Lab 6: DEMs, National Wetlands Inventory and Basic Table Manipulations in ArcGIS - ArcMap

Purpose: To gain experience with two common digital data types, and introduce a number of rudimentary operations.

To Do: Display and perform operations on digital National Wetlands Inventory (NWI) data from Alaska and a Digital Elevation Model (DEMs) for Boulder Beach.

To Turn In: Two maps: 1) summary wetlands, and 2) a contour map with roads overlain. Both maps are due in lab one week after the assignment is handed out.

Extensions: Spatial Analyst

Data Source: S:\GEY430_630_Spr04\dems

Data Files: Wetlands, Anchorage Alaska wetlands data
imgrd1, a DEM of the Boulder Beach USGS 7.5 minute quadrangle
clipped_roads, road layer from USGS digital line graphs, of the Boulder Beach quadrangle
Observer_point, an observer point located at a boat launch.

Coordinate System and Units: Wetland data are projected in UTM Zone 6N NAD83 and the other Data are in UTM Zone 11, NAD27, meters, Many spatial data are available from various government sources. Among the most valuable for natural resource management are DEMS and NWI data. We'll gain experience with these data in this lab.

National Wetlands Inventory (NWI) data have been developed by the U.S. Fish and Wildlife Service, starting in 1974. Wetland data were photo interpreted from 1:60,000 to 1:130,000 scale aerial photos, and are available for most of the United States. http://www.nwi.fws.gov/downloads.htm

Digital elevation models (DEMs) are among the most commonly used raster data sets. They are particularly useful for many analyses where slope is important, e.g., for locating buildings or facilities, or for identifying the direction of water flow. In this lab, we will have an introduction to raster data sets through manipulation of USGS 1:24,000 scale map-based DEMs. We will use ArcGIS - ArcMap to manipulate, display, and print the elevation and derived data for a DEM.

NWI Data
Start ArcGIS – ArcMap

Data files are in the S:\GEY430_630_Spr04\dems directory. Among these will be the a folder that contains the Alaska wetlands data (wetlands_rivers). Open and display the wetlands **Wetlands.shp**.

Select the Wetlands layer and right click to bring up the submenu. Select Open attribute
Table. As below, you will see the attributes of the wetlands layer. Notice the field
names and values of the fields. We will be working with the field called "Attribute".
This field is the detailed (*System – Subsystem*) Cowerdian classification of wetlands used by
the USFW. A complete list is found at the end of this lab exercise.
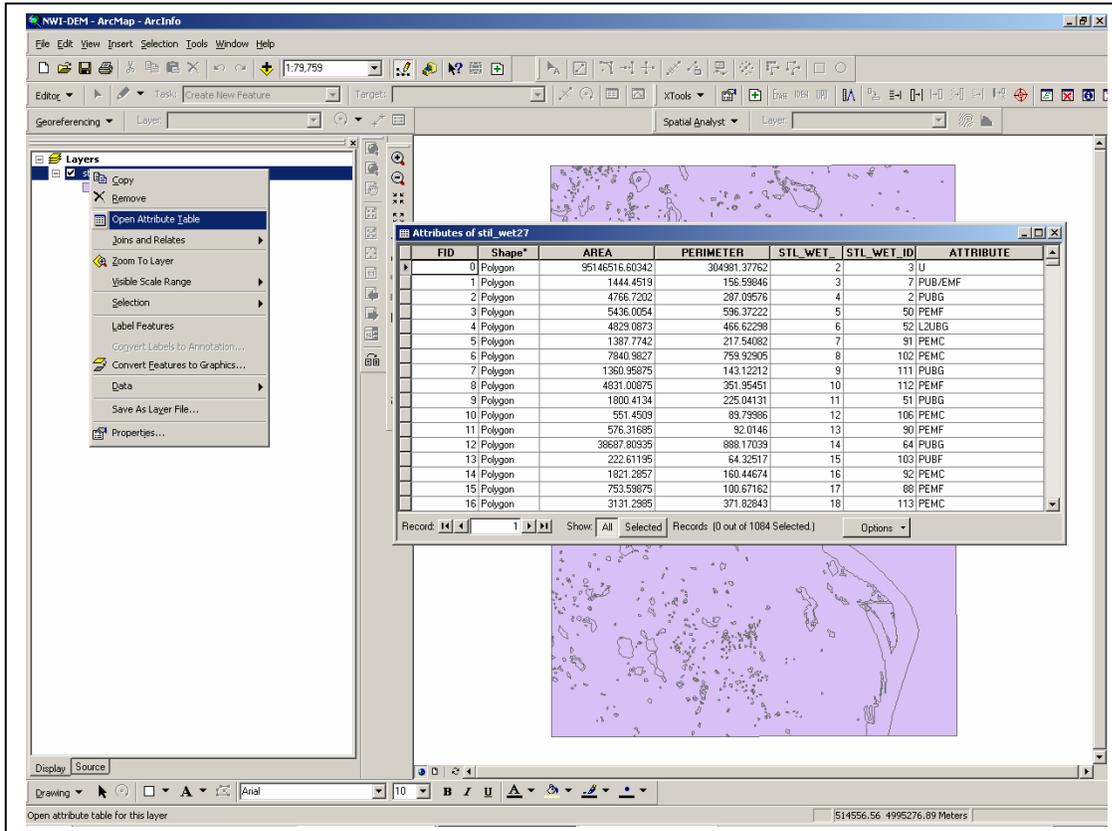
Close the table.
Select again the wetlands layer, then Properties, Symbology tab
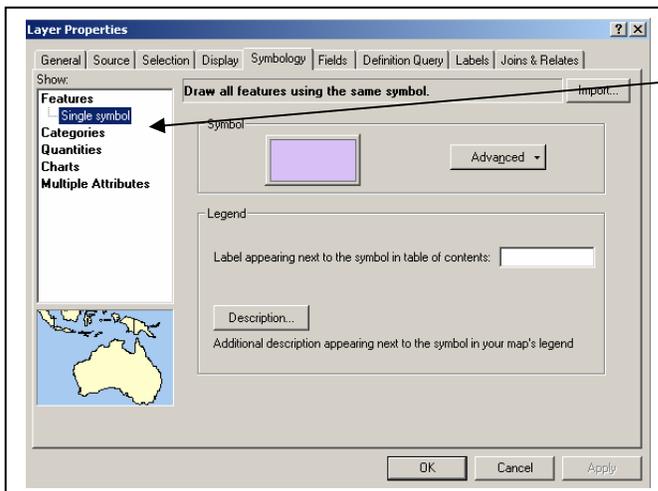
Select the Categories from the Show box.

