Introduction to GIS Mapping and ESRI's ArcGIS Software

Objectives

In this exercise you are introduced to the ArcMap interface and some of the basic skills necessary to begin exploring geospatial data and create simple maps. Once you have successfully completed this part of the tutorial, you should know:

- How to open ArcMap and a Map Document (.mxd)
- How to examine your spatial data using ArcCatalog
- How to add spatial data to your Map Document
- How to join tabular data to geographic boundary files
- How to perform Geoprocessing analyses
- The difference between Data View and Layout View
- How to alter Map Feature Symbology

- How to add Essential Map Elements (North Arrow, Legend, etc…) for effective map creation
- How to modify the properties of a data frame.
- How to set relative pathnames to allow you to move and share your Map Projects
- How to export your map to PDF and JPG

Download the Data

The datasets used in this tutorial are available for download on the Map Collection Website. Feel free to download and use these tutorial materials, as you wish, and to pass them along to interested colleagues.

Go To the **Map Collection Homepage** (www.library.yale.edu/maps) in your **Web Browser**.

Under the Quick Links Section on the right, *Click* on the "Download GIS Workshop Materials" link.

Find the "Data" Link (ArcGIS 9.3.1 (2009 Sessions)) for the "Introduction to GIS Mapping and ESRI's ArcGIS Software." and *Right-Click* on the Link.

In Firefox, *Select* "Save Link As," in Internet Explorer, *Select* "Save Target As…"

Depending on your browser and setup, you may be offered a **Browse Window**, to select the folder into which you want the downloaded file placed. If so, *Browse* to a **Folder** on your hard drive that you have write permission for. For this tutorial, we will assume that you are using the **C:\temp** folder of the machine you are working on.

Save the Downloaded File to this **C:\temp** Folder.

Unzip the Data

You should now have a file called "**Introduction_to_ArcGIS_2009.zip"** in your new folder. It is now necessary to decompress, or unzip, the tutorial data for use. Note that in Microsoft Windows XP and Vista, it is possible to "Explore" a compressed file, as if it were a folder. **ArcMap** does not support this type of browsing, so it is necessary to actually unzip the file for use. This part of the tutorial assumes that you are using Windows' built in Compressed File support.

Browse into the Folder where you saved the **Introduction_to_ArcGIS_2009.zip** file.

*Right-Click* on the File and *Select* "Extract All…"

Click **Next** to arrive at the window shown at the right.

Click Next to *Extract* the File.

Exploring the Data in ArcCatalog

1. From the Windows Start Menu, go to Start>All Programs>ArcGIS>ArcCatalog

This is the ArcCatalog Application of the ArcGIS Suite. It is roughly equivalent to the Windows Explorer interface, in that it provides an interface from which to browse and manage geographic data and databases. Because Windows Explorer does not properly recognize all of the various components of geographic datasets, it is always best to use ArcCatalog to manage your data.
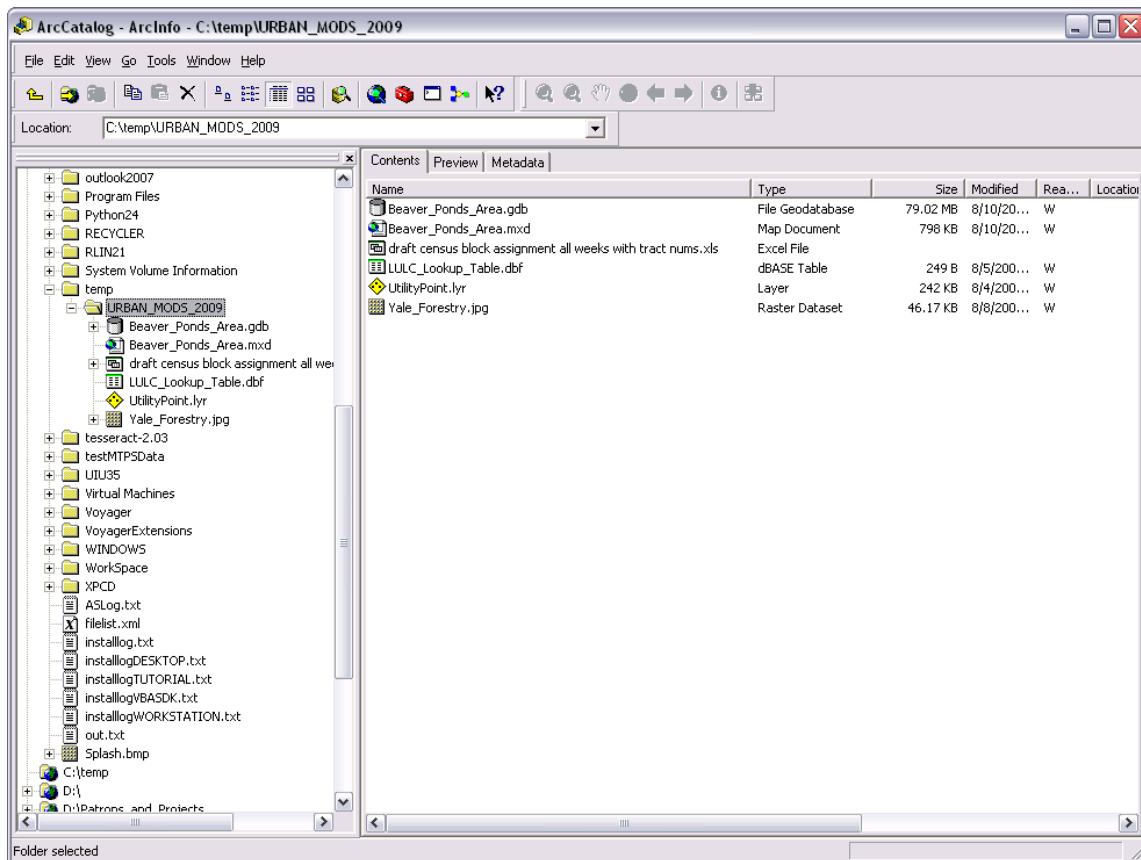
The panel on the left side of the ArcCatalog Screen is the "Catalog Tree" where you can browse folders on your system for geographic data. Note that only folders and files compatible with ArcGIS will be displayed in the Catalog Tree and the View Windows on the right.

1. Expand the C:\ Drive Icon in the ArcCatalog Tree, find the C:\Temp folder and expand it, then Click on the Introduction_to_ArcGIS_2009 Folder to display its contents in the Contents Tab of the View Window on the right.

You'll notice several files in this folder, not all of which are actually geographic data, but are in some way, supported in ArcGIS. The most important of these files for our purposes are the Beaver_Ponds_Area.gdb and the Beaver_Ponds_Area.mxd.

We'll explore the Beaver_Ponds_Area.gdb. first.

