Hands-on GIS Project
Watershed land use changes 1995 – 2007 – Smart Growth?

Introduction

New Jersey smart-growth strategies aim at growing communities in a way that preserves open spaces, minimizes pollution and habitat loss, maximizes economic prosperity, and is equitable to all (http://www.njfuture.org/smart-growth-101/). In the past two decades, New Jersey land resources have been managed, or mismanaged in some cases, during the urban sprawl process, especially in the southern New Jersey where sensitive ecosystems of many wildlife habitats have been affected.

The objectives of this project are to: 1) identify the locations, the direction, and the trend of the land use changes; 2) quantify the changes; and 3) evaluate the changes in the context of New Jersey Smart-Growth strategies. We focus on the lost of natural forest and wetland from 1995 to 2007 and the conversions of the lost forest/wetland using Barnegat Bay Watershed (WMA-13) as an example.

Procedure

1. Open NJ DEP GIS website (http://www.state.nj.us/dep/gis/watershedwide.html) and download the watershed land use maps of your watershed(2 dates: 2002 Landuse/Landcover and 2007 landuse/Landcover) and save them in a new project folder
2. Unzip each of them
3. Closely examine the information in the attribute tables of the two shapefiles. If necessary, go back to read the Metadata.
4. Open ArcMap and click the Catalog button at the upper right side of the window
5. Click Connect to Folder button to connect the folder of S:\Pineland_course\landuse_data
6. Double click S:\Pineland_course\landuse_data folder to expand it
7. Double click the folder of w13lu02, click the shapefile of w13lu02, drag it, and drop it to the map window. This is the land use map of 2002 of the watershed. It also carries the information of land use and cover in 1995 in the attribute table.
8. Double click the folder of w13lu07, click the shapefile of w13lu07, drag it and drop it to ArcMap as well. This is the land use map of 2007 of the same watershed. They are both in the coordinate system of State Plane NAD1983 Feet.

In this workshop, we will identify the areas of natural forests (4000+) and wetlands (6000+) in 1995, 2002, and 2007. How much had been lost, what land use types they were lost to, where the lost should have never happened according to the NJ Smart-Growth Strategies.

9. Check off w13lu07 because we have to do it one at time.
10. Right click w13lu02 and choose Open Attribute Table. In the field LU95 (column named LU95), the land use codes indicates the land use status in 1995.
11. Click the dropdown list of the Table Option button at the upper left corner of the table and choose Select by Attributes
12. In the Select by Attributes dialog box, slide down and double click "LU95" to make sure it gets into the Select box at the lower part. Click > button, type in 4000, click And button, double click "LU95" again, click < button, and type in the number of 5000.
13. Now, you need to include above expression in a pair of parenthesis. Click the Or button, click the parenthesis button, double click "LU95", click > button, type in 6000, click And button, double

click "LU95", click < button, type in 7000, and click the parenthesis. Now, your selection should look like this:
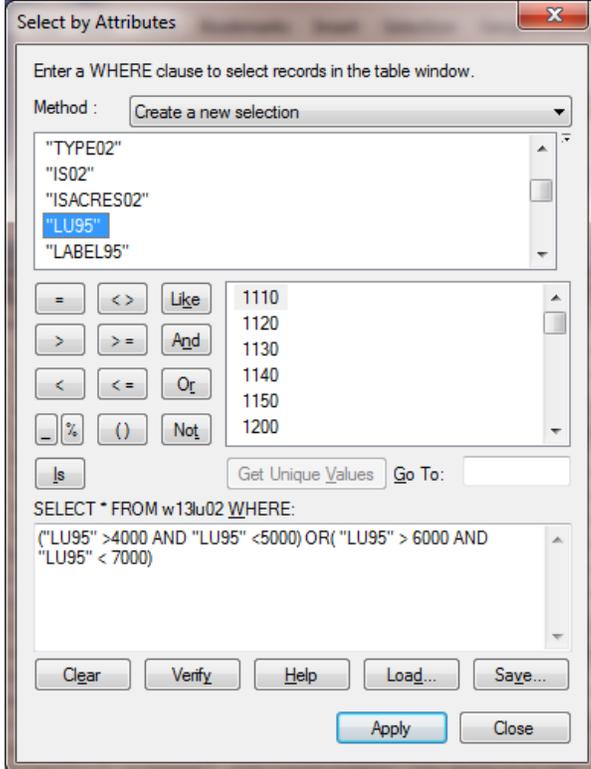
14. If everything is correct, click Apply button at the bottom of the dialog box
15. **All highlighted records are either forest or wetland in 1995.** Close the attribute table.
16. Now you need to export all of these selected records to a new shapefile so that you will find out how much and where of these forests/wetlands have been changed since 1995. Right click w13lu02 in the Table of Contents, point at Data, and choose Export Data.
17. In the dialog box of Export Data, make sure you are exporting only the selected features. In the Output feature class, click the navigating folder button, navigate to your S:\Pinland_course folder, name the new shapefile 95fw.shp, click Save. Click OK to the Export Data dialog.
18. Click Yes to add this new shapefile to your map.
19. Right click w13lu02 and choose Remove because you don't need this one anymore. You should see the map of forest/wetland of 1995.