*You will often do this. Get comfortable
changing layers Symbology.*

*Features just show everything
Categories lets you group things to display
Quanitities allow display of contiuous
attributes like elevation or colors of a air photo*
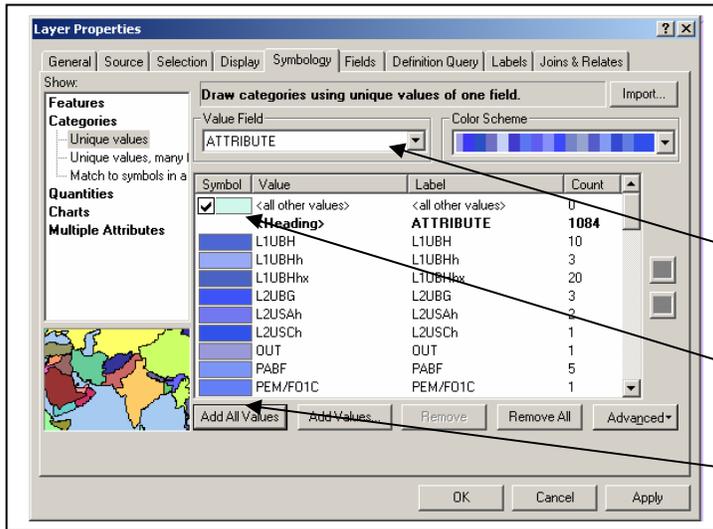
Select <u>Unique</u> values in the Show box

Select Attribute in the Value box

Uncheck <all other values.

Click on Add all Values

Select Apply (to add your changes to the display)

Your display should appears as below:
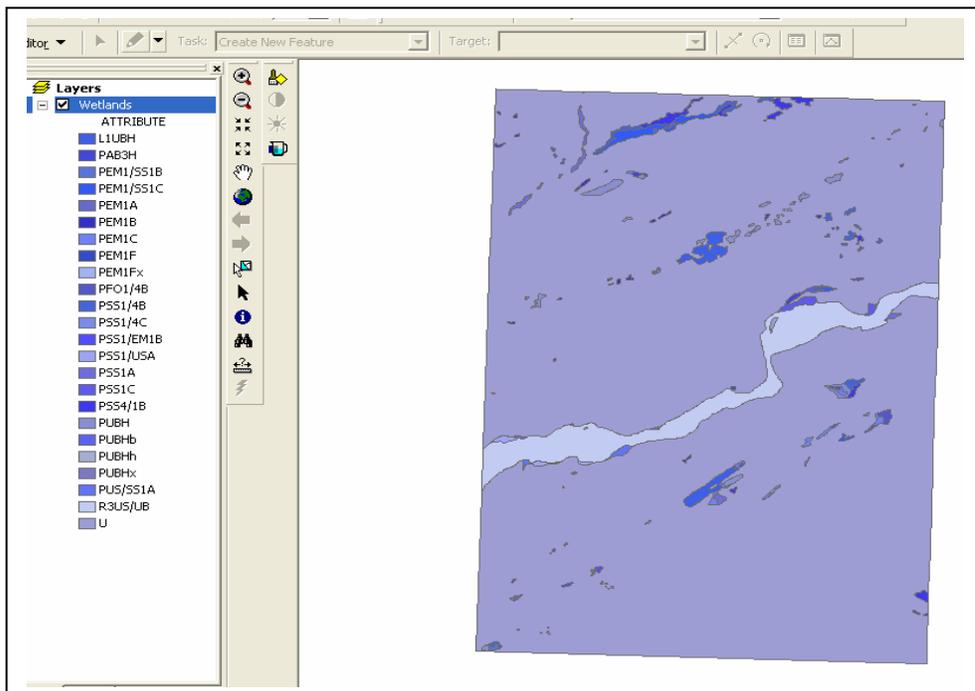
From the center menu bar, select the identify cursor, the [image: button] button. Clicking on a polygon results in a popup table listing the attributes of the selected feature. Examine a few polygons. Try and get an idea of what the codes mean, see the code table at the end of the exercise.

With so many detailed sub codes displayed in the legend the map is not very informative. In order for a map to be useful legends should have a small number of elements, certainly less than eight. Readers can only distinguish a limited number of colors or shades on a map. So to make this map more useful let regroup or "reclassify" the detailed codes into five groups. To do this you will need to aggregate the detailed codes into their "parent" categories.

Note that there are several numbers and letters together in a string in the attribute column, e.g., L1UBH, above. These give the wetland System-Subsystem-Class-Subclass and any modifiers. See the wetlands and deepwaters habitats classification key at the back of this lab. The first letter is for the system (L=Lacustrine, P=Palustrine, etc.), the second is for the subsystem (defined for each system) the third is for Class, etc. Your job is to add a system/subsystem column, with appropriate designators for each record. There are many ways to do this, we'll do this by modifying the tables. The basic steps are 1) add a new item (also called a new field or column), 2) select the appropriate records, and 3) assign appropriate values to the new item for these selected records, 4) repeat steps 2 and 3 until all records are processed, and 5) save your results to a new table/shapefile.

