Geocoding Cookbook:

A Guide to Creating a Point So You Can Make a Point

Tennessee Department of Health

Communicable and Environmental Diseases and Emergency Preparedness

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Introduction

Geocoding is the process of geo-referencing a street address to a location on an electronic map. It is an important step in spatial analysis and can be carried out with programs like EpiInfo, ArcGIS, ArcExplorer, Excel, and a number of free online tools.

Researchers within the public health field have increasingly found geocoding to be a valuable tool with many uses. Current uses include determining geographic distribution of diseases; analyzing spatial and temporal trends; mapping populations at risk; stratifying risk factors; assessing resource allocation; planning and targeting interventions; and monitoring diseases and interventions over time.

This geocoding cookbook is meant to serve as a guide for everyday use. This cookbook does not propose to address every available avenue for cartography, spatial statistics, or geographic information systems comprehensively. There are many great additional resources for this listed in Appendix A.

Chapter 1: Preparing Address Data for Geocoding

Brynn Berger, MPH, CIC, and Laina Stanford

1.1 Background

The purpose of geocoding is to assign geographical coordinates to address data in order to display those data as points on a map. Geocoding matches address data of interest (e.g., hospital locations, patient residences, etc.) to a geographic information system (GIS) reference layer that contains address data for specific geographical features (e.g., street centerlines). This section provides basic tips on cleaning and formatting address data – also called "standardization" – to facilitate the geocoding process. Without proper formatting, your address data may be unmatchable or incorrectly matched to the reference layer, resulting in an inaccurate map. These tips will work for most standard geocoding tools, such as ArcGIS and EpiInfo 7.

1.2 Street Address Elements

Street addresses are comprised of several elements:

- Number: identifies the point along the street at which the address resides
  - Examples: **120** W MAIN ST ; **345** AVENDIA C ; **156** SCENIC PKW SE ; **5870** HWY 200
- Directional: the road direction or "bearing"
  - Examples: 120 **W** MAIN ST ; 345 AVENIDA C ; 156 SCENIC PKW **SE** ; 5870 HWY 200
- Type: a descriptor that identifies the type of street, which can come before or after the street name
  - Examples: 120 W MAIN **ST** ; 345 **AVENIDA** C ; 156 SCENIC **PKW** SE ; 5870 **HWY** 200
- Name: the primary name given to the street
  - Examples: 120 W **MAIN** ST ; 345 AVENIDA **C** ; 156 **SCENIC** PKW SE ; 5870 HWY **200**
  - Note: commonly, "HWY 200" is thought of as the street name, but notice in the above examples that "HWY" is not a part of the street name.

1.3 Storing Address Data

- Data storage: Store your address data in a database-compatible format.
  - Examples: comma-separated values (.csv), tab-delimited text file (.tab), dBase (.dbf), Excel spreadsheet (.xls)
    - If storing data as an Excel spreadsheet, place field names in the first row and do not include formatting rows (e.g., spacer rows).

1.4 Formatting Address Data

- Fields (columns):
  - Place the street address in a single column containing the number, directional, type, and name.
    - Include all necessary address elements that are known (see "Street Address Elements" above). Omission of street types or directionals could result in mismatched records.
      - Example: 123 MAIN could include MAIN ST, MAIN DR, MAIN RD, etc.
    - Intersection names can be included; see "Special Cases" for more information.
    - Secondary address information (e.g., apartment, suite, building, floor) should not be included in the street address field; create a separate field if you need to maintain this information.
  - Place city, state, ZIP code, and attribute data (e.g., hospital bed sizes) in separate fields.
    - Include ZIP code at a minimum if possible.
    - ZIP code should be stored as a text (string) field to maintain any leading zeroes.
  - Follow dBase-compatible formats for field names (e.g., no spaces in field name, maximum of 10 characters).

- Spacing:
  - Include one space between address elements; run-on words can be confusing.
    - Examples: NORTHWEST ST is not the same as N WEST ST; HWY200 should be HWY 200

- Spelling:
  - Correct spelling of street names is critical, especially if the target area contains many streets with similar spellings.

- Punctuation:
  - To expedite the geocoding process, eliminate all punctuation except hyphens (-) in the address string.
  - If a street name contains initials, use an underscore (_) as a separator.
    - Example: S. P. MCCLANAHAN RD = S_P_MCCLANAHAN RD

- Abbreviation:
  - Abbreviations should be standardized to prevent confusion.
    - Acceptable street directional abbreviations: N, S, E, W, NW, NE, SW, SE
    - Acceptable street type abbreviations can be found in Appendix A of http://tnmap.state.tn.us/portal/documents/geocoding_standards.pdf.
    - State, county, and local highway recommendations can be found on p. 7 of http://tnmap.state.tn.us/portal/documents/geocoding_standards.pdf.
    - The street name should never be abbreviated.

1.5 Special Cases

- Intersections:
  - Intersections can be included as addresses as long as they are standardized.
    - Always use the same intersection "connector" (e.g., &).
    - Include all address elements that are necessary; example: BURNET RD & W 51ST ST, not BURNET & W 51ST

- Alphanumeric street numbers:
  - Alphanumeric street numbers should never be separated by a space; this type of street number is typically found in Wisconsin.
    - Example: S4W35020 BAKER ST

- Fractional street numbers:
  - The fraction should be separated from the whole number by one space, or the geocoder will interpret everything to the left of the "/" as a whole number.
    - Example: 12 1/2 MAIN ST, not 121/2 MAIN ST

- Hyphenated street numbers:
  - Hyphenated street numbers are typically found in New York, Hawaii, and parts of California. Be careful not to confuse these numbers with address ranges.
    - Example: 1210-4 is not the same as 1210-1214

- Spanish-language addresses:
  - A list of acceptable common abbreviations can be found on p. 15 of http://tnmap.state.tn.us/portal/documents/geocoding_standards.pdf.

References and Resources:

Much of the information in this section was adapted from:
"Geocoding Standards" developed by the Tennessee Office for Information Resources, GIS Services:
http://tnmap.state.tn.us/portal/documents/geocoding_standards.pdf

Tufts GIS Tip Sheet: http://ocw.tufts.edu/data/54/626652.pdf

Other resources include:
ArcGIS Desktop 9.3 Help: http://webhelp.esri.com/arcgisdesktop/9.3/index.cfm?TopicName=Preparing_reference_and_address_data

Address Geocoding with ArcGIS: http://www.gsd.harvard.edu/gis/manual/geocoding/index.htm

United States Postal Service (USPS) Publication 28:http://pe.usps.com/cpim/ftp/pubs/Pub28/pub28.pdf

USPS Online Abbreviation Standards: http://www.usps.com/ncsc/lookups/abbrev.html

Federal Geographic Data Committee (FGDC) Addressing Standards: http://www.fgdc.gov/standards/projects/FGDC-standards-projects/street-address/index_html

Chapter 2: Free Online Resources for Geocoding

Tristan Victoroff, MPH

2.1 Background

A number of websites provide free resources for geocoding street addresses. They have various advantages and disadvantages with regard to ease of use, exporting maps, and the ability to geocode addresses outside of the United States. In many cases, regardless of what the web interface looks like, you will be steered to a Google map of your geocoded points. This may be all you are interested in - if so, you can stop there. If not, you can plug the geocodes into EpiInfo's map-making tool (see Chapter 3: Creating Maps Using Epi Info 7) and make your own map. ***Note: geocoders are not always precise. Approximate latitudes and longitudes can be found for most addresses, especially in urban areas.** The exact latitude and longitude can vary by a few decimal points depending on which geocoder you use. The following list is by no means comprehensive. There are literally dozens of geocoding websites that can accommodate single postal addresses, batch addresses, or both. These are just a few sites that are easy to find and easy to use.

2.2 FreeGeocoder.com

www.freegeocoder.com - Appropriately named, this is a straightforward site that only does forward geocoding. That is, it enables you to look up the latitude and longitude of a location using a traditional U.S. street address, but not vice-versa. Simply enter an address, hit "go," and the site delivers an interactive Google map along with your latitude and longitude coordinates.

Advantages:

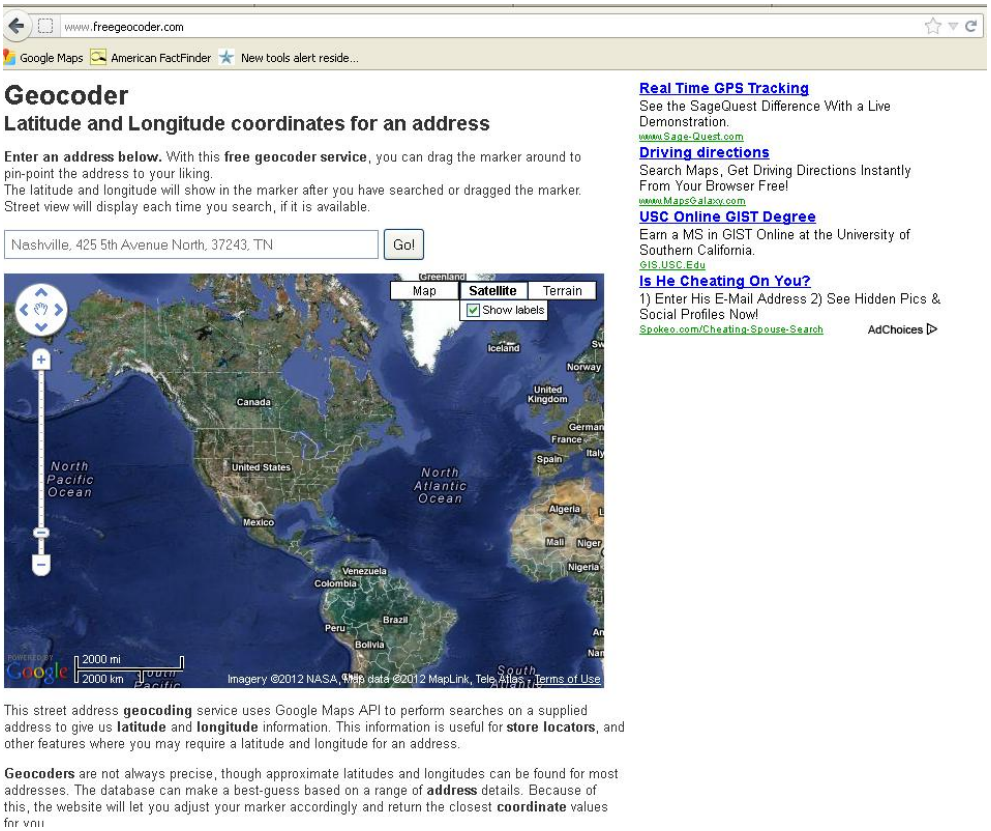
- The site gives you a Google street view of your coordinates, if it is available.
- The map view can be changed from "map" to "satellite" to "terrain" as you desire
- The marker that indicates your geocoded point on the map can be dragged around to pin-point the address as you desire. The coordinates will adjust to wherever you place the marker
- The geocoder is fairly forgiving with regard to how you enter the address information.
  Example: The following two formats will be geocoded identically:
  - 425 5th Avenue N, Nashville, TN, 37243
  - Nashville, 425 5th Avenue North, 37243, TN

Disadvantages:

- The site doesn't provide a way to export your Google map
- You will have to copy and paste the latitude and longitude if you want to do anything more than see your point on a map, and this can be cumbersome
- You can only geocode one address at a time
- The street view application only approximates your address - if you're not familiar with the address, don't assume you're looking at the precise building to which the address corresponds

Relevant screen shots from www.freegeocoder.com:

Home page:



Entering a street address, as shown in the image above, will take you to a map like this:

2.3 Maporama GeoWebtools

http://world.maporama.com - Maporama GeoWebtools is a collection of several web mapping applications. The site can do a great deal more than just geocode addresses. For the purpose of this discussion, I will only deal with the geocoding features. At this site, geocoding is a 3-step process that begins with uploading an excel file with your address information. Conveniently, the site provides a downloadable spreadsheet template that you can use if you're hesitant about how to format your addresses.

Advantages:

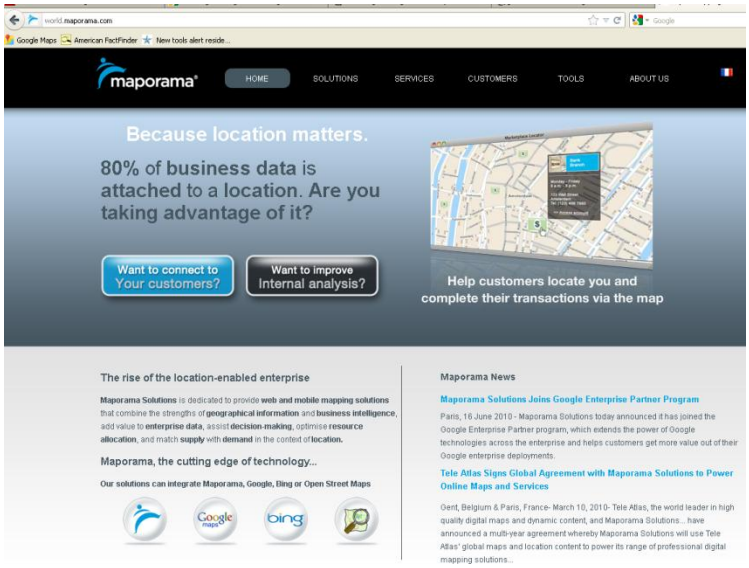
- The geocoder accommodates batch entries
- The geocoder provides a Google map with your points mapped, and as usual you can choose the type of presentation for your map (map, satellite image, terrain, or hybrid)
- The batch geocodes can be exported in an excel file to a PC

Disadvantages:

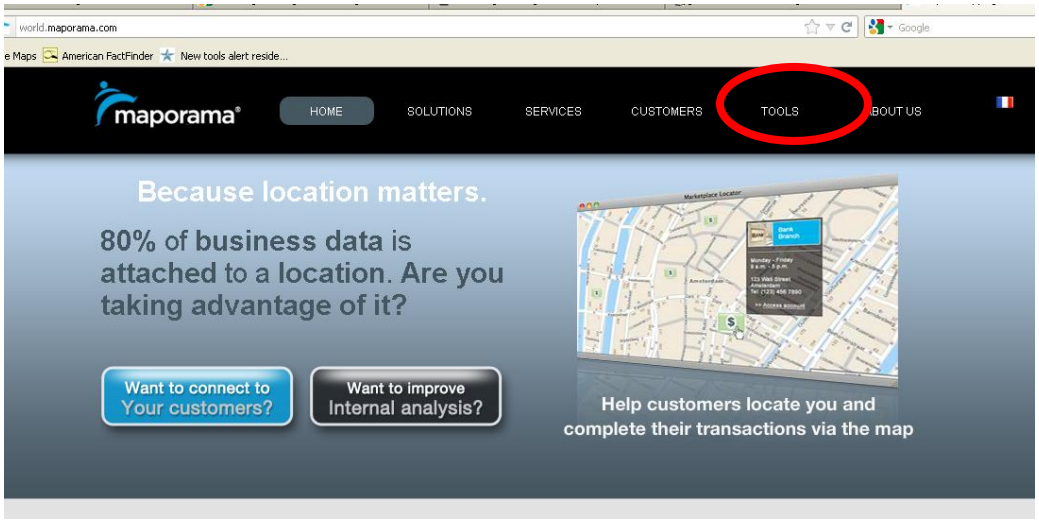
- The map you get is not fully interactive in the way a traditional Google map is: no Google Streetview, and less ability to manipulate the image
- The map is not exportable. You can take a screen shot of the map of course, but this leaves you with a crude, low-quality, static image that is really only useful for a "quick glance" at your locations
- The site does not seem to be able to export to a Mac computer (in any case, this has not been tested, so don't count on it working for Macs)

Relevant screen shots for Maporama:

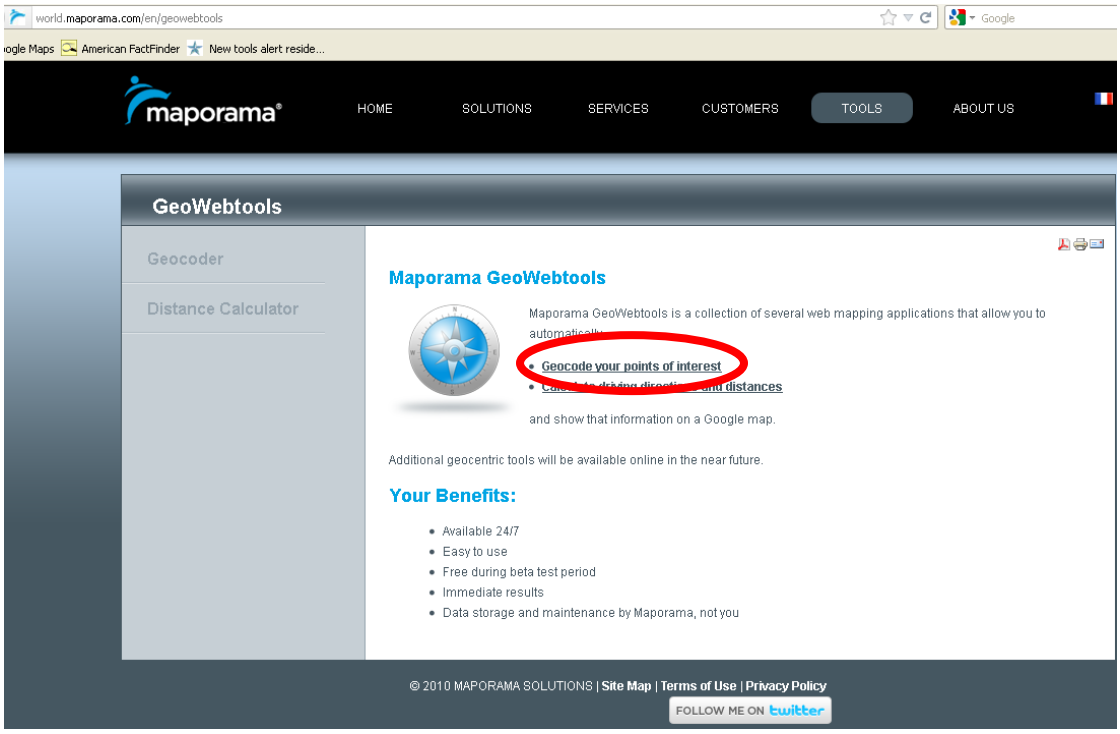
Home page: **http://world.maporama.com/**



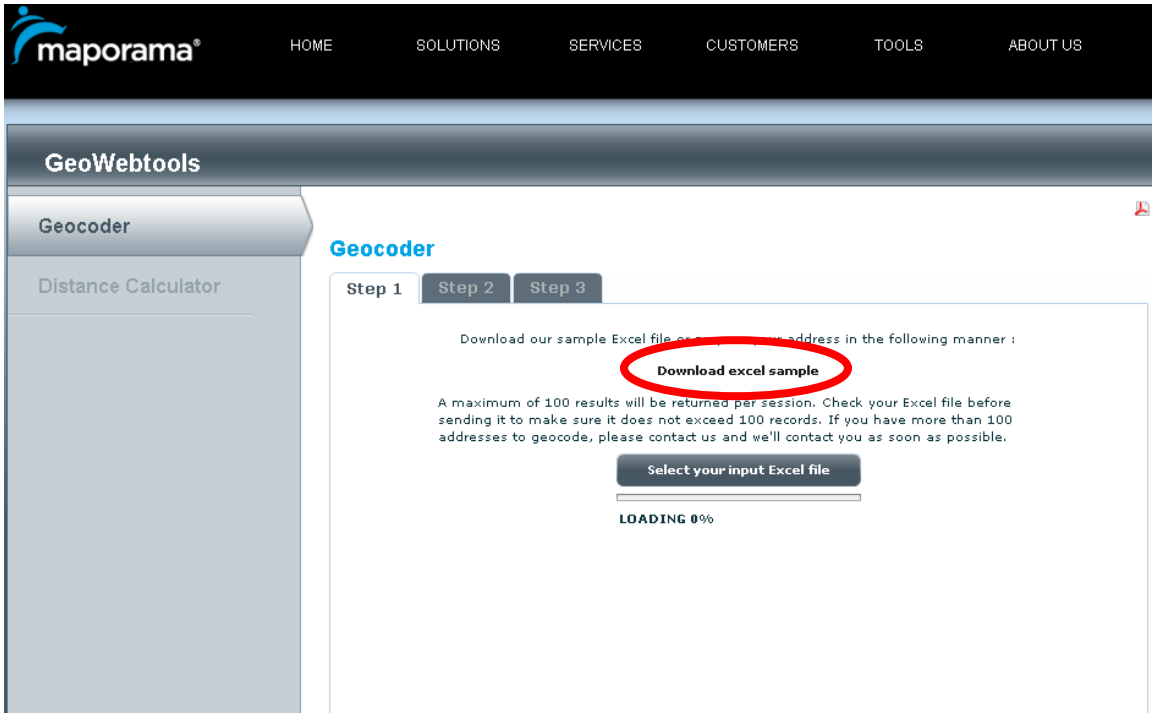
Step 1: Select “tools” from the top right-hand side of the home page.



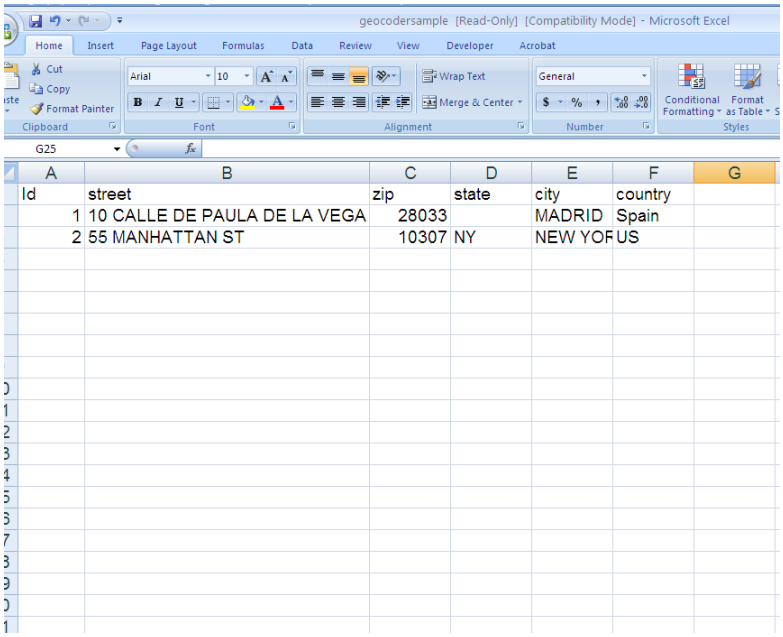
Selecting “tools” will take you to this page: **http://world.maporama.com/en/geowebtools.** Select the button in the center of the screen that says “geocode your points of interest.”



Next, you will be given an option to select your input file (an excel spreadsheet with address components separated by columns). I recommend downloading the template the website provides and using it.

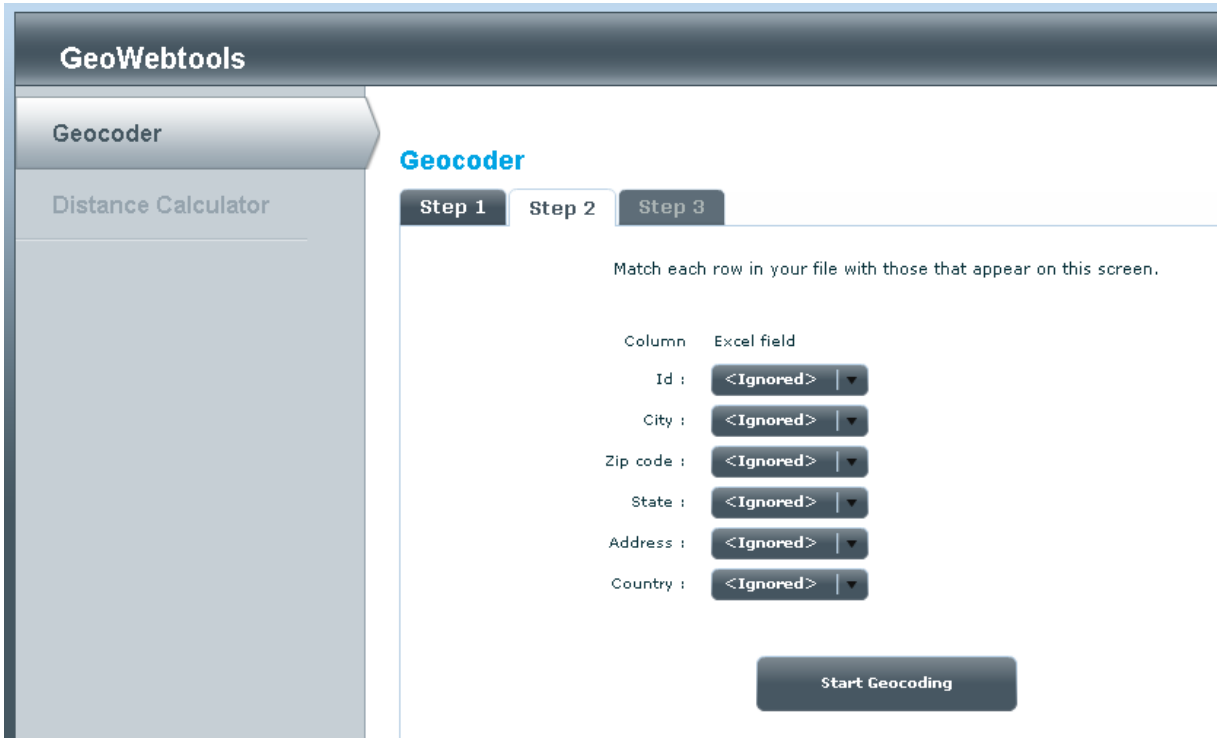


Sample excel template:

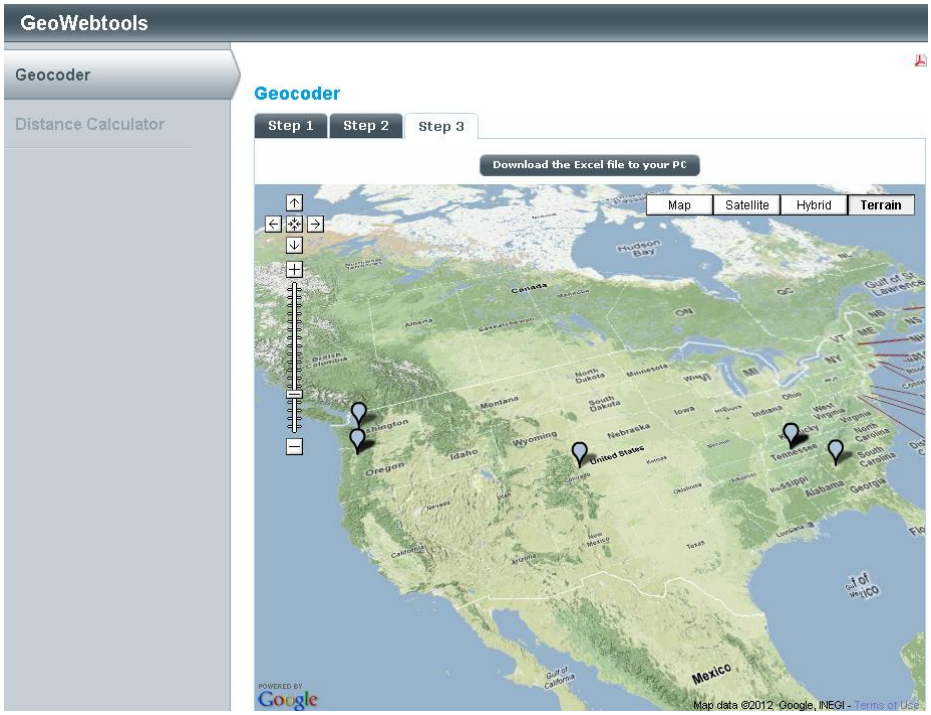


Id	street	zip	state	city	country
1	10 CALLE DE PAULA DE LA VEGA	28033		MADRID	Spain
2	55 MANHATTAN ST	10307	NY	NEW YOF	US

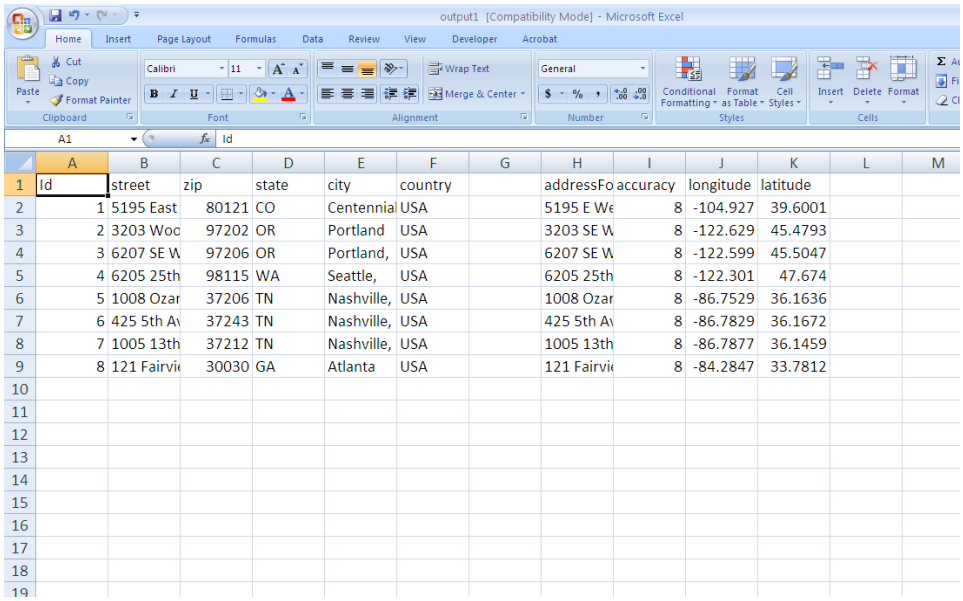
Next, you will need to verify the column headings from your spreadsheet using pull-down menus that correspond to what this geocoder thinks are the components of your address:



Once you have verified your address components, hit the “start geocoding” button and you will arrive at a diagonally-tilted map whose angle is not at your command. Select “download the excel file to your PC” in order to obtain a spreadsheet with your coordinates listed for each address.



Example of the exported spreadsheet with latitude and longitude coordinates:



Id	street	zip	state	city	country		addressFo	accuracy	longitude	latitude
1	5195 East	80121	CO	Centennial	USA		5195 E We	8	-104.927	39.6001
2	3203 Woo	97202	OR	Portland	USA		3203 SE W	8	-122.629	45.4793
3	6207 SE W	97206	OR	Portland,	USA		6207 SE W	8	-122.599	45.5047
4	6205 25th	98115	WA	Seattle,	USA		6205 25th	8	-122.301	47.674
5	1008 Ozar	37206	TN	Nashville,	USA		1008 Ozar	8	-86.7529	36.1636
6	425 5th Av	37243	TN	Nashville,	USA		425 5th Av	8	-86.7829	36.1672
7	1005 13th	37212	TN	Nashville,	USA		1005 13th	8	-86.7877	36.1459
8	121 Fairvi	30030	GA	Atlanta	USA		121 Fairvi	8	-84.2847	33.7812

2.4 “Find Latitude and Longitude”

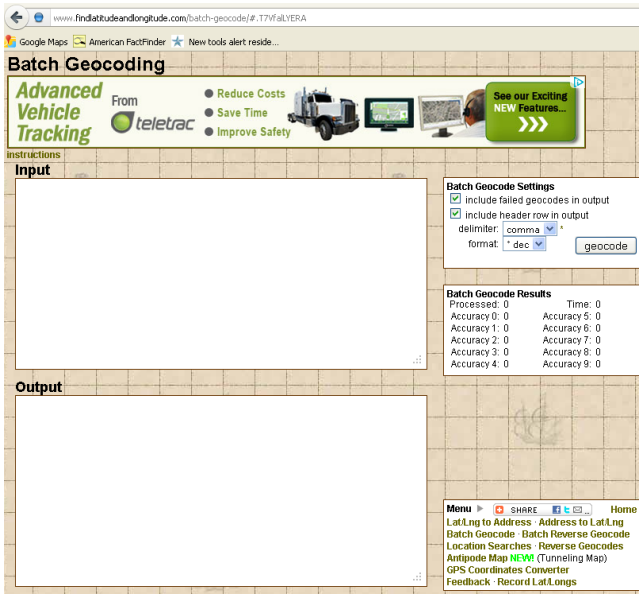
Homepage

http://www.findlatitudeandlongitude.com - The “finding latitude and longitude” website provides many tools, some of which are outside the scope of this chapter. However, the home page (above) allows the user to select a point on a Google map, and will give approximate coordinates for that point (you don’t need an address).

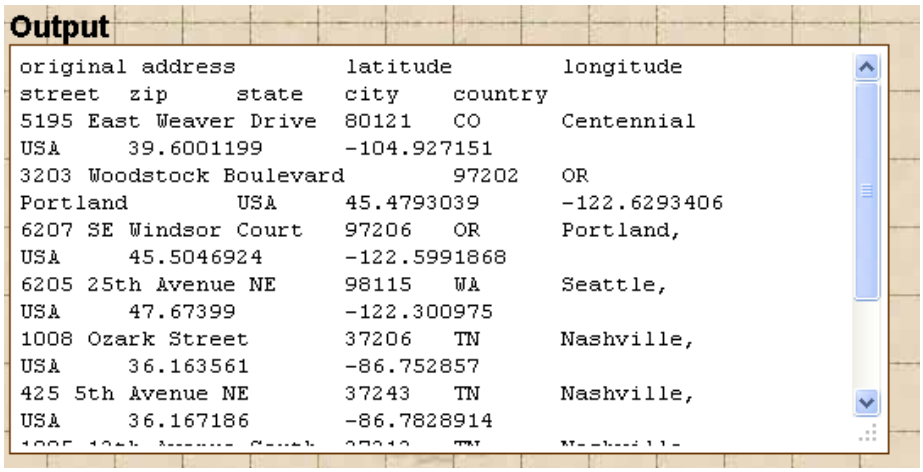
Batch geocoding

The site also geocodes batch address information. The tool for that can be hard to find from the home page - instead go to the batch geocoding page: http://www.findlatitudeandlongitude.com/batch-geocode/#.T7VfalLYERA

This geocoder allows you to paste address information, one address per line in an input box:



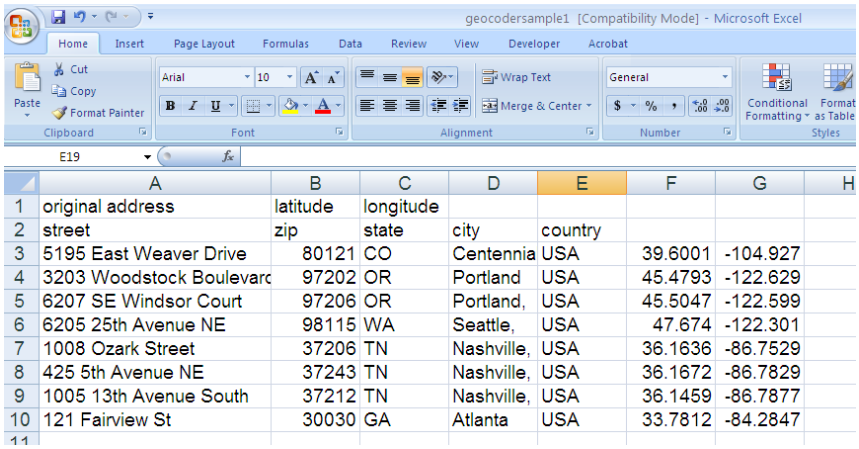
The geocoder also provides instructions for how to enter the address data. If you're doing batch geocoding, most likely you have your address information stored in a spreadsheet. Simply copy and paste directly from the spreadsheet into the "input window." There are a few options for how to display the output. A sensible choice is the tab-delimited format. If you choose the comma -delimited format, your street addresses will be flanked by quotation marks. After you have specified the output format, (this is achieved by selecting from the "batch geocode settings" window to the right of the input window), press the "geocode" button. Here is an example of the output from a batch geocoding operation:



Output

```
original address          latitude          longitude
street   zip      state    city     country
5195 East Weaver Drive    80121    CO        Centennial
USA      39.6001199       -104.927151
3203 Woodstock Boulevard          97202     OR
Portland         USA      45.4793039        -122.6293406
6207 SE Windsor Court     97206    OR        Portland,
USA      45.5046924       -122.5991868
6205 25th Avenue NE       98115    WA        Seattle,
USA      47.67399         -122.300975
1008 Ozark Street         37206    TN        Nashville,
USA      36.163561        -86.752857
425 5th Avenue NE         37243    TN        Nashville,
USA      36.167186        -86.7828914
```

It looks disorganized but if you select all the information in the window, you can copy and paste it into an Excel spreadsheet and it will come out as you would expect. The final two columns on the right represent the latitude and longitude, respectively:



	A	B	C	D	E	F	G	H
1	original address	latitude	longitude					
2	street	zip	state	city	country			
3	5195 East Weaver Drive	80121	CO	Centennia	USA	39.6001	-104.927	
4	3203 Woodstock Boulevarc	97202	OR	Portland	USA	45.4793	-122.629	
5	6207 SE Windsor Court	97206	OR	Portland,	USA	45.5047	-122.599	
6	6205 25th Avenue NE	98115	WA	Seattle,	USA	47.674	-122.301	
7	1008 Ozark Street	37206	TN	Nashville,	USA	36.1636	-86.7529	
8	425 5th Avenue NE	37243	TN	Nashville,	USA	36.1672	-86.7829	
9	1005 13th Avenue South	37212	TN	Nashville,	USA	36.1459	-86.7877	
10	121 Fairview St	30030	GA	Atlanta	USA	33.7812	-84.2847	

Advantages:

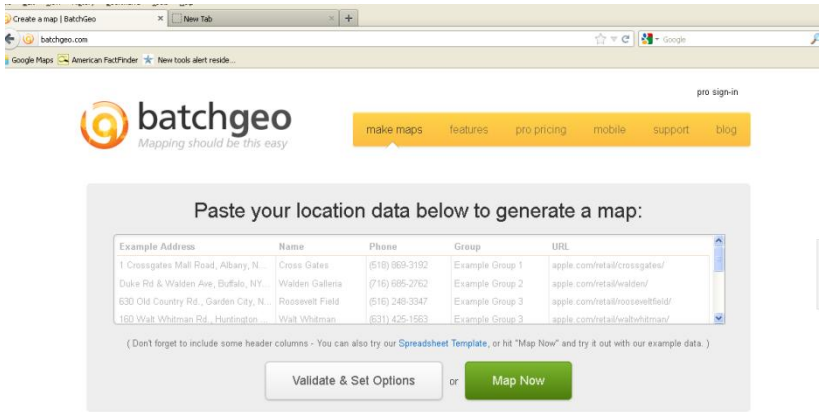
- The geocoder accommodates batch entries, and can extract appropriate street, city, state, and country parameters even if they were all together in the same spreadsheet cell (some sites require that the different address components come from separate cells)
- The geocoder can also reverse geocode (find addresses from latitude and longitude information). To do this, paste your latitude and longitude information for each location on the same line, separated by commas as in this example: 39.6001199, -104.927151
- This site provides accuracy measures along with your coordinates, estimating how much confidence the geocoder has in the accuracy of the information
- The home page of the site (**http://www.findlatitudeandlongitude.com**) does allow you to map coordinates on a Google map

Disadvantages:

- The map feature only appears to allow single entries. I have not yet found a way to map batch entries with this site, although that may be possible.
- The map this site produces is not exportable

2.5 BatchGeo

https://batchgeo.com - This is another great website that provides many tools, including single and batch geocoding. Simply paste your address information into the input window. Hit "map now" or, if you are less confident about your address information, there is a button for validating your column headings.