1. In the Catalog Tree, on the left, expand the Beaver_Ponds_Area.gdb to reveal its contents.

This dataset is referred to as a File Geodatabase, and it contains several different types of geographic data, including vector feature classes, raster data in the form of imagery and tabular data related to the geographic data in the geodatabase. It is important to note that the File Geodatabase is a file structure that can only be managed within ArcCatalog.
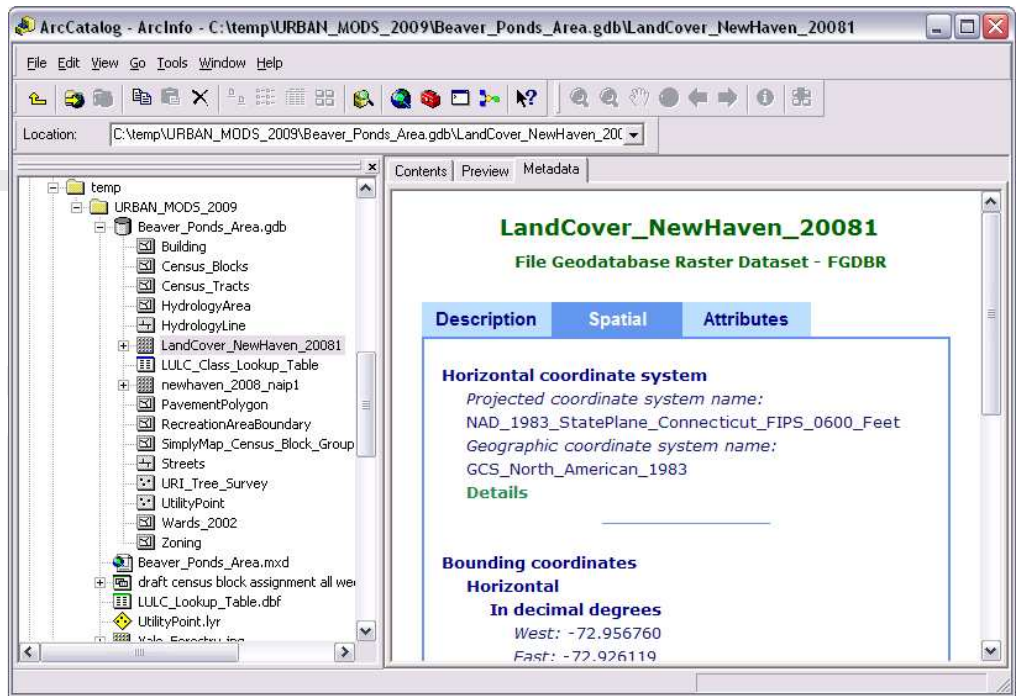
1. Click on the LandCover_NewHaven_20081 Raster Layer

2. Click on the Preview Tab in the View Window on the right of ArcCatalog.

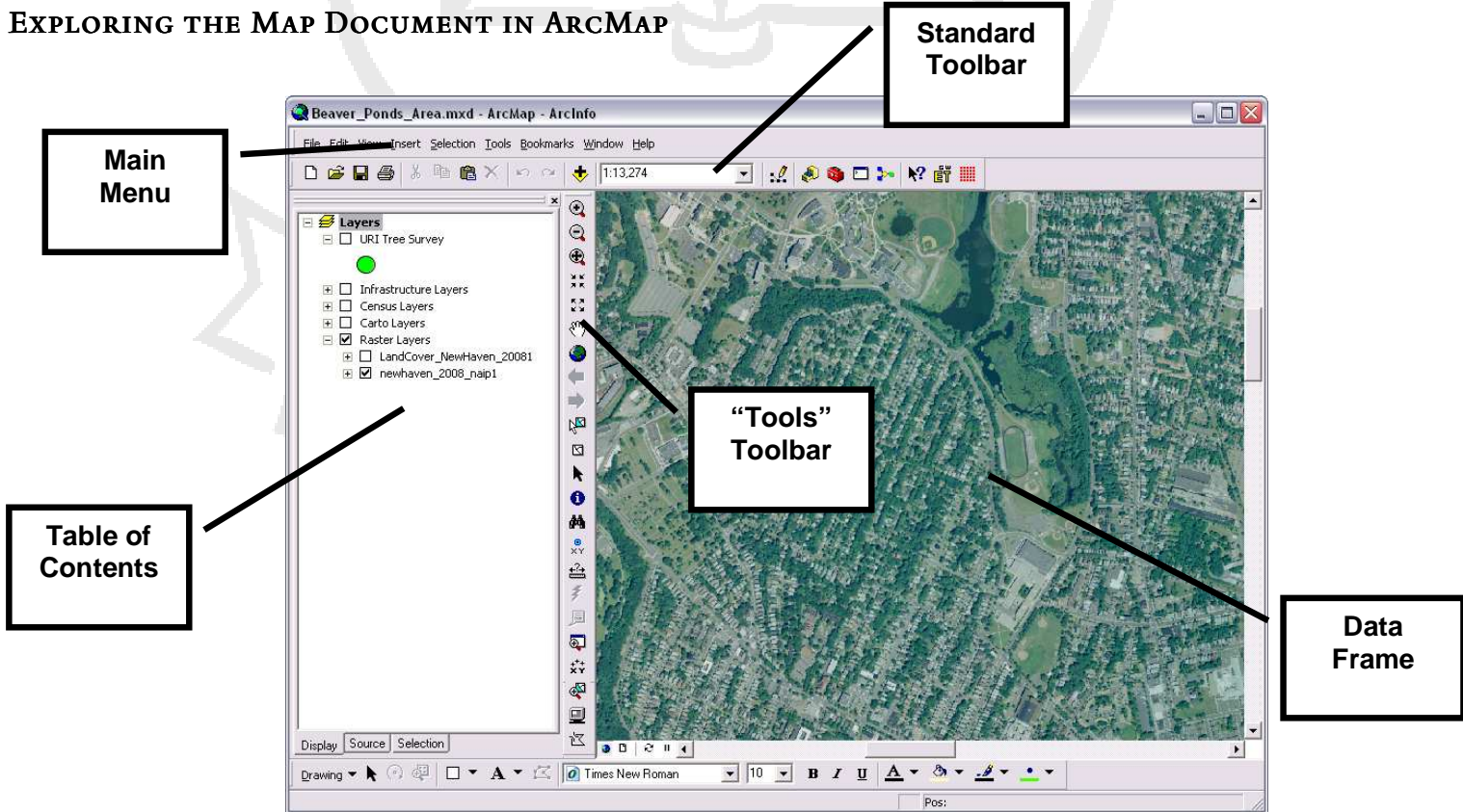Note that you can preview the geographic dataset in ArcCatalog.

3. At the bottom of the Preview Screen, change the Preview: Drop-down to Table, and examine the table for this dataset.

4. Change to the Metadata Tab, at the top of the ArcCatalog View Window, and Select the Spatial Page.

Metadata is "Data about Data." In this case, there is not much to see, except for the very important information about the Spatial Reference of the Dataset. Here, ArcCatalog displays the Projection being used for this dataset, as well as the underlying Coordinate System.

1. In the Catalog Tree, find the Beaver_Ponds_Area.mxd

2. Double-click on the Beaver_Ponds_Area.mxd Document.

Exploring the Map Document in ArcMap

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ADDING DATA TO A MAP DOCUMENT

This .MXD file is the Map Document. Currently, it has many data layers already added. Before we go any further, we will add another data layer to the map document.