Next, you need to know where and how much of these forests/wetlands no longer existed in 2002.
20. Right click 95fw and choose Open Attribute Table. The field LU02 shows the land use status of these records in 2002.

21. Use the same approach as that in steps 12 and 13 above to find the forests and wetlands that were no longer there in 2002. Your dialog box of Select by Attributes should look like this:
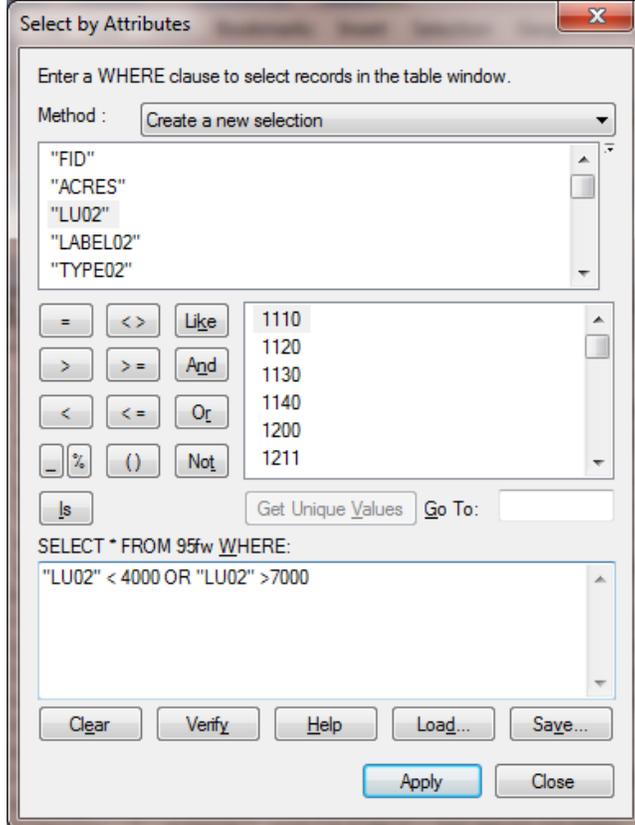
22. Click Apply button. Now, **all highlighted records are those forests or wetlands lost from 1995 to 2002.** Close the table.
23. You need to export these records as well to a new shapefile.
24. Right click 95fw, point at Data, and choose Export Data. Make sure that you are exporting all selected records.
25. In the textbox of Output feature class, give a new name to the shapefile, 02nfw.shp. Click OK.
26. Click Yes to add it to ArcMap.
27. Check off 95fw and you should see the areas where forests and wetlands had been lost from 1995 to 2002.
28. You may change the color to red by double clicking the color symbol, reduce the Outline Width to 0, and choose red color for Fill Color. Click OK when done.

Next, you will quantify them and learn how much had been lost:
29. Right click 02nfw and choose Open Attribute Table
30. Right click at ACRES and choose Statistics. The Statistics chart opens like this:
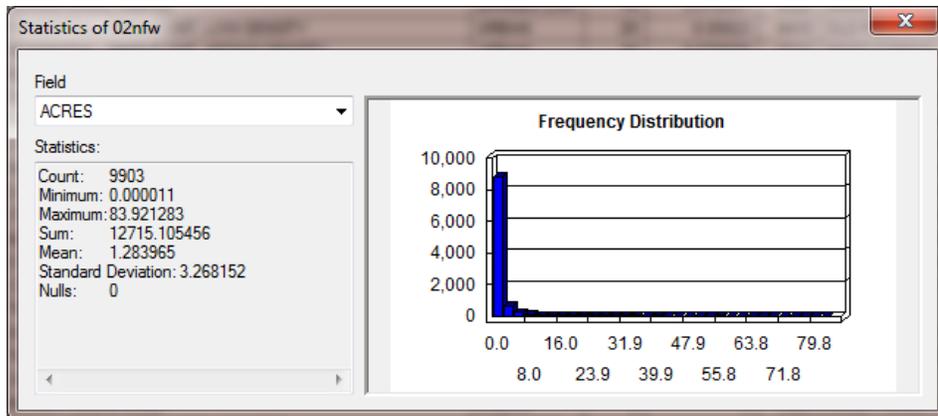
While shows **the total areas of forest and wetland lost from 1995 to 2002 was about 12715 ac**. Close it when you done.