***Note:** This site is noteworthy for allowing you to produce an exportable map as a KML file, which can be opened in Google Earth. It is possible to view the latitude and longitude coordinates for your map points by hovering the cursor over the point while in Google Earth. It is also possible to open the KML file in Excel. The spreadsheet will look like a minor disaster, but your coordinates will be there, on the same line as their corresponding addresses.

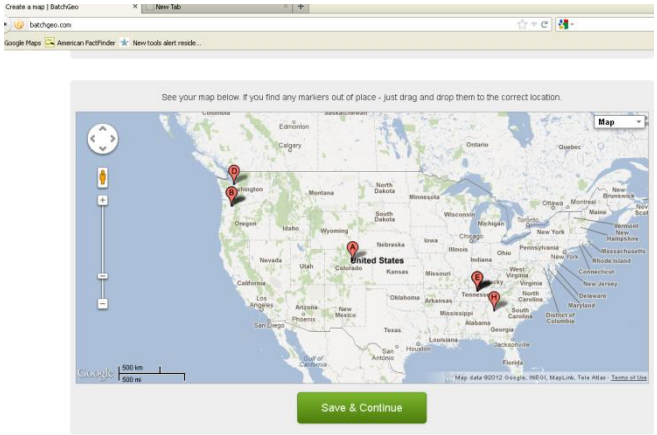
Advantages:

- BatchGeo can geocode batch entries
- BatchGeo Produces an Google map along with coordinates
- The site produces an exportable Google map, which can be opened in Google Earth

Disadvantages:

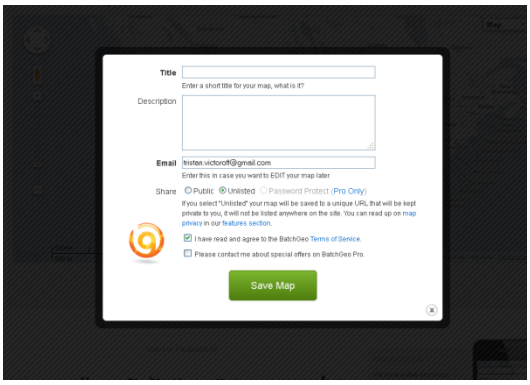
- If you cannot handle KML files, you will have challenges opening the map this geocoder produces. This would most likely be because your IT department has helpfully blocked you from installing software by yourself (for example, if you work for the CDC)
- If you open your KML file in an Excel spreadsheet, you may be exposed to intimidating spreadsheet gibberish as well as you longitude and latitude coordinates
- If you want to save your map and extract your coordinates, you must agree to give your email address to Google so that they can begin advertising GIS products to you subliminally as you conduct your routine email commerce. This is not a big deal unless you are prone to impulse software purchases

Step 1: Enter addresses by cutting and pasting into the input window as for the other geocoding sites discussed. Hit the green "Map Now" button, or the pale "Validate & Set Options" button if you wish to validate your column headings (not a bad idea). Your map will appear, as in the example pictured here:



Step 2:

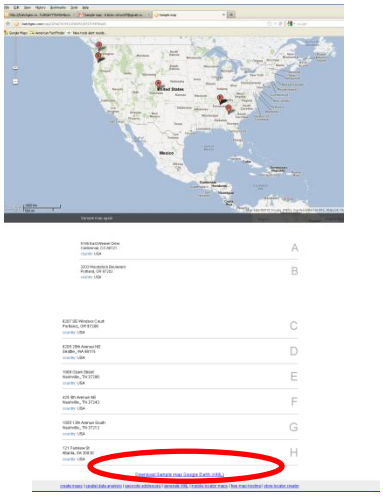
If you press the "save and continue" button, you will be taken to another window that forces you to name your map and enter your email address, so you can be sent instructions for editing your map.



If you are uncomfortable providing your email address, just remember that Google already knows who you are and everything about you that would be relevant for advertisers/Homeland Security, so get over it and move on to your KML file. Name your map something sensible, and be sure to tick the "please contact me with special offers" box so that BatchGeo can harass you about buying the "Pro" version of this software.

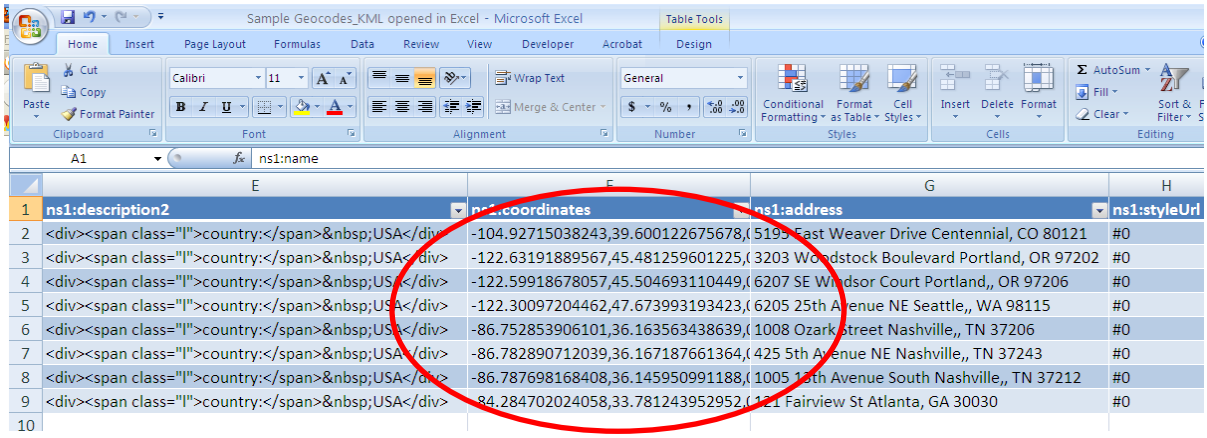
Step 3: At this point, the site will email you a link to your map, and instructions for editing it. It will also open the map in what looks like just another browser window, but *at the very bottom of the page is a link that says "Download Sample Map Google Earth."* Depending on your default settings, this will save the KML file to somewhere on your computer, most likely the temporary internet files on your computer. You can open the downloads window from your browser in order to find the file (the file path to your temporary internet files folder can be tricky to locate).

Scroll to the bottom of the page to find the download link



If you are more interested in the Map, the best way to view it and manipulate it is with Google Earth. Downloading and installing Google Earth is easy. Simply go http://www.google.com/earth/index.html. Follow the download instructions, and Google will walk you through the rest. You can then open your KML file in Google Earth.

If you are more interested in the coordinates themselves, and less interested in a map, you can still get those through BatchGeo. When you download your KML file, simply open it with Excel. You might get something that looks like this:



	E	F	G	H
1	ns1:description2	ns1:coordinates	ns1:address	ns1:styleUrl
2	country: USA	-104.92715038243,39.600122675678,0	5195 East Weaver Drive Centennial, CO 80121	#0
3	country: USA	-122.63191889567,45.481259601225,0	3203 Woodstock Boulevard Portland, OR 97202	#0
4	country: USA	-122.59918678057,45.504693110449,0	6207 SE Windsor Court Portland,, OR 97206	#0
5	country: USA	-122.30097204462,47.673993193423,0	6205 25th Avenue NE Seattle,, WA 98115	#0
6	country: USA	-86.752853906101,36.163563438639,0	1008 Ozark Street Nashville,, TN 37206	#0
7	country: USA	-86.782890712039,36.167187661364,0	425 5th Avenue NE Nashville,, TN 37243	#0
8	country: USA	-86.787698168408,36.145950991188,0	1005 16th Avenue South Nashville,, TN 37212	#0
9	country: USA	-84.284702024058,33.781243952952,0	121 Fairview St Atlanta, GA 30030	#0
10				

Remain calm. There is some extraneous information in your spreadsheet, but the coordinates are readily visible, and obviously correspond to addresses appropriately placed in the adjacent column.

Chapter 3: Creating Maps Using Epi Info 7

Rendi Murphree, PhD, and Meredith Kanago, MSPH

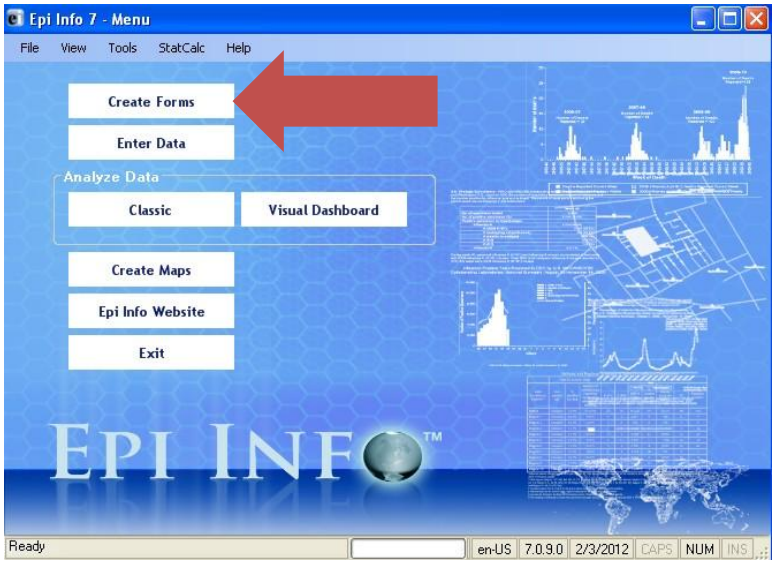
3.1 Download and Launch Epi Info 7

Instructions for downloading and installing Epi Info 7 are available at http://wwwn.cdc.gov/epiinfo/7/index.htm. After the download has been completed, follow the instructions for producing a case cluster map using the Epi Info 7 GeoCoder.

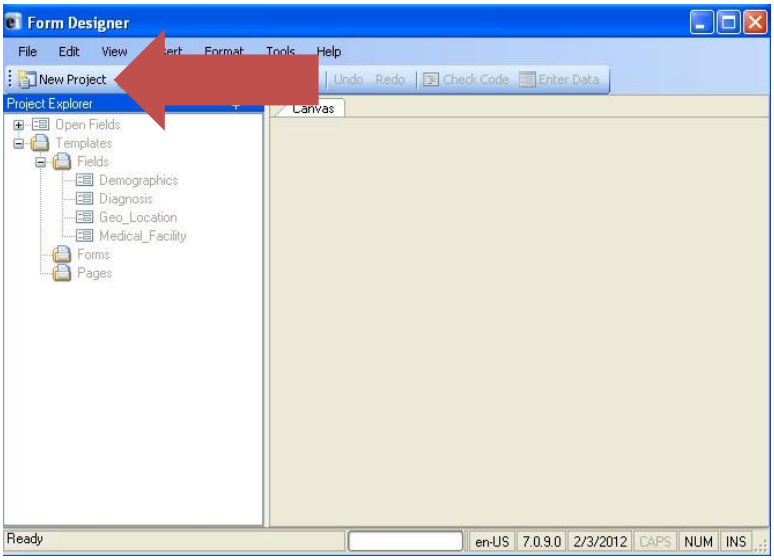
3.2 Create a Case Cluster Map Using the Epi Info 7 GeoCoder

Step 1. Launch the Epi Info 7 application by double clicking the Epi Info 7 Icon on your desktop.

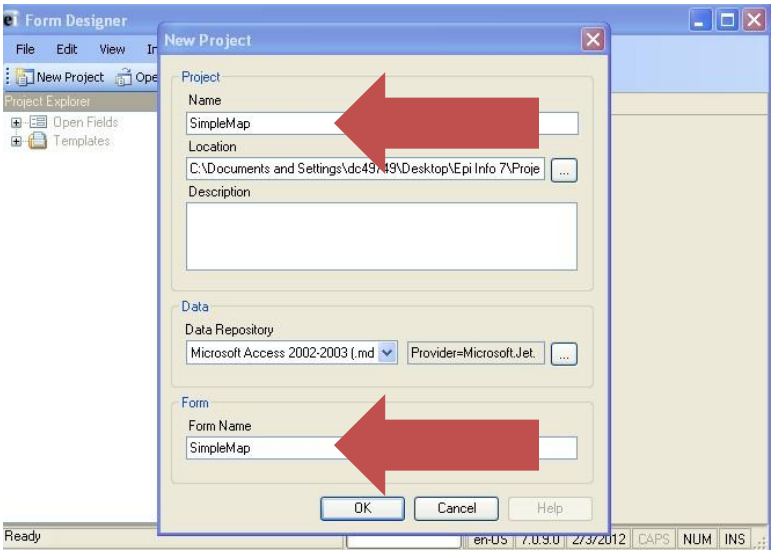
Step 2. Click the Create Forms tab on the Epi Info 7 Menu.



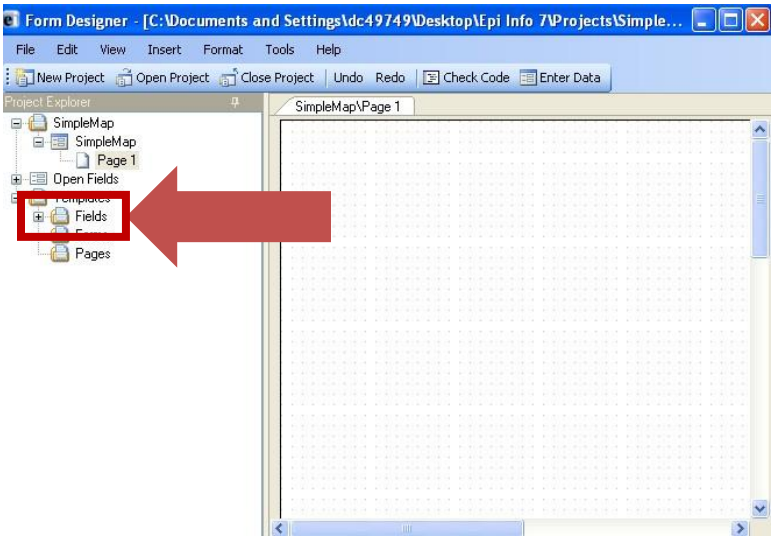
Step 3. Click New Project



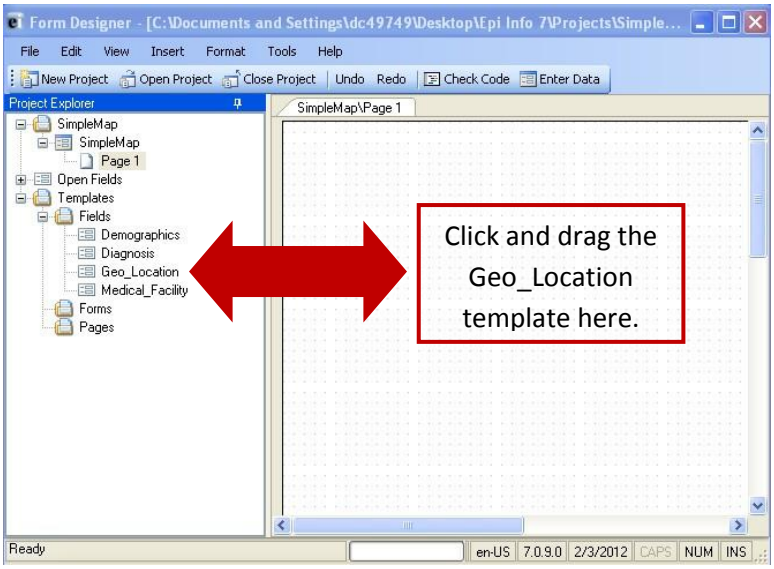
Step 4. Name the Project and Form. In this example, the project name and form name is “SimpleMap”. You can assign any names you choose, but spaces and special characters are not allowed.



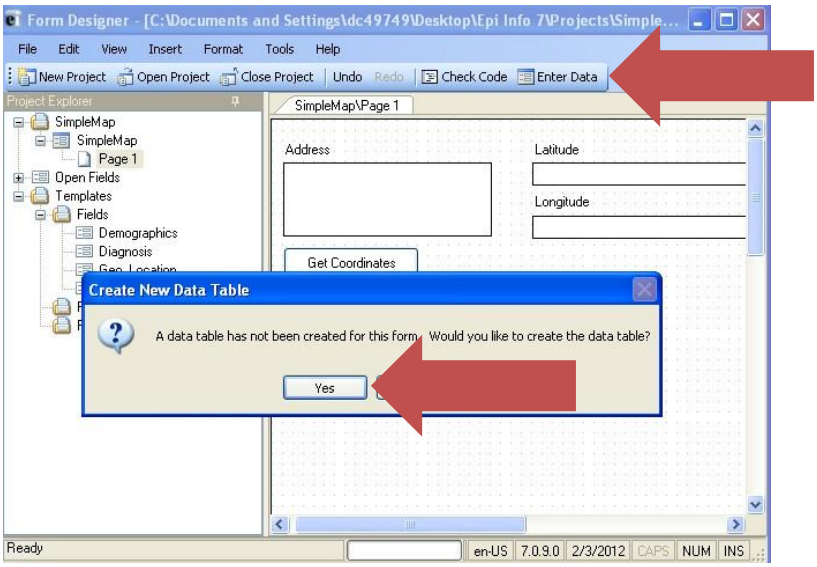
Step 5. Expand the Templates:Fields menu by clicking the small + to the left of the Fields folder.



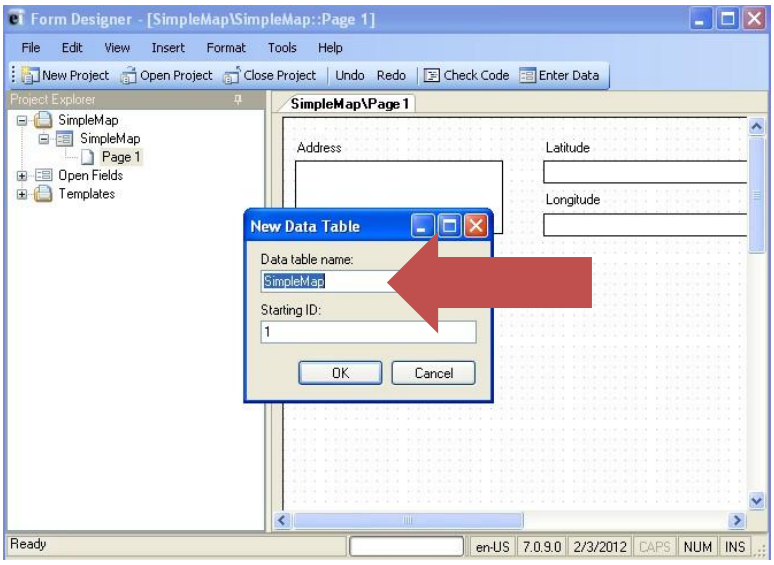
Step 6. Click and drag the Geo_Location template to the Page 1 canvas.



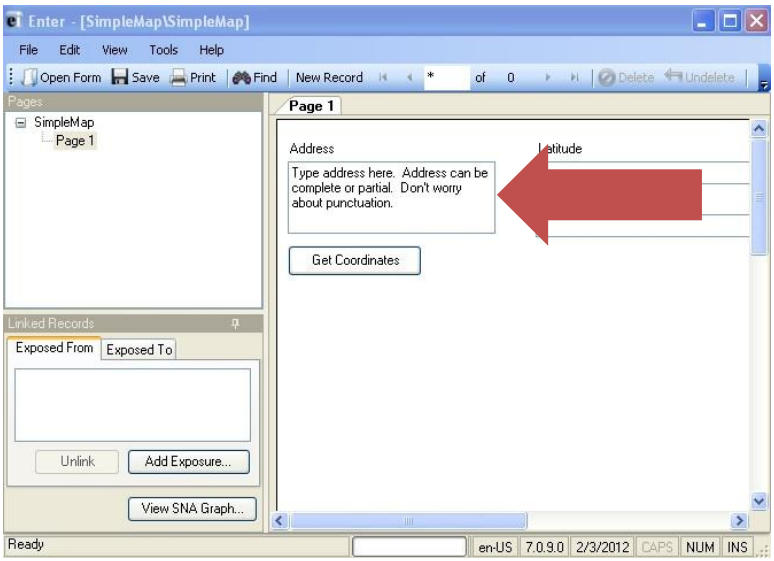
Step 7. Once your canvas contains the Geo_Location fields as shown below, click Enter Data to switch to the data entry module of Epi Info 7. Then click Yes to Create New Data Table.



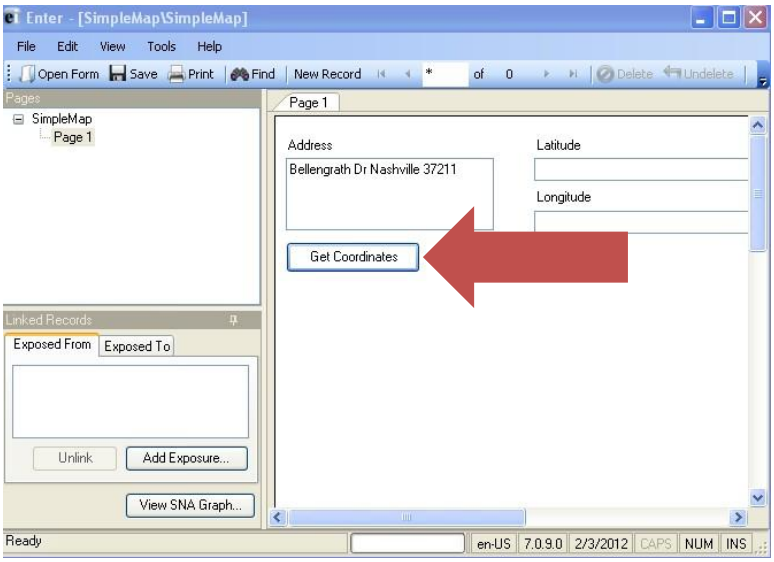
Step 8. Enter a name for your Data Table.



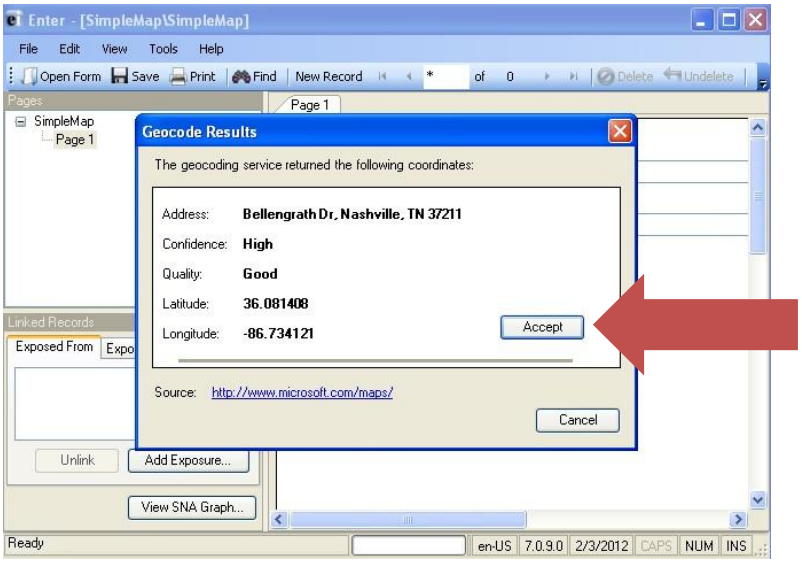
Step 9. Now, you can begin using the Epi Info 7 GeoCoder. Enter one address per record in the address field. Addresses can be complete or partial. Careful attention to punctuation is not necessary. The field is not case sensitive.



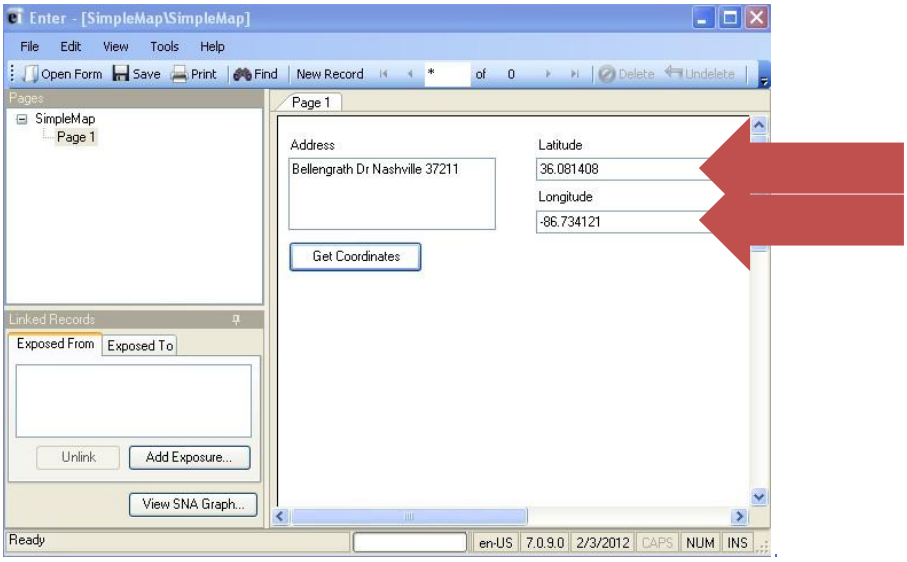
Step 10. After you type an address, click the Get Coordinates button. You must be connected to the internet.



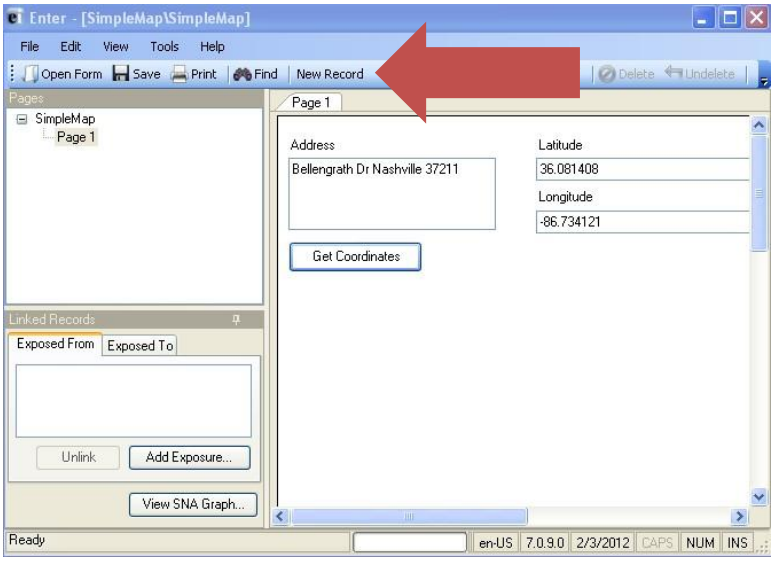
Step 11. Geocode Results will appear. If the address looks like a good match, click Accept. If the address does not look like a good match, click Cancel, modify your address data, and try again.



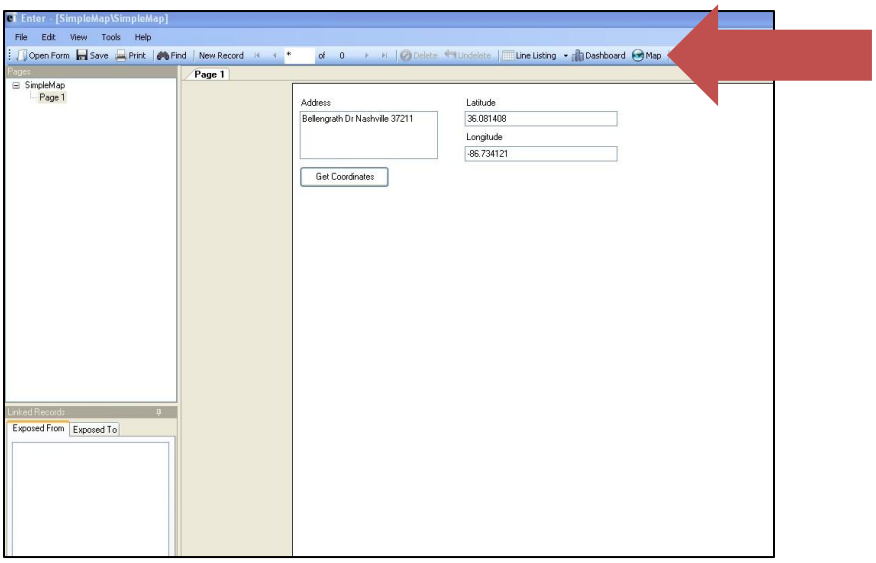
Step 12. If you Accepted the results in Step 12, Epi Info 7 automatically populates the Latitude and Longitude fields.



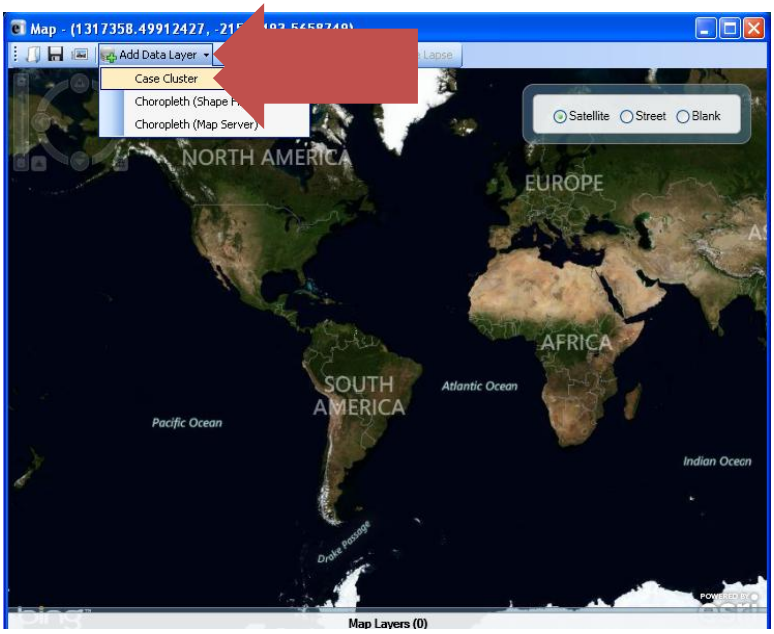
Step 13. Click New Record to enter another address. Repeat steps 11–14 until all addresses are entered and Geocoded.



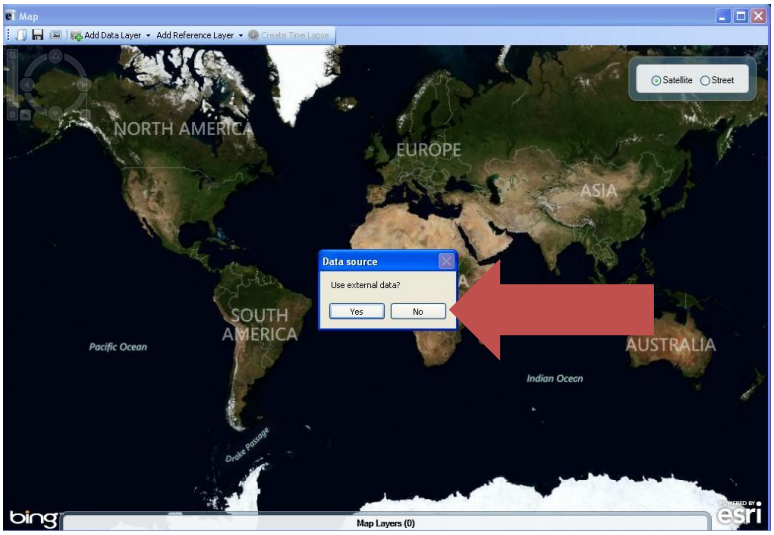
Step 14. Launch the Epi Info Map module by clicking Map on the toolbar.



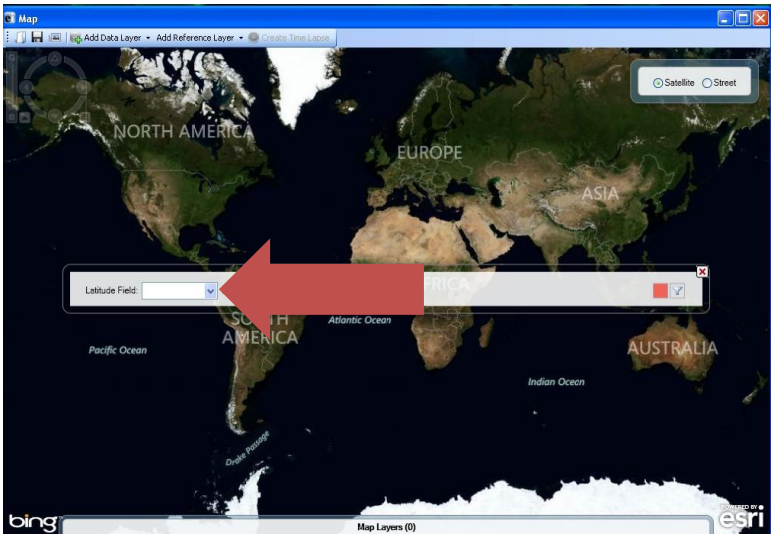
Step 15. After the Map module opens, click Add Data Layer on the toolbar.



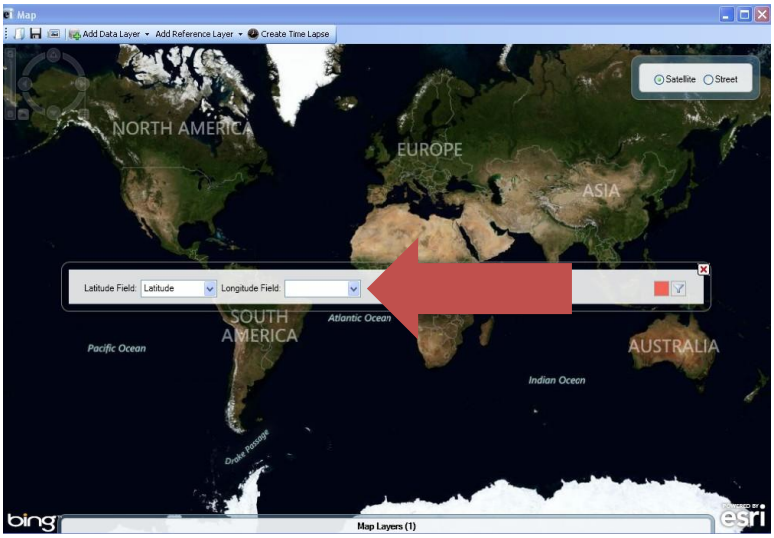
Step 16. When asked if External Data will be used as your Data Source, click No.