1. On the Standard Toolbar, click the Add Data Button

2. Browse to the C:\Temp folder and into your Introduction_to_ArcGIS_2009\Beaver_Ponds_Area.gdb

3. Find and Select the URI_Tree_Survey feature class.

4. Click Add.

5. If necessary, click on the checkbox next to the newly added URI_Tree_Survey Layer, at the top of the Table of Contents.
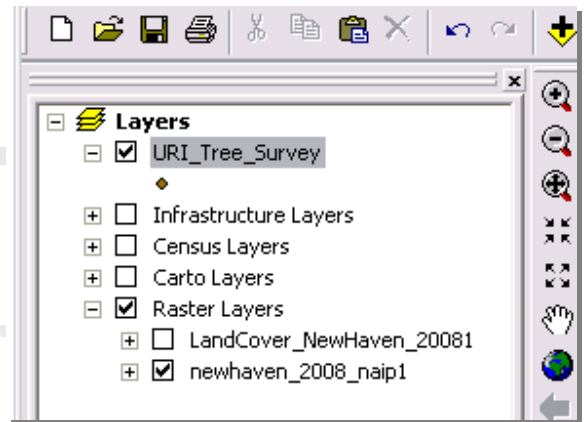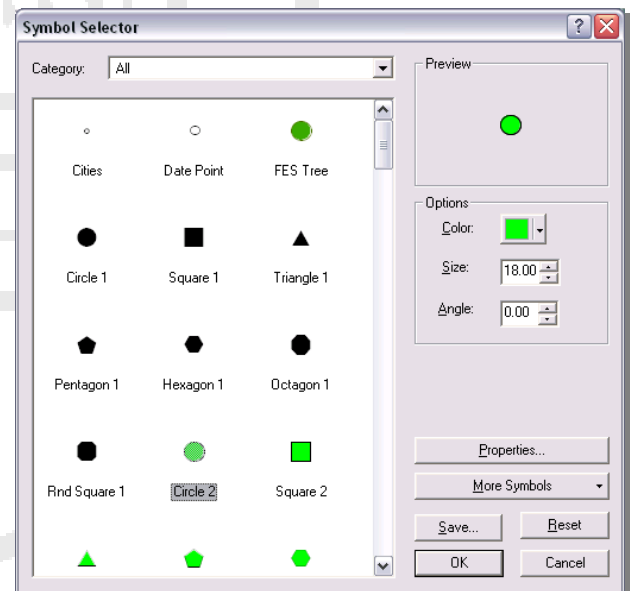
Because you are zoomed so far out of the Data Frame, you may not immediately see the tree points render in the map.

CHANGE THE SYMBOLOGY OF THE URI_TREE_SURVEY LAYER

1. Click on the Point Symbol, underneath the URI_Tree_Survey Layer name, in the Table of Contents.

2. In the Symbol Selector dialog box, select Circle 2, and click OK.
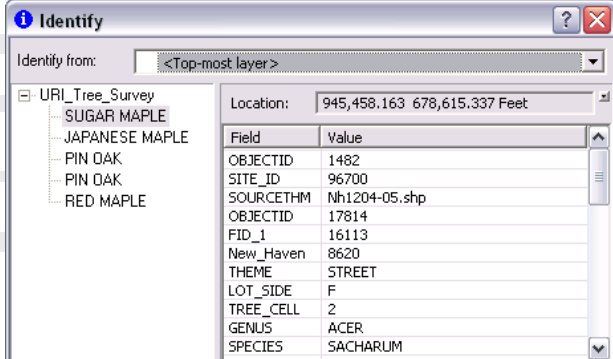
You may now notice that the tree layer is slightly more visible.

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Navigating the Data Frame in ArcMap

Now you will familiarize yourself with the navigation tools in ArcMap.

1. The Zoom In and Zoom Out Tools work, for the most part, like you would expect. Select the Zoom In Tool and drag a box across a small area in the center of the Data Frame.

2. Select the Zoom Out Tool and click several times in the center of the Data Frame.

3. Click on the Previous Extent Button and note that it works much like the back button on your web browser, stepping you back through your previous extents. The Next Extent Button steps you forward through your extent history, in the same way.

4. The Data Pan Tool is used to change the extent of your Data View, without changing the scale at which the data is viewed.

5. The Info Tool is used to quickly query the attributes of one or more of the features in your Data Frame. You can click on a single feature to bring its attribute table up, or you can drag a box to view the attributes of several features.

6. The Select Elements Tool doesn't do much in the Data View, but is a good tool to keep active, for this reason.

7. Finally, on the Main Menu, go to Bookmarks>Beaver Ponds Area to zoom to the original extent of the Map Document.

Exploring the Table of Contents

The Table of Contents is the Panel on the left side of the ArcMap interface. It is where all of your Layer Names are displayed in ArcMap and where, for the most part, you interact with those layers.

1. Click on the + sign next to the Census Layers Group to Expand it in the Table of Contents.

Note that one of the layers in this group is enabled; however since the group that contains it is not enabled (checked) it is not currently displayed in the Data Frame.

2. Click in the Census Layers checkbox to enable the visibility of the Census Layers Group.

3. Enable visibility for the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer.

4. Click-Hold-Drag-Drop the Census_Blocks Layer to just above the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer.

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Note that the red boundary lines for the Census Blocks from the Census_Blocks layer are now visible on top of the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer. The order of display in the Table of Contents is the order of Display in the Data Frame.

5. Right-Click on the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer and take a look at the context menu options available.

6. Select Open Attribute Table.

7. Scroll to the right of the Attribute Table and take a look at the attribute values contained in this Feature Class.

8. Click on the Options Button and take a look at the actions available.

9. Select Clear Selection.

10. Right-Click on the MedianHouseholdIncome Field Header and Select Statistics. Note the report available, and that you can switch to other attribute fields within the Statistics Report window.

Statistics of SimplyMap_Census_Block_Groups_New_Haven_County_CT

Field
MedianHouseholdIncome

Statistics:
Count: 40
Minimum: 9886
Maximum: 90294
Sum: 1629712
Mean: 40742.8
Standard Deviation: 17179.454903

Frequency Distribution

11. Close the Statistics Report.

12. Close the Attribute Table.

13. Click on the Source Tab, at the bottom of the Table of Contents.
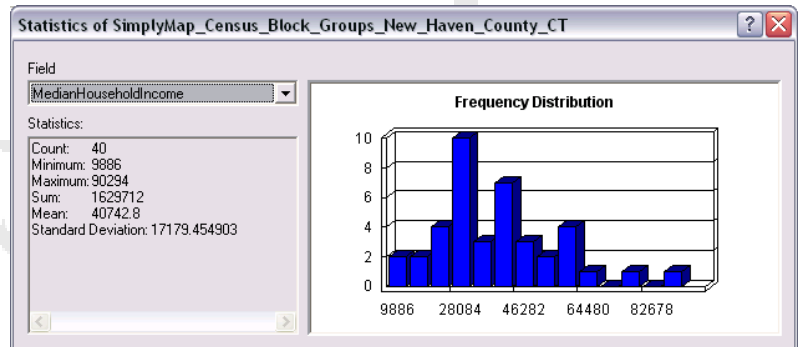
Note that this TOC View shows the paths to all datasets that are in the Map Document. Note also, at the bottom of the TOC Source Tab View, that there is a table (LULC_Lookup_Table) that was not visible in the Display Tab View of the TOC. This is because this table does not have explicit geographic data to visualize in the Data Frame.