First, we'll add an item.
- Select the layer Wetlands.
- Open the Table and select the Options button in the lower right of the Table window.
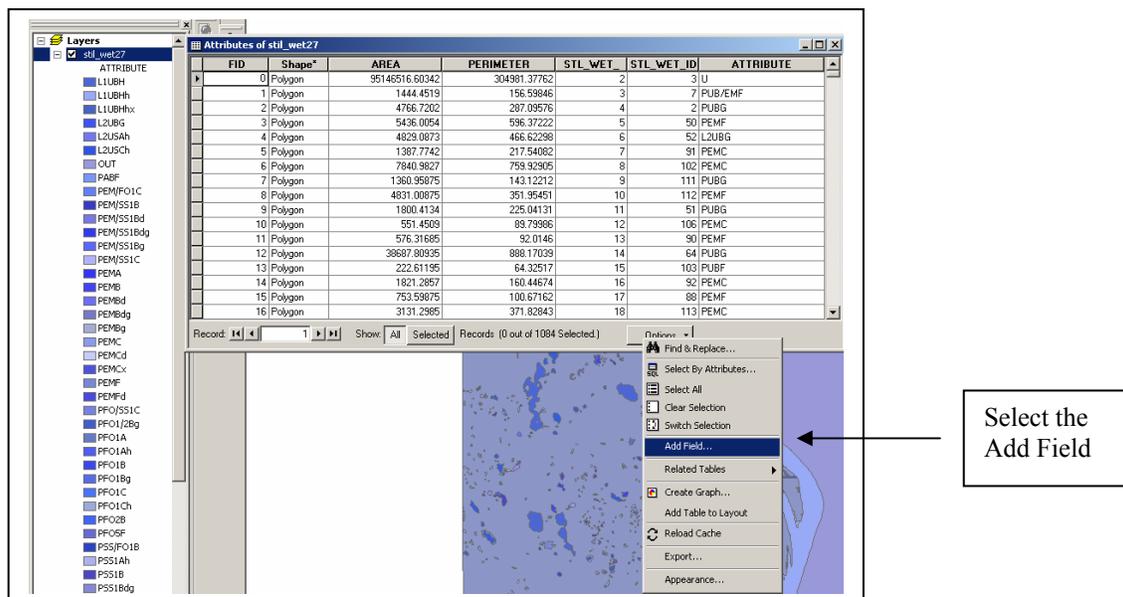
- Add a field with a name you can remember, something like Reclassed.

- Make sure your new field has a "Text" type. Other wise you will be restricted to only using number in your new field.

- Make sure you do not preserve excessive spaces, change the length to >5 characters to save space.

Narrow the columns or expand the window to the right and look at your new field.

You have created an additional column at the end of the table that looks like this:

FID	Shape*	AREA	PERIMETER	STL_WET_	STL_WET_ID	ATTRIBUTE	Reclassed
0	Polygon	95146516.60342	304981.37762	2	3	U	
1	Polygon	1444.4519	156.59846	3	7	PUB/EMF	
2	Polygon	4766.7202	287.09576	4	2	PUBG	
3	Polygon	5436.0054	596.37222	5	50	PEMF	
4	Polygon	4829.0873	466.62298	6	52	L2UBG	
5	Polygon	1387.7742	217.54082	7	91	PEMC	

- Start Editing the Wetlands file. Select Start Editing from the **Editor menu**.

To select the records to begin aggregating the codes, select Options from the Table window and click on Select by Attribute
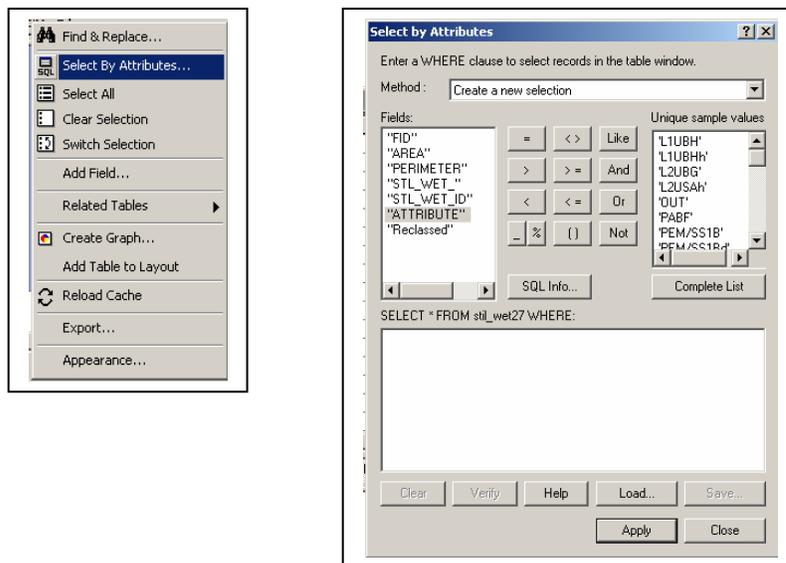
Now we need to select the records to edit.

- Double-click the field named Attribute on the left, single-click the <= operator in the middle, and then double-click the "L1UBH" value on the right.