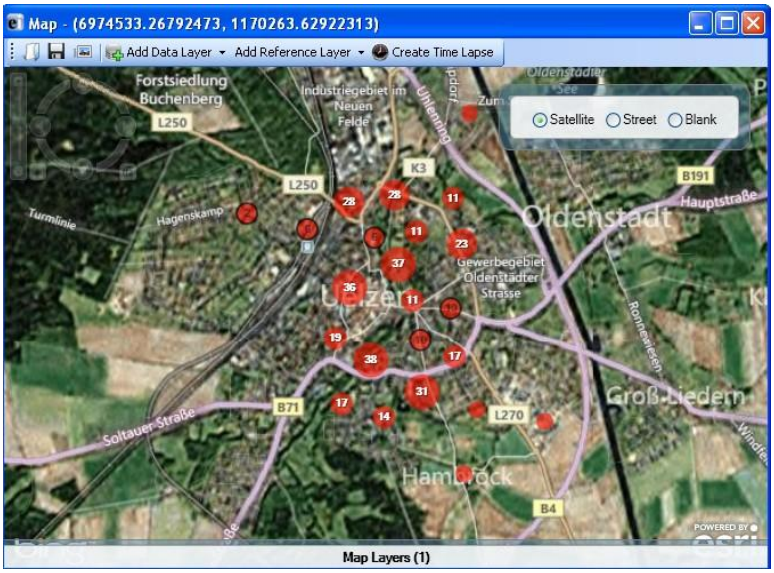
Step 17. Click the drop down arrow next to Latitude Field and select the field name latitude.



Step 18. Click the drop down arrow next the Longitude Field and select the field name longitude.



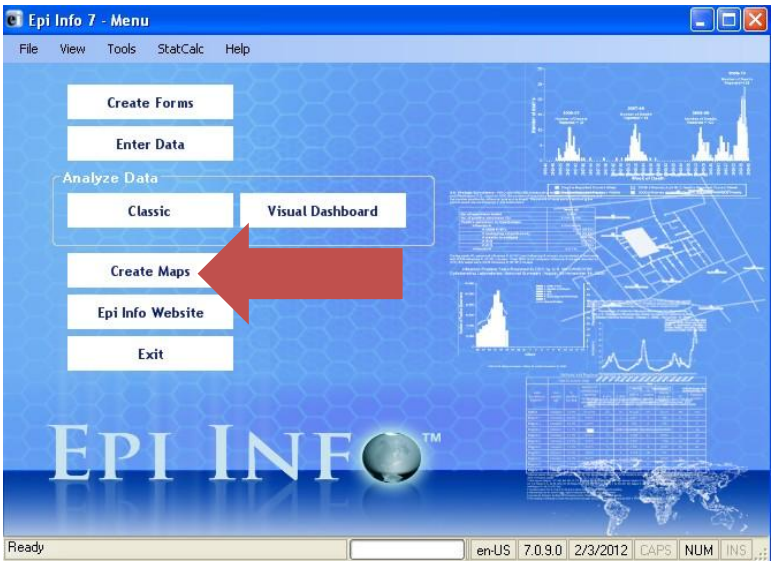
Step 19. A map will appear.



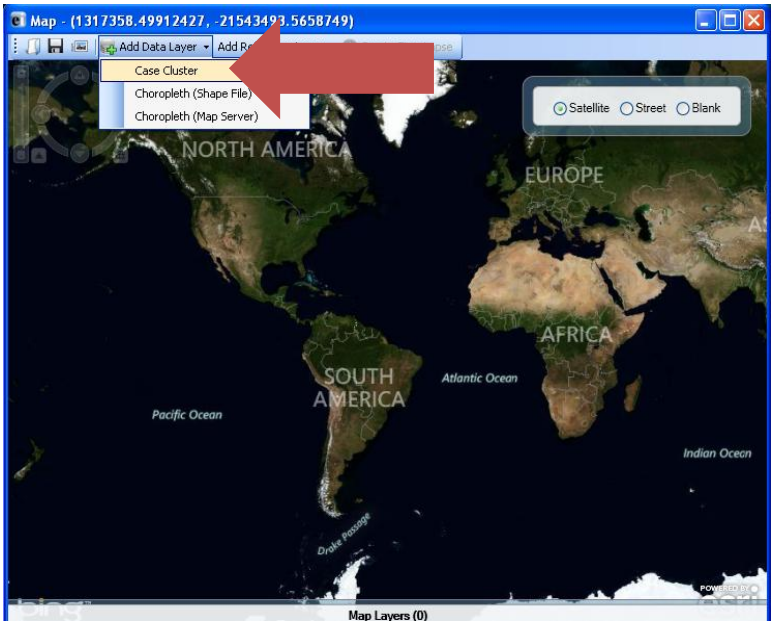
3.3 Create a Case Cluster Map Using an External Data Source

Step 1. Launch the Epi Info 7 application by double clicking the Epi Info 7 Icon on your desktop.

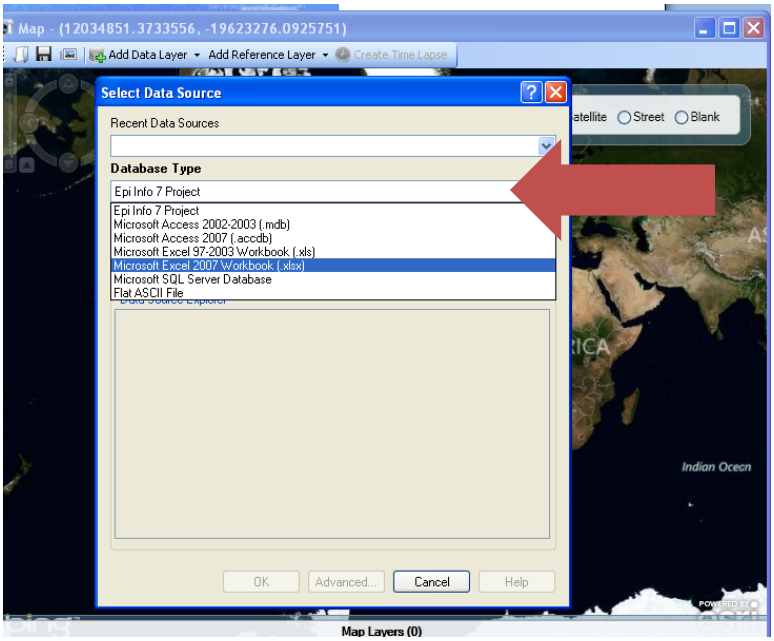
Step 2. Click the Create Maps tab on the Epi Info 7 Menu.



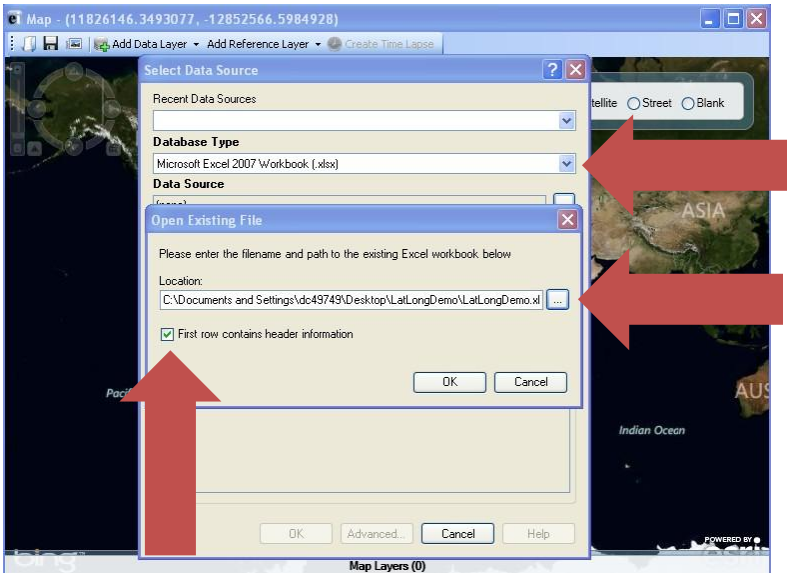
Step 3. After the Map module opens, select Case Cluster from the Add Data Layer drop down menu.



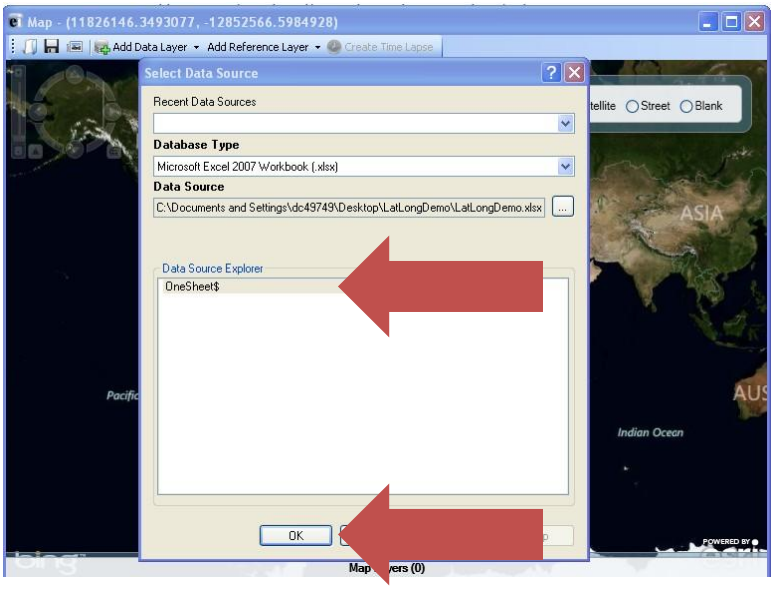
Step 4. Specify the external data file type from the Database type drop down menu. Your external data file must contain one field containing latitude and one filed containing longitude. Free tools for converting addresses into latitude and longitude coordinates are described in Section 3.



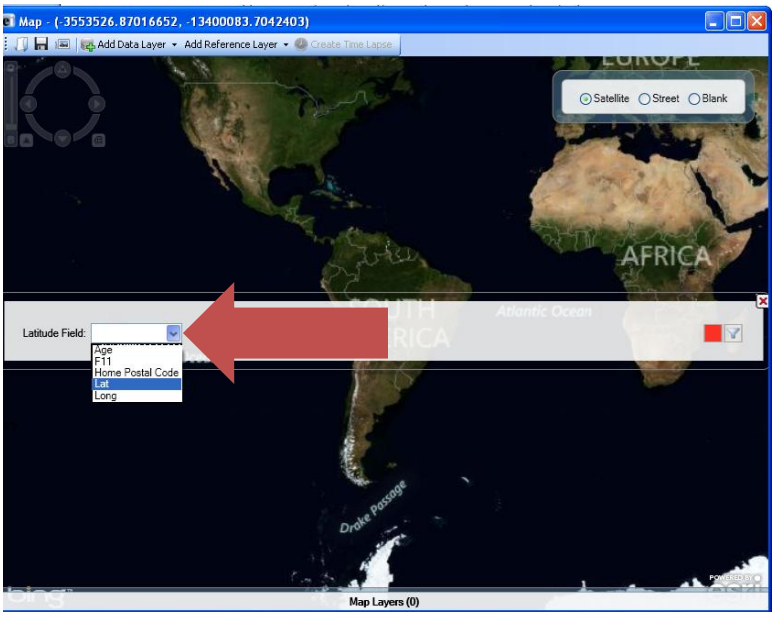
Step 5. Click on the small box to the right of the Data Source box and point to your existing file. If your existing file does not contain header information in the first row, uncheck the appropriate box.



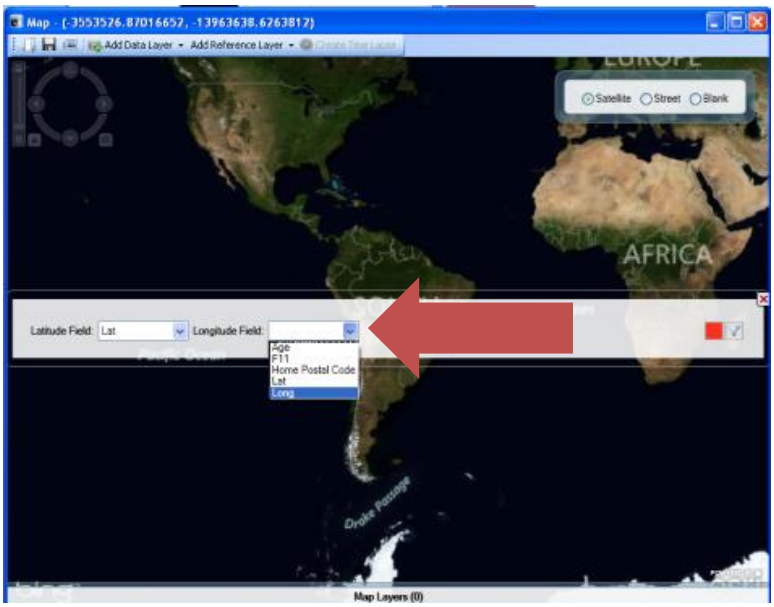
Step 6. Highlight the worksheet containing your data then click ok.



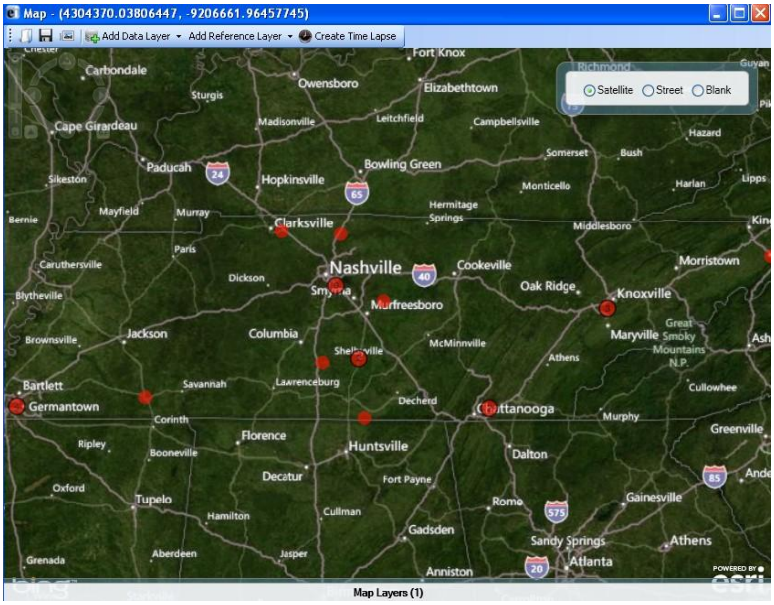
Step 7. Click the drop down arrow next to Latitude Field and select the field that contains latitude.



Step 8. Click the drop down arrow next to Longitude Field and select the field that contains longitude.

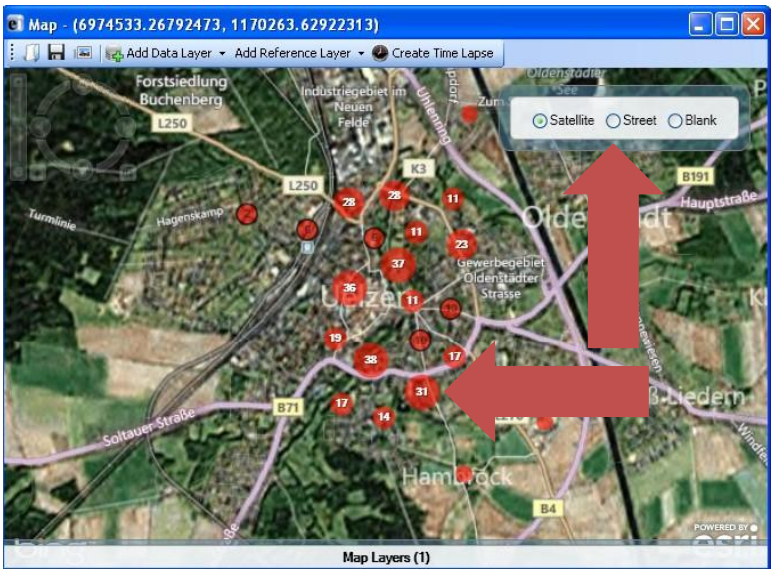


Step 9. A map will appear.

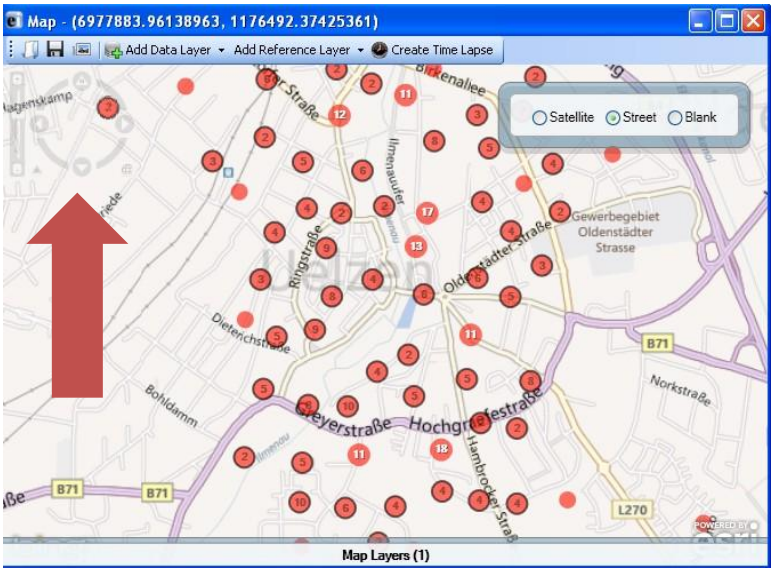


3.4 Manipulating Map Features

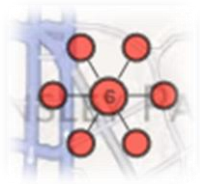
Step 1. The default background is Satellite. You can change the background by clicking another radio button. Options include Street and Blank. Red dots mark a single geocoded address. Larger red dots represent clusters. The number of records included in a geographic cluster is printed on the red dot. For example, the largest cluster represents 31 records.



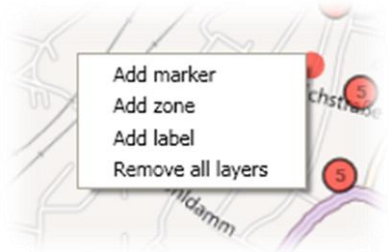
Step 2. Zoom in and out using the navigation tools in the upper left hand corner of the map. As you zoom, the diameter of red dots will change in relation to the number of records they represent.



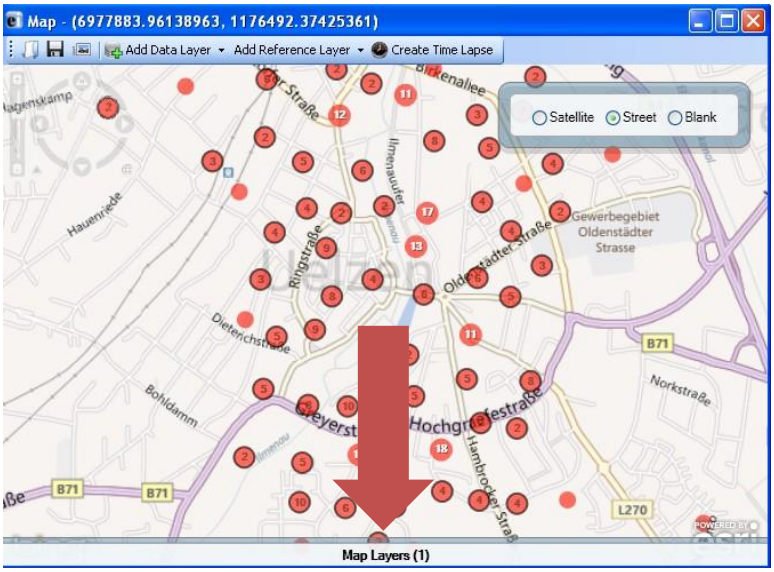
Step 3. If you click on a cluster, a graphic showing the number of records represented will appear.



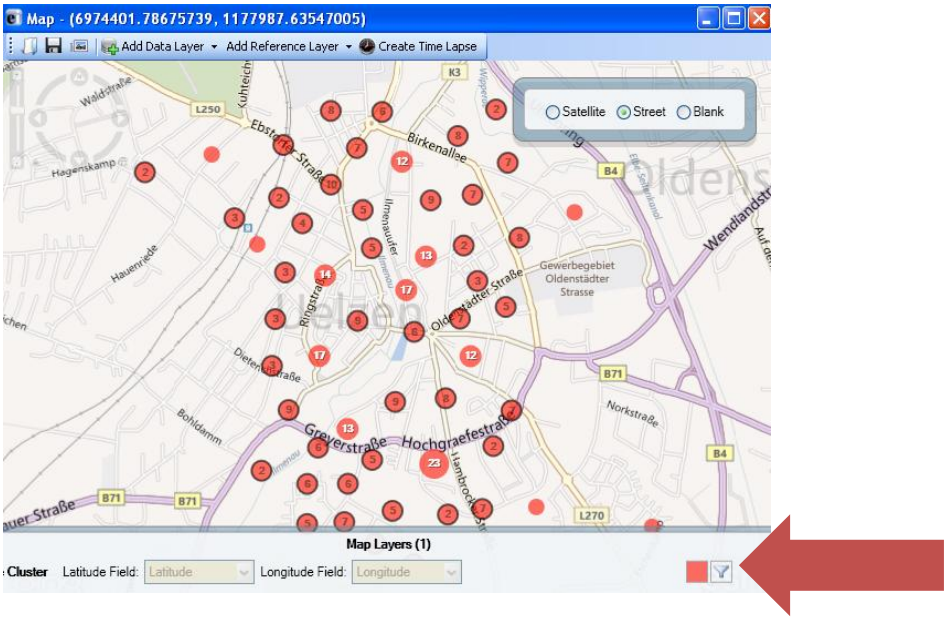
Step 4. Right click on the map to add a marker, zone, or label



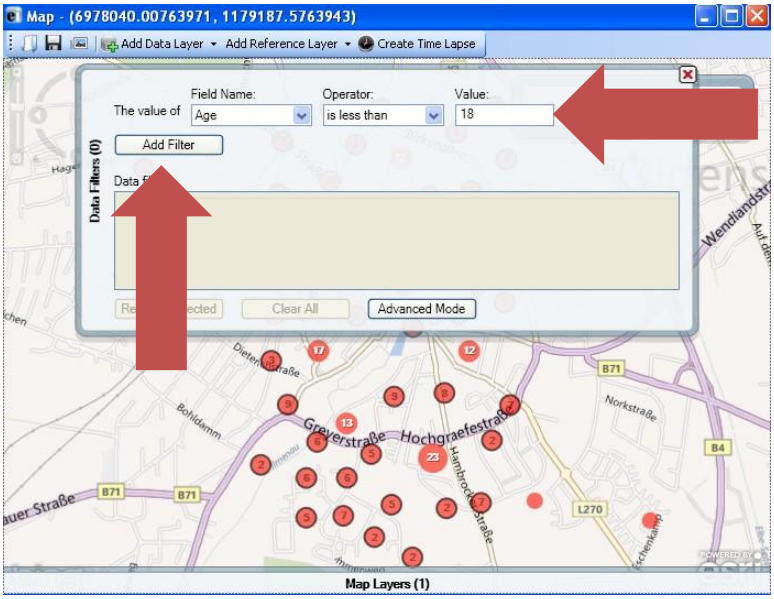
Step 5. If you wish to apply (or remove) a filter to your data, hover over the Map Layers tab at the bottom of the map.



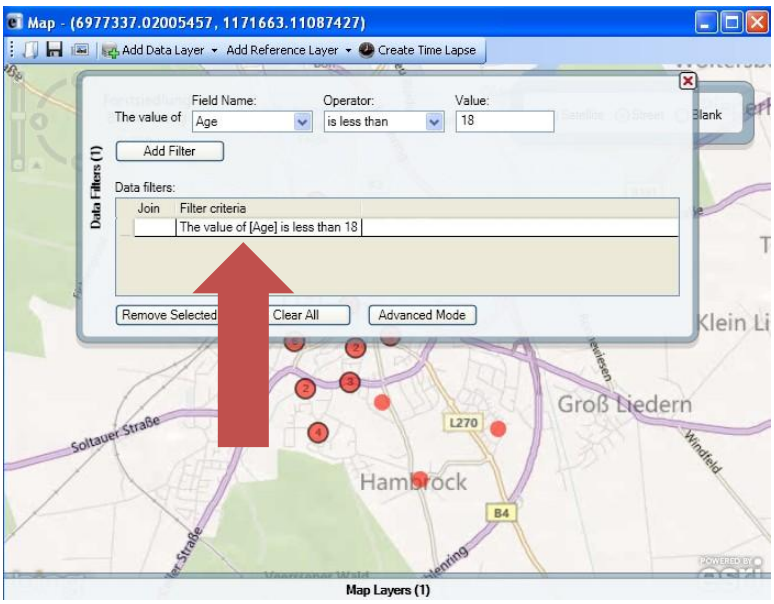
Step 6. To add a filter to your data, click the tiny funnel in the lower right hand of the map.



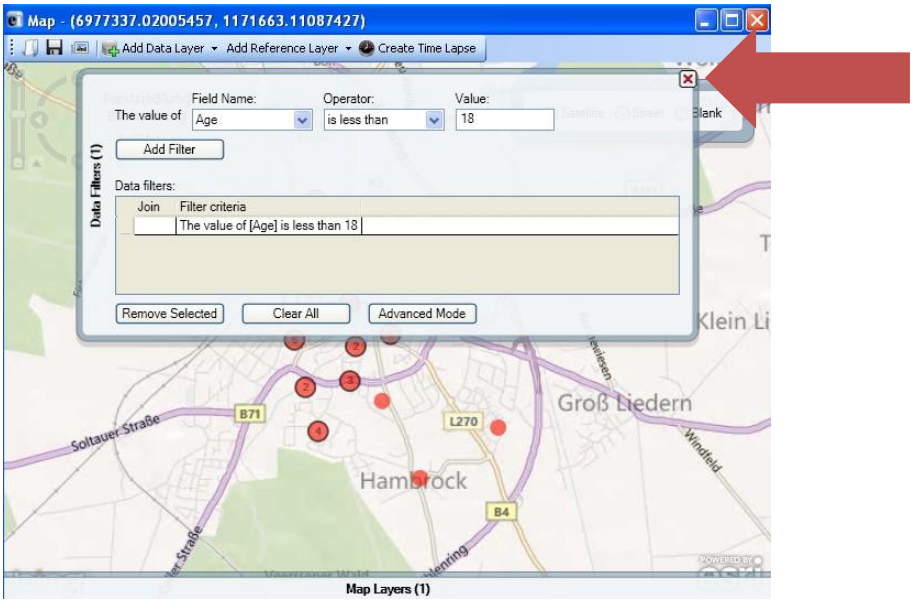
Step 7. In this example, data will be restricted to children. Use the drop down arrows to set the filter condition. Then click Add Filter.



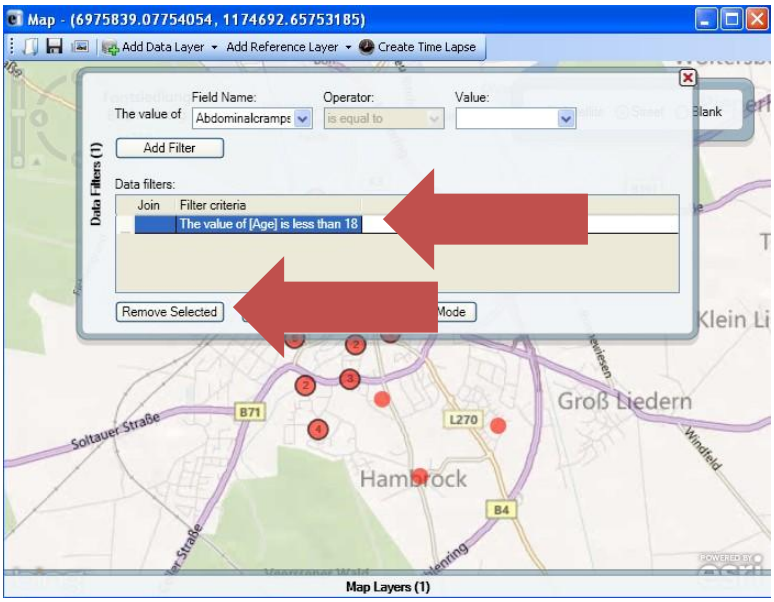
Step 8. This Filter Criteria is then shown in the Data filters box and immediately applied to the map.



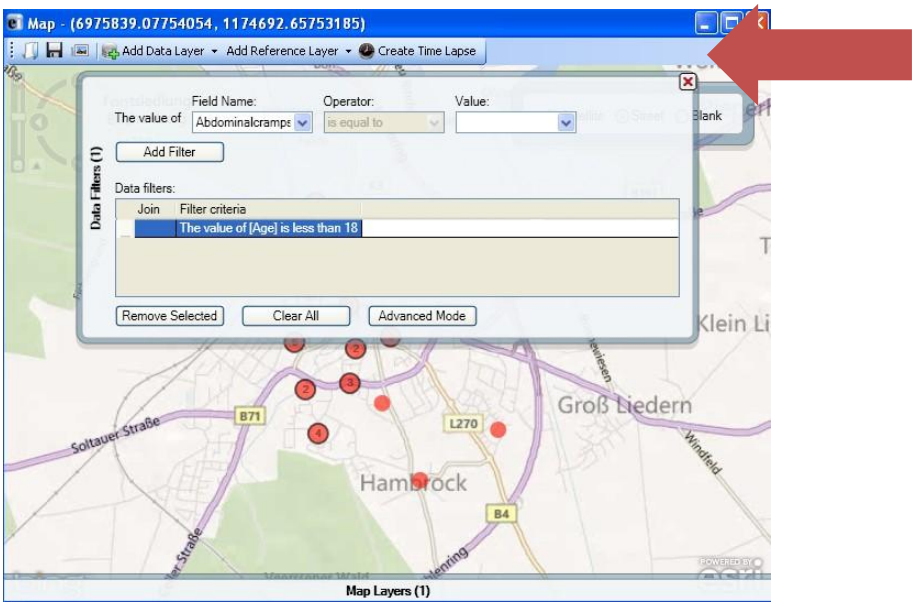
Step 9. Click the red arrow to close the Data Filters box and return to the map.



Step 10. To remove the Filter, repeat Step 5 and 6. Then click on the filter you wish to remove, and click Remove Selected from the Data Filter box. Click the red arrow to close the Data Filters box and return to the map.



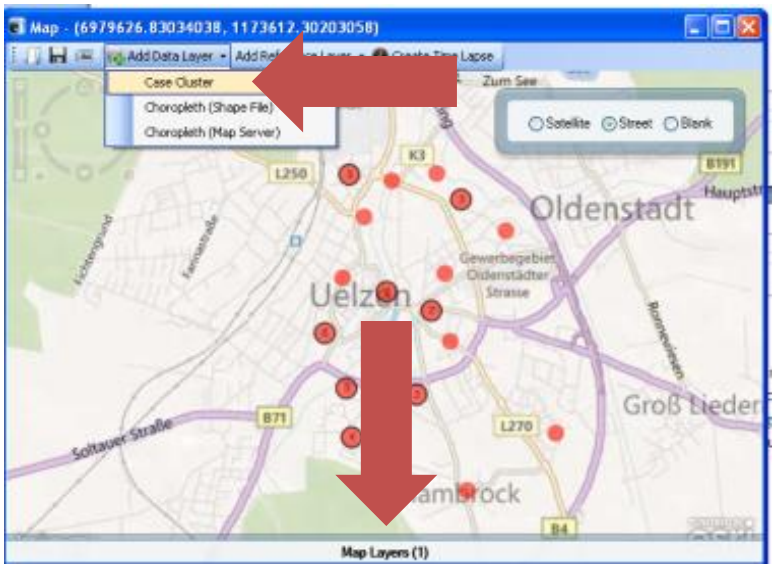
Step 11. Click the red arrow to close the Data Filters box and return to the map. The map will immediately return to the original, unfiltered data.



3.5 Display >1 Case Cluster Layer or Apply >1 Filter

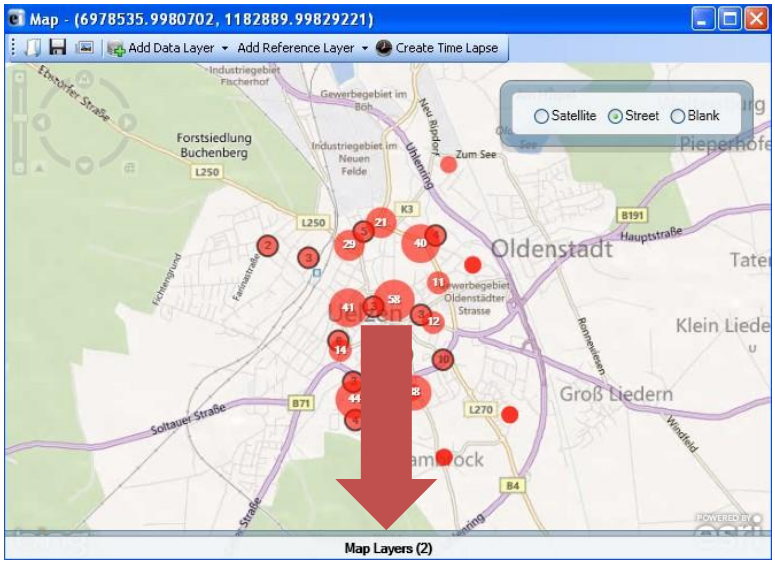
In Section 3.4 Steps 5–8 you learned how to apply a filter to your case cluster map. In our example, we restricted the data display to case patients who were less than 18 years old (i.e., children). Suppose you want to view case patients 18 years or older (i.e., adults) on the same map, but using a different color marker.

Step 1. First you'll need to Add Data Layer:Case Cluster to bring another copy of your data onto the map. You can review step-by-step instructions in sections 3.2 and 3.3.

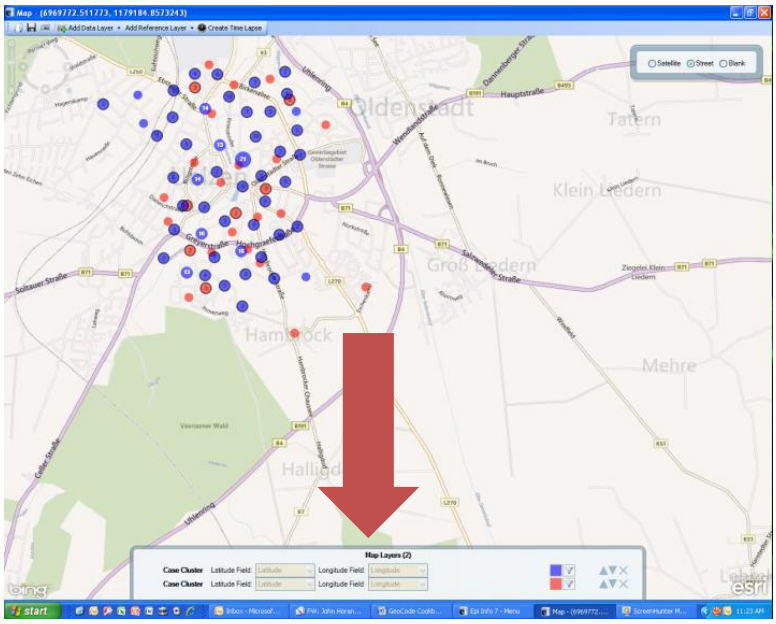


Note: The map layers tab indicates 1 layer is active.

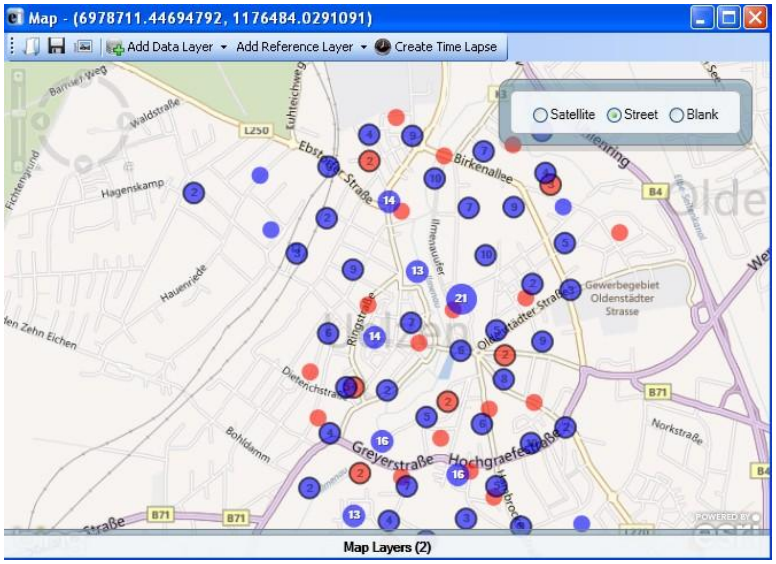
Step 2. Once you have successfully brought in another copy of your data, you have two Map Layers to work with.