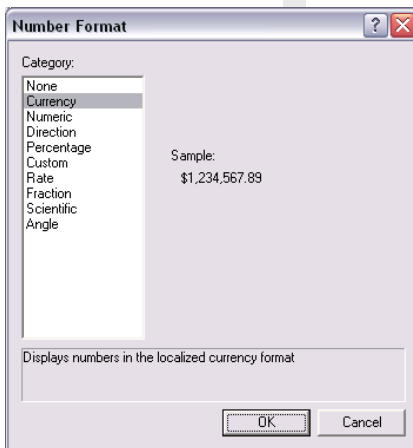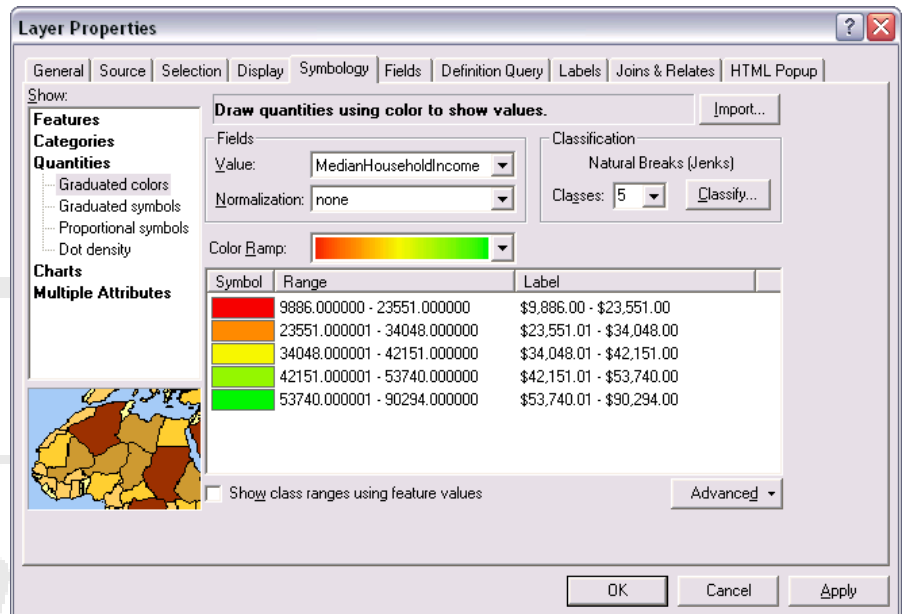14. Click on the Selection Tab of the TOC.

This is where you can assign the "Selectable Layers" within your ArcMap Document. This is most useful when you are using the

interactive Select Features Tool [icon] since this tool's default is to select features from ALL LAYERS. The currently selectable layers should be set to the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer and the URI_Tree_Survey Layer. If they are not, check these layers and uncheck all others.

15. Click on the Display Tab of the TOC.

SYMBOLIZING A LAYER BASED ON AN ATTRIBUTE VALUE

1. Right-Click on the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer and Select Properties.

2. Click on the Symbology Tab, at the top of the Properties Dialog Box.

3. In the Left panel of the Symbology Properties, select "Quantities" and leave "Graduated Colors" as the selected method.

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4. In the "Fields:Value:" Drop-down, select MedianHouseholdIncome as the field to base symbology upon.

5. Under "Color Ramp:" Select the Red to Green Color Ramp.

6. In the Legend Panel, where the Classes and corresponding colors should now be displayed, click on the Label field header and select "Format Labels."

7. Select "Currency" and click OK.

Layer Properties

General | Source | Selection | Display | Symbology | Fields | Definition Query | Labels | Joins & Relates | HTML Popup |

Show:
Features
Categories
Quantities
  Graduated colors
  Graduated symbols
  Proportional symbols
  Dot density
Charts
Multiple Attributes

Draw quantities using color to show values.   Import...

Fields
Value: MedianHouseholdIncome
Normalization: none

Classification
Natural Breaks (Jenks)
Classes: 5   Classify...

Color Ramp:

Symbol	Range	Label
	9886.000000 - 23551.000000	$9,886.00 - $23,551.00
	23551.000001 - 34048.000000	$23,551.01 - $34,048.00
	34048.000001 - 42151.000000	$34,048.01 - $42,151.00
	42151.000001 - 53740.000000	$42,151.01 - $53,740.00
	53740.000001 - 90294.000000	$53,740.01 - $90,294.00

☐ Show class ranges using feature values   Advanced ▾

OK   Cancel   Apply

Number Format

Category:
None
Currency
Numeric
Direction
Percentage
Custom
Rate
Fraction
Scientific
Angle