Now the questions are how many acres changed to what land use classes? That is what you will do next:

31. Right click TYPE02 field (or column) and choose Summarize
32. In the #2 textbox, double click ACRES, and check mark Sum from the list underneath it.
33. In the #3 textbox, navigate to S:\Pineland_course\ folder, click the dropdown list of Save as type, choose dBase Table, name the new table ChangeTo_95_02, and click Save.
34. Click OK to the Summarize dialog box and click Yes to add it to the ArcMap. Close the attribute table.
35. Right click the table of ChangeTo_95_02 and choose Open:

36. **The numbers in Sum_ACRES are the total forest/wetland areas lost to the other land use categories.** As you can see, urban areas took the most. Close the table when you done.
37. To show where they are, double click 02nfw, click Symbology tab
38. Click at Categories in Show box at the left side of the Layer Properties dialog box

39. Click Unique values, click the dropdown arrow of Value Field, choose TYPE02, click Add All
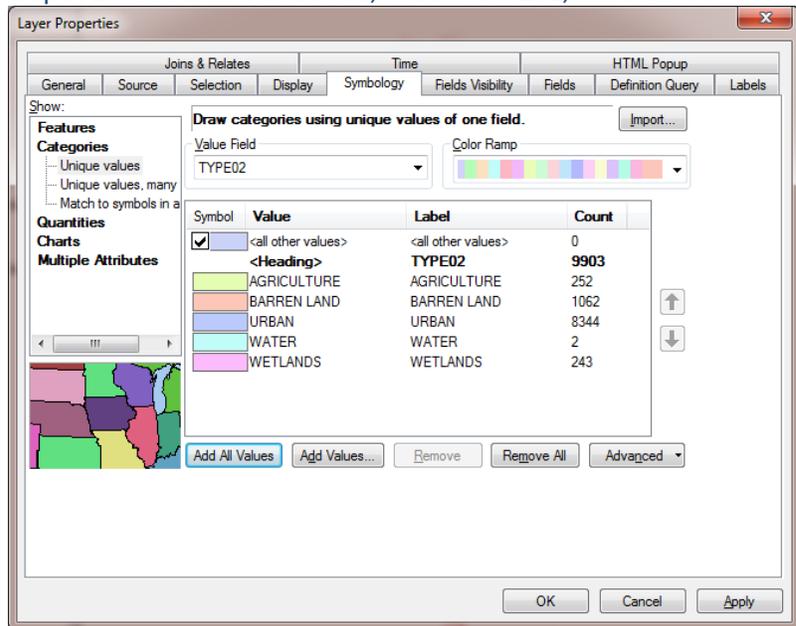
Values button at the bottom:

40. Click OK. Now the map colors don't show well because of the polygon outline. You need to get rid of the outline of every categries. Click one color symbol at time like what you did in step 28 and reduce the outline to 0. You may change colors as you wish. This how it looks like now:
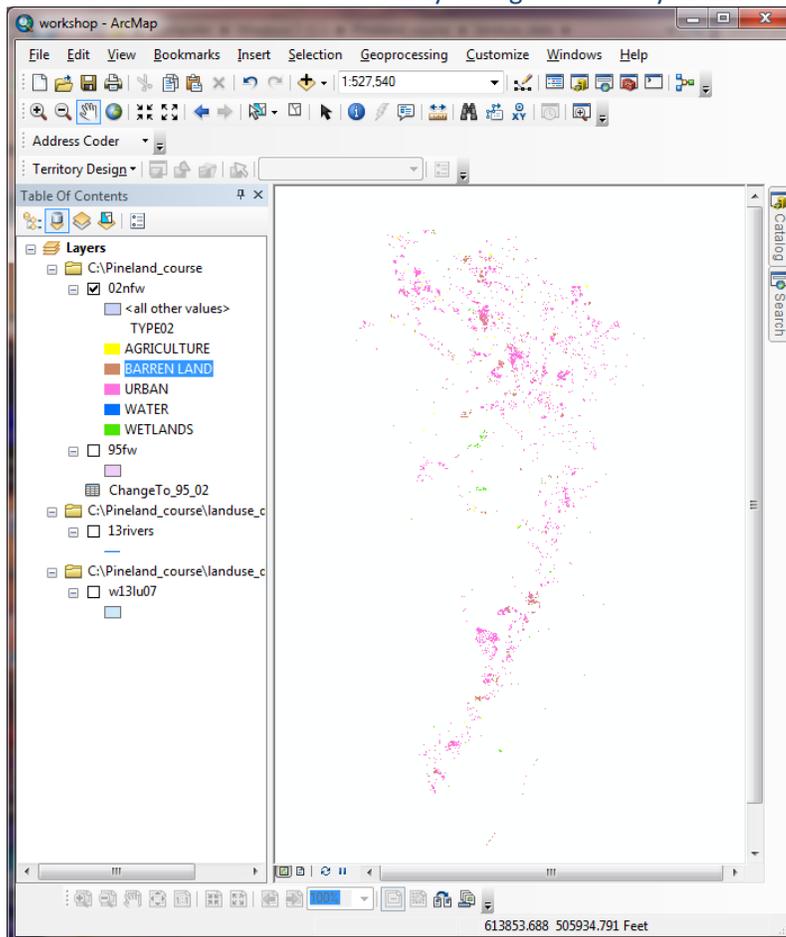
How do we know where the changes are not in line with the NJ smart-growth strategies? : Let's pick one criterion - "Preserve critical environmental areas". Rivers and wetlands are critical environmental areas because it is so sensitive to pollution. They should have protective buffer zone.

Next, you will try to identify the lost forest/wetland from 1995 to 2002 that were inside a buffer zone of the rivers and wetlands.

41. Click the Catalog button at the upper right side of the ArcMap widow
42. Navigate to S:\Pineland_course\landuse_data\ folder, drag and drop 13rivers to the map. These are major rivers of the watershed and associated with wetlands.
43. To create buffers around the rivers, click Geoprocessing menu and choose Buffer.
44. In the Buffer dialog box, click the dropdown arrow of Input Features, choose 13rivers
45. Click the navigator folder button for the Output Feature Class, navigate to S:\Pineland_course\ folder and name the new shapefile, river_buff. Click Save.
46. For the Distance , type in 500 for Linear unit and make sure that Feet is the unit.
47. Under Dissolve Type, click the drop down arrow and choose ALL.
48. Leave everything else alone. Click OK
49. Click Selection menu and choose Select By Location...
50. Check mark 02nfw from the Target layer's list because you want to know which polygons from this layer (map) are the ones too close to the rivers/wetlands.
51. Click the dropdown arrow of the Source layer and choose river_buff because this is the boundary map (or source layer) you are comparing with.
52. Click the drop down arrow of the Spatial selection method and choose "are within the source
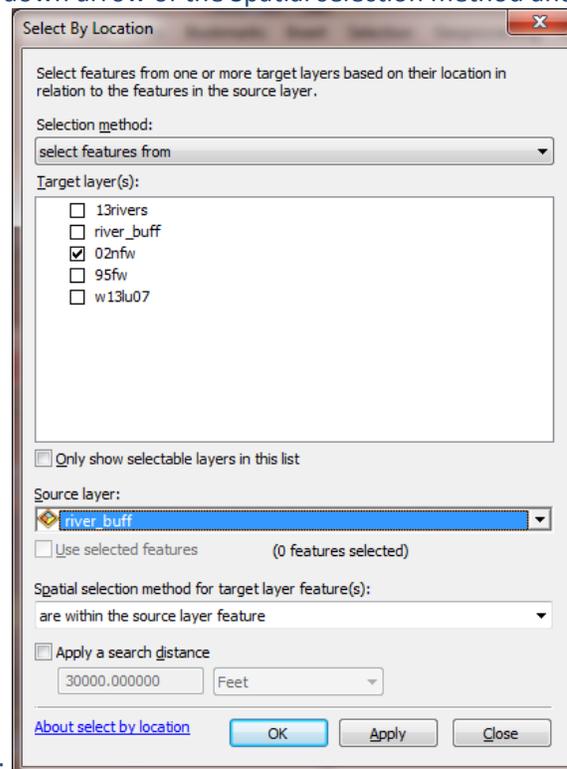
layer feature":