Step 3. Now you can add a filter to the second copy of your case cluster data. In the example below, children are mapped in red, and I added a new filter for adults mapped in blue. You can review step-by-step filter instructions in section 3.4.

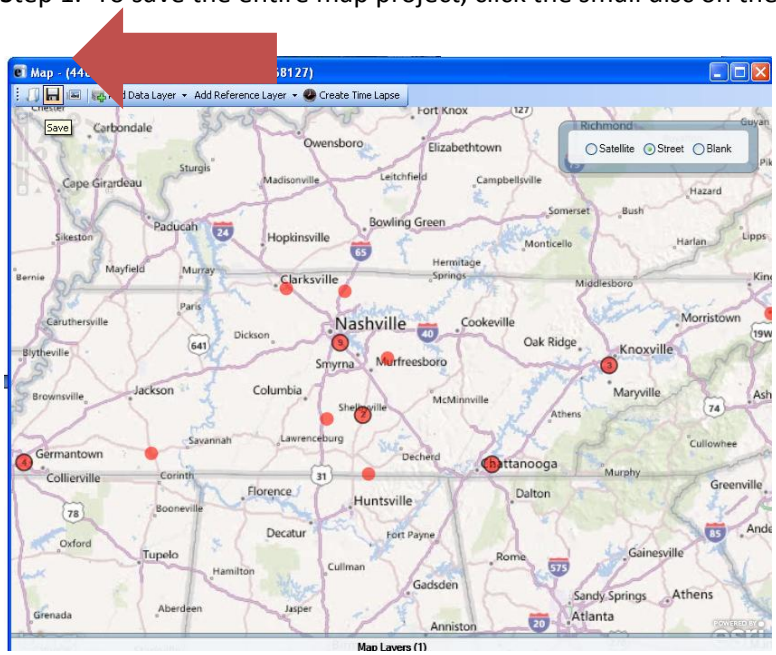


Step 4. You can repeat these steps to add as many data layers and filters as you like. One note of caution: to date, Epi Info 7 lacks the option to add a legend, so keep track of your color scheme.

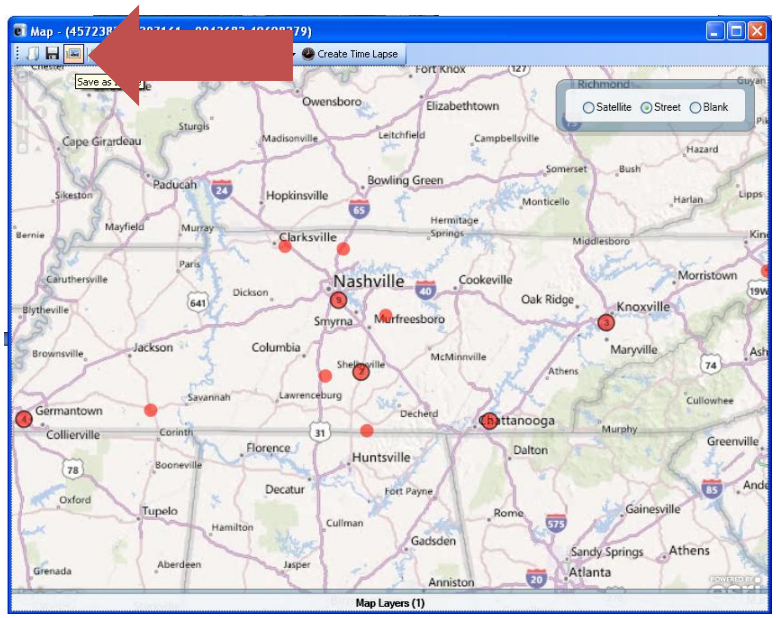


3.6 Saving Map Projects and Map Images

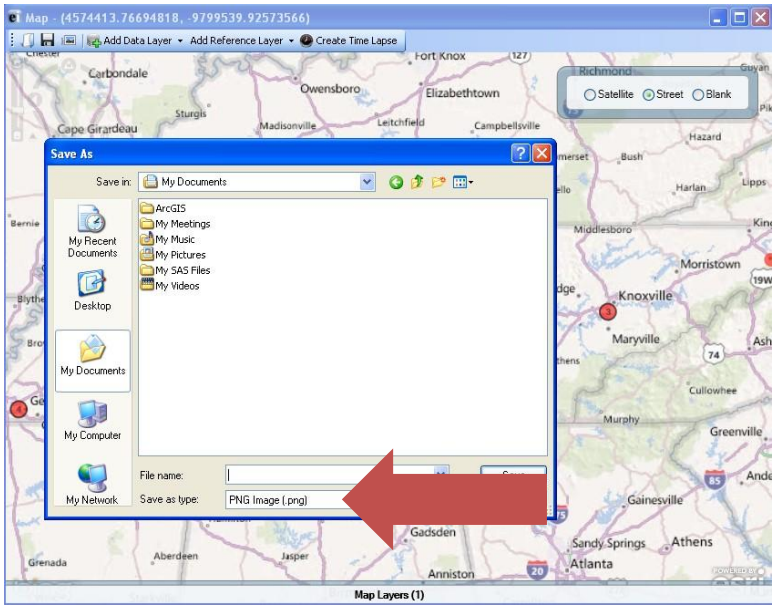
Step 1. To save the entire map project, click the small disc on the toolbar.



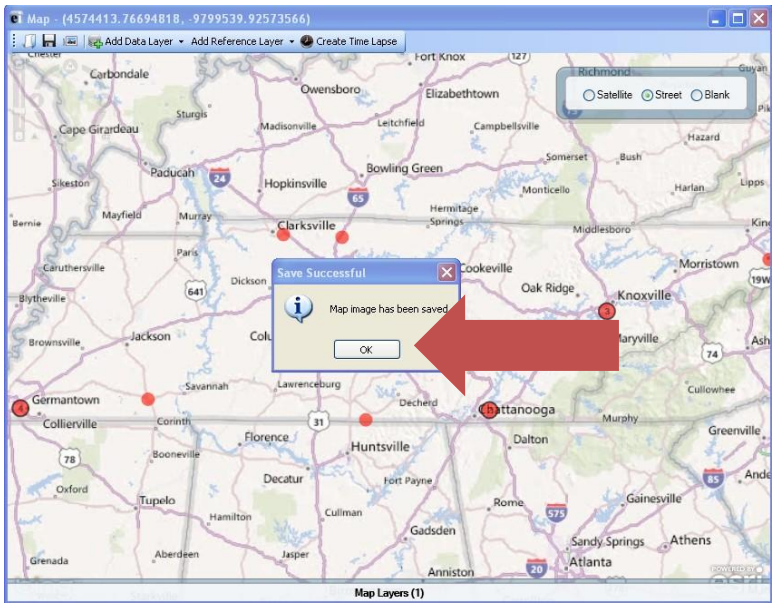
Step 2. To save the map as an image, click the small photo on the toolbar.



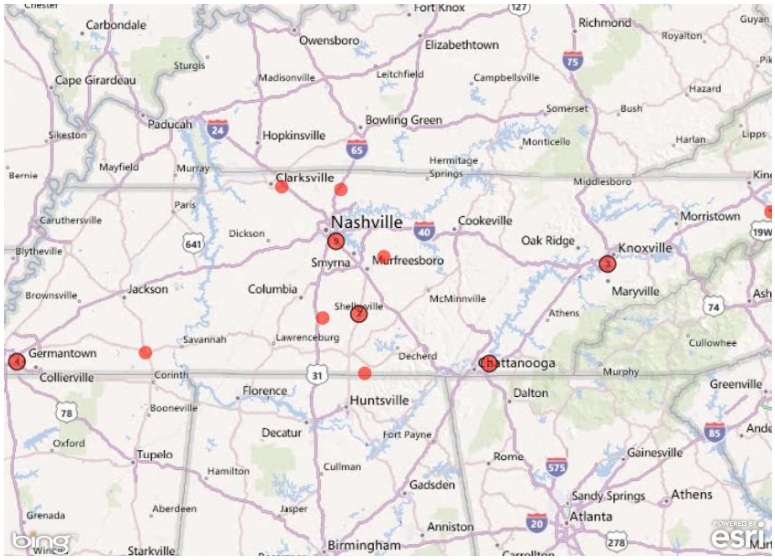
Step 3. Maps are stored as PNG image files.



Step 4. Click OK to close the pop up box indicating that your map image has been saved.

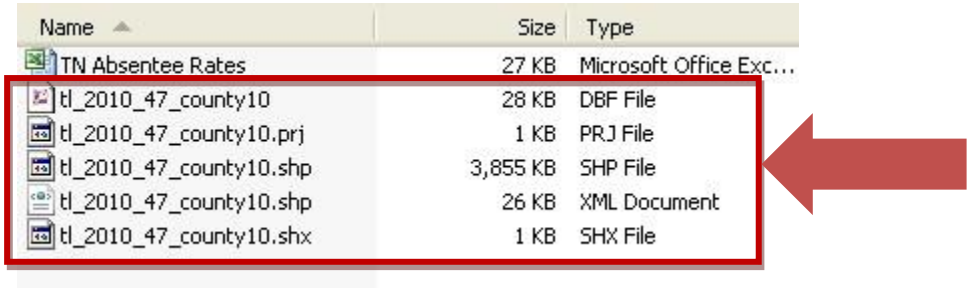


Step 5. You may now insert the map image into your Power Point presentation or Word document as done here.



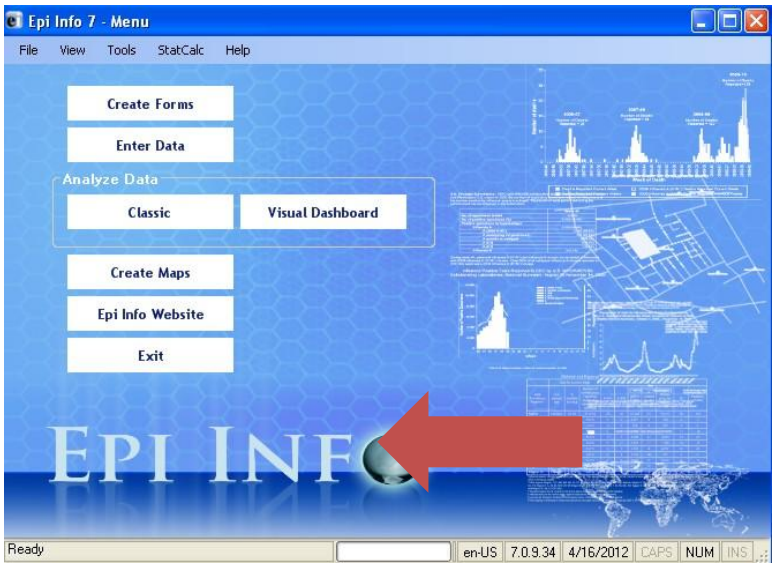
3.7 Create a Choropleth Map Using External Data Aggregated by Geographic Units

Step 1. Prior to producing a choropleth map in Epi Info 7, you must have your data file containing the aggregate data you wish to represent on a map (TN Absentee Rates by County for this example) and the Shape for the geographic region of interest (TN Counties). Note that a Shape file is usually a collection of 5 individual files. In this example, the shape file for all Tennessee counties was downloaded at http://www.census.gov/cgi-bin/geo/shapefiles2010/main. See Sections 3 or 5 for more information on downloading Shape files.

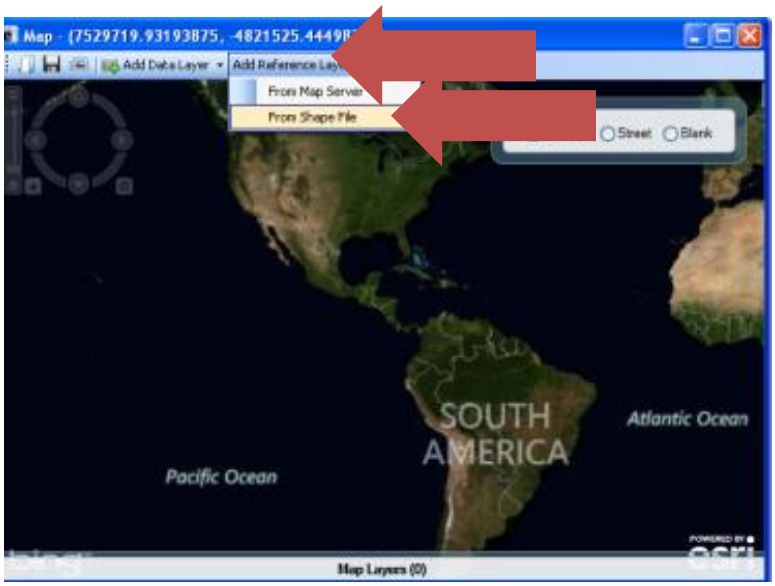


Name	Size	Type
TN Absentee Rates	27 KB	Microsoft Office Exc...
tl_2010_47_county10	28 KB	DBF File
tl_2010_47_county10.prj	1 KB	PRJ File
tl_2010_47_county10.shp	3,855 KB	SHP File
tl_2010_47_county10.shp	26 KB	XML Document
tl_2010_47_county10.shx	1 KB	SHX File

Step 2. Now that you have the necessary data and shape files stored, click Create Maps on the Epi Info 7 menu.



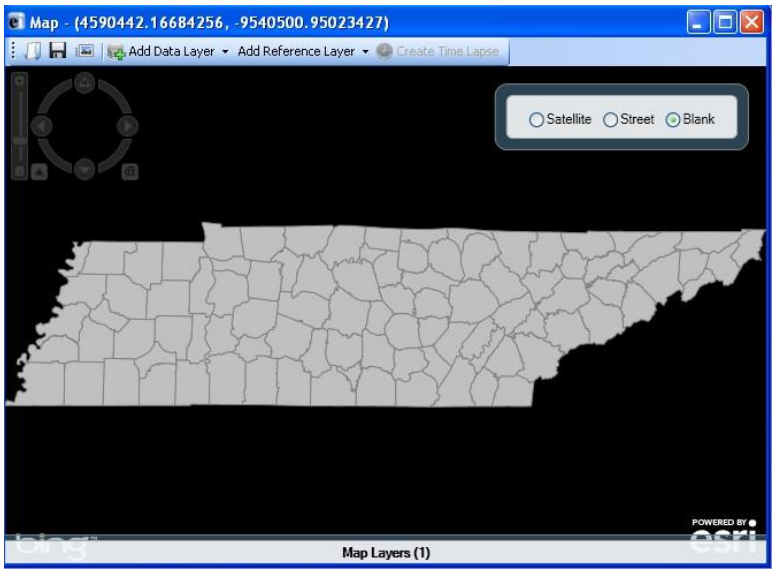
Step 3. From the Add Reference Layer tab on the toolbar, select From Shape File.



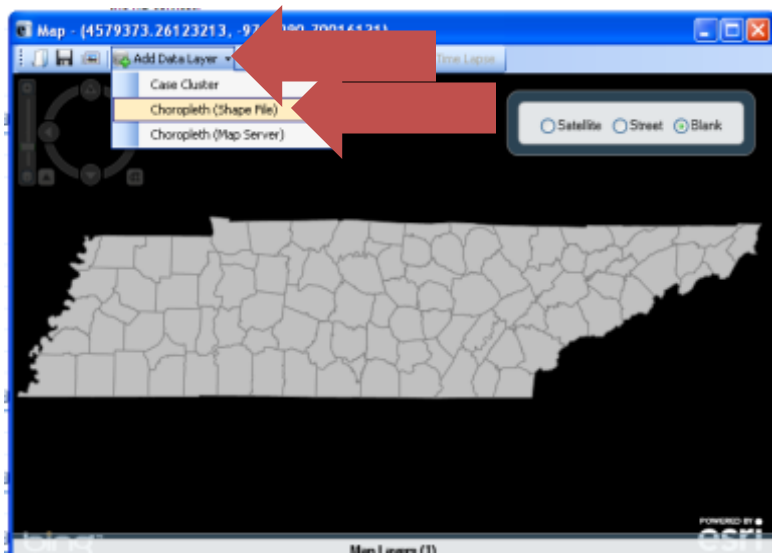
Step 4. Point to your shape file. Note that only the *.shp file will appear (not the other files associate with a Shape file).

Step 5. An outline of Tennessee counties will appear. Change the background to Street or Blank if you wish.

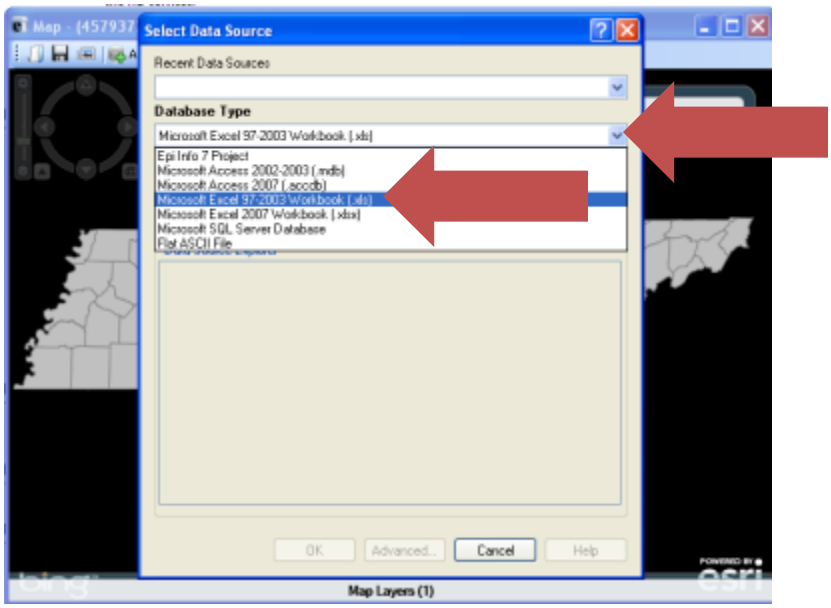
Step 6. A blank background will be used for this example.



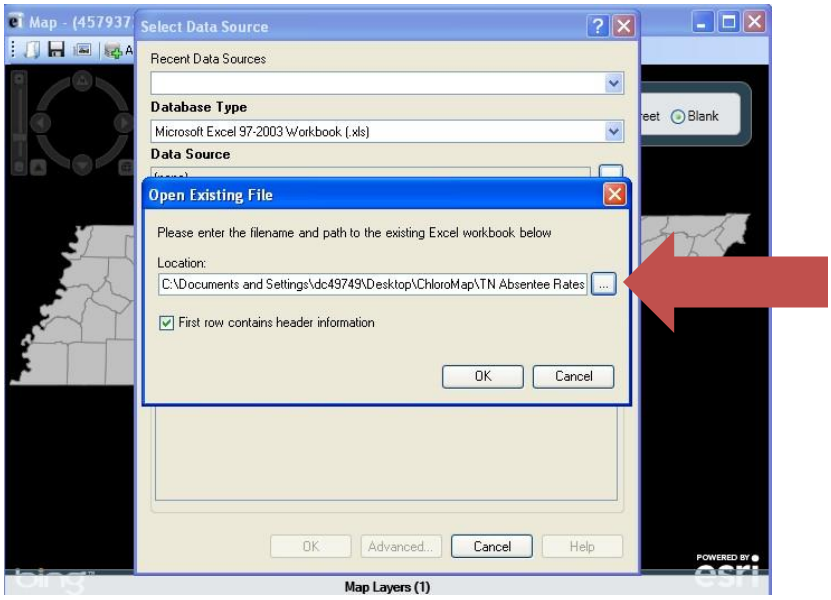
Step 7. To continue, hover over Add Data Layer on the toolbar and select Choropleth (Shape File).



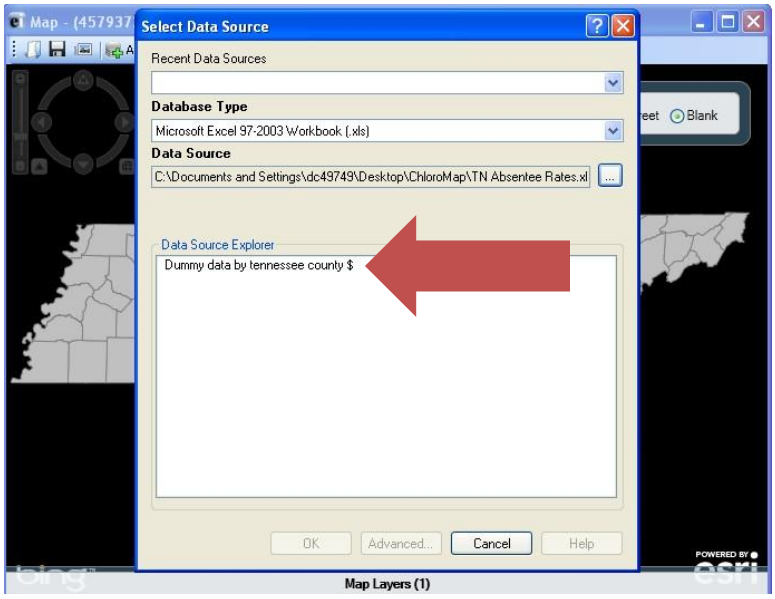
Step 8. Point to the database file containing your aggregate data. This example uses *.xls data.



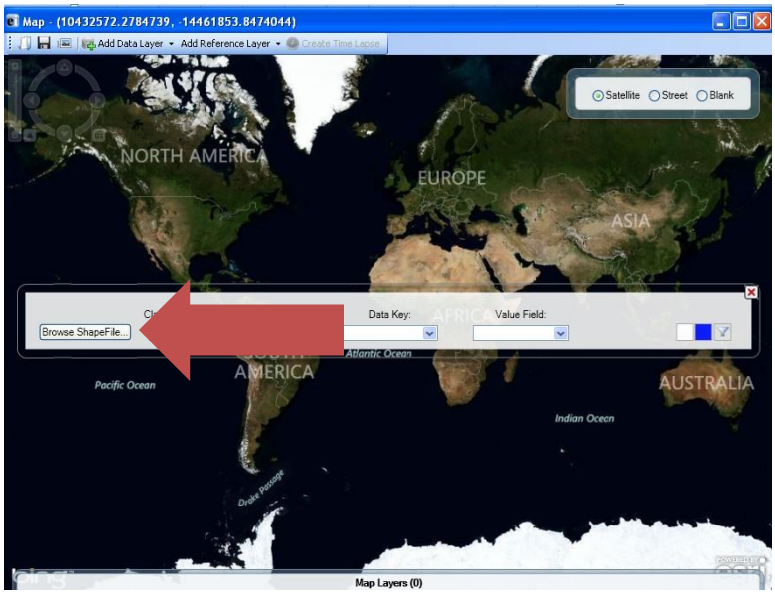
Step 9. Navigate to the database file location.



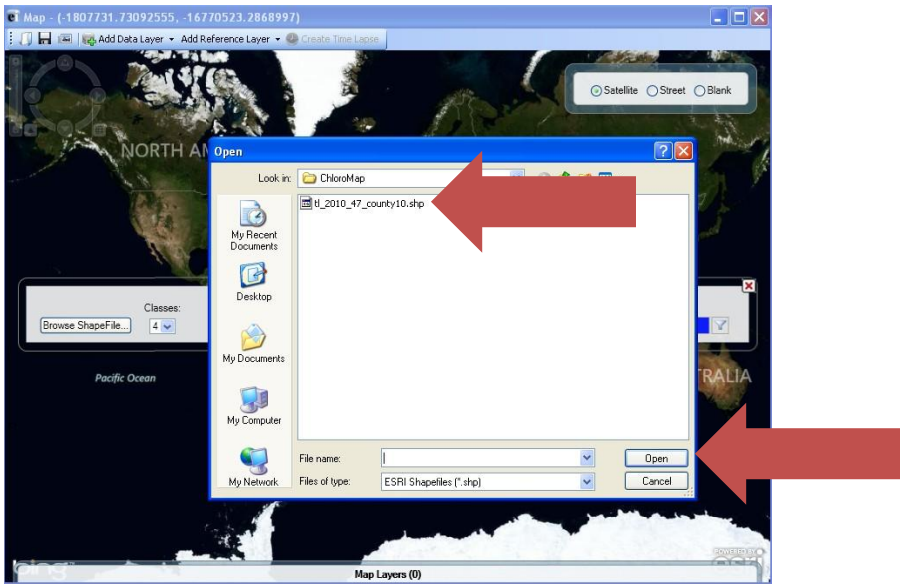
Step 10. Select the worksheet/table containing the aggregate data.



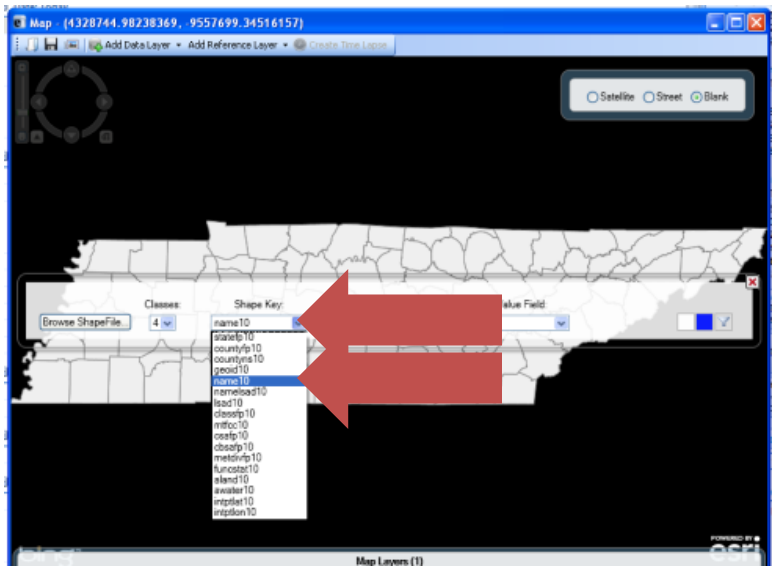
Step 11. Click Browse Shape File.



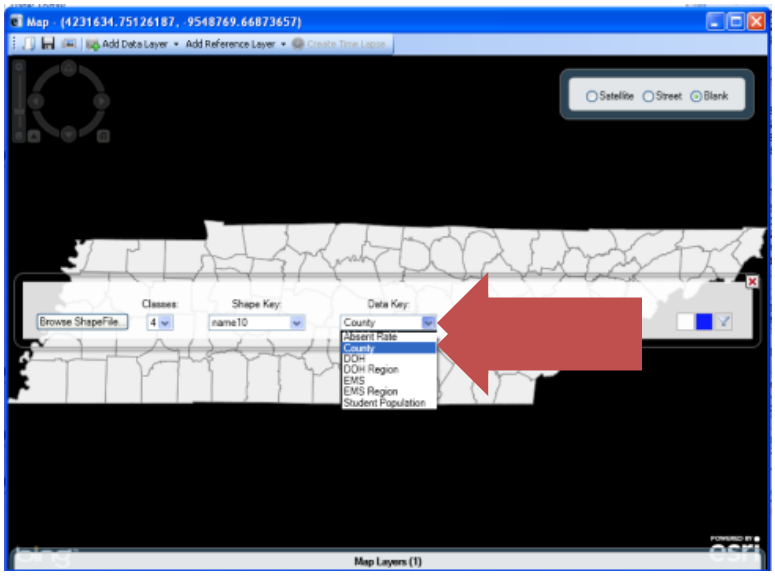
Step 12. Navigate to the *.shp file then click Open.



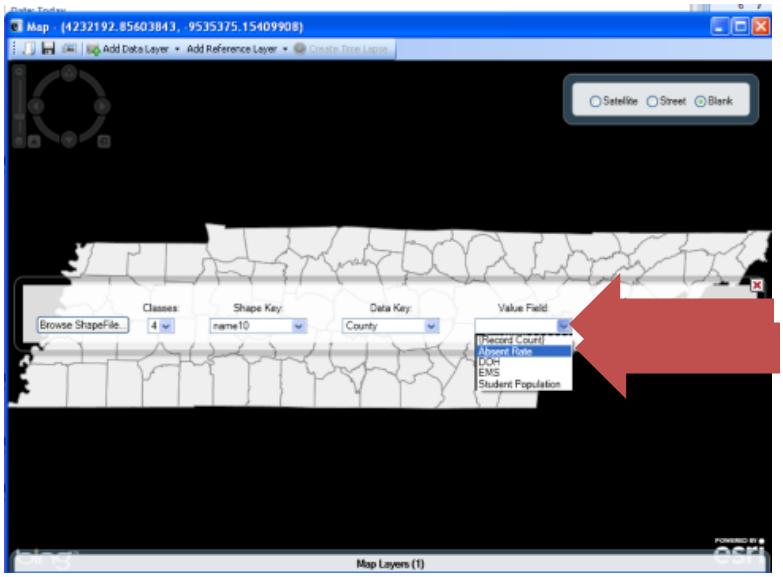
Step 13. Click the Shape Key drop down menu. Highlight the name of the field containing the name/number of your geographic unit of interest (county in this example). Note: this unit must match the geographic unit in the database (see Step 14).



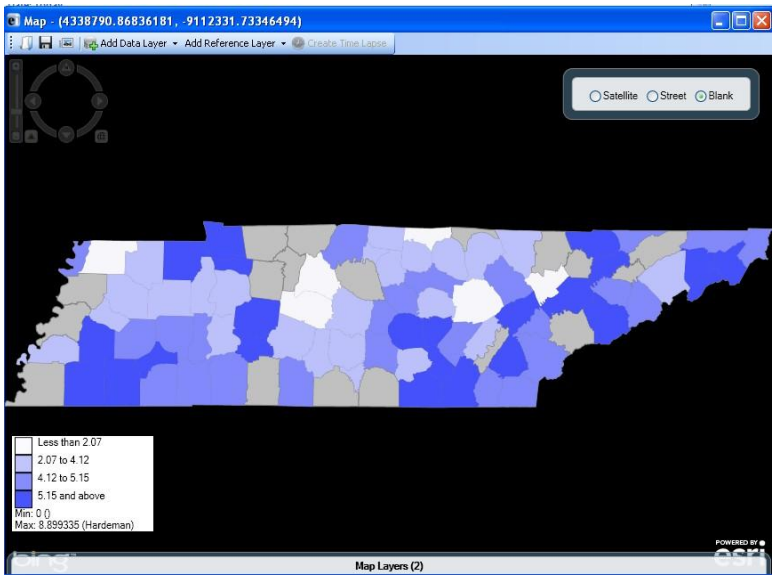
Step 14. Click the Data Key drop down menu. Highlight the name of the field containing the name/number of your geographic unit (county in this example). Note: this unit must match the geographic unit in the *.shp file (see Step 13).



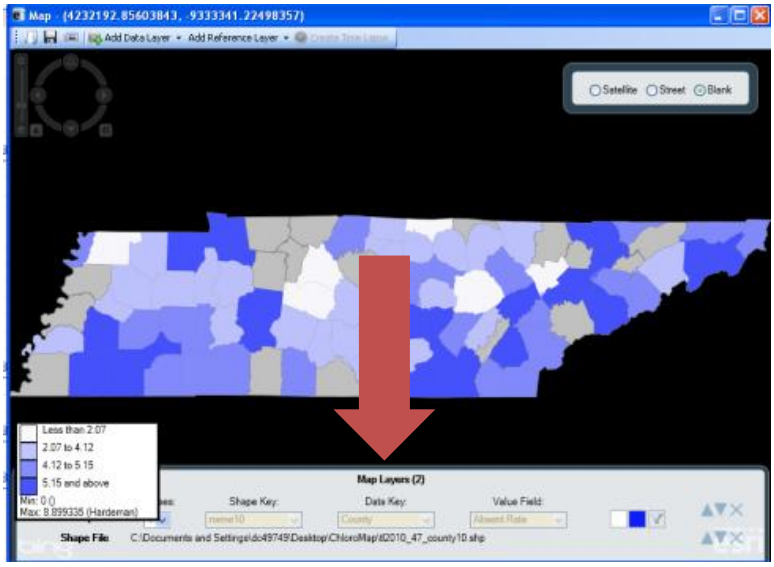
Step 15. Click the Value Field drop down menu. Highlight the name of the field containing the data values you wish to map (TN Absentee Rates in this example).



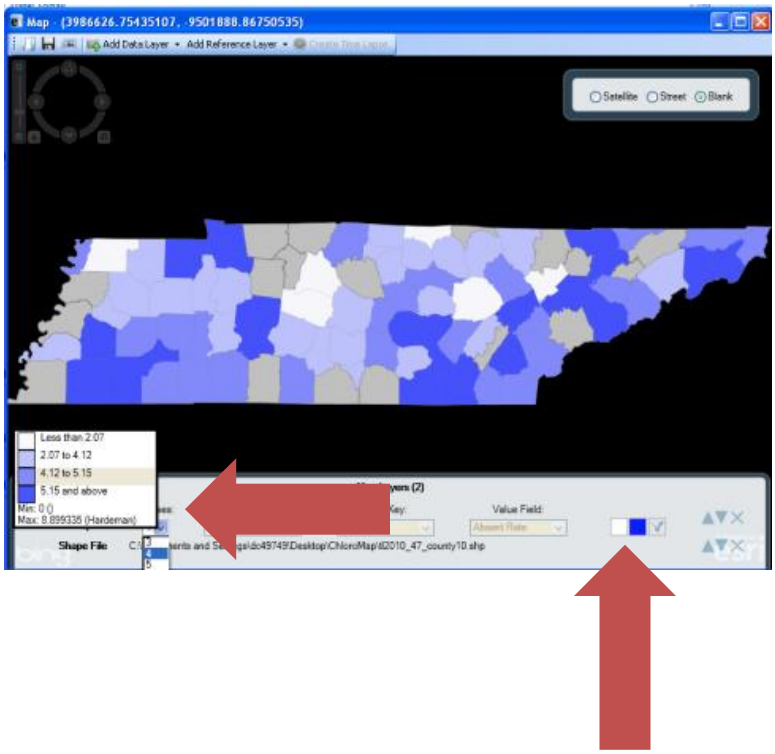
Step 16. A map will appear.



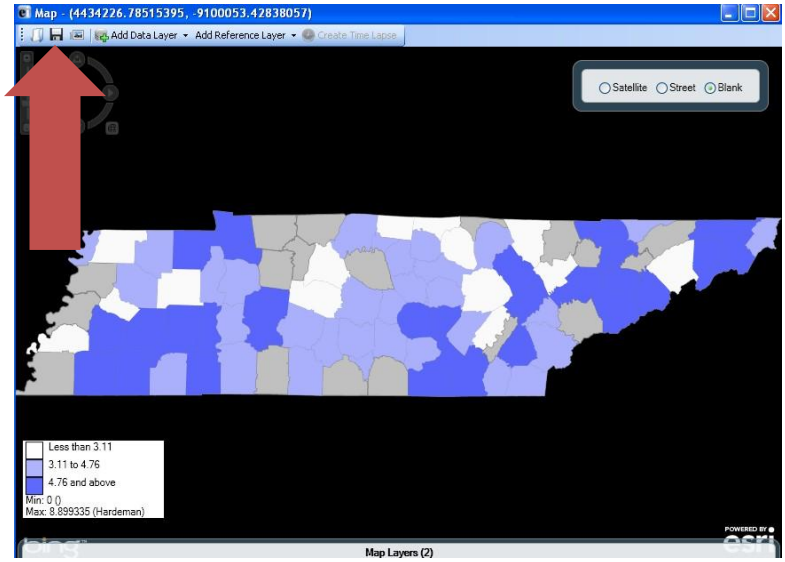
Step 17. Hover over the Map Layers tab at the bottom of the screen to expand this menu.



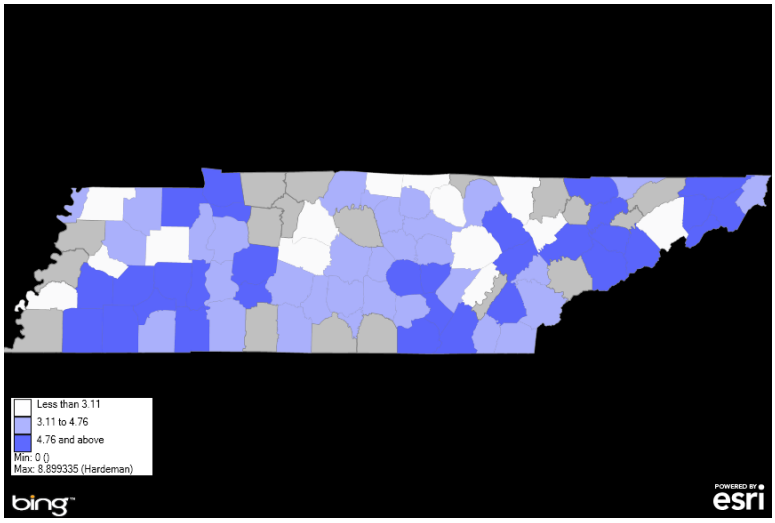
Step 18. Here, you can change the number of Classes (3–6) or change the graph colors. Unfortunately, you cannot customize the range of each class at this time.