Sample:
$1,234,567.89

Displays numbers in the localized currency format

OK   Cancel

8. Click Apply to Preview your Symbology.

9. Click on the Display Tab.

10. Set the Transparent Property to 40%.

11. Click OK

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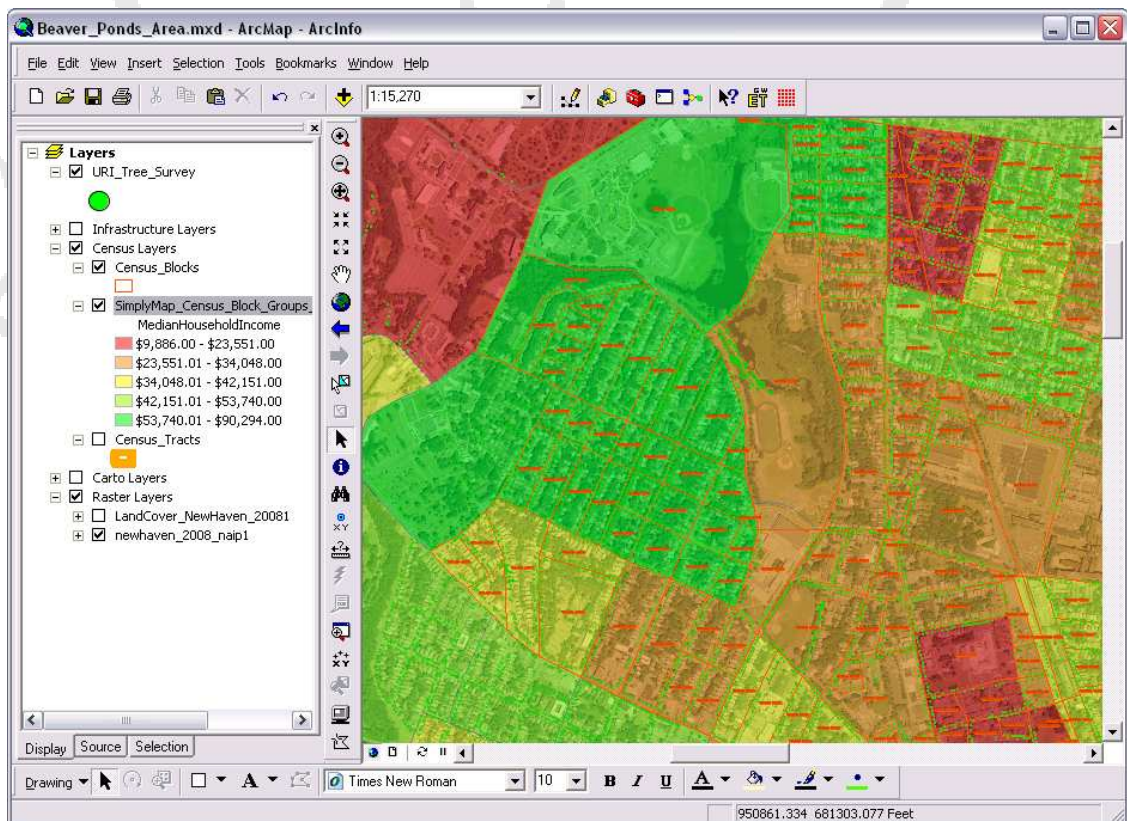
NORMALIZATION OF DATA FOR SYMBOLOGY
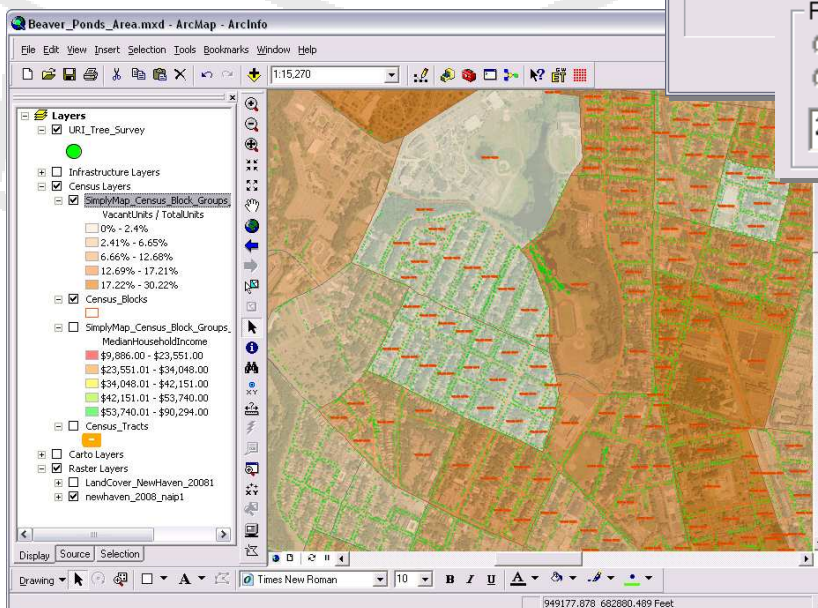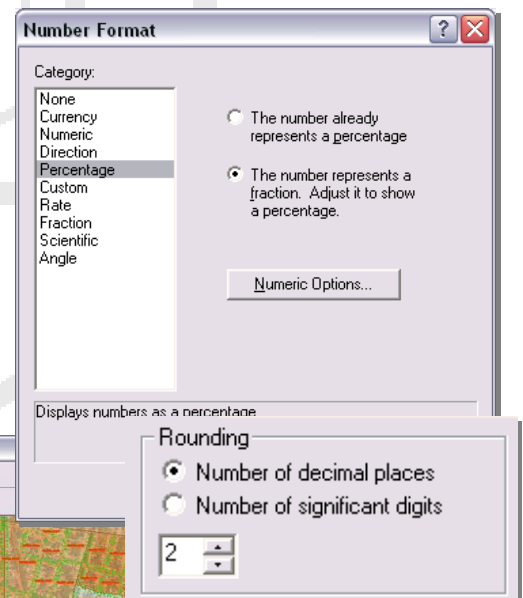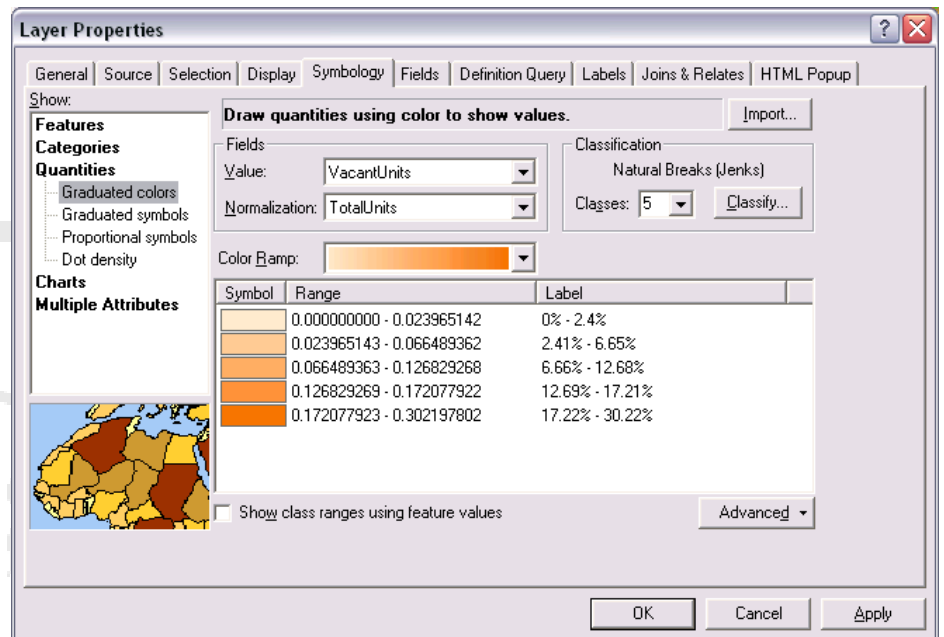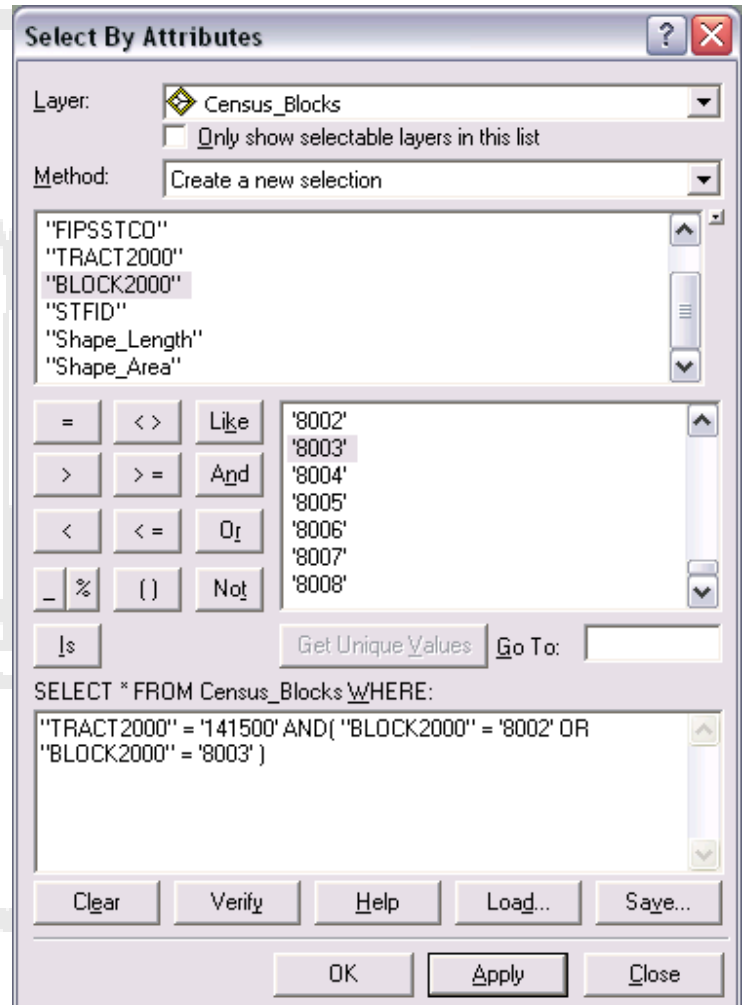
1. Uncheck the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer to turn off it's visibility.