In this way you build the expression to select all string values of attribute which meet your criteria. The < , <= operators work, in that the string values are ordinarily ranked in alphabetical order, so the expression in the example here selects all the polygons in the system/subsystem L1. **You'll always want to make sure you double click on the Fields and Values to enter them in the formula, but only single click on the operators**.
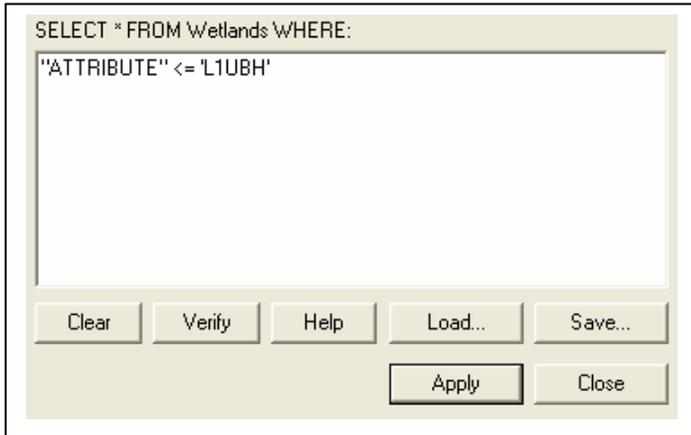
Once you have the proper expression select Apply.

If you don't have correct expression, you may get a syntax error window, clear the expression and try again.

To convince yourself that this operation selected the records you want, look at the bottom of the Table window.
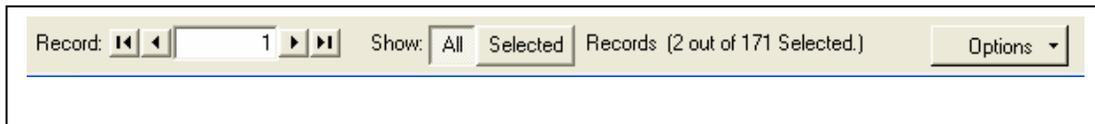
Click on the Selected button and you will see only your "Selected" records displayed.

Now put the cursor in to the heading "Reclassed" in the Table Window and right click to bring up a submenu.
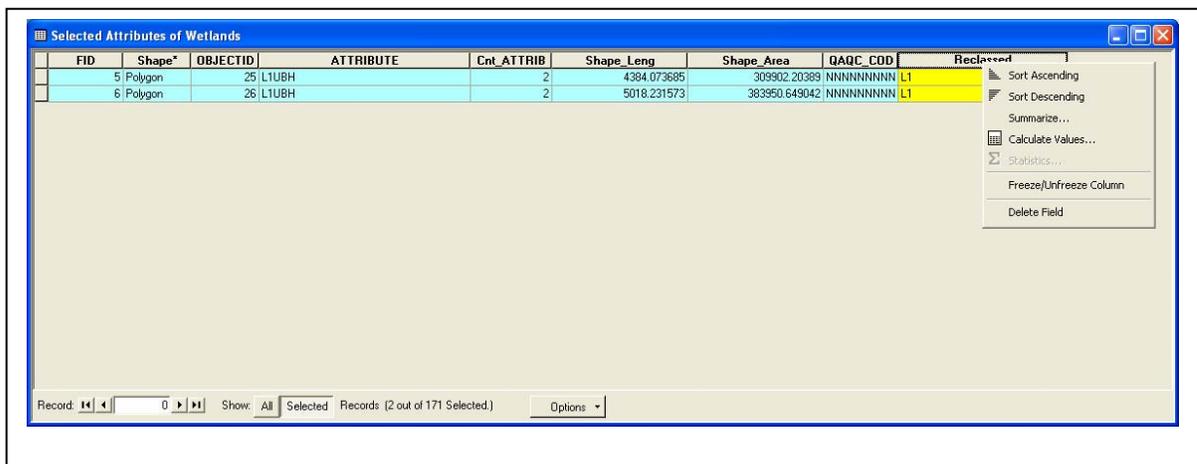
Select Calculate Values and
the Field Calculator appears

Enter the code you want to be used to
aggregate. In this case use the 1st two
positions of the detail records.

"L1"

it is necessary in text fields to include
the quotes.
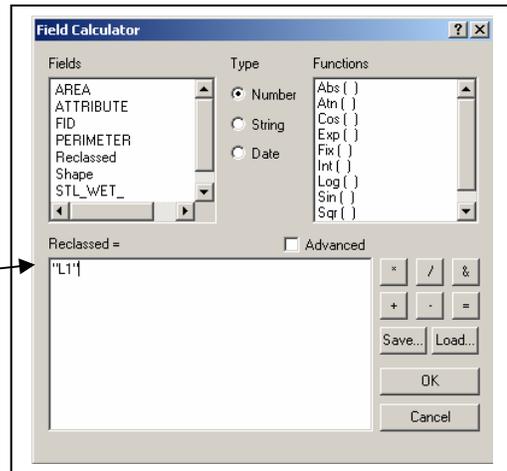
- Click o.k. If we have something selected, the assignment only occurs for the selected records (if nothing or if everything is selected the formula will apply to all records). Click OK, and you should see "L1" appear for only the selected records in the table (scroll down the table to ensure that this is the case).

Now repeat the process for the next group of items (those with "Attribute" fields starting with "P"). This is a compound selection, so we'll have to use the "and". In query builder, enter the formula shown in the figure here:
You have to get the formula just right, or you'll get a syntax error. Click on Apply, and you should see the second set selected. Do the assignment, this time putting an "P" in the Reclassed field.