Step 19. To save the image, click the tiny disk on the toolbar.



Step 20. You may now insert the map image into your Power Point presentation or Word document as done here.



3.8 Tips and Other Features

- It is possible to map more than one data layer at a time, though it gets a little tricky. Seek assistance from Rendi.Murphree@tn.gov or another Epi Info user.
- The Epi Info 7 Quick Start guide can be downloaded at http://www.phconnect.org/group/epiinfo/forum/topics/epi-info-7-quick-start-guide
- Check these websites frequently for updates and new releases. http://wwwn.cdc.gov/epiinfo/ and http://www.phconnect.org/group/epiinfo
- The Epi Info 7 1st Draft User manual is available at http://www.phconnect.org/group/epiinfo/forum/topics/epi-info-7-user-manual
- Dr. Andrew Dean has published an excellent Epi Info book that covers all statistical aspects of the program and is available for free at http://www.epiinformatics.com
- Shapefiles can be downloaded at the CDC Epi Info website http://wwwn.cdc.gov/epiinfo/script/shapefiles.aspx
- For further Epi Info 7 support, or to report problems with the software, contact the Epi Info Helpdesk, at epiinfo@cdc.gov

Chapter 4: ArcGIS Explorer Desktop- GIS for Everyone *(AKA: Free GIS for regular people)*

Laina Stanford and Brynn Berger, MPH, CIC

4.1 Overview, Download, & Training

ArcGIS Explorer Desktop Overview

ArcGIS Explorer Desktop is a free GIS viewer from Esri® that gives you an easy way to explore, visualize, share, and present your geographic information. With ArcGIS Explorer Desktop, you can:

- Access ready-to-use ArcGIS Online basemaps and layers
- Fuse your local data with map services to create custom maps
- Add photos, reports, videos, live web cams, websites, and other information to your maps
- Perform spatial analysis (e.g., visibility, modeling, proximity search)

Download ArcGIS Explorer at: http://www.esri.com/software/arcgis/explorer/download.html

Free Online Training

There are several good online tutorials to get started. Since this information is easily available for free, we will not discuss those basics in detail in this document. Here are some of the highly recommended online tutorials:

> ***Getting Started: The Ribbon, Navigation, and More - 8:41 minutes***
> Learn how to navigate your way around ArcGIS Explorer Desktop.
> http://www.esri.com/software/arcgis/explorer/demos.html

There are several other short, yet informative, online training tutorials located at the Esri ® Resource Center: http://resources.arcgis.com/gallery/video/arcgis-explorer
These three are highly recommended and provide you with all the basics for getting started:

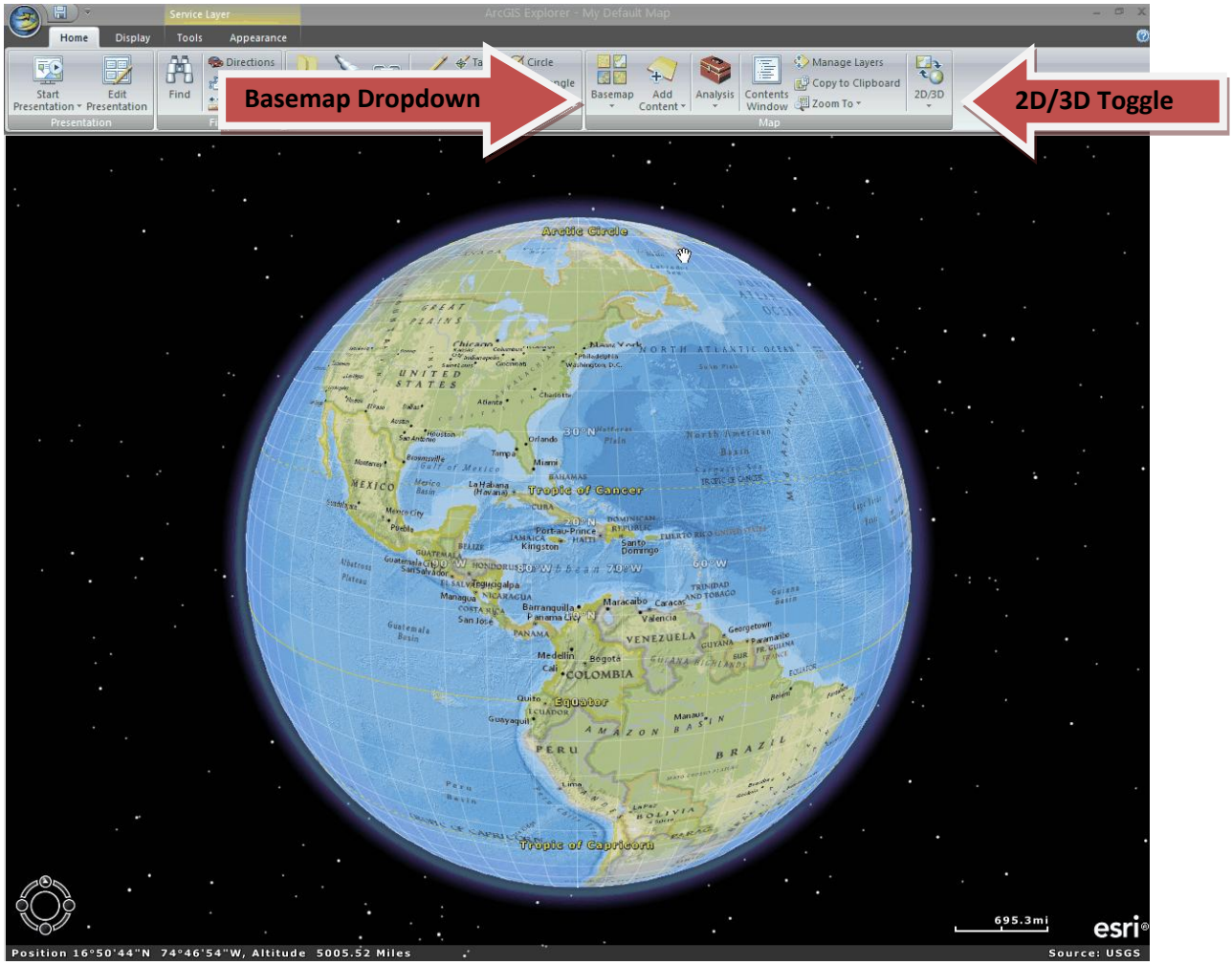
- ArcGIS Explorer Basics – 3:50 minutes
- DS2011: Implementing ArcGIS Explorer – 11:27 minutes
- Add points to your map using text files – 5:15 minutes

The benefit to ArcGIS Explorer Desktop is that you can download it and learn all the main functionality in under an hour. Plus, it is FREE – GIS for everyone.

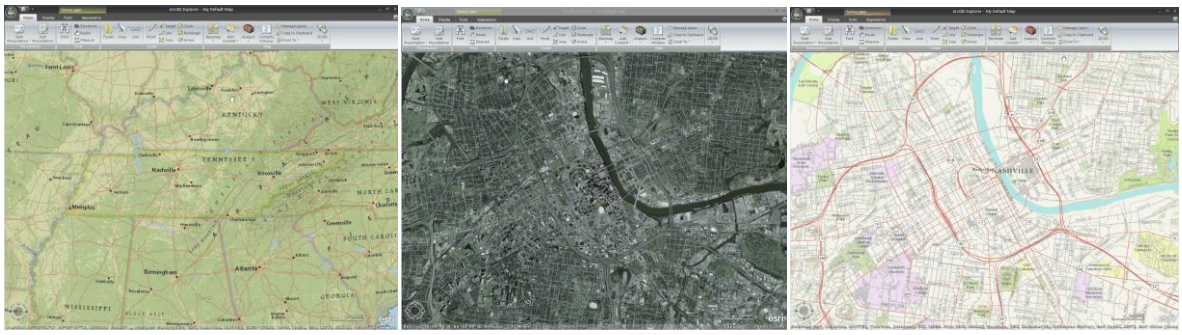
(NOTE: An online version of ArcGIS Explorer is also available for free but is not discussed here. If you would like to learn about capabilities of the ArcGIS Explorer Online, view this free seminar: http://training.esri.com/gateway/index.cfm?fa=catalog.webCourseDetail&courseid=2144)

4.2 Configuring your basemap and overlay maps

Once you have downloaded the software, it is time to start setting up your map. You can toggle between 2D & 3D and set your basemap to a variety of different choices.



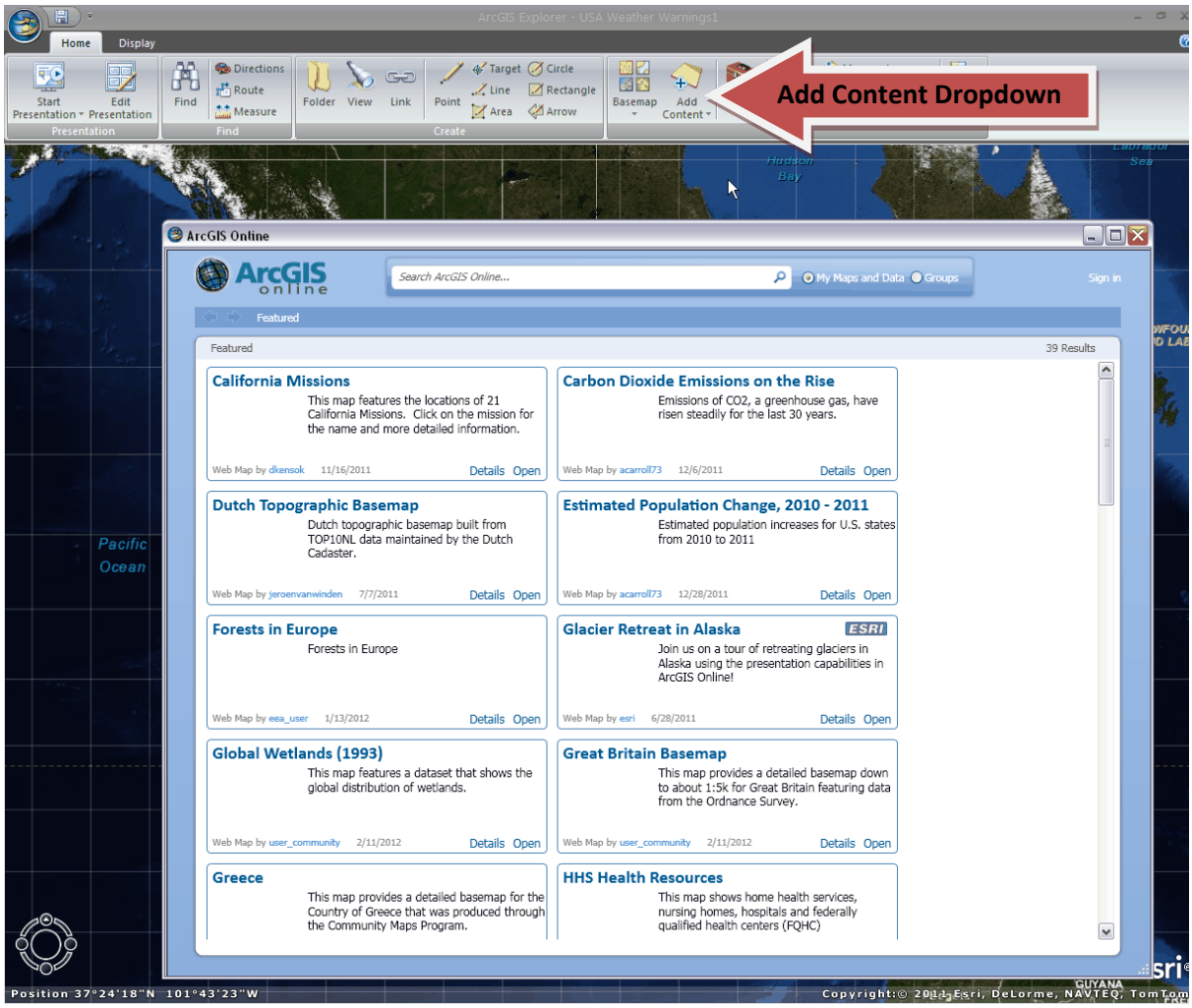
Roadmaps, imagery maps, aerial maps, topography maps, terrain maps, physical maps, etc., are all part of the basemaps that come with the basic download. Here are some examples:



You could also select maps from a variety of other sources.

ArcGIS Online

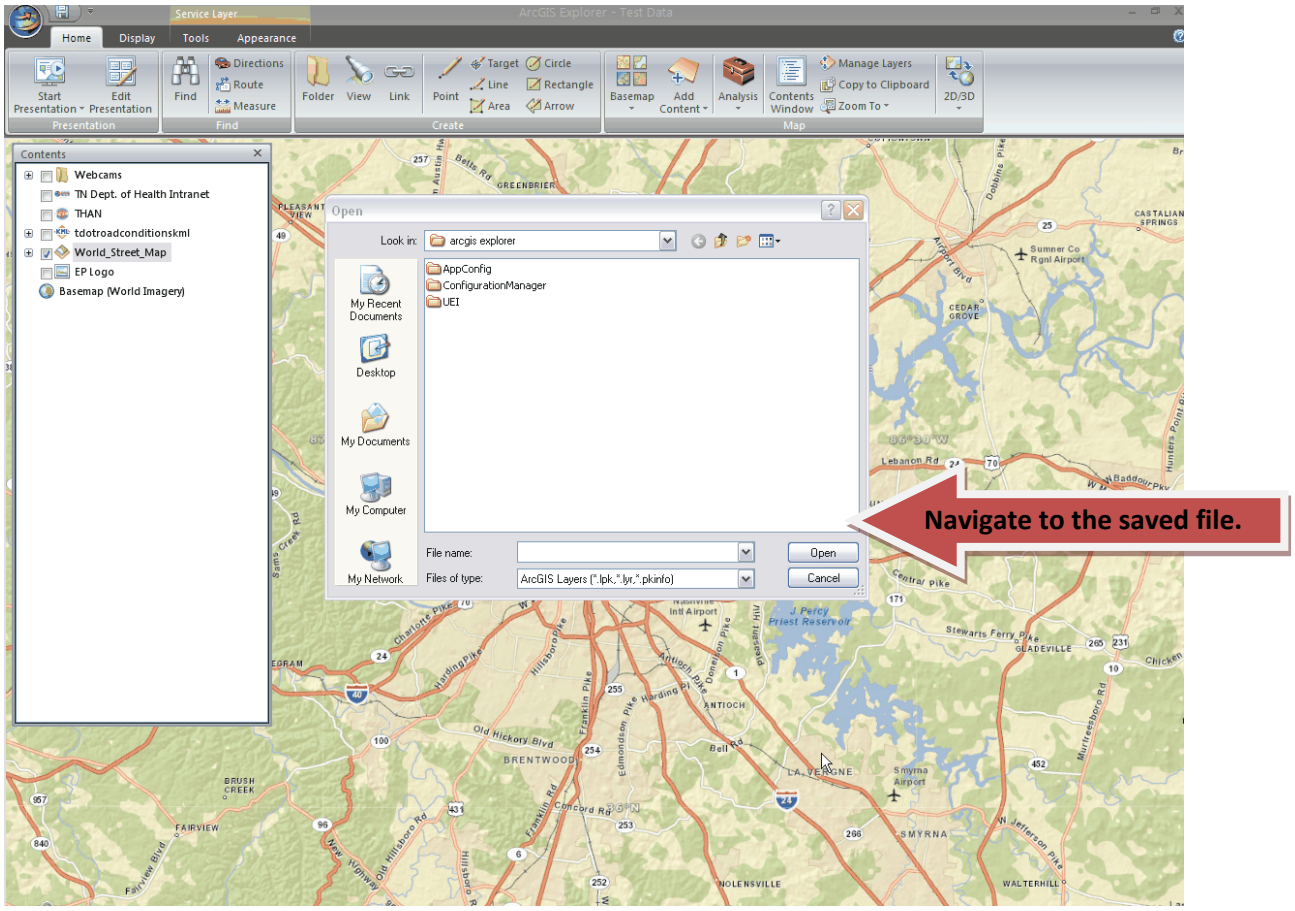
Under "**Add Content**" click "**ArcGIS Online**". There will be a variety of other map choices, plus you can search their online catalog of maps. You can view the details of the map before opening it to ensure it will be useful. Click "**Open**" to load the content.



Maps as Layers

You can import maps as layers over your basemap, and you will have the ability to turn the map layers off and on with a click. These are available from an external source or from online services.

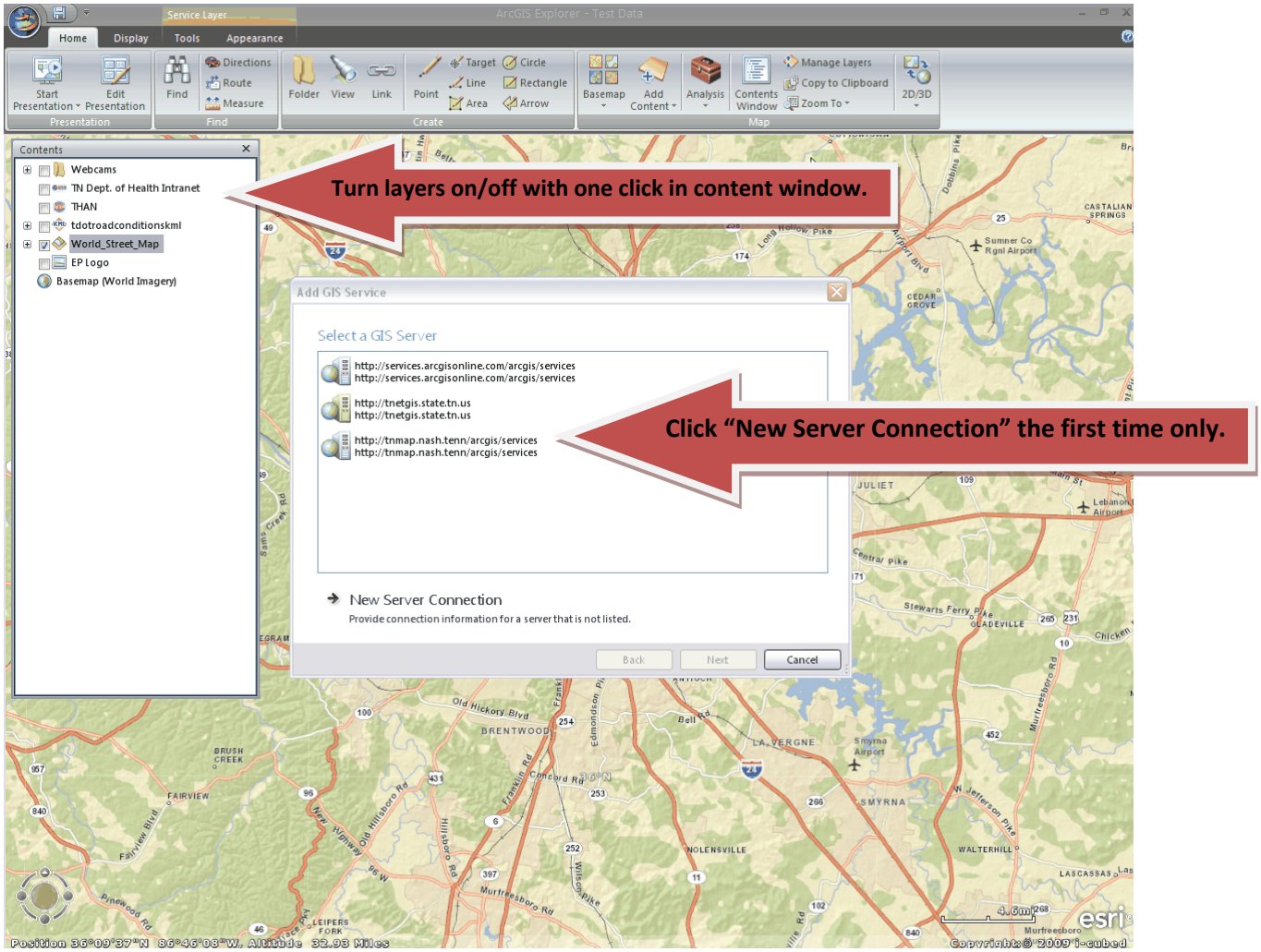
To import a layer from an external source (such as a GIS user who created one), save the data to a place where you can find it, click "**Add Content**", then click "**Arc GIS Layers**", and navigate to the place it is saved. (For those in the Central Office, **H:/CEDS/GIS/** is a great source of these kinds of files specific to Health.) Map layers have these file extensions: *.lpk *.lyr *.pkinfo



Another way to add layers is through GIS Services. Click "**Add Content**", then "**GIS Services**", then "**New Server Connection**". Enter one of the links below to connect to a GIS server.

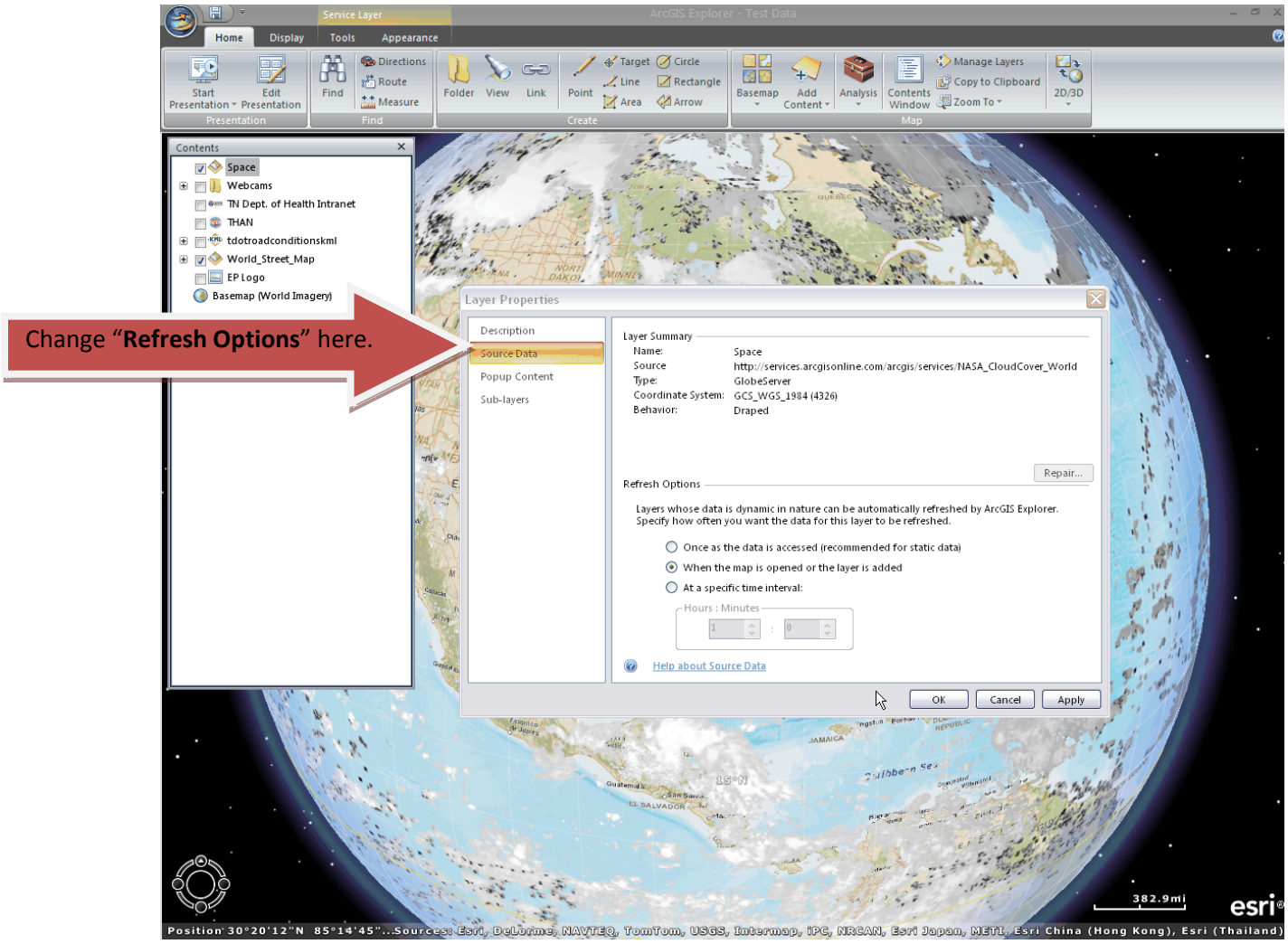
To find more data from ArcGIS Services : http://services.arcgisonline.com/arcgis/services

To find more data from the State of Tennessee GIS Services: http://tnetgis.state.tn.us

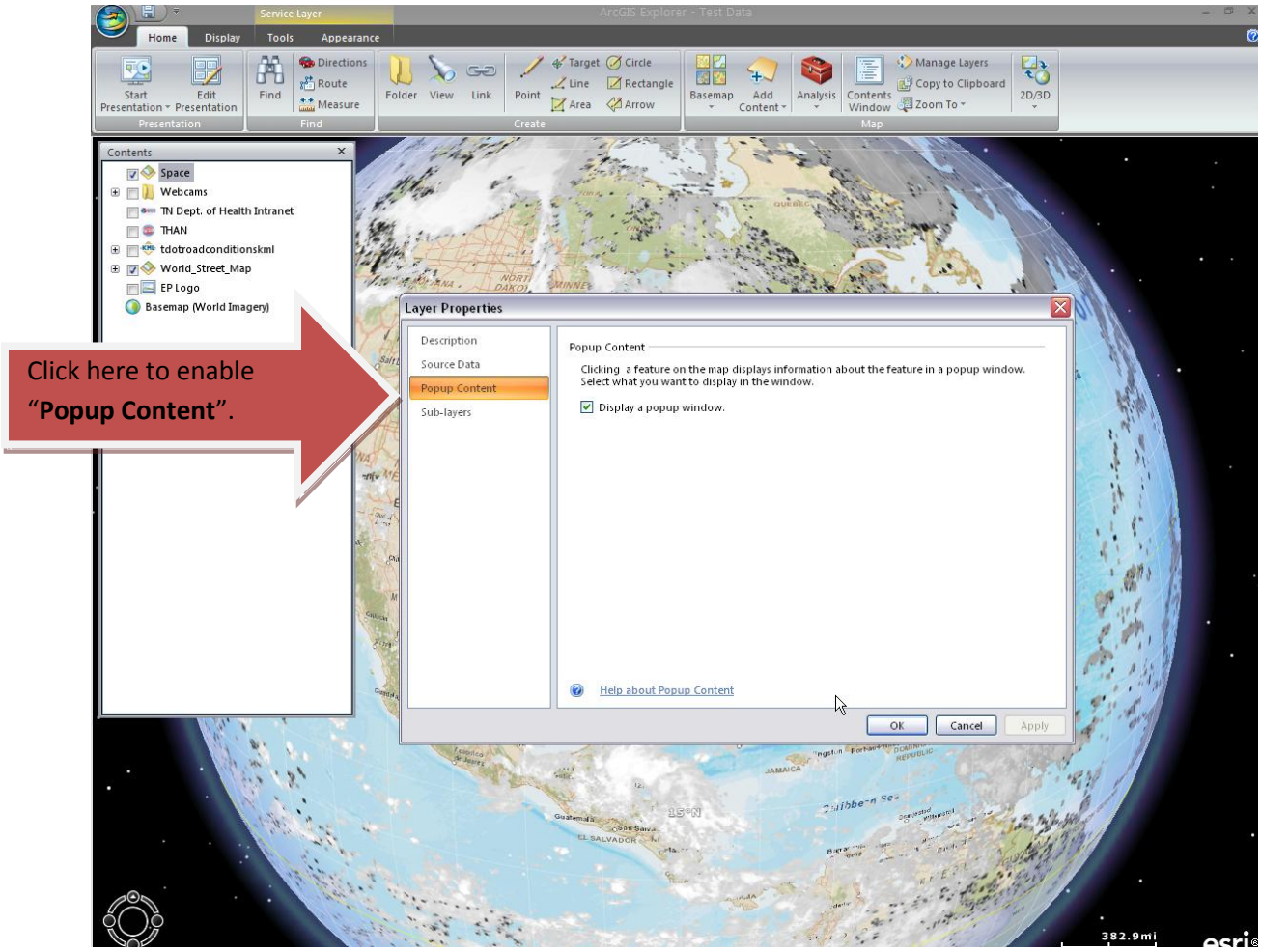


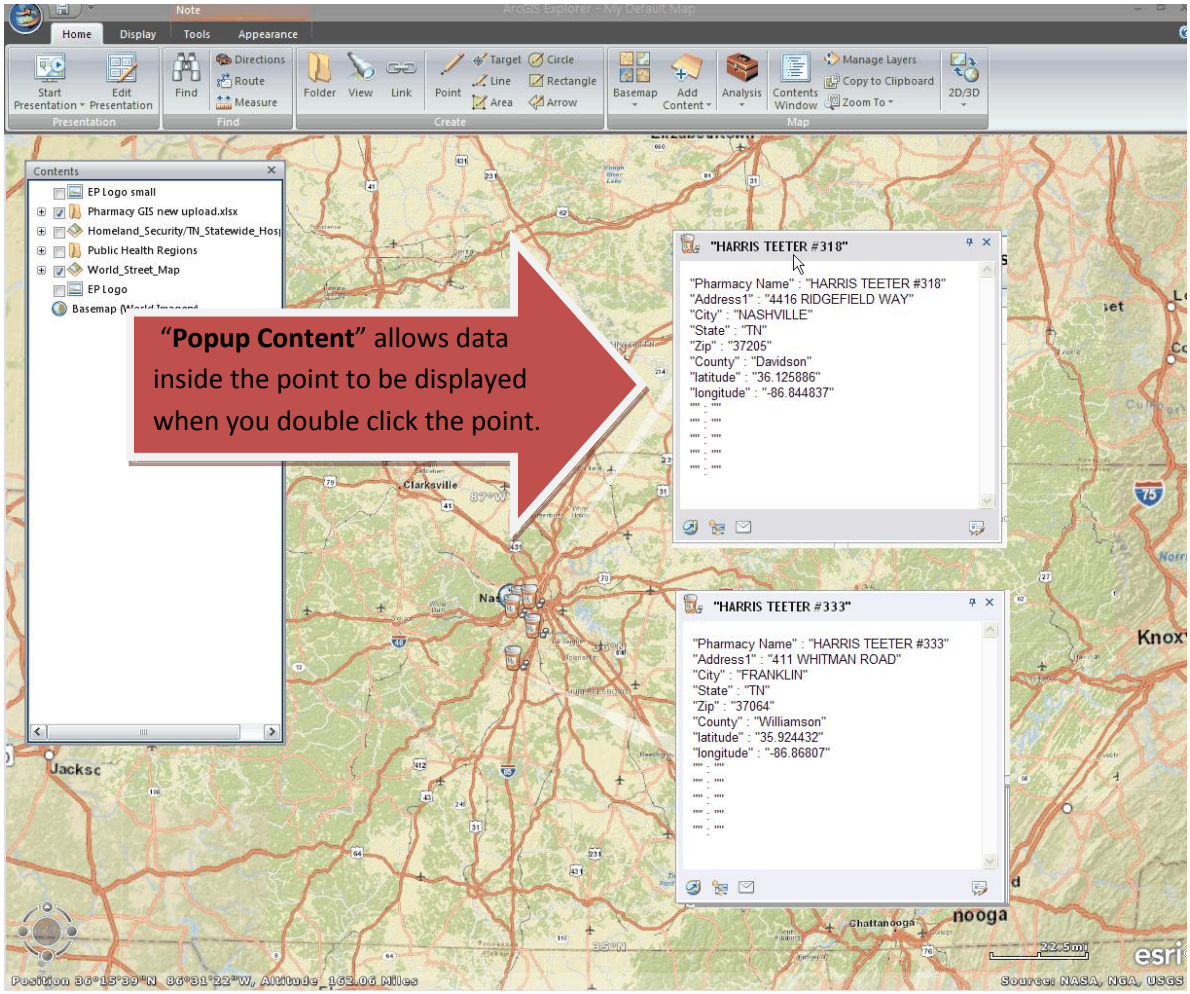
It is HIGHLY recommended that you preview these various services on the agency's website before importing. Some of these layers are very large and may take a long time to load, so you want to be sure that the map will be useful before you spend time loading it. These maps will import as a service layer and can be turned off and on with a click in the Contents window.

These links to external GIS services are live data sources and can be set to refresh at certain intervals or every time you open your map. Configure this functionality by **right clicking** the item in the Content Window and selecting "**Properties**". Go to the "**Source Data**" tab to change the "**Refresh Options**".



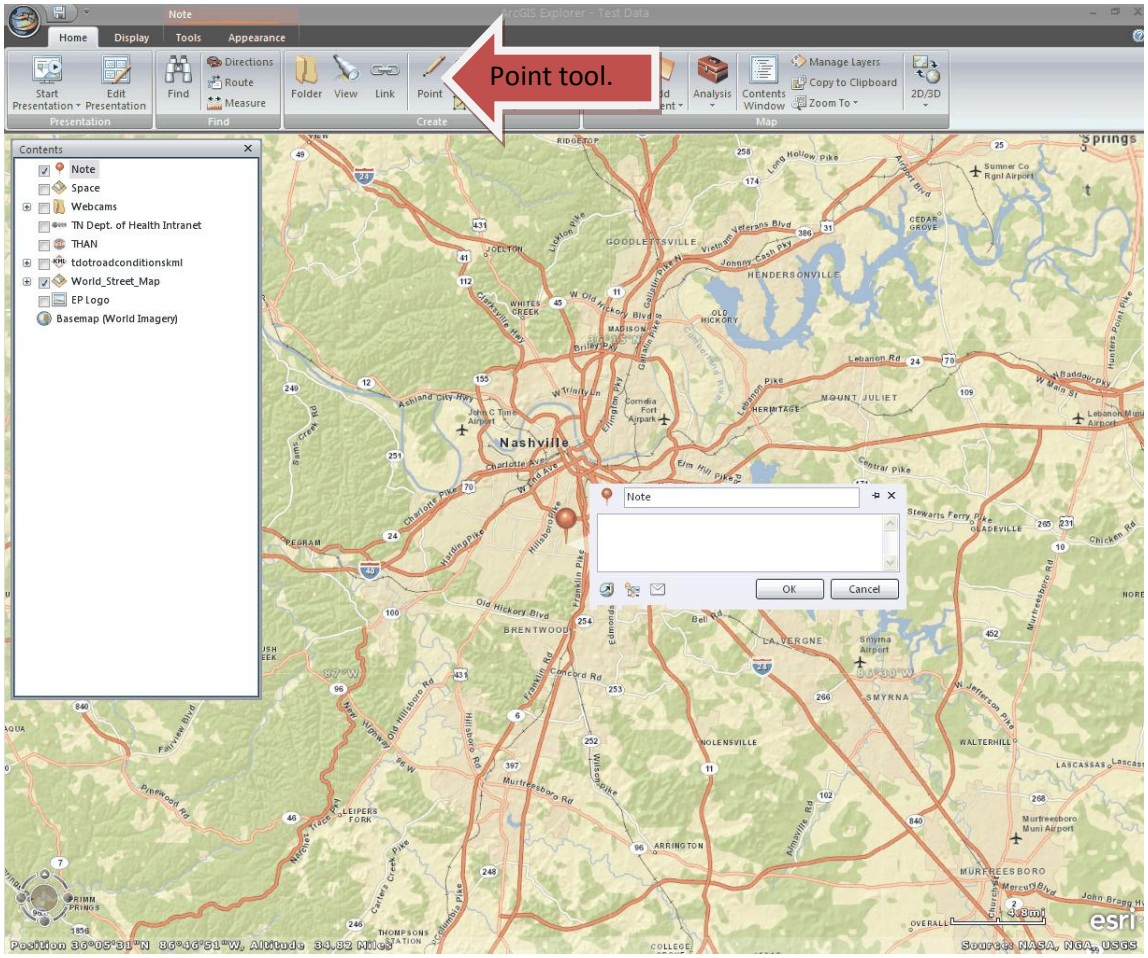
If the map you are importing from a service has points with data about each point, **right click** the item in the Content Window and select "**Properties**". Go to the "**Popup Content**" tab and check "**Display a popup window.**" This will allow the point to display all the characteristics in a popup window. This is helpful because it displays embedded data only when you click a particular point.