2. Right-Click the SimplyMap_Census_Block_Groups_New_Haven_County_CT Layer and select Copy.

3. Right-Click on the Census Layers Group name and Select Paste Layer(s).

4. Make the new layer visible.

5. Open the Properties for the newly pasted layer and click on the Symbology Tab.

6. Change the "Fields:Value:" drop-down to VacantUnits.

7. For the Normalization Field, select TotalUnits.

8. For the Color Ramp, select the White to Orange Ramp.

9. Click on the Labels Header and open the Format Labels dialog.

10. Select Percentage, and click on the "…number represents a fraction…" option.

11. Click on the Numeric Options Button.

12. Set the Rounding option to 2 decimal places.

13. Click ok, twice.

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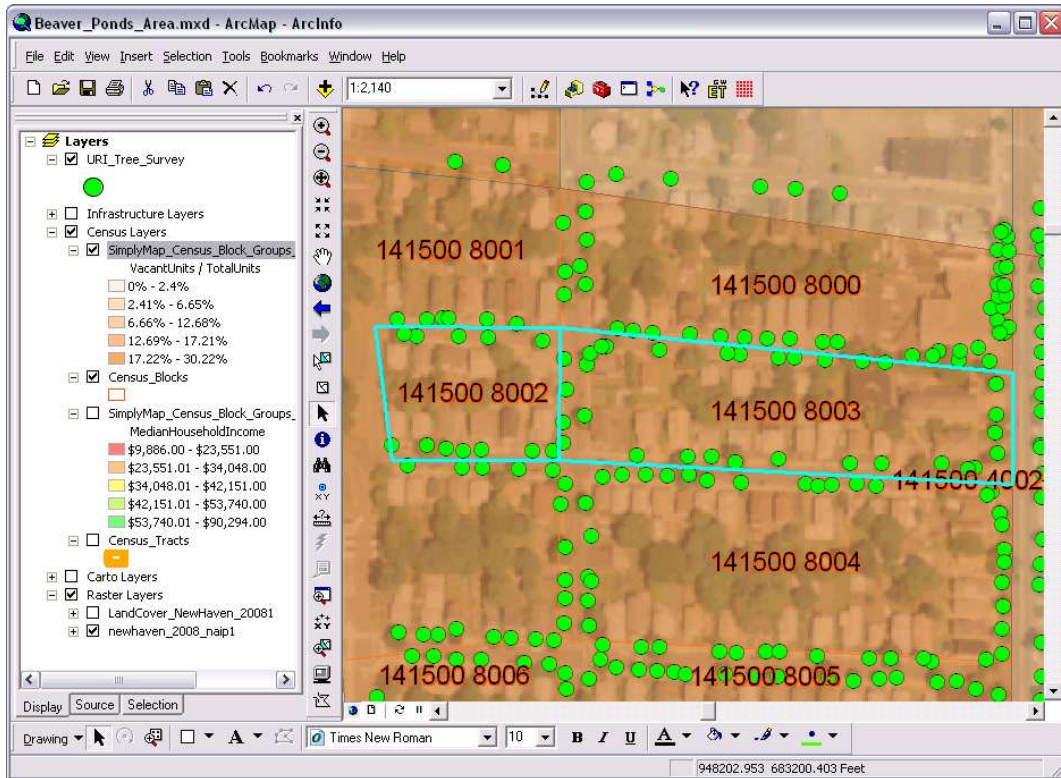www.library.yale.edu/maps

SELECTING FEATURES BY ATTRIBUTES

Now you will select the Census Blocks you have been assigned to survey and will focus on that area for the remainder of the tutorial.

1. Use the following values for the next steps TRACT#: **141500** ; CENSUS BLOCK #'s: **8002 & 8003**

2. On the Main Menu, go to Selection>Select by Attributes.

3. For the Target Layer, select Census_Blocks.

4. Make sure "Create New Selection" is the Method.

5. Find the "TRACT2000" Field name and double-click it to place it in the Query Window.

6. Click on the "=" operator button.

7. Click Get Unique Values, and double-click your Tract Number.

8. Click the AND button.

9. Click on the () button and place your cursor inside the parentheses.

10. Double-Click "BLOCK2000"

11. Click on the "=" operator button.

12. Click Get Unique Values, and double-click your first Block Number.

13. Click on the OR Button

14. Double-Click "BLOCK2000"

15. Click on the "=" operator button.

16. Click Get Unique Values, and double-click your second Block Number.

17. Click the Verify Button to check your syntax.

18. Click OK to apply the Selection.

19. On the Main Menu, go to Selection>Zoom to Selected Features. Verify that the Block Labels match your assigned blocks.

20. On the Main Menu, go to Bookmarks>Create and name your new bookmark "My Blocks"

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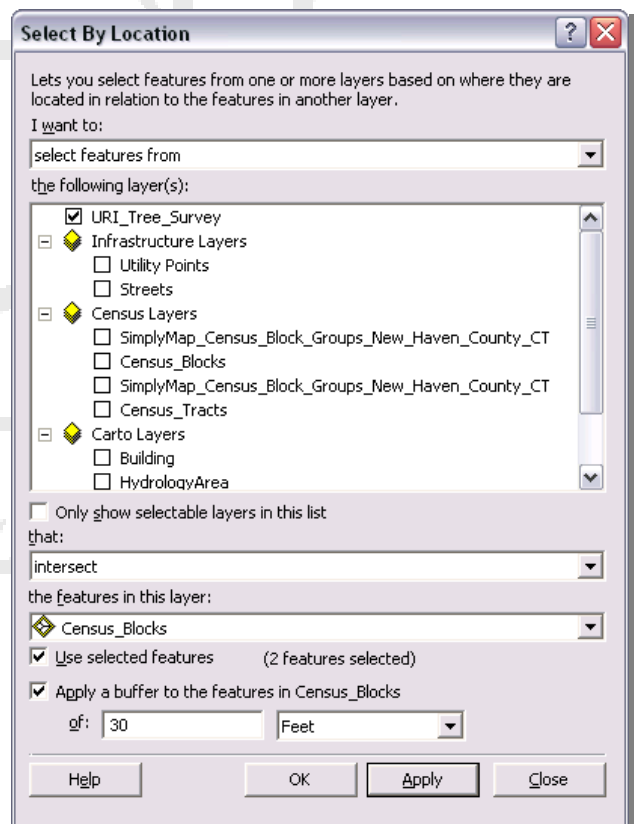203-432-8269 / stacey.maples@yale.edu
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SELECTING FEATURES BASED ON LOCATION

Now, you will select the trees in your area, based upon their proximity to the Census Blocks you just selected.

1. On the Main Menu, go to Selection>Select by Location.

2. Check the URI_Tree_Survey as the only layer to be selected.

3. Make sure that next drop-down is set to "intersect."

4. The next drop-down needs to be set to "Census_Blocks."

5. "Use selected features" should be automatically checked.

6. Check the "Apply a buffer…" option and set it to 30 feet.

7. Click Apply and observe the results in your Data Frame.

8. Click OK to close the "Select by Location" dialog box. Your selection should remain active.

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SUMMARIZING THE TREE SPECIES DISTRIBUTION FOR YOUR ASSIGNED BLOCKS

1. On the Standard Toolbar, click the ArcToolbox Button [icon] to open the ArcToolbox Panel.

2. Click on the Search Tab, at the bottom of the ArcToolbox Panel.

3. Enter "Frequency" as the Search Term and click Search.

4. Double-Click on the "Frequency – Analysis Tools" search result to launch the Frequency dialog box.

5. Click "Show Help" at the bottom of the dialog to show the context sensitive help panel for this tool.

6. Select URI_Tree_Survey as the Input Table.

7. The default Output Table should be : "C:\temp\INTRODUCTION_TO_ARCGIS_2009\Beaver_Ponds_Area.gdb\URI_Tree_Survey_Frequency". If it is not, change it accordingly.