Repeat this selection/assignment until Reclassed values have been assigned for each record (four categories, L1, P, R and U). Save occasionally with Edit Menu - Save Edits. When you

DEMs, Wetlands: 7
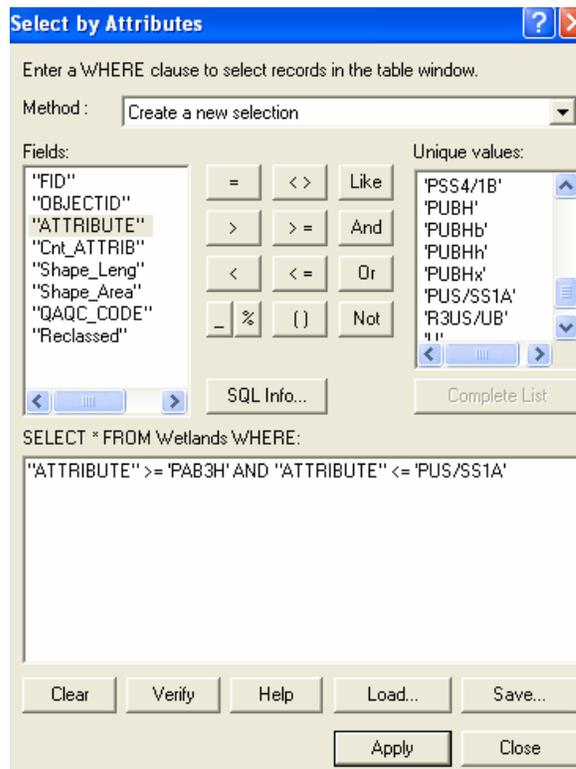
are done, select Edit -Stop Editing, saving edits at the end. Once you are finished editing, clear the selection. Options, Clear selection.

Next change your legend display item (Layer Properties – Symbology) from Attribute to your new Reclassed field.

Finally change the legend symbols used for the Reclassed field from colors to patterns that will print nicely in black and white. Layer Properties- Symbology can also be used to add more descriptive legend items.

Produce a map of the wetland data. Use your system/subsystem categories for the legend. Color the upland (U) polygons white, and the others as appropriate to distinguish among them. Remember to include a scale bar (coverage units are meters), North arrow, name, title, description, legend, and a descriptive name to the legend heading.
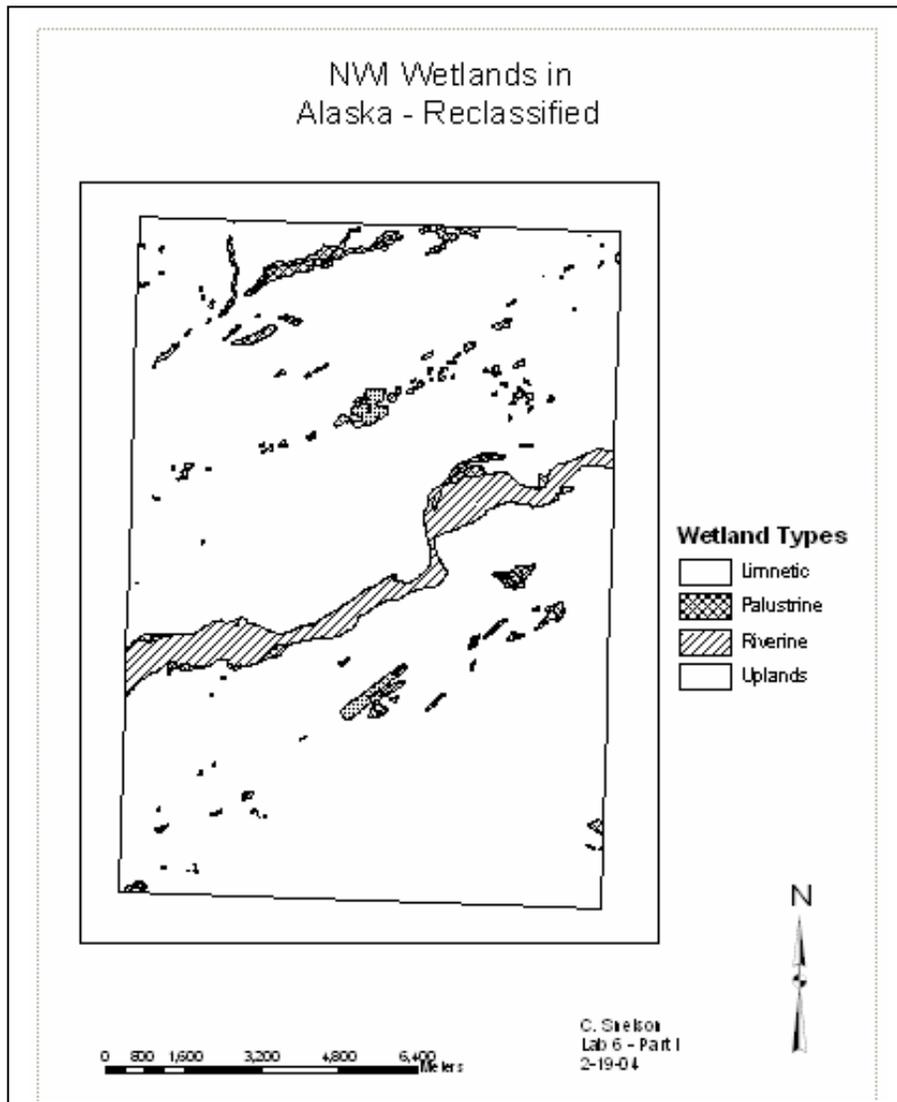
DEMs
- Open a new Map and and load the DEM labeled imgrd1 in the BoulderBeach_DEM folder. Make sure you have selected the Spatial Analyst tool bar and turned on the Spatial Analysis extension from the Tools menu.

Check to display the DEM in the view, and you should get a shaded image, dark shades indicating lower elevations, lighter values higher elevations. Elevations are in meters. Notice as you pan across the image with the identify cursor, the coordinates in the lower-right corner vary, and are set to the UTM coordinates. Clicking with the identify cursor will display the elevation of the cell under the crosshairs, in the item name Value, and the number of cells with the same elevation, named Count.