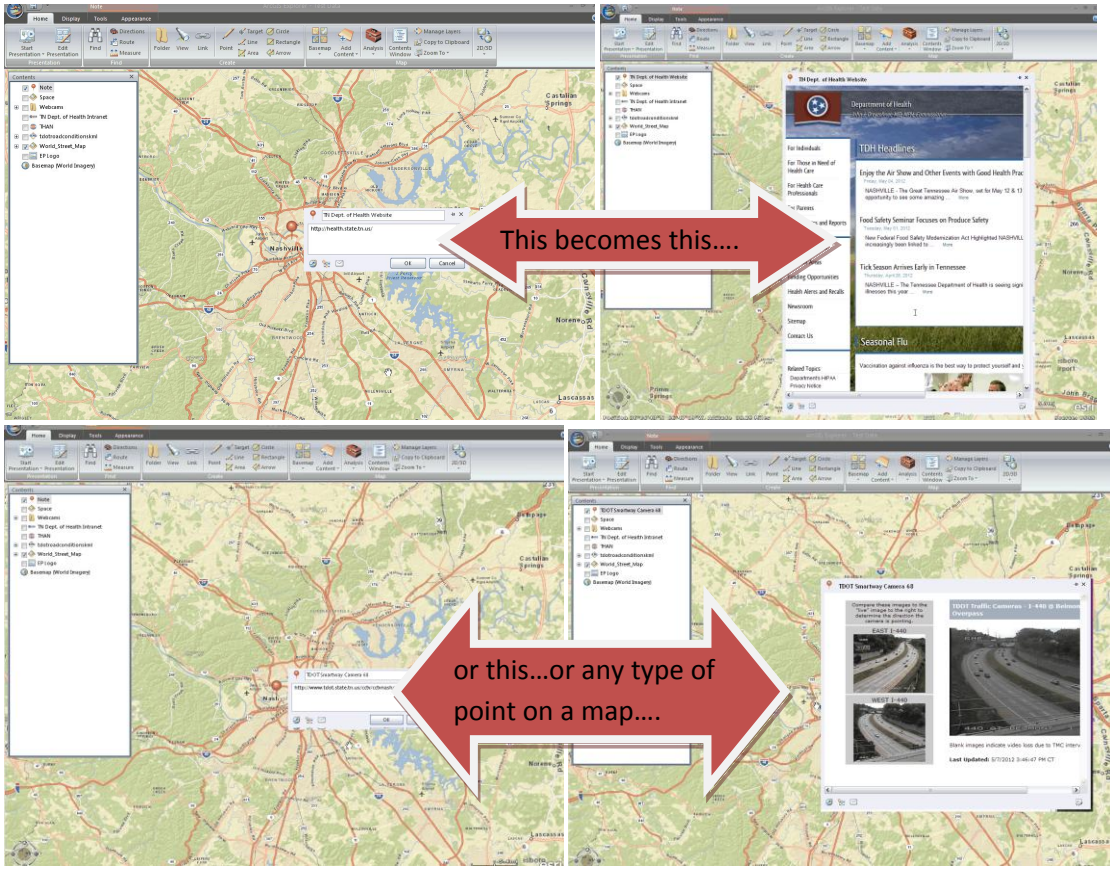

"Popup Content" allows data inside the point to be displayed when you double click the point.
"HARRIS TEETER #318"
"Pharmacy Name" : "HARRIS TEETER #318"
"Address1" : "4416 RIDGEFIELD WAY"
"City" : "NASHVILLE"
"State" : "TN"
"Zip" : "37205"
"County" : "Davidson"
"latitude" : "36.125886"
"longitude" : "-86.844837"
"HARRIS TEETER #333"
"Pharmacy Name" : "HARRIS TEETER #333"
"Address1" : "411 WHITMAN ROAD"
"City" : "FRANKLIN"
"State" : "TN"
"Zip" : "37064"
"County" : "Williamson"
"latitude" : "35.924432"
"longitude" : "-86.86807"
Contents
EP Logo small
Pharmacy GIS new upload.xlsx
Homeland_Security/TN_Statewide_Hosp
Public Health Regions
World_Street_Map
EP Logo
Basemap
Clarksville
Chattanooga
Knox
Source: NASA, NGA, USGS

4.3 Adding a single point on a map

After you select a suitable basemap or starting layer for your project, then it is time to put points on your map and fill it with content. Click "**Point**" and then select a location on your map to put that point. Using this method, you will need to locate where you want the point to be placed on the map be zooming in to find the location. This method is recommended if you don't know the address and only have a few individual points to plot.



This comes in as a note. Simply copy and paste your own content into the box and rename the note. Here is an example to insert a website page. This also works for online web cameras.



***Other helpful tips**:*

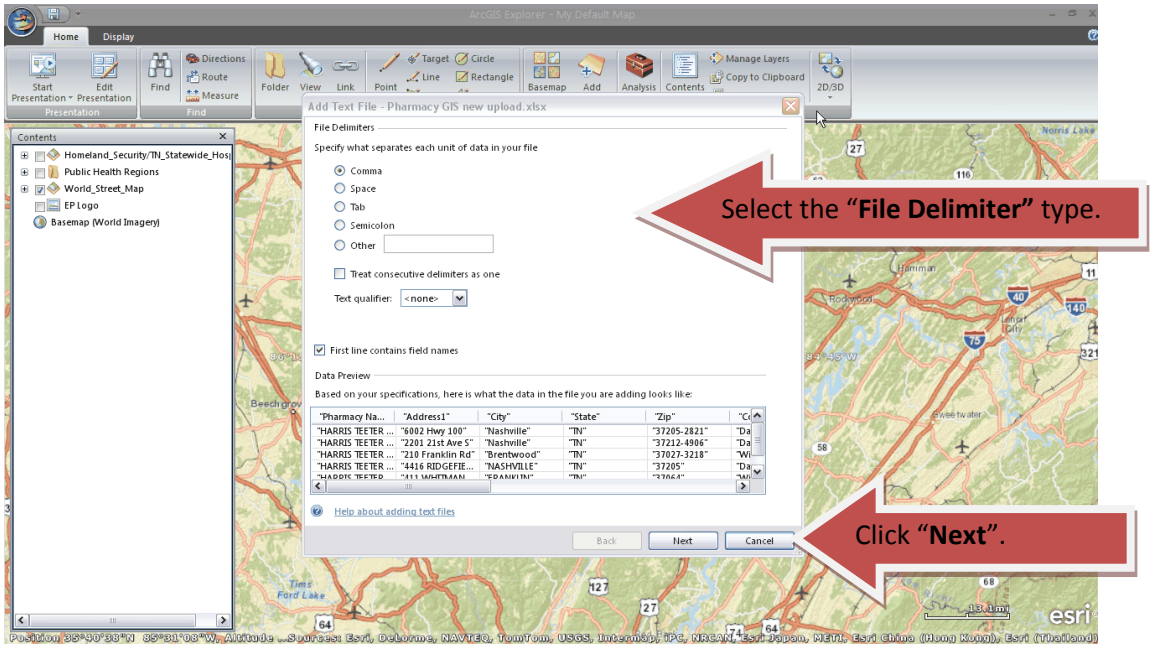
* You can pin any window to your map to make it stay open. Every window has a small pin icon in the upper right corner next to the "X" to close the window.

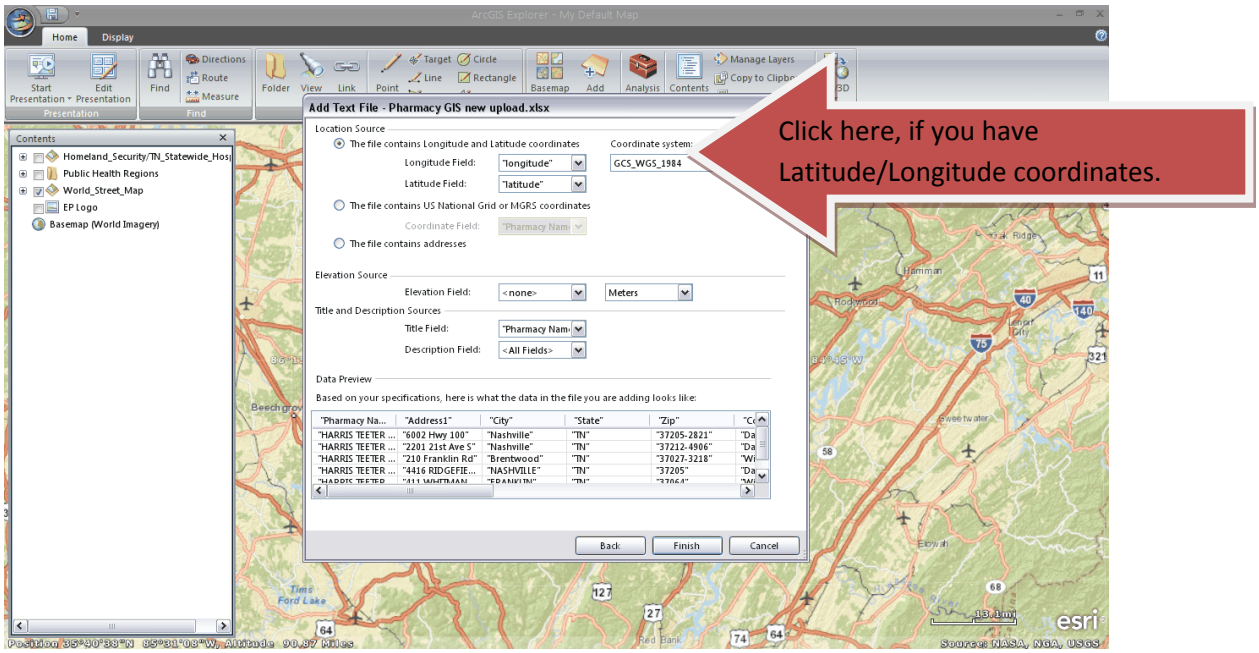
* To change the default icon for the note, **right click** on it in the "**Contents"** window (or on the map). Go to "**Symbol**" and change to another photo or browse to your own saved image file. To do this for a group of items, highlight all the items (or the folder they are all saved under) and follow the same process.

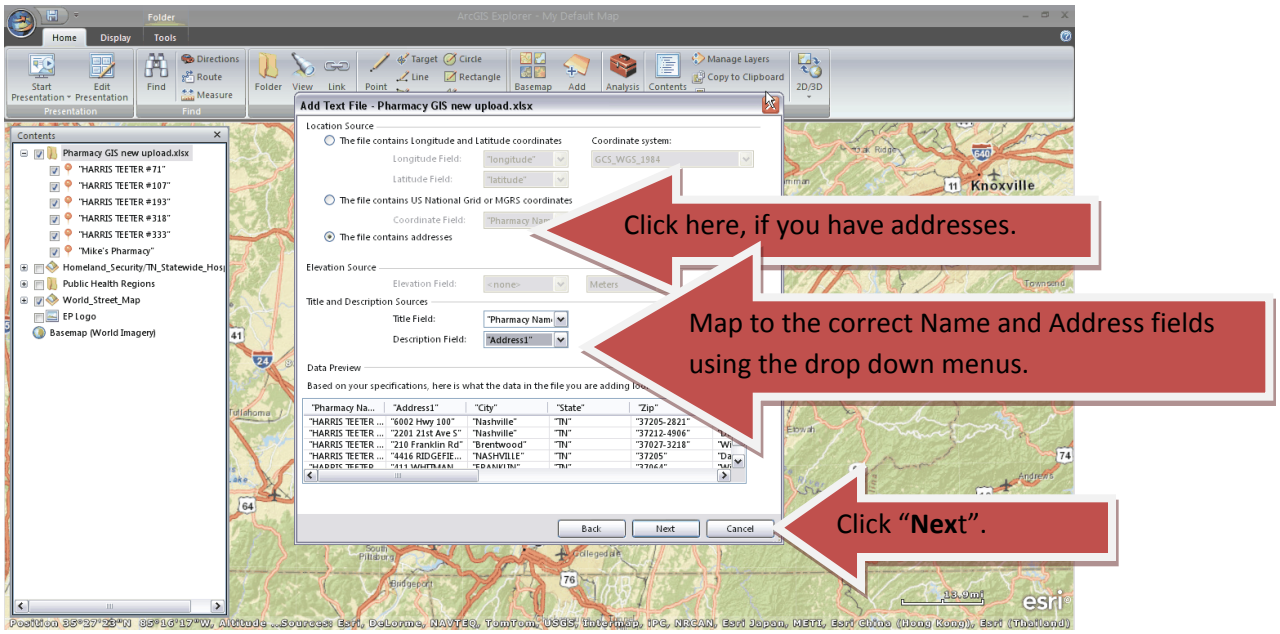
* Under "**Properties",** you can specify the Longitude/Latitude of the point for accuracy.

4.4 Adding multiple points to your map using text files

This method of adding points to your map is recommended if you know the address, lat/long coordinates or have multiple points to add at one time. If you have a list of addresses or latitude/longitude points to as a group, go to "**Add Content,**" "**Text Files**". Your list will need to be in a comma-separated values (.csv) format, which can be created from an Excel Spreadsheet. Navigate to your saved file and follow the prompts.

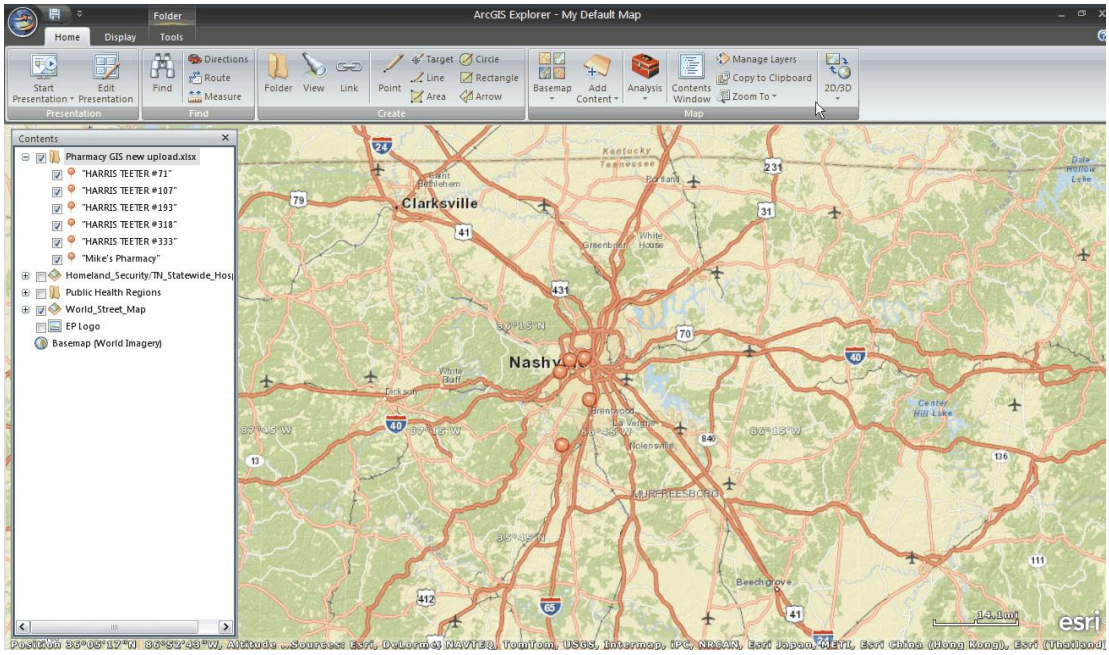




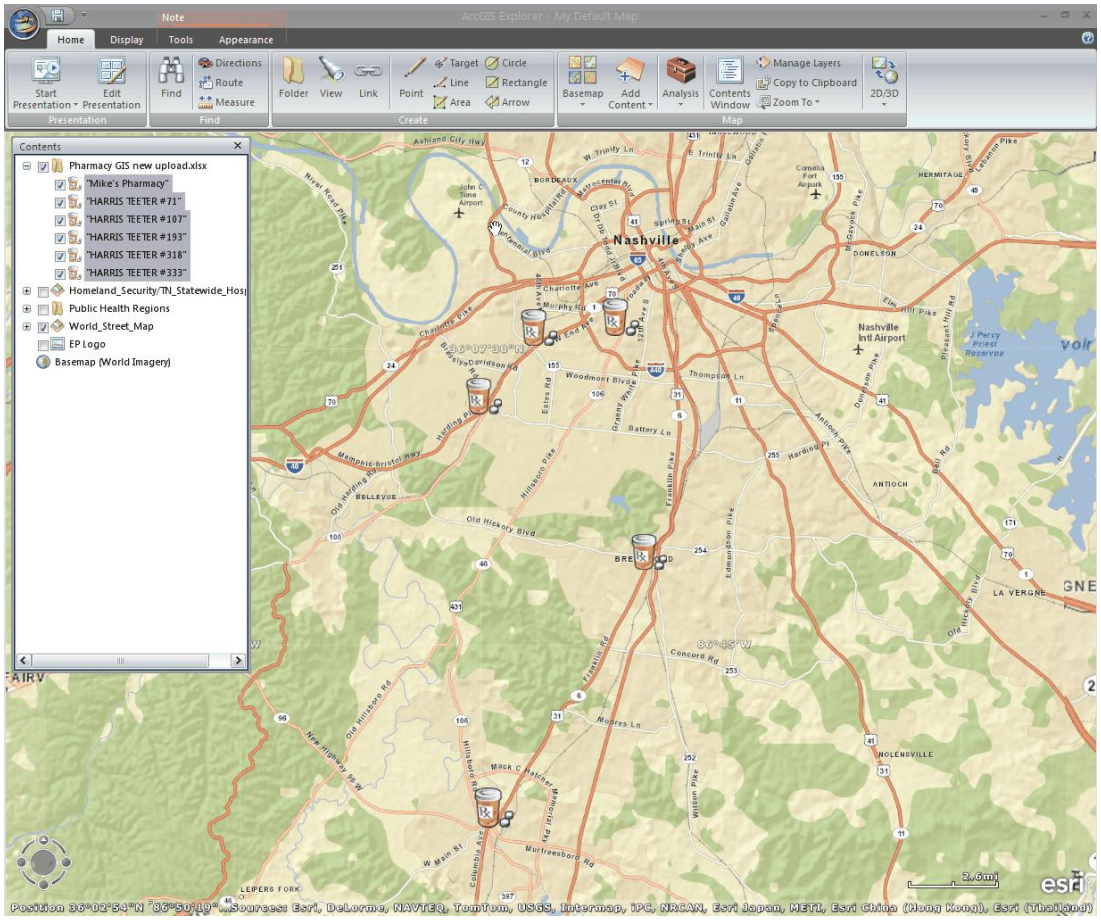


NOTE: For best practices on formatting your data, see Chapter 1 of this Geocoding Cookbook on Geocoding Addresses. This will help eliminate errors and bad data.

The data from your spreadsheet are now points on a map!



To change the default icons, highlight the points in the Contents Window, right click and go to "Symbol" to select another default symbol or navigate to your own saved icon.

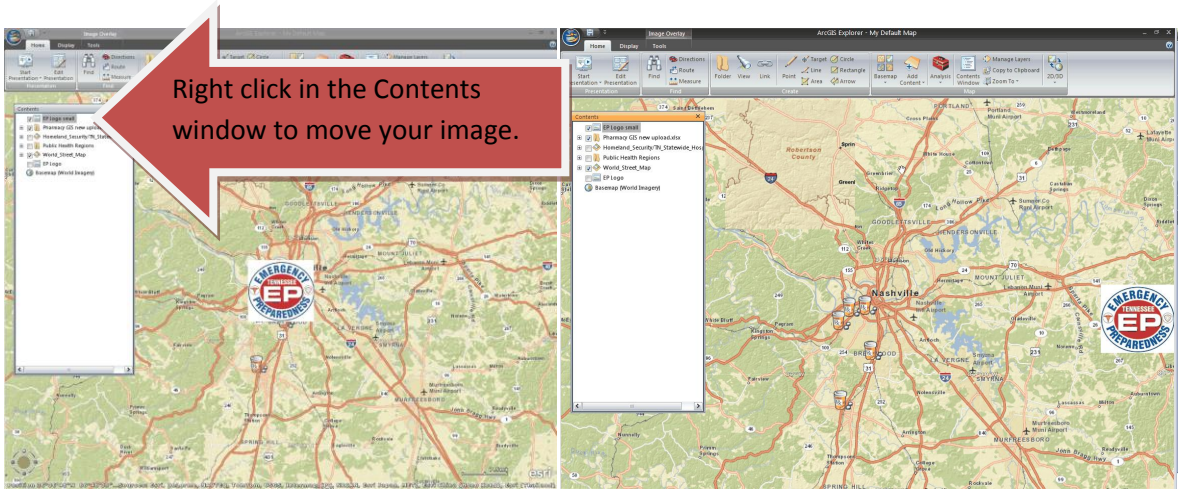


4.5 Adding shape files or other data

Most anything you want to add to your map can be found under "**Add Content**", including shape files, KML files, GPX files, and other standard GIS formats. In general, ArcGIS Explorer has fairly limited functionality. These files would need to be created in other software, but they can be imported into ArcGIS Explorer. For those in the Central Office, a good source of these types of data can be found at: **H:\CEDS\GIS**.

4.6 Adding other image files

If you want to add a logo or other image, you can add most image file types to your map, including .bmp, .jpg, .png, .gif, and .tiff files. Go to "**Add Content**" and click on "**Image Overlays**". Navigate to your saved image file and click "**Open**". To move your image to another part of the screen, **right click** it in the **Contents** window and select "**Position**".



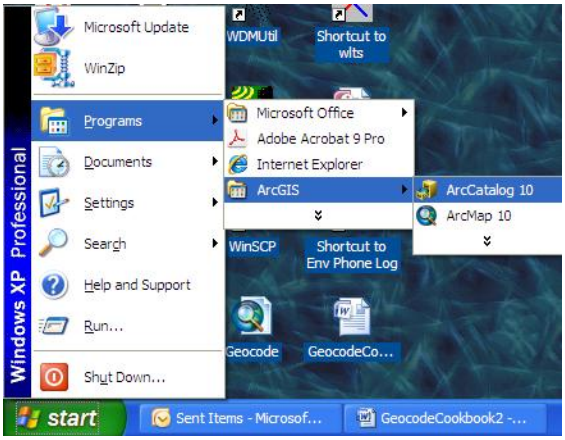
Chapter 5: Geocoding with ArcGIS

Judy Manners, MS, and Heather Henderson, DVM, MPH

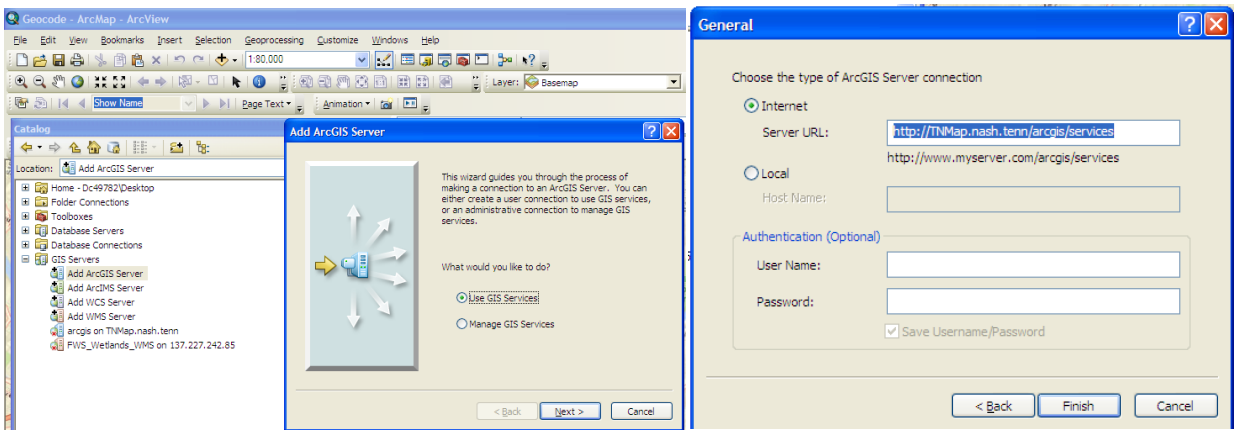
5.1 The Basics

The ArcMap user may need to access data layers from other sources within the state, their division, or external agencies. State employees wishing to access the state's GIS data will first need to set up connections to the folders storing those data. An index of available data may be found on OIR GIS Services website http://tnmap.state.tn.us/portal2/metadata.asp.

There are two options for accessing the state's data. The first is through a GIS Server. To access the state's data on ArcGIS Server, open ArcCatalog by clicking Start, Programs, ArcGIS, then ArcCatalog.



When ArcCatalog opens, navigate to GIS Severs, then double click Add ArcGIS Server. In the Add ArcGIS Server box, click the radio button for Use GIS Services, then Next. In the General box, make sure the Internet radio button is selected. In the Server URL box, type http://TNMap.nash.tenn/arcgis/services , then click Finish.



The second way to access the state's data is through a database connection to OIR-GIS Services' database. A Direct Connect file is required to be installed on the user's computer. To receive the Direct Connect file and instructions, contact OIR-GIS Services at tnmap.gis@tn.gov. The instructions for setting up a direct connection are available here:
http://tnmap.nash.tenn/documents/HowTo_TNMap_Direct_Connect.PDF

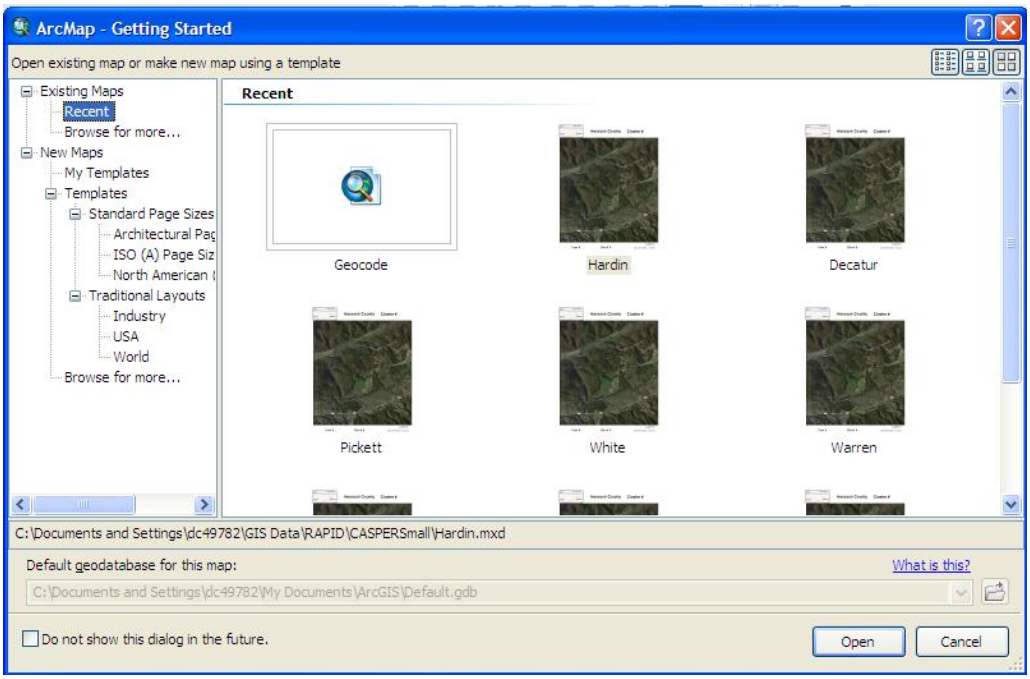
Feature classes or shapefiles are also available for download from ESRI, the U.S. Census Bureau, and other agencies. In addition to what is available from the state, the Department of Health also has some commonly used shapefiles that could be emailed or otherwise made available. (See the resources section on where to find data for your mapping project).

To access and add feature classes or shapefiles (layers) to an ArcMap project, open ArcMap, open a blank map, then either use the Add Data icon or, drag the files to ArcMap from ArcCatalog.

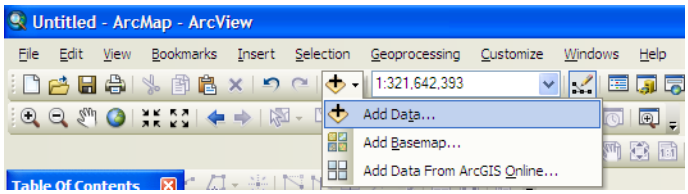
1. Open ArcMap by clicking on the desktop shortcut icon,

or, from the desktop, click Start, Programs, ArcGIS, then ArcMap.

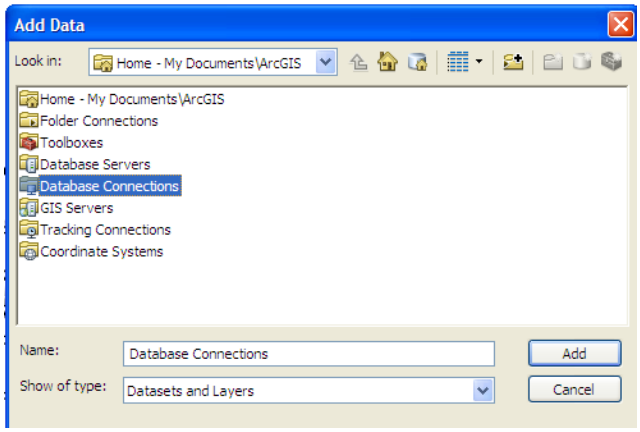
2. When ArcMap opens, open a blank map. When ArcMap is opened, the Getting Started box opens, to get a blank map, click Cancel.

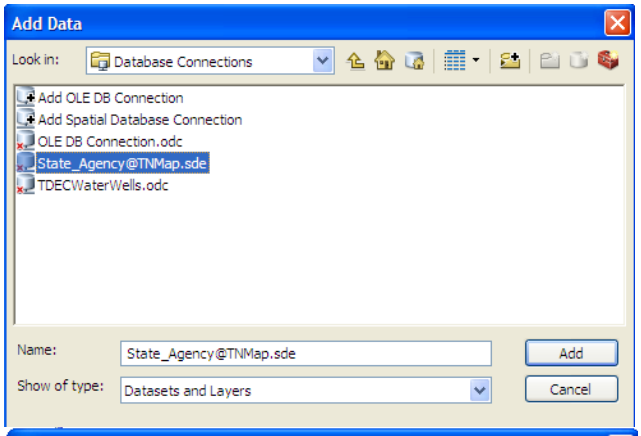


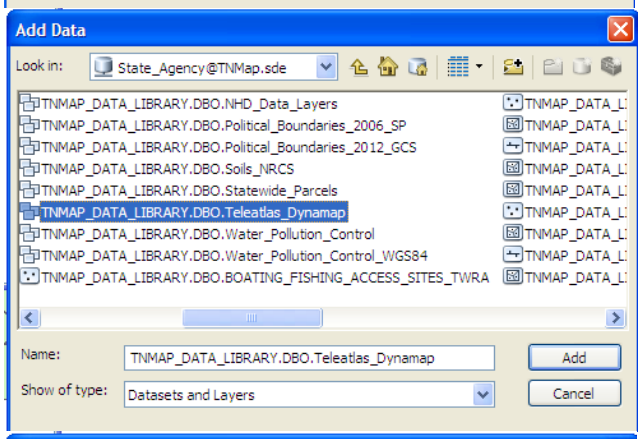
3. To add layers to the map, click the Add Data button.

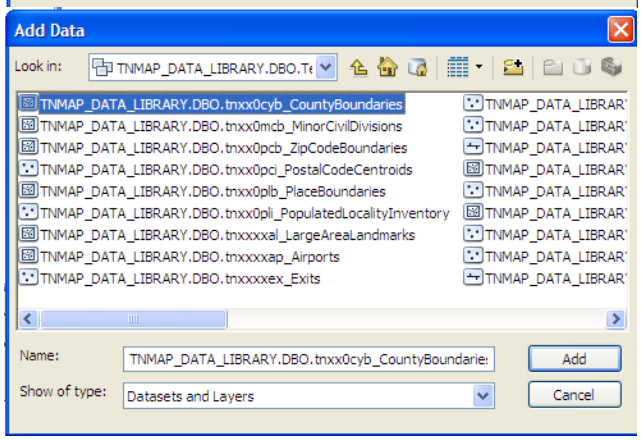


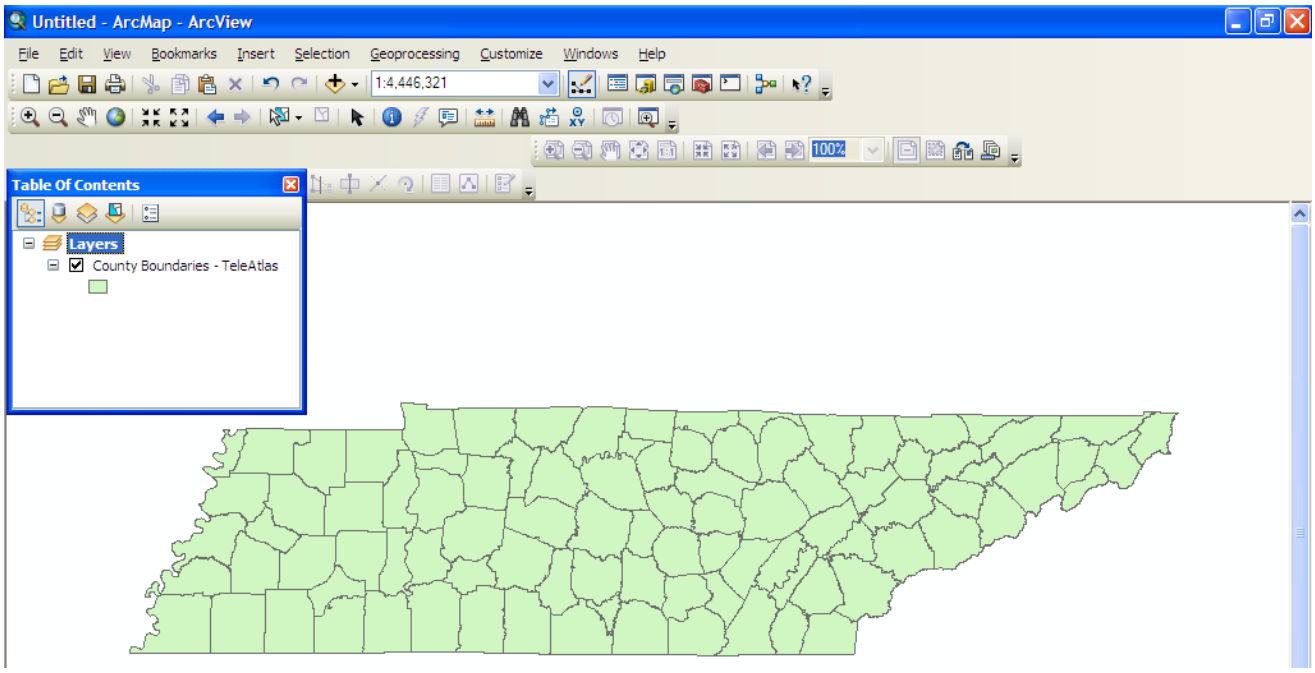
4. Navigate to where the data are stored, then click Add.




Add Data
Look in:
Database Connections
Add OLE DB Connection
Add Spatial Database Connection
OLE DB Connection.odc
State_Agency@TNMap.sde
TDECWaterWells.odc
Name:
State_Agency@TNMap.sde
Add
Show of type:
Datasets and Layers
Cancel


Add Data
Look in:
State_Agency@TNMap.sde
TNMAP_DATA_LIBRARY.DBO.NHD_Data_Layers
TNMAP_DATA_LIBRARY.DBO.Political_Boundaries_2006_SP
TNMAP_DATA_LIBRARY.DBO.Political_Boundaries_2012_GCS
TNMAP_DATA_LIBRARY.DBO.Soils_NRCS
TNMAP_DATA_LIBRARY.DBO.Statewide_Parcels
TNMAP_DATA_LIBRARY.DBO.Teleatlas_Dynamap
TNMAP_DATA_LIBRARY.DBO.Water_Pollution_Control
TNMAP_DATA_LIBRARY.DBO.Water_Pollution_Control_WGS84
TNMAP_DATA_LIBRARY.DBO.BOATING_FISHING_ACCESS_SITES_TWRA
Name:
TNMAP_DATA_LIBRARY.DBO.Teleatlas_Dynamap
Add
Show of type:
Datasets and Layers
Cancel


Add Data
Look in:
TNMAP_DATA_LIBRARY.DBO.Te
TNMAP_DATA_LIBRARY.DBO.tnxx0cyb_CountyBoundaries
TNMAP_DATA_LIBRARY.DBO.tnxx0mcb_MinorCivilDivisions
TNMAP_DATA_LIBRARY.DBO.tnxx0pcb_ZipCodeBoundaries
TNMAP_DATA_LIBRARY.DBO.tnxx0pci_PostalCodeCentroids
TNMAP_DATA_LIBRARY.DBO.tnxx0plb_PlaceBoundaries
TNMAP_DATA_LIBRARY.DBO.tnxx0pli_PopulatedLocalityInventory
TNMAP_DATA_LIBRARY.DBO.tnxxxxal_LargeAreaLandmarks
TNMAP_DATA_LIBRARY.DBO.tnxxxxap_Airports
TNMAP_DATA_LIBRARY.DBO.tnxxxxex_Exits
Name:
TNMAP_DATA_LIBRARY.DBO.tnxx0cyb_CountyBoundaries
Add
Show of type:
Datasets and Layers
Cancel



5. To add a base map with roads, topography or imagery, click Add Basemap, select the one you want, and then click add. The base map will be added to your map and Table of Contents. If the basemap is added before other layers in your map, the base map will likely be zoomed out to the world view. To avoid having to zoom back in, add a layer to the map before adding the base map. To zoom in and out on the map, use the items on this tool bar . The blue arrow takes you back to the previous extent.