8. Select COMM_NAME as the Frequency Field.

9. Click OK to run the analysis

10. Switch to the Source Tab of the TOC.

11. Scroll to the bottom of the TOC and find the URI_Tree_Survey_Frequency Table, right-click and Open it.

12. Right-Click on the Frequency Field Header and select Sort Descending.

13. Close the URI_Tree_Survey_Frequency Table.

14. Turn off the visibility of the all but the Census Blocks Layer in the Census Layers Group.

15. Turn on the visibility of the Infrastructure Layers & Carto LayersGroups.
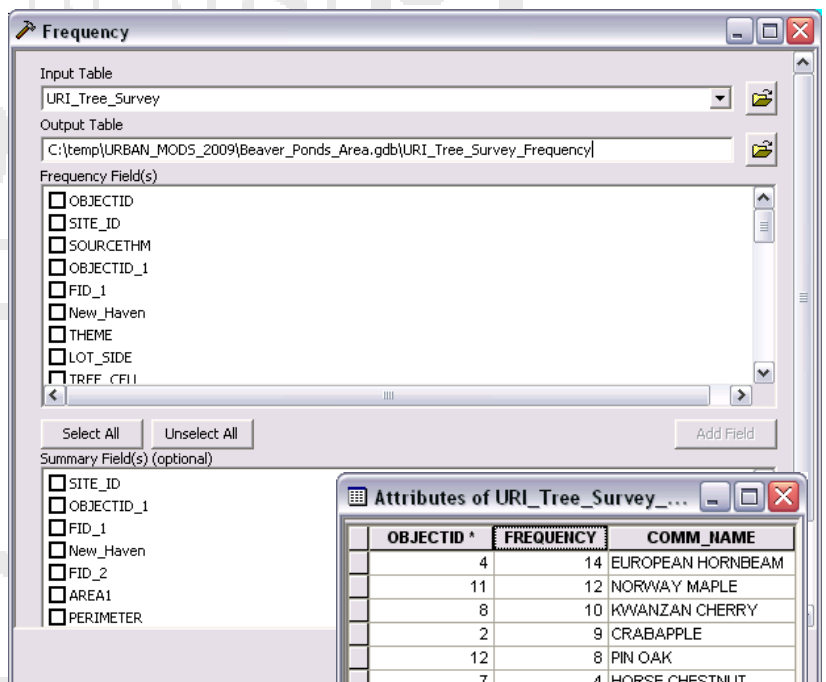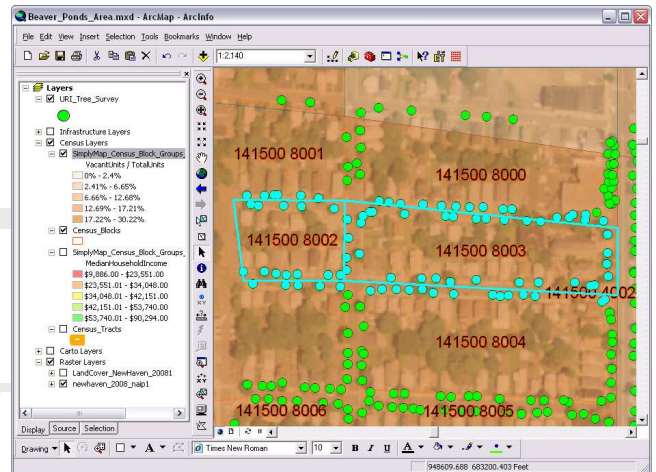
OBJECTID *	FREQUENCY	COMM_NAME
4	14	EUROPEAN HORNBEAM
11	12	NORWAY MAPLE
8	10	KWANZAN CHERRY
2	9	CRABAPPLE
12	8	PIN OAK
7	4	HORSE CHESTNUT
15	4	RED MAPLE
17	4	SUGAR MAPLE
3	3	CRIMSON KING MAPLE
14	3	PS SMALL GRASS
1	2	CALLERY PEAR
6	2	GREEN ASH
9	2	LITTLE LEAF LINDEN
16	2	STUMP
18	2	SWEETGUM
5	1	FLOWERING DOGWOOD
10	1	MAPLE SPECIES
13	1	PS LARGE GRASS

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## CREATING A MAP

GETTING FAMILIAR WITH LAYOUT MODE

1. Look for the View Toolbar at the bottom left of the Data Frame and click on the Layout Button, which looks like a piece of paper.

    Notice that you should now see the Layout Toolbar, which contains many tools that are nearly identical in appearance to those on the "Tools" toolbar.

2. Select the Layout Zoom Tool and drag a box across some portion of the Map Document Layout that now is shown in place of the Data Frame.

    Note that the scale of the map does not change, but that you are now zooming into the Map Layout. The rest of the Layout Tools function in the same way. While they mimic the actions of the Tools Toolbar navigation tools, they act on the Page Layout, rather than the Map Data.

3. Click on the Page Extent Button to zoom to the full page layout.
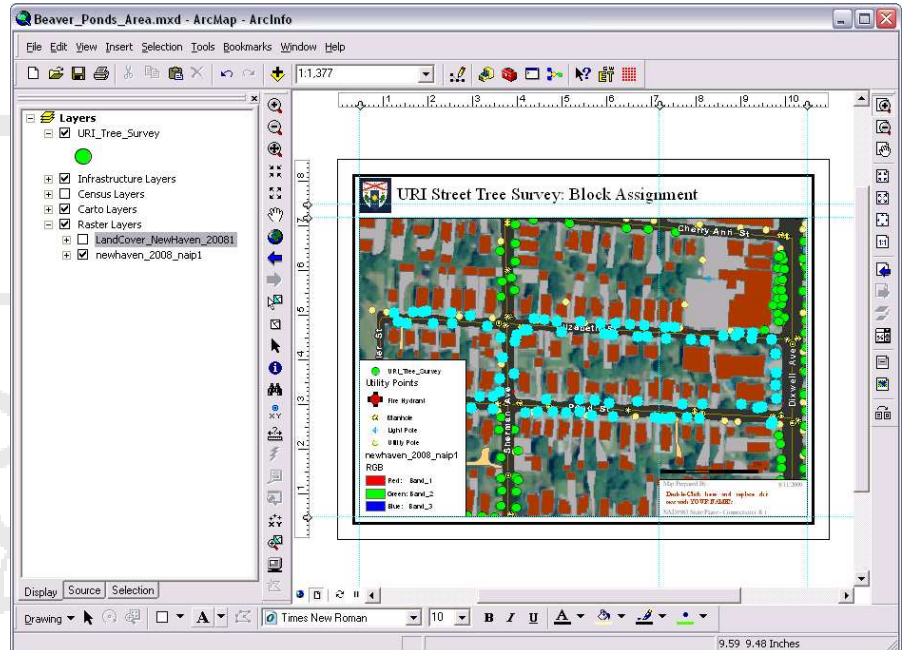
CHANGING THE TREES SYMBOLOGY

