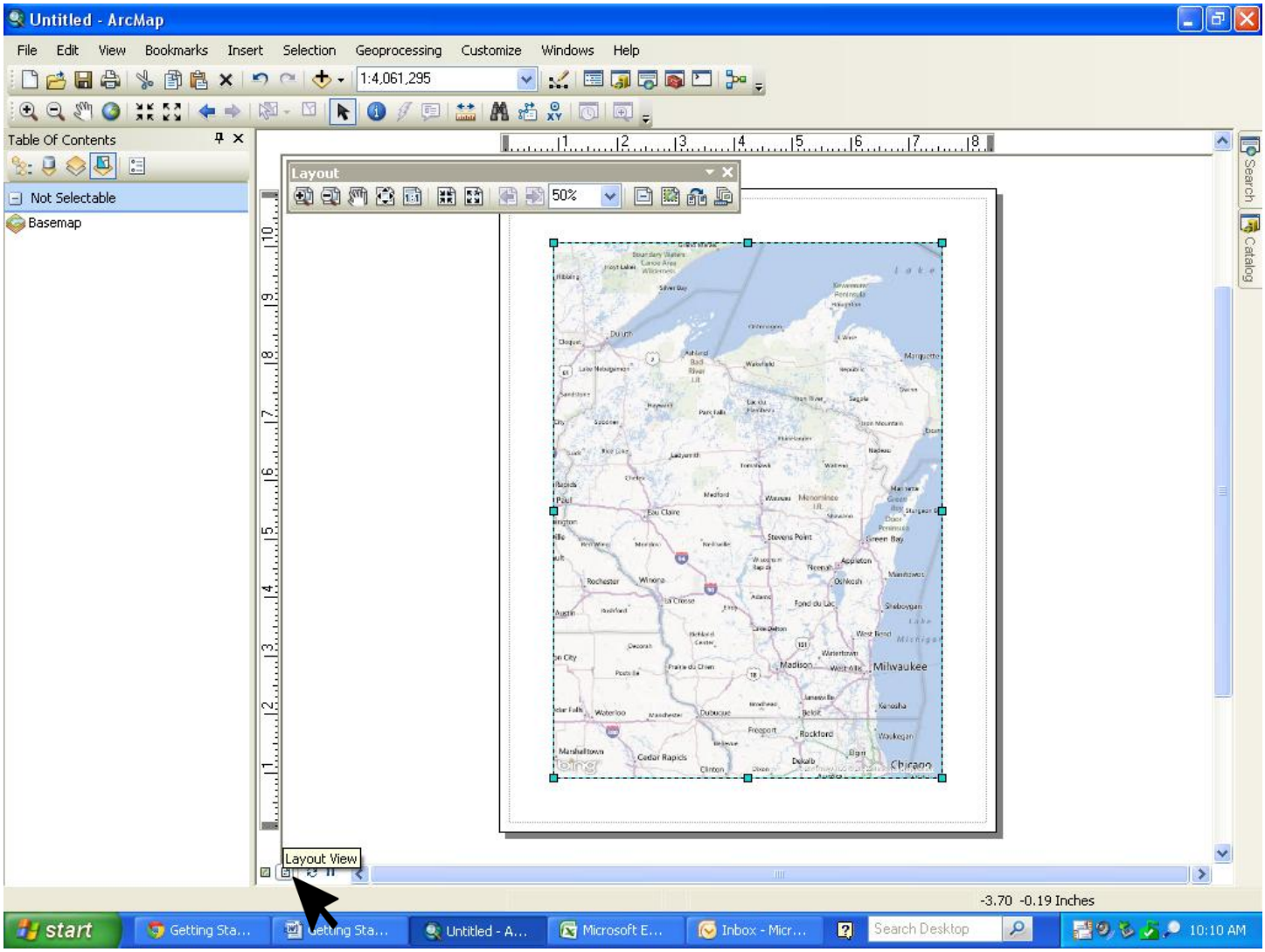
A B



5. Tools on Menu bar



6. Making a map with Layout View



7. Other Topics…

- *If you get here and want me to provide resources on some topic, email Kim Ness your topic ideas: gspec@badriver-nsn.gov .*

8. Searchable ArcGIS Resources

- http://resources.arcgis.com/en/help/main/10.1/#/Welcome_to_the_ArcGIS_Professional_Help_Library/00qn0000001p000000/
- http://resources.arcgis.com/en/help/main/10.1/#/A_quick_tour_of_ArcMap/018q0000000500000/