5.2 Geocoding Addresses

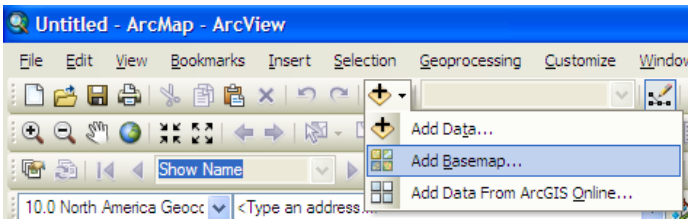
1. Open ArcMap by clicking on the desktop shortcut icon,

or, from the desktop, click Start, Programs, ArcGIS, then ArcMap.

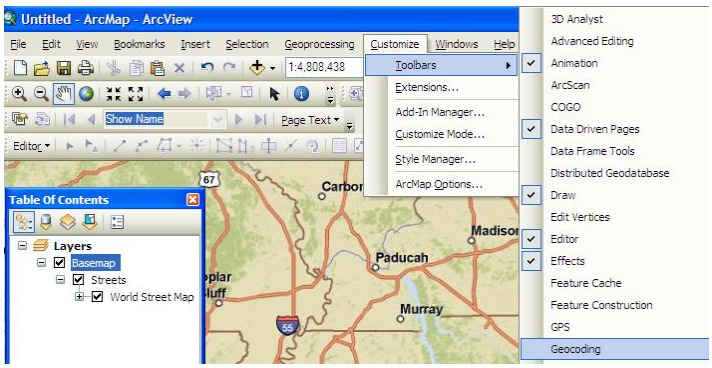
2. When ArcMap opens, open a blank map.

3. (Optional but recommended) Add county and zip code boundaries. Adding these reference polygons will help in correcting or validating data points. To use the state's data, users will need access to the data via the GIS Server and/or the Direct Connect feature from OIR GIS Service's data.

4. As a reference, add a base layer which contains streets.

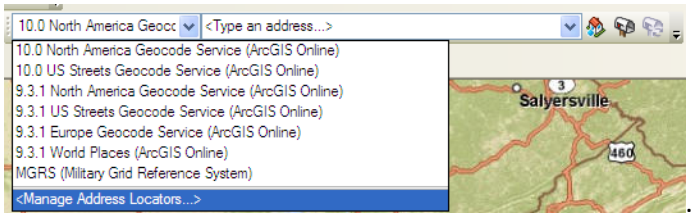


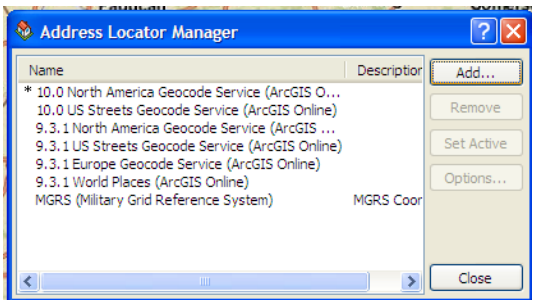
5. Add the Geocoding Toolbar by clicking on the Customize tab, Toolbars, then Geocoding.



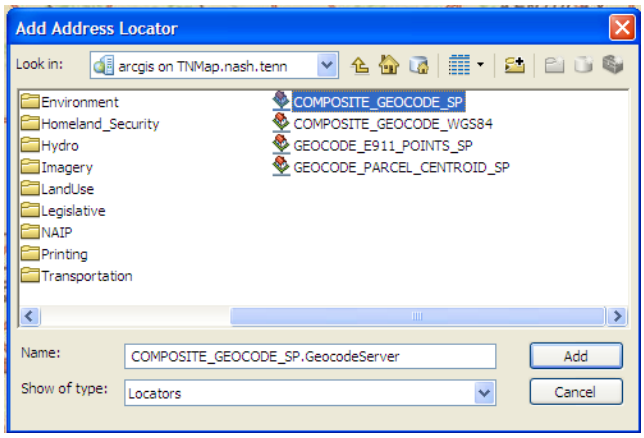
6. When the tool bar appears,

use one of the Geocode Services listed or add one from another source. To change the Geocoding Service, click on the first drop down menu in this toolbar, and select the desired geocoding service. Or, to add a geocoding service, such as one from the State of Tennessee's OIR GIS Services, use the first drop down menu in the tool bar, click Manage Address Locators, then click Add in the Address Locator Manager box (See Section 5.1 above for access to the state's data).



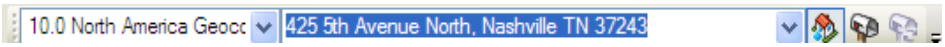


7. Navigate to the location of the geocoding service. If using the state's geocoding service, navigate to GIS Servers, arcgis on TNMap.nash.tenn. If using the state's geocoding service, the Composite_Geocode_Sp is the recommended service because it includes multiple means of plotting an address on the map and because this service uses the State Plane Feet projection. After the selection is made, click Add. This service should now be available for selection in the drop down menu on the geocoding toolbar.

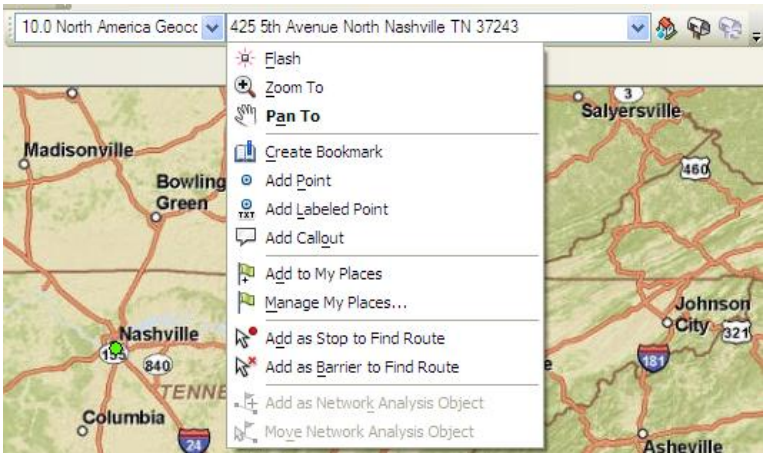


Single Addresses

Single addresses may be geocoded by typing the address in the address field of the Geocoding Toolbar.



After typing in the address, right click then choose an option.

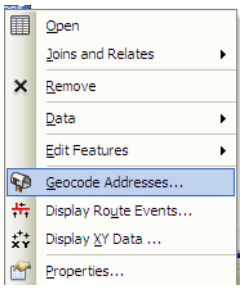


Lists of addresses

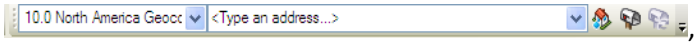
To geocode a list of addresses, first make sure that all of the addresses are as complete as they can be and are in a standard format in Excel. (See Chapter 1)

There are a couple of ways to geocode addresses:

1. Add the table of addresses to ArcMap, either by using the Add Data button, or by dragging the table over from ArcCatalog. The table will appear in the Table of Contents. Right click on the table of addresses in the Table of Contents. Then, click the geocoding addresses option.



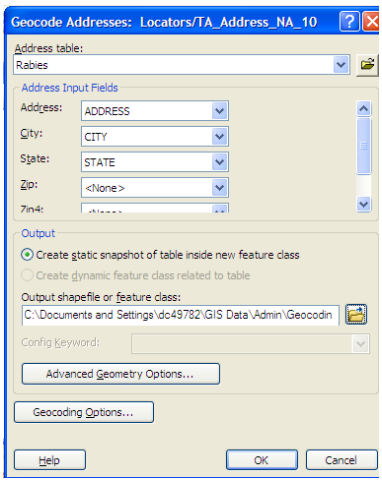
Or, on the Geocoding Toolbar click the mailbox

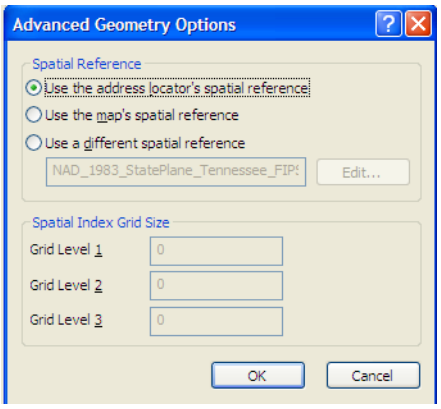


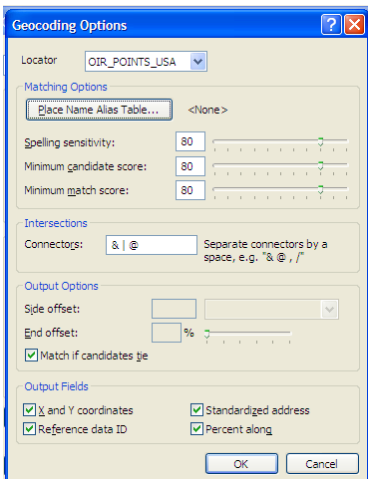
select the geocoding service you would like to use and click OK.

2. No matter which way you chose to geocode, a Geocode Addresses box should appear. In the Geocode Addresses box (shown below), navigate to the table of addresses then use the drop down arrows under Address Input Fields to point the geocoder to the fields in the table containing address, city, state, zip, or zip4. It is not necessary to have all of these fields in your list, but it is necessary to have an address and city or ZIP code.

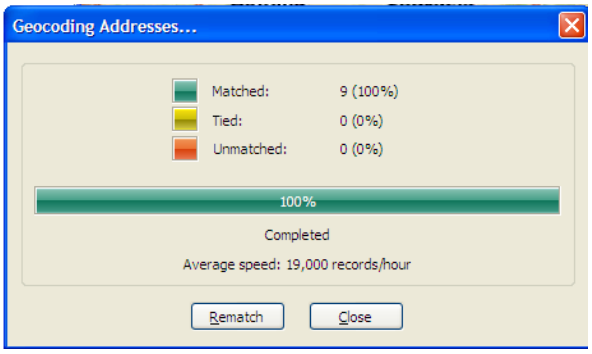
3. The "Create static snapshot of the table inside new feature class" radio button should be populated. The dynamic feature is only available if you have an ArcEditor or ArcInfo License. The Advanced Geometry Options are to create output in a different spatial reference (i.e. projection or geometry) than that of your current map project. The Geocoding Options allows for changes to the default geocoding settings such as changes to the spelling sensitivity or match candidate score. Depending on what condition the data are in and how the data are to be validated, it might prove beneficial to increase the Match Score. Increasing the Match Score increases the reliability of those addresses being "matched" to a real address on the map, but it also may create more "Ties" or "Unmatched" records that will need to be validated.



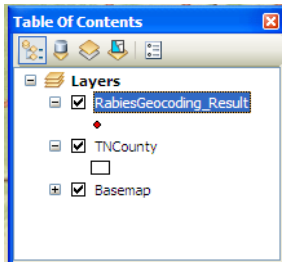




4. Once geocoding is complete, a box will appear showing how many records were “Matched” to a single address, “Tied” to multiple addresses or “Unmatched” to any address in the geocoder.



5. You can either click Close to close the dialog box or Rematch to open the Interactive Rematch box to review, edit and rematch the addresses. When you click Close, the addresses that were “Matched” or “Tied” are added to the map as points and the geocoding result feature class or shapefile (layer) appears in the Table of Contents.

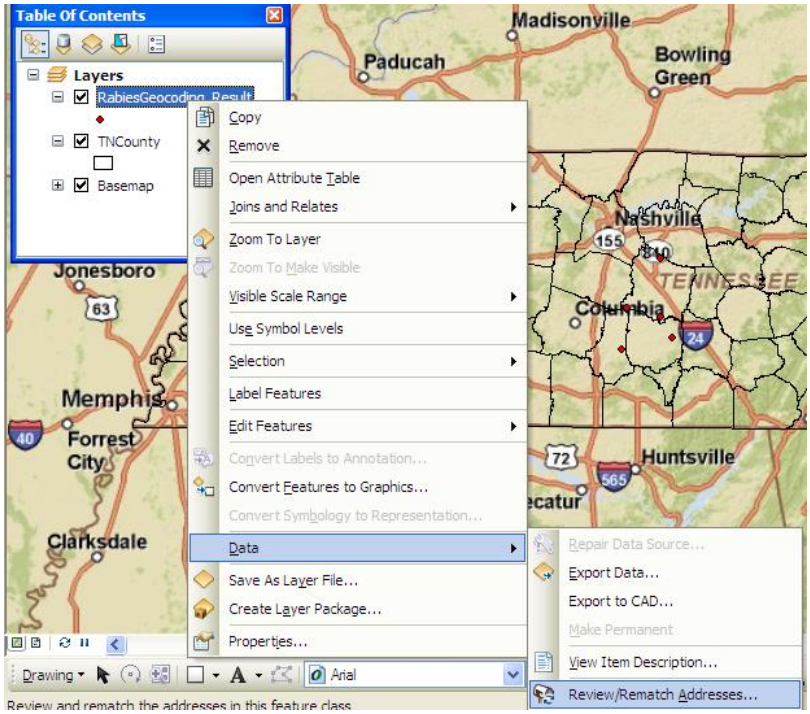


5.3 “Rematching” Geocoded Addresses

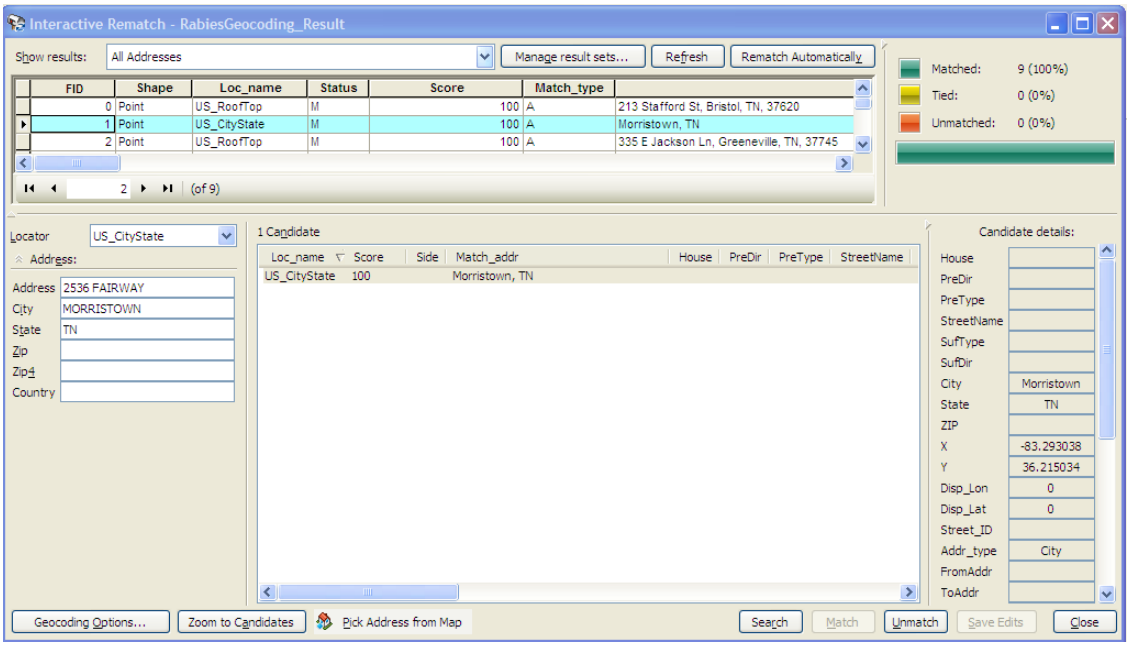
Just because a dot on the map was created and the geocoder indicated that “Matches” were found for 100% of the addresses, does not mean that the dots on the map actually correspond to real addresses! Depending on the intended use of geocoded data, it may be necessary to do a little quality assurance.

To edit addresses, to select only one address to use when the geocoder found “Tied” or multiple addresses, or to use a place on the map as the address, “rematching” can be done at step 4 above or any time after the geocoded results have been added to the Table of Contents, see step 5 above.

If rematching is necessary after the results have been added to the map and the Table of Contents, right click on the Geocoded Results layer in the Table of Contents; go to Data, then Review/Rematch Addresses.



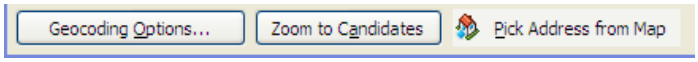
When you click Rematch, the Interactive Rematch box opens.

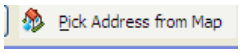


The Loc_name, Status, and Score columns contain important information to evaluate the accuracy of the addresses shown on the map. For addresses that were “Matched” to a location on the map, the most accurate address is one that has a Loc_name of “US_RoofTop”, Status of “M” (for Matched), and a Score of “100”. The least accurate “Matched” address would be one that has Loc_Name of “US_State”, Status of “M”, and a Score of “100”. The latter means that the only place on the map that could be found was the state. So, the geocoder placed the dot in the center of the state, likewise for US_Zipcode, or US_City. For example, the highlighted record above was matched only to the city of Morristown. So, the corresponding dot on the map is in the center of Morristown, not the 2356 Fairway address shown to the left.

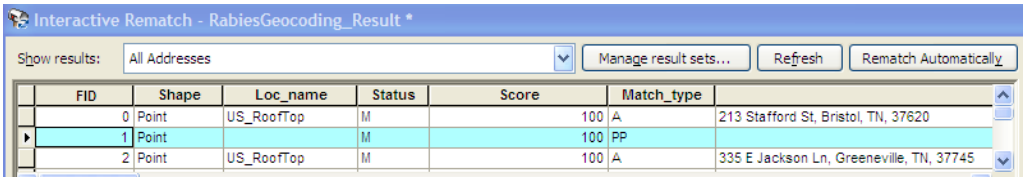
To edit addresses, use the box at the left to type in the correct address for the highlighted record.

For “Tied” addresses, one of the addresses found by the geocoder may be selected. To zoom in to a location, use the Zoom to Candidates button at the bottom of this interactive box. When this button is clicked, the map zooms in to the record in question.



An address can be picked from the map by clicking the 

button at the bottom of this interactive box. Highlight a record to be edited, click the Pick Address from Map button, minimize the interactive box, and zoom in to the desired location on the map. The cursor should be an arrow with a dot at the tip. When you find the right spot, right click, and choose Pick Address. This places the dot on the map and updates the address locator record to Status of "M", Score 100, and Match Type PP.



FID	Shape	Loc_name	Status	Score	Match_type	
0	Point	US_RoofTop	M	100	A	213 Stafford St, Bristol, TN, 37620
1	Point		M	100	PP	
2	Point	US_RoofTop	M	100	A	335 E Jackson Ln, Greeneville, TN, 37745

When you are satisfied with the accuracy of the locations, click the close button in the lower right-hand corner of the Interactive Rematch Box. Your changes are saved in both the map and the associated shapefile. The geocoded shapefile is available outside of this map project and can be added to another map or shared with others.

5.4 Labeling and Symbolizing the Map

After geocoding the addresses, there should be dots representing addresses, a reference base map, and ideally, city, county, or zip code boundaries on the map. But this map doesn't really provide any information and the dots may be difficult to see. So, you may want to change the colors and symbols, add some labels, title, legend, scale bar and north arrow.

To change the color and shape of the symbols on the map, change the color or symbol in the Table of Contents by double clicking the symbol under the layer name. The Symbol Selector box should open, from which a variety of shapes, colors, and sizes of symbols can be selected. If the shape you are interested in is not shown, others are available by clicking on the Style References button and adding the category of symbols you are interested in seeing on your map.

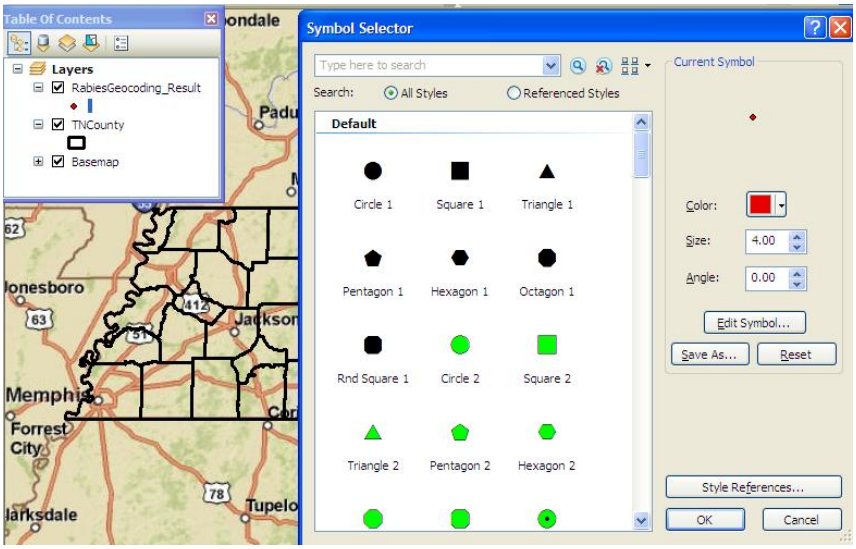
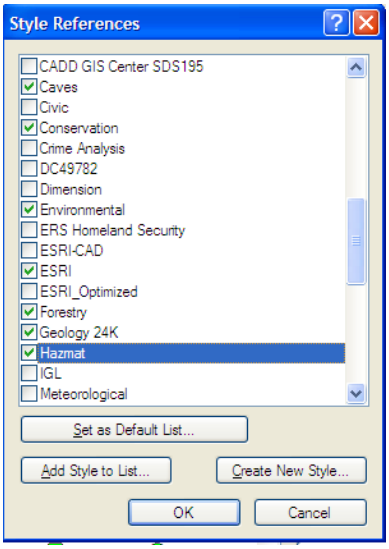
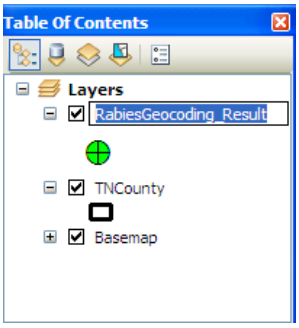


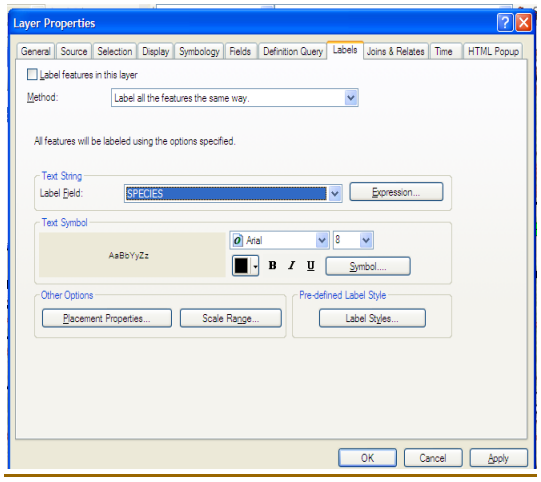
Table Of Contents
Layers
RabiesGeocoding_Result
TNCounty
Basemap
Symbol Selector
Type here to search
Search:
All Styles
Referenced Styles
Default
Circle 1
Square 1
Triangle 1
Pentagon 1
Hexagon 1
Octagon 1
Rnd Square 1
Circle 2
Square 2
Triangle 2
Pentagon 2
Hexagon 2
Current Symbol
Color:
Size:
4.00
Angle:
0.00
Edit Symbol...
Save As...
Reset
Style References...
OK
Cancel
Memphis
Forrest City
Tupelo
Jackson


Style References
CADD GIS Center SDS195
Caves
Civic
Conservation
Crime Analysis
DC49782
Dimension
Environmental
ERS Homeland Security
ESRI-CAD
ESRI
ESRI_Optimized
Forestry
Geology 24K
Hazmat
IGL
Meteorological
Set as Default List...
Add Style to List...
Create New Style...
OK
Cancel

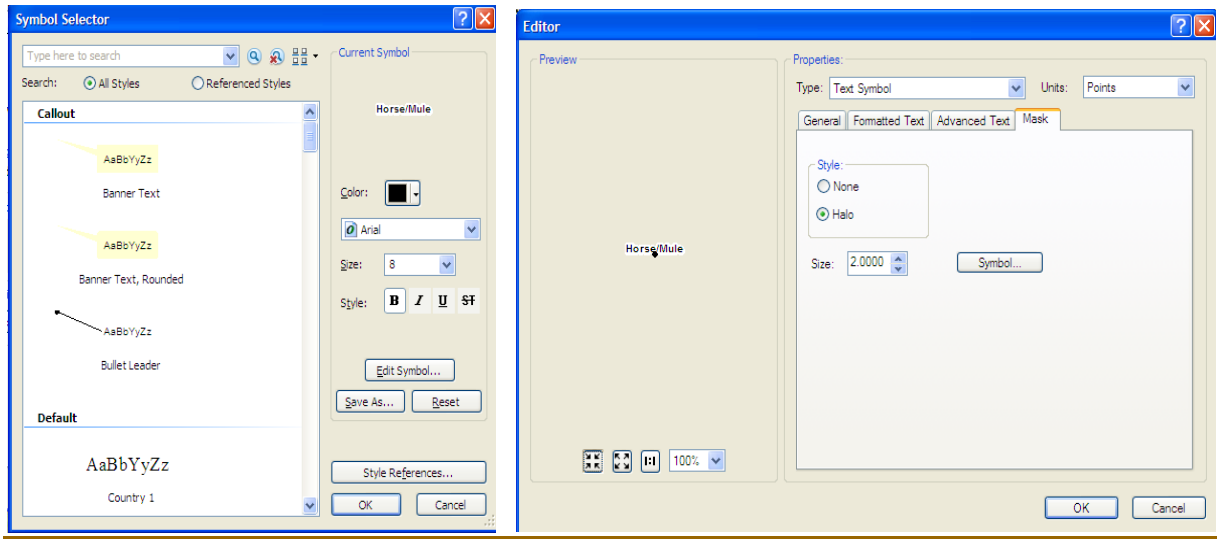
To change the name of the layer, click the name of the layer in the Table of Contents. The words should highlight and you should be able to move the cursor to where you want it and type in the box. This could be important later if you want to add a legend to your map, as the layer name appears in the legend as it is in the Table of Contents and it is easier to edit from the Table of Contents than it is in the legend. Remember that changing the name of the layers in the ArcMap project does not change the name of the geocoded results shapefile that was saved previously.



To label features on your map, right click on the layer name in the Table of Contents, scroll down to Properties, then click the Labels tab. There you will find several choices. In the Label Field drop down menu should be a list of all the fields in the attribute table for the layer you have selected. Any of these fields or a combination of fields can be a label on your map. To make a combination of two fields as a single label, use the Expression button. Different font types and sizes can be selected.



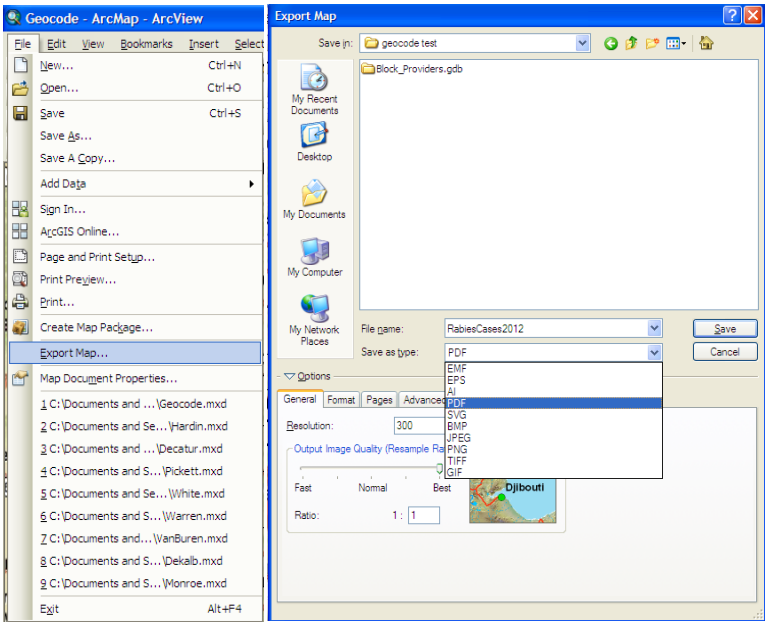
Also, by clicking the Symbol button more label styles are available in the Symbol Selector box. In the Symbol Selector box, click Edit to change the appearance of the label, or to give it a background color or halo.



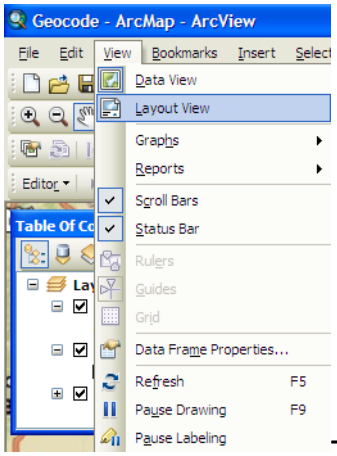
Save your ArcMap Project!

5.5 Exporting the Map and Layout View

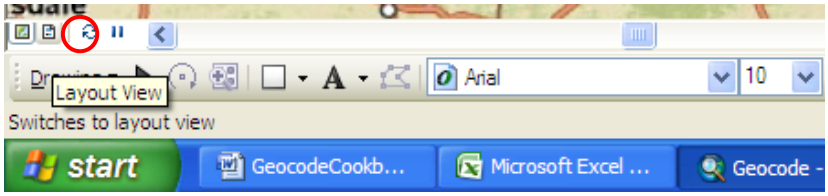
There are several ways to export or save an image of your map. The easiest is to go to File, Export Map, and then choose the format in which you would like to save the map. The map could be saved as a jpeg, TIFF, GIF or pdf that could then be added to a PowerPoint or other document.



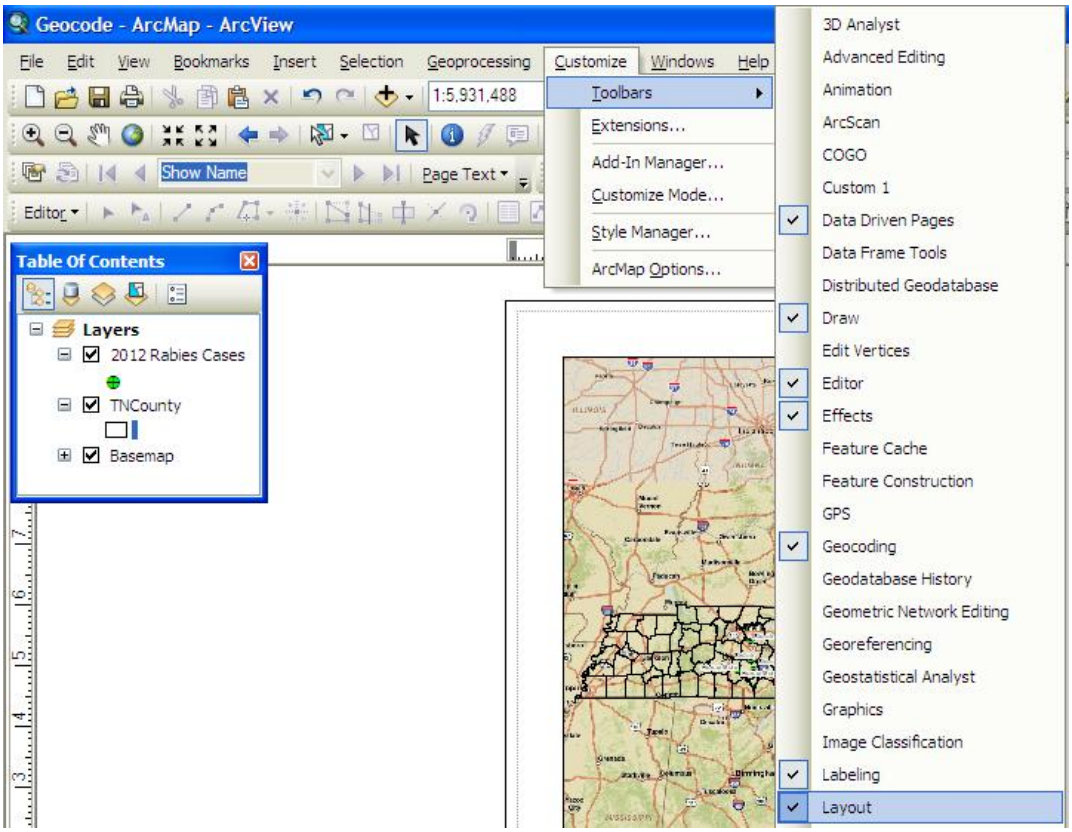
Exporting the map this way in the Data View does not give you the opportunity to add a legend or other map symbols, such as a legend, north arrow, scale bar, or title, etc. To get this added functionality; go to the Layout View by clicking the View tab, then Layout View – OR– Click the Layout View icon in the lower left corner of the map.



–OR–

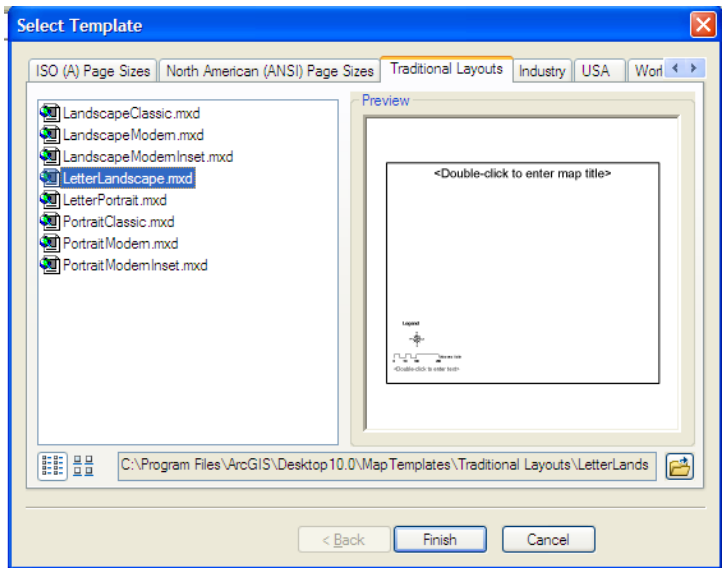


In the Layout View, make sure the Layout Toolbar is available by clicking the Customize tab, Toolbars, then Layout.

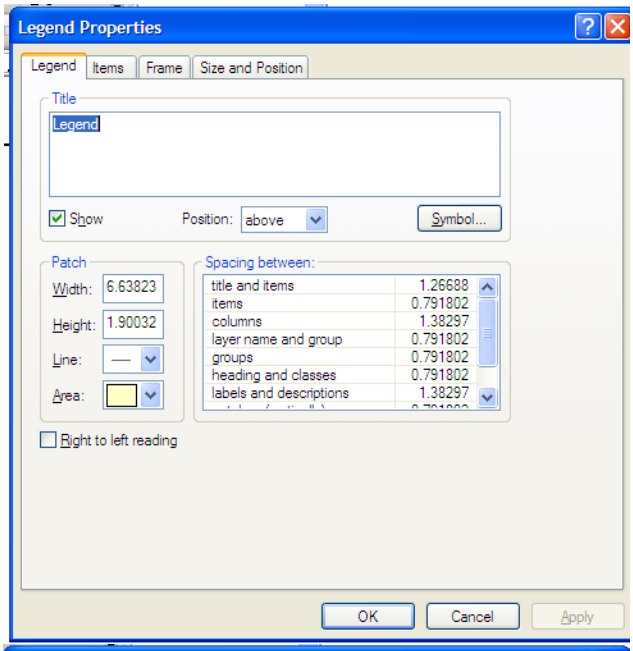


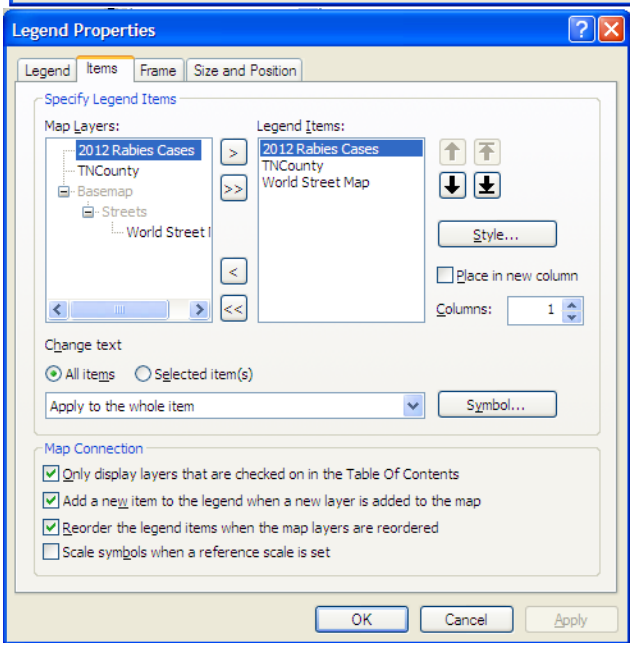
This tool bar should be added to the top of your map.