53. Click OK when you done. Your map should look like this:
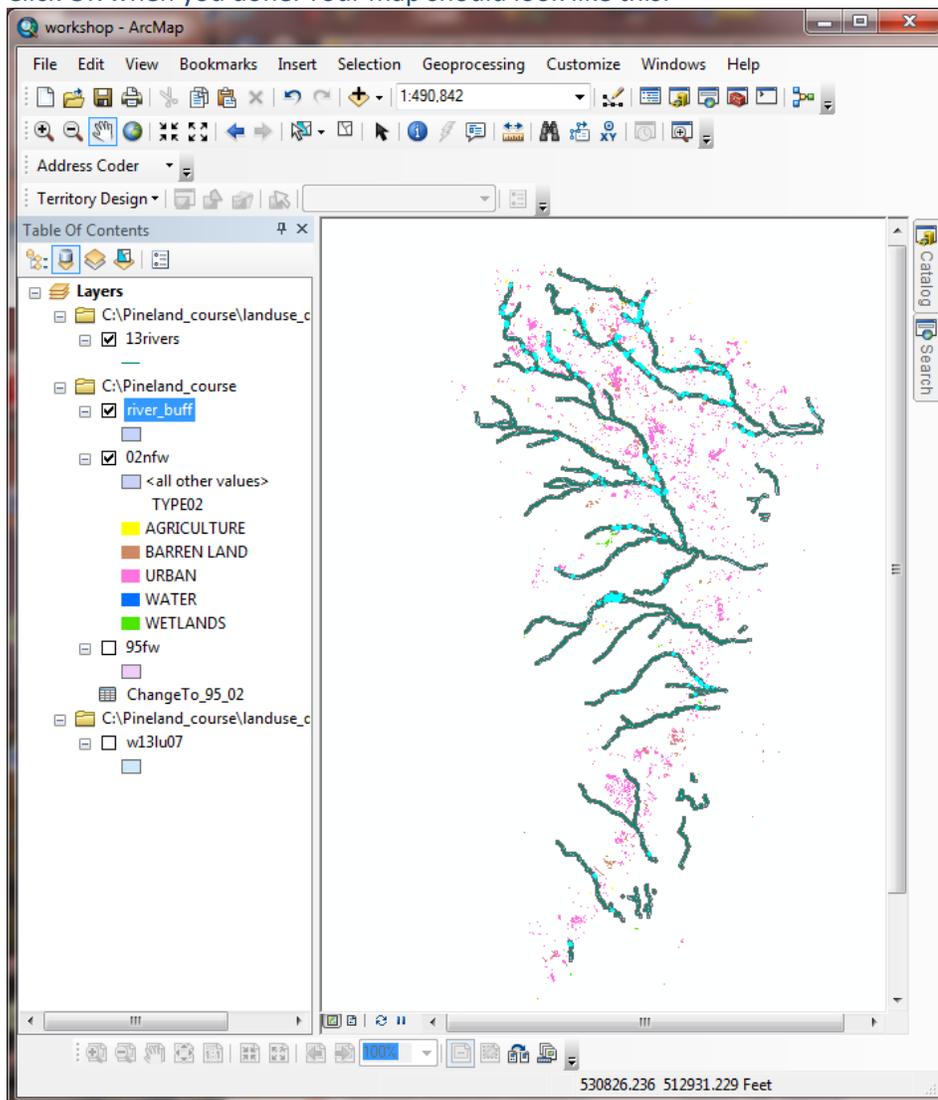
54. **The highlighted polygons are the lost forests/wetlands that were too close to the rivers/wetlands, which were not in line with the NJ Smart Growth strategies**. You may zoom in to each of them to get the exact areas. To quantify them, you need to export the selected records again to a new shapefile and get the total areas using descriptive statistics.

It is time for you to do the same things with w13lu07 to identify and quantify the land use changes from 2002 to 2007. After you finished, you can fill up the blanks in an Excel table like what you see below to compare for the trend of the changes:

	A	B	C	D
1		1995-2002	2002-2007	
2	Total forest/wetland loss	12715		
3	Urban gain	10163		
4	BarrenLand gain	1958		
5	Farmland gain	242		
6				
7				
8				
9				

Please let me know when you need help.