Click on the histogram button, in the upper extreme right when the DEM view is active, and you should get an elevation histogram giving you the distribution of elevations for the Boulder Beach DEM.
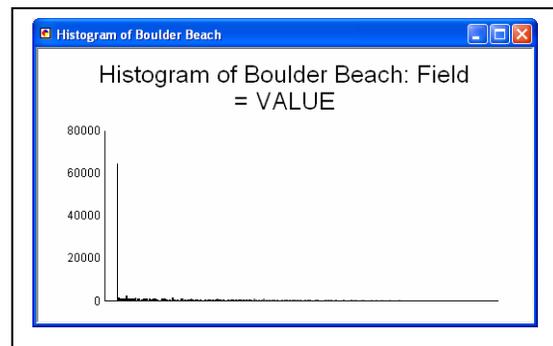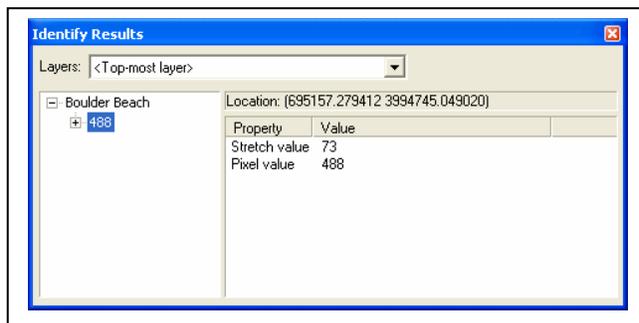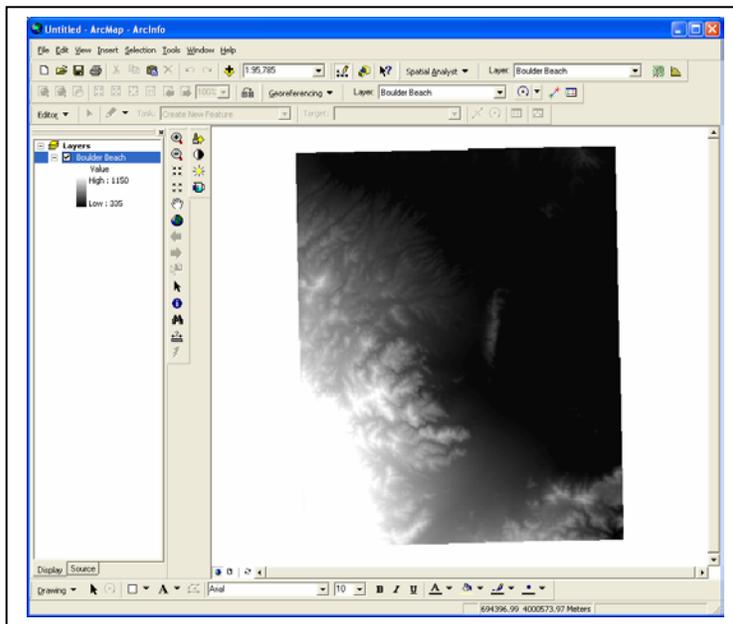
Now we'll derive some surfaces. With the Boulder Beach DEM the active theme in the view window Select the Spatial Analyst – Surface Analysis
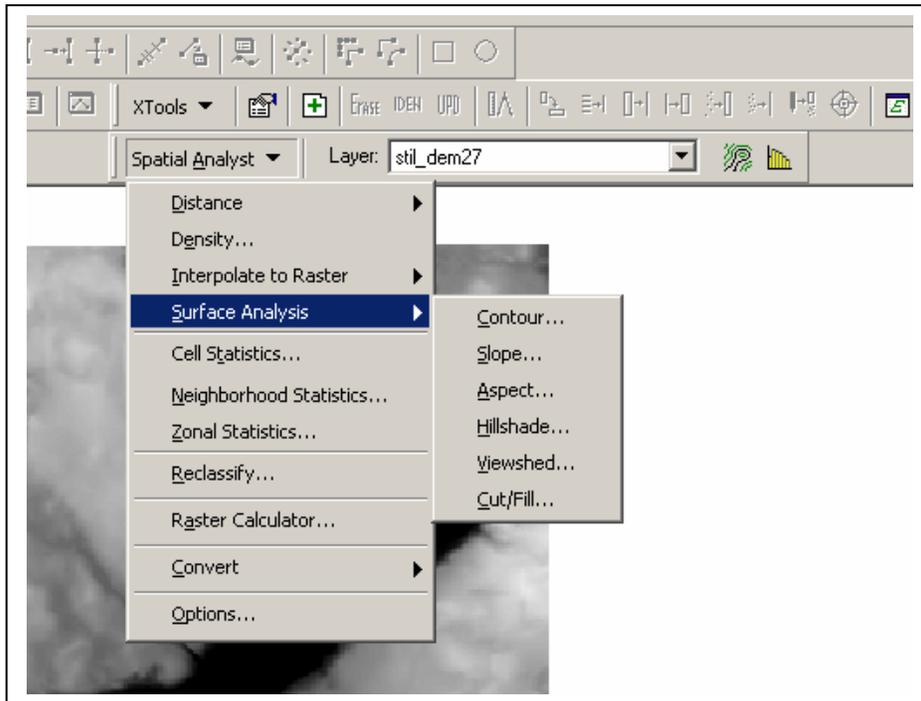
You'll see a range of options available in a dropdown list. These options allow you to calculate a number of derived surfaces. Slope is often important, because it affects landuse or management options for a parcel. Aspect, the compass direction of maximum slope, may also be computed from a DEM. Analytical Hillshading gives a layer with a three-dimensional feel and Viewshed shows what features are visible from a specific point. Contours are often created to represent elevation on vector maps.