It may be necessary to change the Layout to landscape. Do this by clicking on this button on the layout tool bar and selecting the desired layout. Click the Finish button when finished.



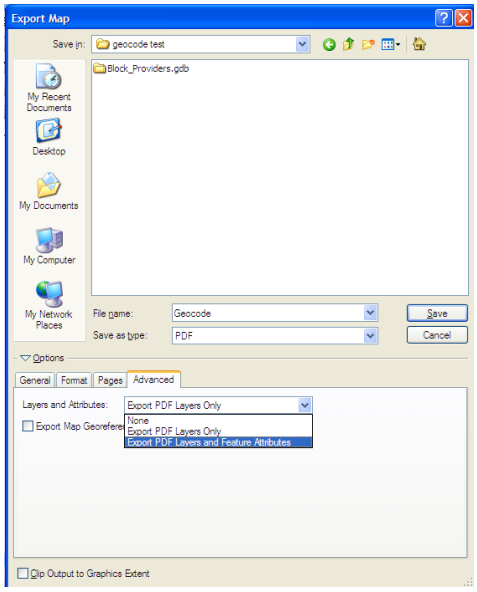
The map layout now will have several elements that you can move, delete or edit such as, scale bar, title box, and legend. To edit these map elements, right click on the one you want to edit, then go to Properties. For example on the legend, right click, go to Properties. Then a Legend Properties box pops up where you can edit the items in the legend.

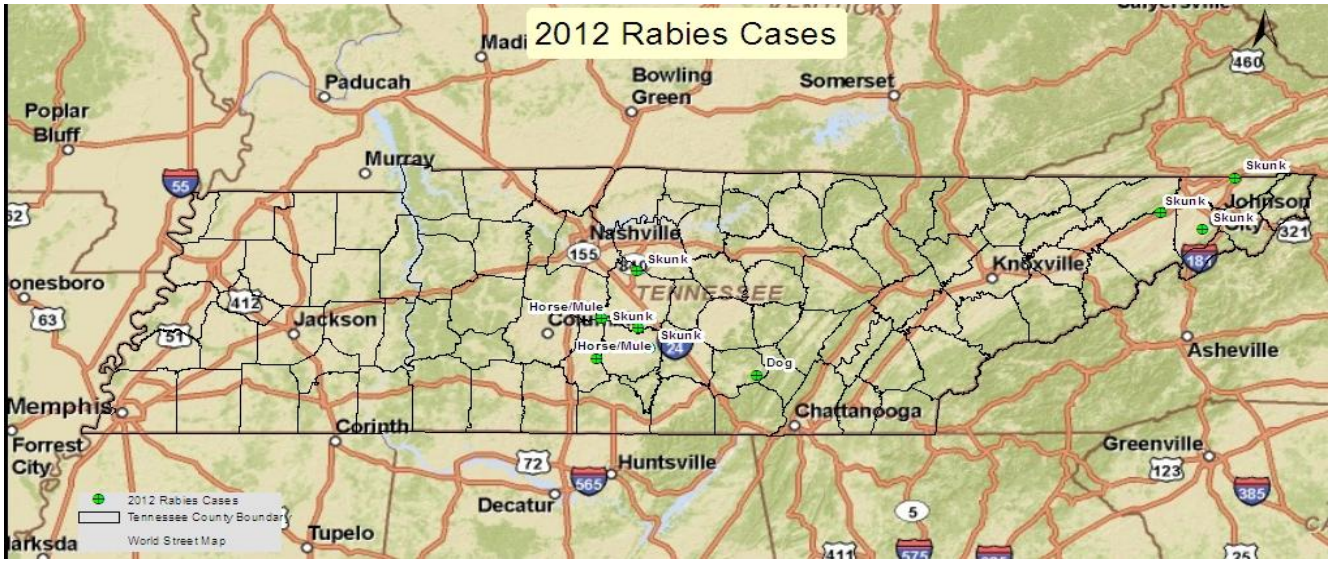




When the map is the way you want it, save it by going to the File tab, then Save. Export the map by going to File, then Export.

Note: If exporting to pdf there is an option to export a georeferenced map. This pdf would contain all the data in the attribute table for layers depicted in the map. Exporting in this manner allows others to use the map to get latitude and longitude and to use the identify tool in Adobe Acrobat Pro or Reader to click the dots on the map and get information about each dot. To export a georeferenced .pdf, go to the File tab, Export Map and under the Advanced tab choose the Export PDF Layers and Feature Attributes. A word of caution: if case patient names and addresses are in the attribute table they will be available to viewers of this georeferenced pdf.

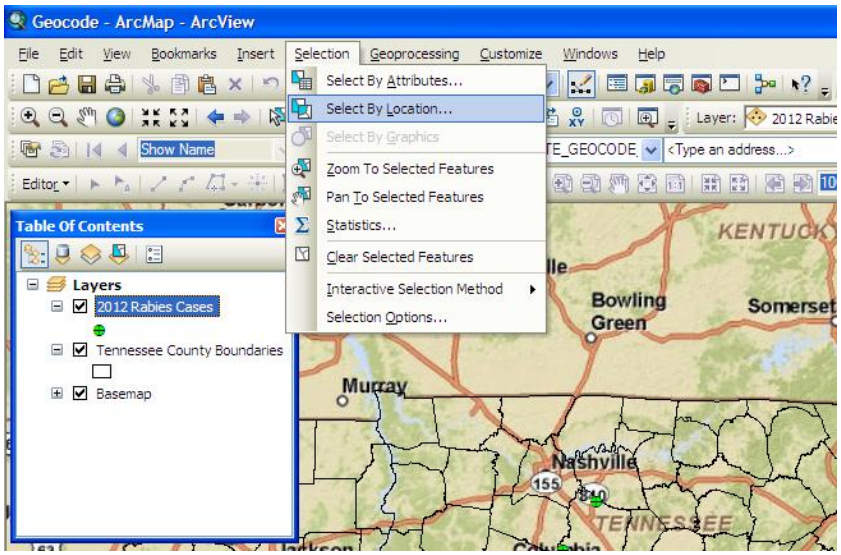




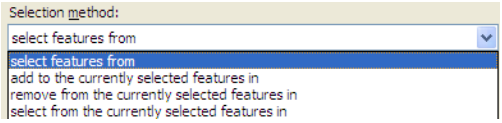
5.6 ArcMap is more than a map!

ArcMap is part of the overall ArcGIS suite of tools available for visualizing and analyzing data, it is a visual database. Within ArcGIS are many different kinds of tools to create various types of maps, statistical analyses or other geographic analyses. There may be many different ways to complete a task in ArcGIS, depending on how the data are compiled and are to be used.

One common task that can be accomplished in ArcMap is creating a map depicting counties or census tracts containing case patient addresses. To select counties which contain the geocoded cases, go to the Selection tab, then Select by Location. A Select by Location box will appear providing choices of ways items can be selected based on the layers in your Table of Contents.

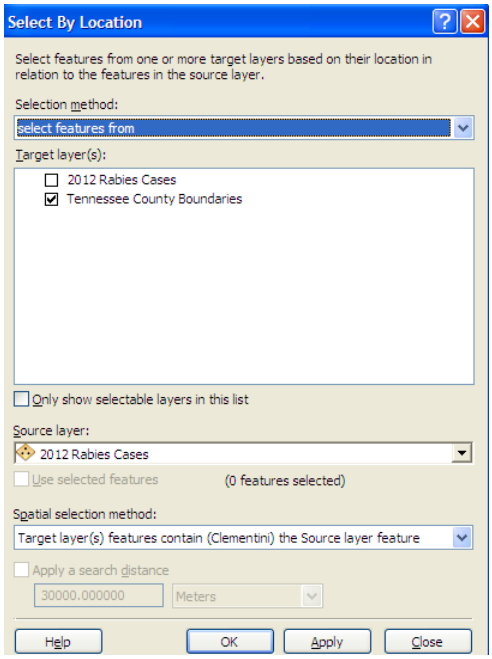


In the Select by Location box, under the Selection Method Drop down are choices related to whether the selected data will be unique or added to or removed from other selections in the layer that you select in the Target Layers drop down.

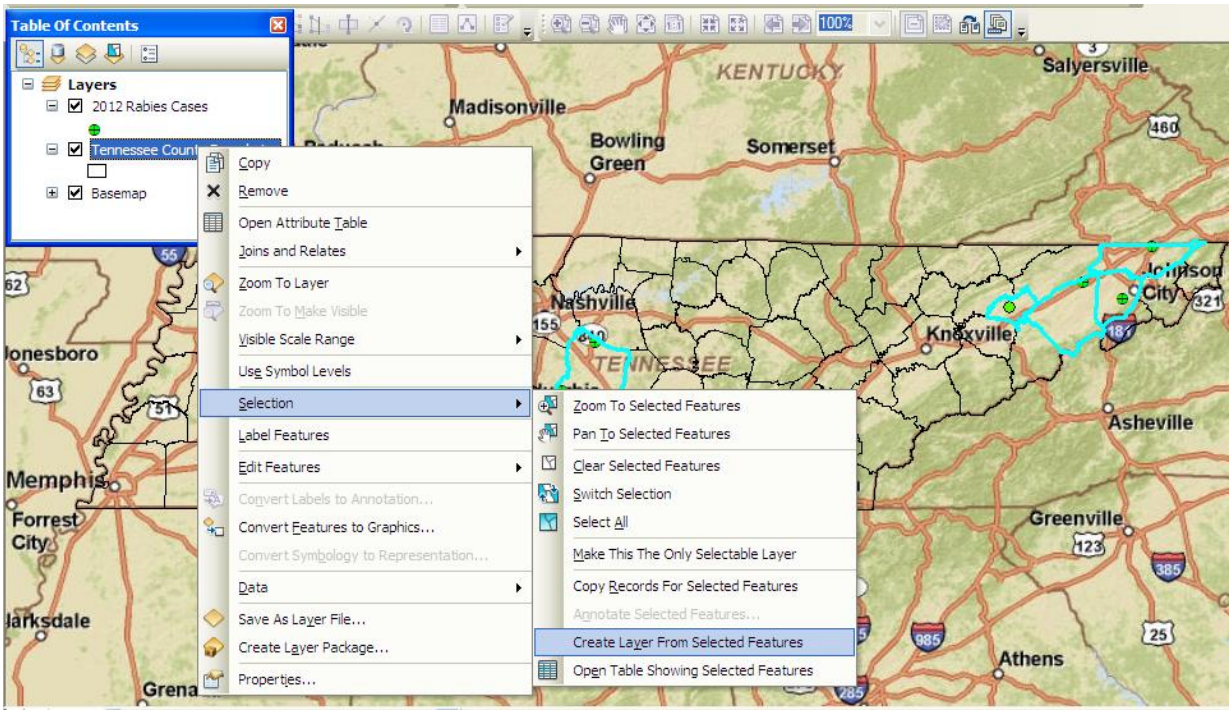


The Target Layers box refers to which layer the selection will be made in. The Source Layer drop down lets you choose which layer contains the information on which to base the selection. So, in our example we want to select counties containing rabies cases. The Target Layer is Counties and the Source Layer is the Rabies Cases.

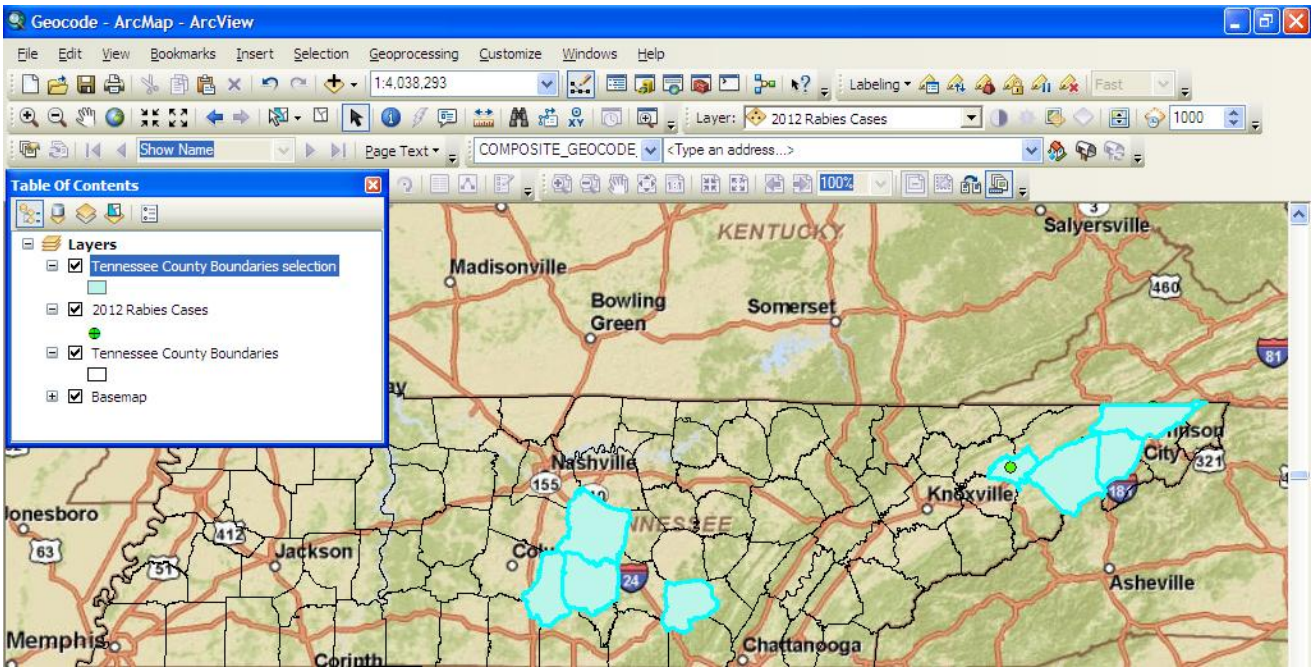
The Spatial Selection Method drop down, provides choices related to how the selections will be made based on where the items from the Source Layer are on the map as related to where the items in the Target Layer are on the map. For this example, we want the selection of counties to be made depending on whether rabies cases are contained within the county. There are several choices in this drop down, and several ways that spatial containment is defined. The help text is useful in understanding the differences, some of which sound subtle, but make huge differences in the result! For this example, the choice that defines "Contains" as Clementini will generate the best result.



The counties with cases should now be selected on the map. This is just a temporary selection. Interaction with only the selected data in this layer would be difficult as it is still linked to the layer containing all of the counties. Creating a layer of just the selected features is beneficial if you need to interact with only those selected features. To do this, right click the layer containing the selected features, click Selection, and then Create Layer from Selected Features.



This will add a new layer to the Table of Contents and the map.

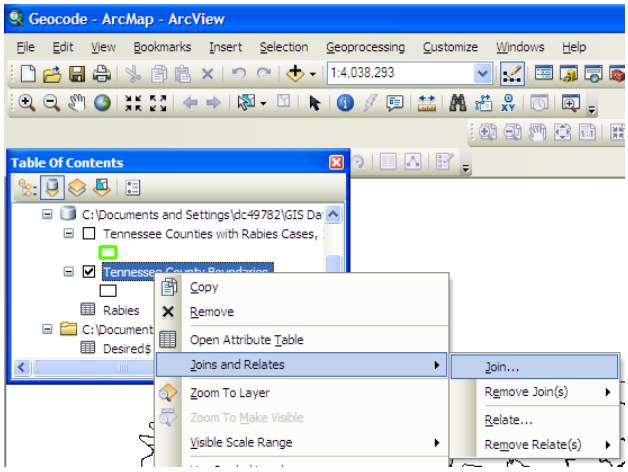


A shapefile will be created, saved in the location you specify, and then a question will be asked if you want to add this layer to the map.

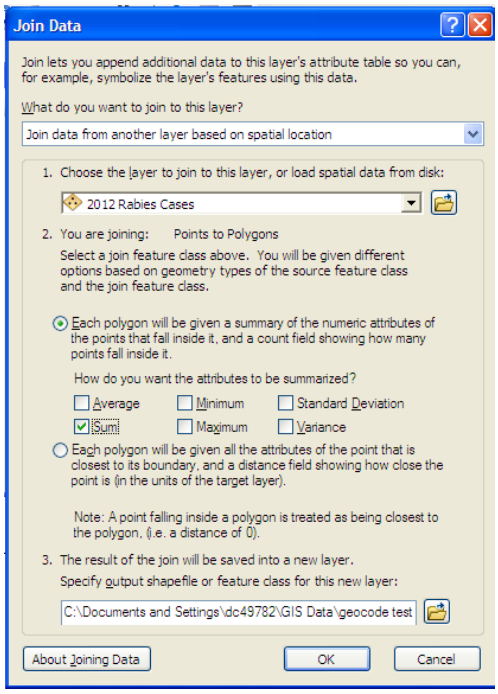
Layers are shown on the map in the order that they appear in the Table of Contents, with the top layer being on top of everything else in the map. So, when you make this new layer it will go to the top position in the Table of Contents. To get the geocoded points back on top, just click on the layer you want to move and drag it to the position where you want it to be shown on the map. To clear out the selections on the map, click this button on the Standard toolbar.

For geocoded data, a choropleth map can be made. There are several ways to make this type of map, but in this example we are using a spatial join with the Tennessee Counties layer and the 2012 Rabies Cases layer made from our geocoded table of addresses.

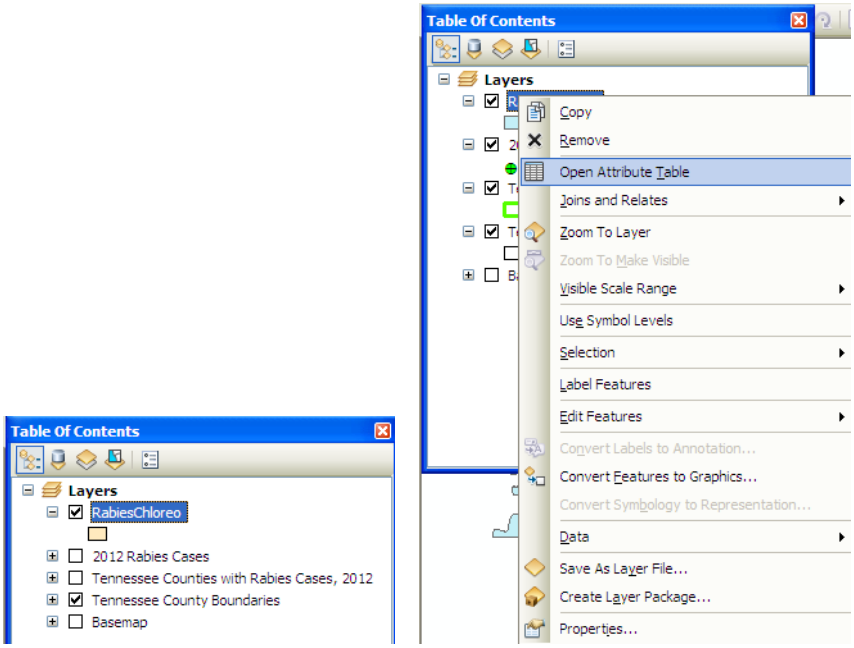
Right click on the county layer, then click on Joins and Relates, then Join.

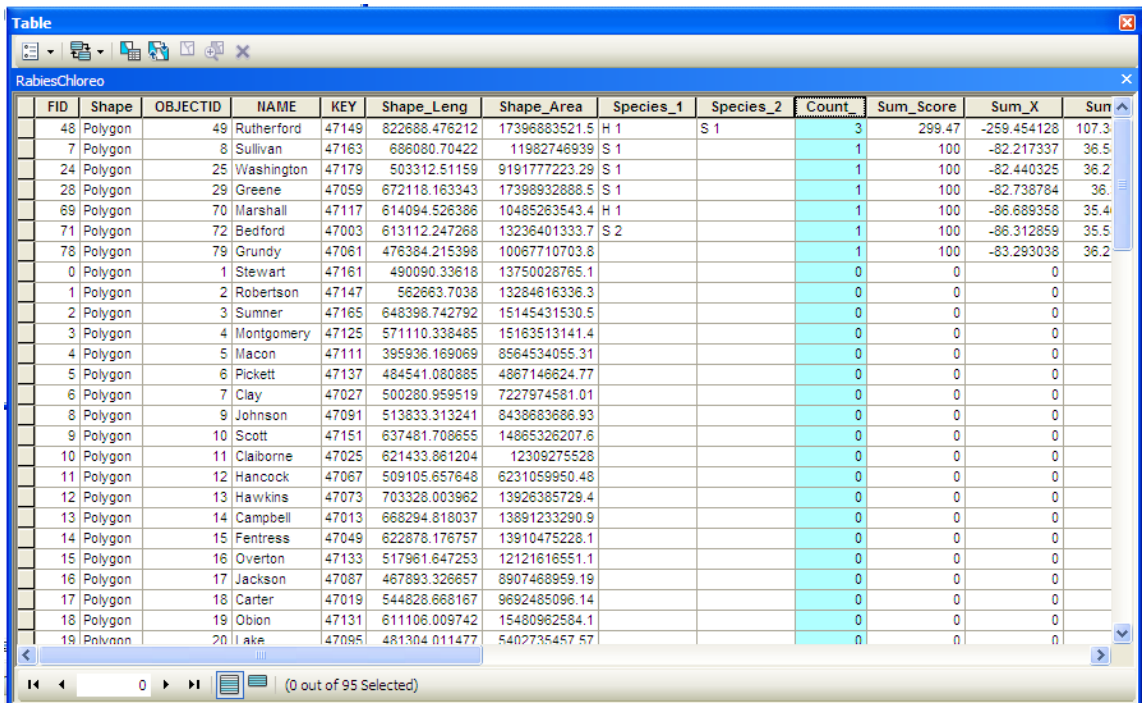


A Join Data box should appear. The drop down box asks “What do you want to join to this layer?” In this example, we are “joining data from another layer based on spatial location”. The next box, item #1 asks us to choose a layer to join to this layer. The item #2 box gives choices related to joining the data in the two layers based on whether the feature is a point, line or polygon and since this data are points how we want the number of points in the polygon (county) to be shown in the table. To make a choropleth map, we need the sum of points in the county so that we can symbolize the map based on number of cases. Item #3, asks where you want to save the resulting shapefile. The newly created layer will be added to your map.



When the new layer adds to the Table of Contents, open the attribute table to make sure that new layer has fields from both layers and the number of cases were counted. Right click on the new layer, then click Open Attribute Table.





Table

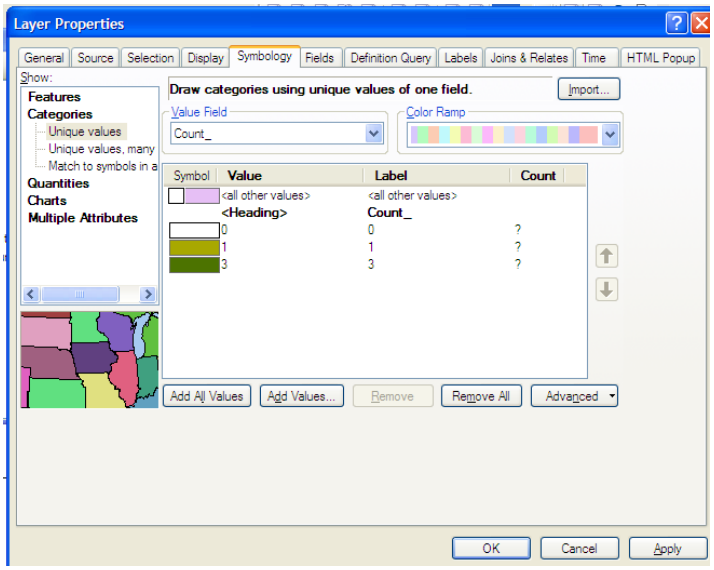
RabiesChloreo

FID	Shape	OBJECTID	NAME	KEY	Shape_Leng	Shape_Area	Species_1	Species_2	Count_	Sum_Score	Sum_X	Sun
48	Polygon	49	Rutherford	47149	822688.476212	17396883521.5	H 1	S 1	3	299.47	-259.454128	107.3
7	Polygon	8	Sullivan	47163	686080.70422	11982746939	S 1		1	100	-82.217337	36.5
24	Polygon	25	Washington	47179	503312.51159	9191777223.29	S 1		1	100	-82.440325	36.2
28	Polygon	29	Greene	47059	672118.163343	17398932888.5	S 1		1	100	-82.738784	36.
69	Polygon	70	Marshall	47117	614094.526386	10485263543.4	H 1		1	100	-86.689358	35.4
71	Polygon	72	Bedford	47003	613112.247268	13236401333.7	S 2		1	100	-86.312859	35.5
78	Polygon	79	Grundy	47061	476384.215398	10067710703.8			1	100	-83.293038	36.2
0	Polygon	1	Stewart	47161	490090.33618	13750028765.1			0	0	0	
1	Polygon	2	Robertson	47147	562663.7038	13284616336.3			0	0	0	
2	Polygon	3	Sumner	47165	648398.742792	15145431530.5			0	0	0	
3	Polygon	4	Montgomery	47125	571110.338485	15163513141.4			0	0	0	
4	Polygon	5	Macon	47111	395936.169069	8564534055.31			0	0	0	
5	Polygon	6	Pickett	47137	484541.080885	4867146624.77			0	0	0	
6	Polygon	7	Clay	47027	500280.959519	7227974581.01			0	0	0	
8	Polygon	9	Johnson	47091	513833.313241	8438683686.93			0	0	0	
9	Polygon	10	Scott	47151	637481.708655	14865326207.6			0	0	0	
10	Polygon	11	Claiborne	47025	621433.861204	12309275528			0	0	0	
11	Polygon	12	Hancock	47067	509105.657648	6231059950.48			0	0	0	
12	Polygon	13	Hawkins	47073	703328.003962	13926385729.4			0	0	0	
13	Polygon	14	Campbell	47013	668294.818037	13891233290.9			0	0	0	
14	Polygon	15	Fentress	47049	622878.176757	13910475228.1			0	0	0	
15	Polygon	16	Overton	47133	517961.647253	12121616551.1			0	0	0	
16	Polygon	17	Jackson	47087	467893.326657	8907468959.19			0	0	0	
17	Polygon	18	Carter	47019	544828.668167	9692485096.14			0	0	0	
18	Polygon	19	Obion	47131	611106.009742	15480962584.1			0	0	0	
19	Polygon	20	Lake	47095	481304.011477	5402735457.57			0	0	0	

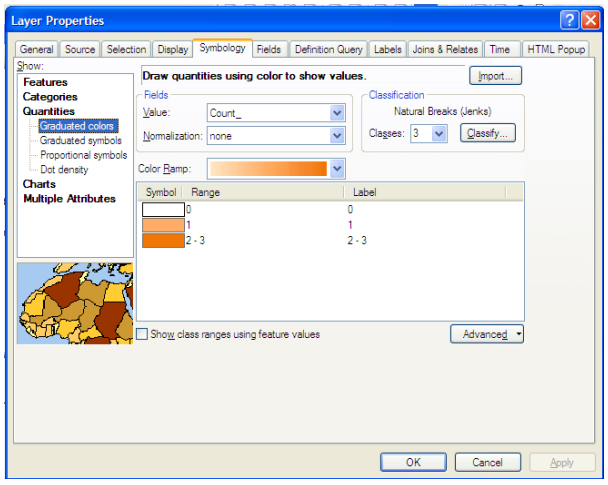
0 (0 out of 95 Selected)

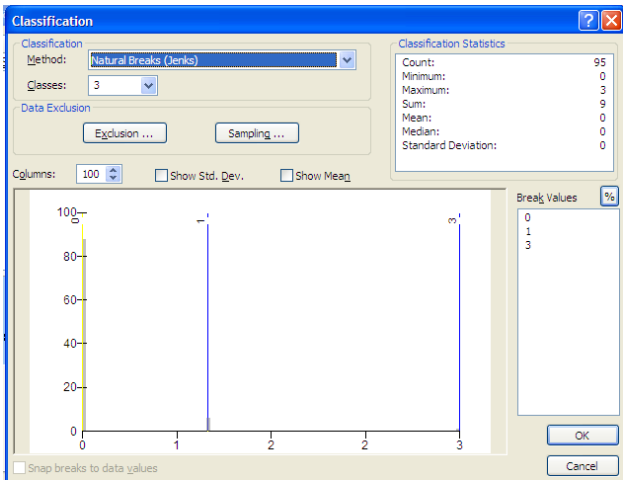
Counties can be shaded according to how many cases have been reported in each county or the number range for cases in each county.

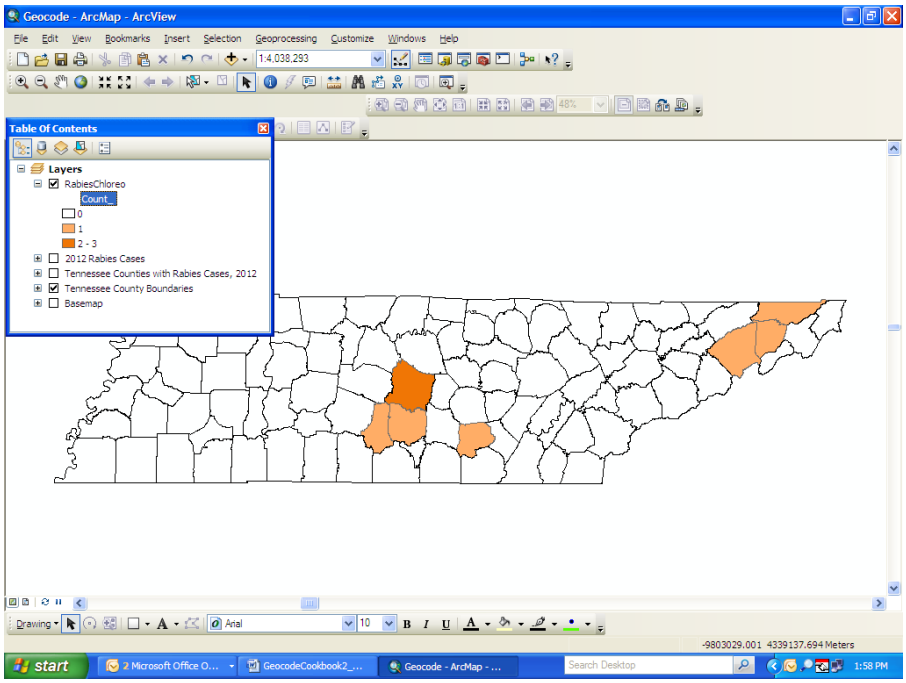
Right click on the layer, then click Properties. In the Layer Properties box, click the Symbology tab. To symbolize based on the number of cases, in the Layer Symbology box, click Unique Values under Categories in the Show box on the left. In the Value field choose the column in the attribute table corresponding to the count or number of cases per county. Colors can be chosen from the Color Ramp or individually assigned by clicking on the colored boxes under Symbol. Uncheck the “all other values” in the Symbol box, then click OK.



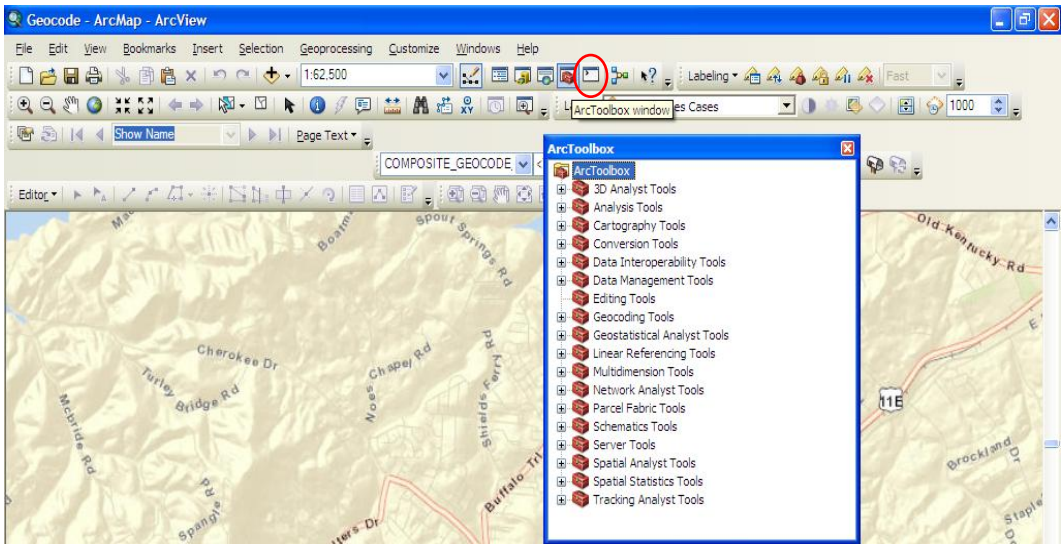
To symbolize using a range of numbers, in the Layer Symbology box, click Quantities in the Show box, then Graduated Colors. In the Value drop down choose the column that contains the number of cases per county. In the Classification box, different divisions of the data range can be made by different statistical methods. To change the Classification method, click the Classify button. To change the number of breaks in the data, use the drop down menus.







Many other tools and analysis methods are available within ArcGIS. Some off the shelf tools are located in the ArcToolbox. Others are available depending on which license is available or as add–on extensions.



The ArcGIS help text is extremely useful and there are many opportunities for online or classroom training. Please see the resources section for training information.

References

Tennessee OIR–GIS Services, January 11, 2007. *Geocoding Standards*.http://tnmap.state.tn.us/portal/documents/geocoding_standards.pdf

TNMap Portal, http://tnmap.state.tn.us/portal2/StateUsers.asp

ArcGIS Resource Center http://resources.arcgis.com/

Training

http://training.esri.com/gateway/index.cfm

http://gis.state.tn.us/

http://www.fws.gov/southeast/gis/gistraining_cookeville_2k10.htm

http://www.globalpositions.com/Free.html

Appendix A: Additional Resources

Where to find further support

TN Department of Health GIS User Group

Geocoding and GIS User Group within the Department of Health. Notification of meetings, trainings, webinars, etc.
Contact: Rendi Murphree | Rendi.Murphree@tn.gov | 615-253-1365

TN OIR GIS User Group

Geocoding and GIS User Group between all agencies in the State of Tennessee. Notification of meetings, trainings, webinars, and on-going inter-agency projects and enhancements.
Contact: Dennis Pedersen | Dennis.Pedersen@tn.gov | 615-741-9356

TN Map

http://tnmap.tn.gov/portal/ - TNMAP serves as the portal for accessing a wide variety of GIS related information, resources, and on-line mapping services in Tennessee.

OIR GIS Intranet

http://tnmap.state.tn.us/portal2/StateUsers.asp - GIS presentations, links, data sources, services and FAQ's available on the State of Tennessee intranet, but not available to users on the internet.

U.S Department of Health & Human Services – MedMap project

https://medmap.hhs.gov/ - HHS is developing an interactive geographic information system (GIS)-based mapping system, called MedMap, which will include data for resources in a response to any type of hazard such as potential medical care sites and assembly centers in the U.S., evacuation routes, hazards, etc. so that up-to-date information will be immediately available by which to organize the response. Determining which local medical care and assembly center facilities are functional or not in the exposure area is essential, as is having information on what regional and nationwide resources are available.

Esri ® Training Center

http://training.esri.com/gateway/index.cfm - Wide variety of geocoding and GIS courses from Esri ®.

Esri ® Middle TN Contact

Zach Layne | zlayne@esri.com | 615-599-4120

Appendix B: Glossary

ArcGIS	GIS software from Esri®. There are various "flavors" of the software with differing features and pricepoints: ArcGIS Desktop, ArcGIS Explorer, ArcGIS Online, ArcGIS Mobile, ArcGIS Server
Attribute	Information about a geographic feature in a GIS, usually stored in a table and linked to the feature by a unique identifier. For example, attributes of a river might include its name, length, and sediment load at a gauging station.
Case Cluster Map	A map which uses symbols to represent diseases of cases as points in geographical space, potentially stratified by attributes
Choropleth Map	A map that uses graded differences in shading or color or the placing of symbols inside defined areas on the map in order to indicate the average values of some property or quantity in those areas.
Epi Info	Public domain statistical software for epidemiology developed by Centers for Disease Control and Prevention (CDC). Its latest release, Epi Info 7, contains several public health mapping tools.
Esri ®	Software development and services company providing Geographic Information System (GIS) software and geodatabase management applications such as ArcGIS. This company has one-third of the global market share in this industry.
Geocoding	The process of assigning geographic coordinates (e.g. latitude-longitude) to street addresses, as well as other points and features. With geographic coordinates, the features can then be mapped and entered into Geographic Information Systems.
Georeference	To align data to a known geographic location so it can be viewed, queried, and analyzed with other data on a map.
GIS	A Geographic Information System, or GIS, integrates, data, hardware, software and GPS to assist in the analysis and display of geographically referenced information.
Shapefile	For ArcGIS software, a format for storing the location, shape, and attributes of geographic features. A shapefile is stored in a set of related files and contains one feature class.