1. On the Main Menu, go to Selection>Clear Selected Features.

2. Right-Click on the URI_Tree_Survey Layer ans open it's Properties.

3. Click on the Symbology Tab.

4. Select Categories.

5. Select 'REINV' as the Value Field and click Add All Values at the bottom of the Properties Window.

6. Click the Symbol Field Header and Select Properties for All Symbols.

7. Select Circle 2 and click OK.

8. Under the Label Field, Replace <NULL> with 'Unsurveyed by URI', replace '1' with 'Surveyed by URI'

9. Uncheck 'All other values'. Click OK

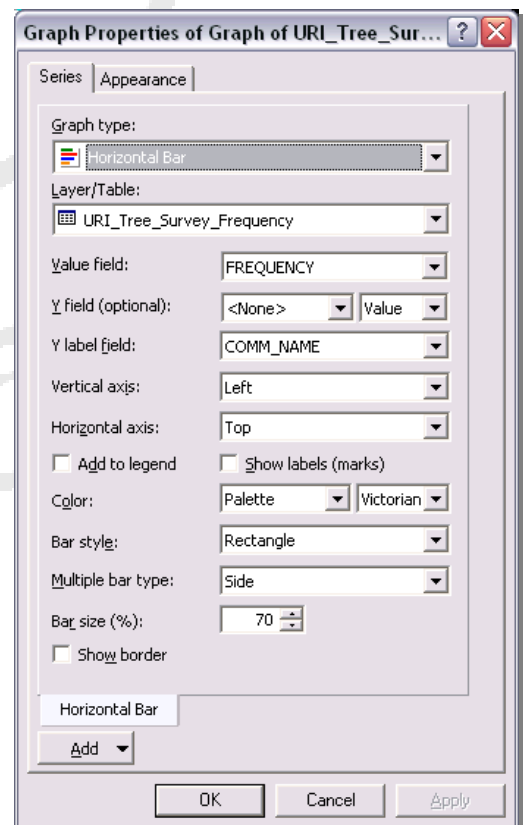10. Right-Click on the Symbol for Unsurveyed Trees and Select Red for the color.

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Cleaning up the Legend

1. Select the Select Elements Tool [icon] and click on the Legend in the map layout until it is the only object highlighted bright blue, with resize handles.

2. Right-Click the selected Legend and open its Properties.

3. Using the Ctrl Key, highlight all but the URI_Tree_Survey and Utility Points Layers.

4. Click on the Remove Button [icon] to remove the selected items from the legend. Click Apply. Click OK.

5. In the TOC, Click once on the URI_Tree_Survey Layer name, wait a second and click again to highlight it for editing.

6. Replace the underscores '_' with clank spaces.

7. Change 'REINV' to 'Status', using the same method.

8. If necessary, resize the legend, using the blue resize handle at the upper right corner.
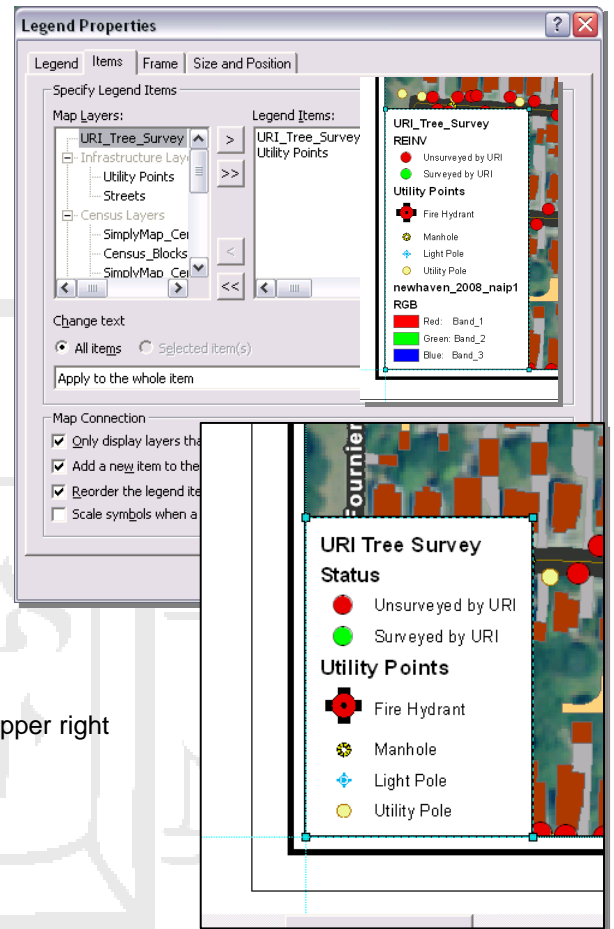
Adding a Graph of Tree Species Frequency

1. On the Main Menu, go to Tools>Graphs>Create.

2. Change the Graph Type to Horizontal bar.

3. Change the Layer/Table to URI_Tree_Survey_Frequency.

4. Make FREQUENCY the Value Field.

5. For Y Label Field, Select COMM_NAME.

6. Change Horizontal Axis to 'Top'

7. Uncheck 'Add to Legend'

8. Change Color: to 'Palette/Victorian'

9. Click Next.

10. Uncheck Graph Legend.

11. Click Finish.

12. Right-Click in the Graph and select "Add to Layout"

13. Move and resize the Layout Graph, as needed.

14. Close the Graph Window.

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ADDING AND ALTERING ADDITIONAL MAP ELEMENTS

NORTH ARROW

1. On the Main Menu, go to Insert>North Arrow.

2. Choose a North Arrow, and Click OK.

3. Resize and reposition the North Arrow, as needed.

FORMATTING TEXT

1. Using the elects Elements Tool [cursor icon], select the red text in the lower right corner of the Map Layout.

2. Right-click on the selected text and open its properties.

3. Replace the Text with the Names of your Crew Members. Click OK
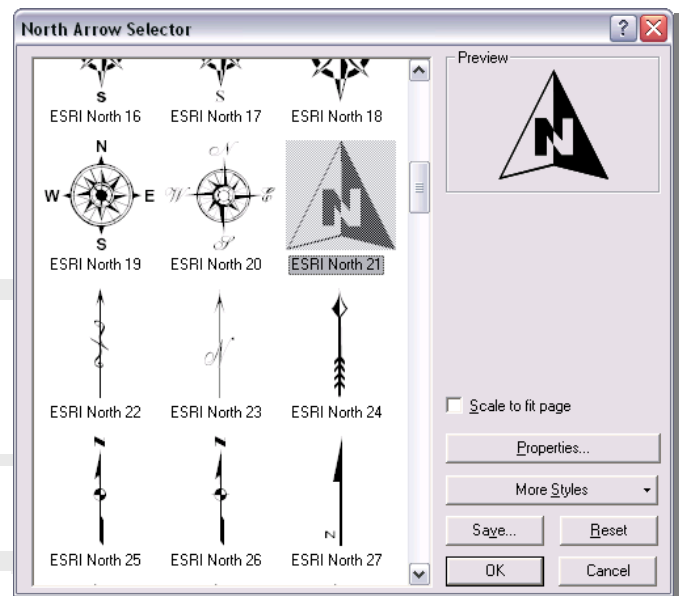
EXPORTING YOUR MAP TO PDF

1. On the Main Menu, go to File>Export Map.

2. Change the Save As Type to PDF.

3. Set the Resolution to 200dpi

4. Under the Format Tab, Check "Convert Marker Symbols to Polygons" and "Embed All Document Fonts"

5. Browse to the C:\Temp\ folder and save your PDF using the Default Filename (which is the name of your Map Document).

6. Click Save.

The Yale Map Collection
At Sterling Memorial Library
130 Wall Street, Room 707

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