- First pick Spatial Analysis - Surface Analysis- Slope, *(Go with the default options)* and display the created slope map.
  Note where the steepest slopes are, and their values (slopes are calculated in degrees from horizontal). Note that the Identify cursor will not work on the derived surfaces such as slope. These are temporary surfaces and are not automatically saved (you can save them, but we'll not cover how in this lab).
- Uncheck the slope layer
- Next try Spatial Analysis - Surface Analysis - Aspect option, *(Go with the default options)* display the aspect, and view the degree of azimuth for each sample in the DEM.
- Uncheck the aspect map,
- Try Spatial Analysis - Surface Analysis - Hillshade. *(Go with the default options)*. Display the hillshade map. This map combines both the slope and aspect surfaces, and calculates the strength of reflected sunlight with the selected solar azimuth and

zenith elevation angles. While often not particularly useful for analyses, hillshade displays are often quite eye-catching, and used in presentations.

- Next add the shapefile layer Observer_point to the map and try the Spatial Analysis - Surface Analysis – Viewshed. *(Check the Earth Curavature box)*. This shows the landscape is visible from an observer point selected located at a boat launch near Lake Mead.

- Finally do Spatial Analysis - Surface Analysis - Contour.

This is produces a contour map, you can set the interval as you wish, however it is probably best viewed with an interval between 5 and 15. Notice when you change the contour interval from 10 to 15 the "Total number of contour values" changes at the bottom of the dialog window.
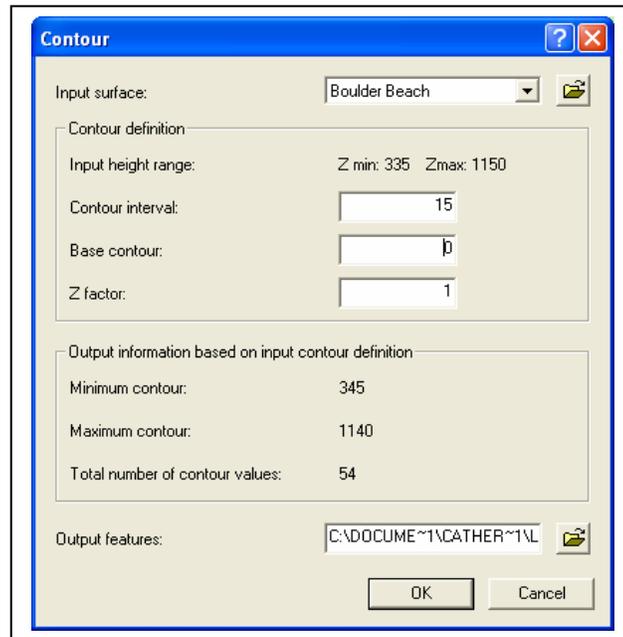
Uncheck the display of the DEM and add the shapefile for roads named clipped_roads.

Display only the roads and contour file for the final map. You may want to use the Layer Properties – General tab to change the title of each layer that will be on your printed Map.

To Turn In:
Create a layout and plot a second map to turn in. The map should contain the roads and contour lines you developed. Remember to include a descriptive legend, title, your name, north arrow, and scale bar.

Remember to turn in both maps, 1) the wetlands map you produced earlier, and 2) the contours/roads map. These are due at the beginning of lab, one week after this assignment.

Extra Credit:
Create a new layout that includes the Lake Mead Water. To add the water, you must figure this out and not ask the TAs. Hand in this new map for credit.

Contours of Boulder
Beach, NV Quadrangle

Meters

| 0 | 800 | 1,600 | 3,200 | 4,800 | 6,400 |

C. Snelson
Lab 6 – Part II
2-19-04

Roads
15 meter contour intervals
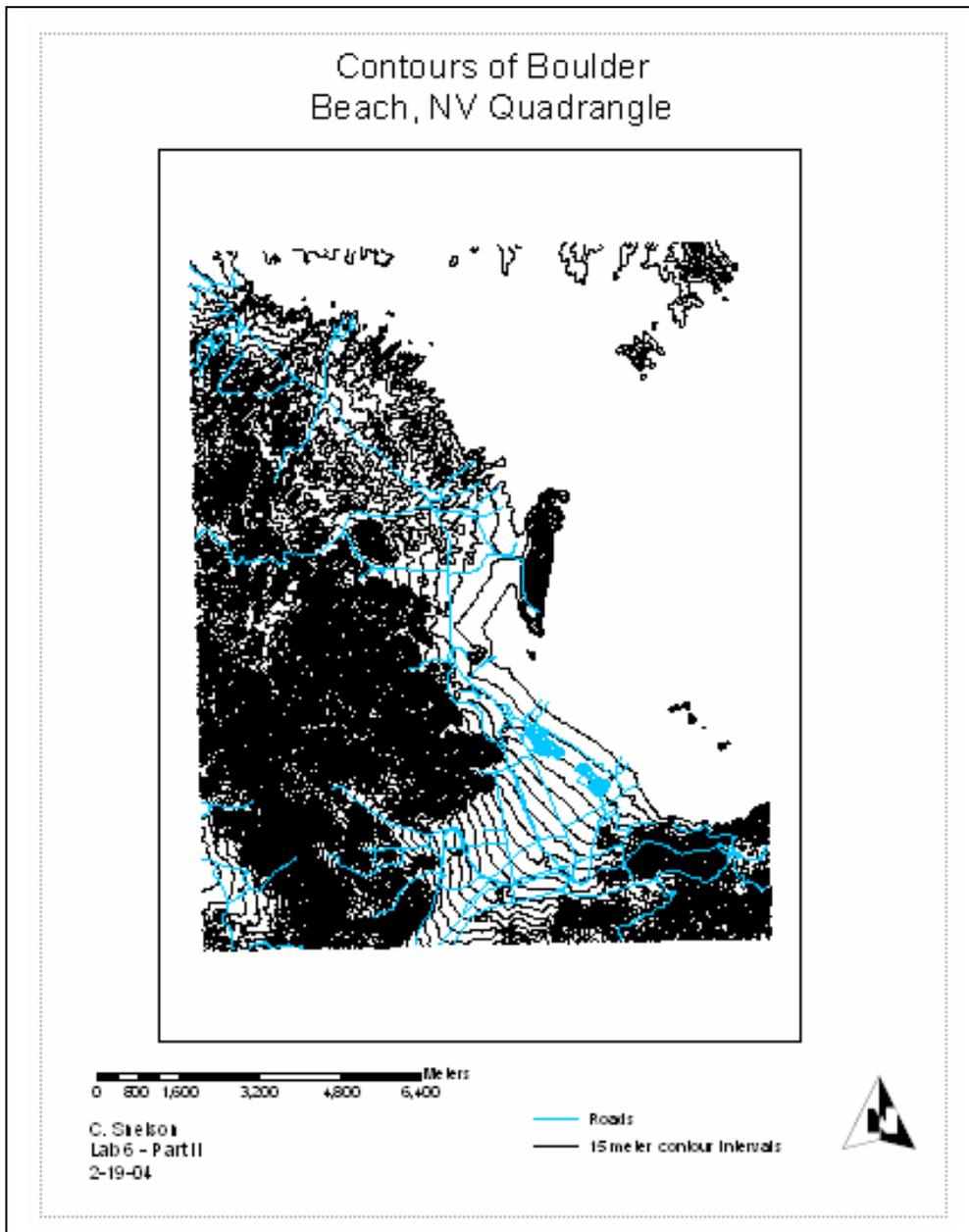
WETLANDS AND DEEPWATER HABITATS CLASSIFICATION

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Wetlands codes are typically a string of characters, each corresponding to an attribute in
a hierarchy.  For example, a wetland might be labeled L1UBG, indicating it is a Lacustrine
(System, see below), Limnetic (Subsystem), Unconsolidated Bottom(Class), which is
intermittently exposed (modifier G in L1UBG, see modifiers at end of this list).  There
are at least two shortened designators which may appear on wetlands maps,

U = Uplands, and

OUT = out of the mapped area

Below is the hierarchy.



SYSTEM                  SUBSYSTEM        CLASS                       SUBCLASS

                                         |- RB=Rock Bottom           1=Bedrock
                                         |                           2=Rubble
                                         |
                                         |- UB=Unconsolidated Bottom 1=Cobble-Gravel
                                         |                           2=Sand
                                         |                           3=Mud
                                         |                           4=Organic
                                         |
                        |-- 1=LIMNETIC----|- AB=Aquatic Bed          1=Algal
                        |                |                           2=Aquatic Moss
                        |                |                           3=Rooted Vascular
                        |                |                           4=Floating
                        |                |                             Vascular
                        |                |                           5=Unknown
                        |                |                             Submergent
                        |                |                           6=Unknown Surface
                        |                |
                        |                |- OW=Open Water/Unknown Bottom (used on older
                        |                                                  maps)
L=LACUSTRINE----|       |
                |       |
                |       |- RB=Rock Bottom           1=Bedrock
                |       |                           2=Rubble
                |       |
                |       |- UB=Unconsolidated Bottom 1=Cobble-Gravel
                |       |                           2=Sand
                |       |                           3=Mud
                |       |                           4=Organic
                |       |
                |       |- AB=Aquatic Bed           1=Algal
                |       |                           2=Aquatic Moss
                |       |                           3=Rooted Vascular
                |       |                           4=Floating
                        |-- 2=LITTORAL----|         Vascular
                        |                           5=Unknown
                        |                             Submergent
                        |                           6=Unknown Surface
                        |
                        |- RS=Rocky Shore           1=Bedrock
                        |                           2=Rubble
                        |
                        |- US=Unconsolidated Shore  1=Cobble-Gravel
                        |                           2=Sand
                        |                           3=Mud
                        |                           4=Organic
                        |                           5=Vegetated
                        |
                        |- EM=Emergent              2=Nonpersistent
                        |
                        |- OW=Open Water/Unknown Bottom (used on older
                                                           maps)
```

```
SYSTEM               SUBSYSTEM       CLASS                  SUBCLASS

                                     |- RB=Rock Bottom       1=Bedrock
                                     |                       2=Rubble
                                     |
                                     |- UB=Unconsolidated Bottom  1=Cobble-Gravel
                                     |                       2=Sand
                                     |                       3=Mud
                                     |                       4=Organic
                                     |
                                     |- AB=Aquatic Bed       1=Algal
                                     |                       2=Aquatic Moss
                                     |                       3=Rooted Vascular
                                     |                       4=Floating
                                     |                         Vascular
                                     |                       5=Unknown
                                     |                         Submergent
                                     |                       6=Unknown Surface
                                     |
                                     |- US=Unconsolidated Shore  1=Cobble-Gravel
                                     |                       2=Sand
                                     |                       3=Mud
                                     |                       4=Organic
                                     |                       5=Vegetated
                                     |
                                     |- ML=Moss-Lichen       1=Moss
                                     |                       2=Lichen
                                     |
P=PALUSTRINE---------------------|- EM=Emergent          1=Persistent
                                     |                       2=Nonpersistent
                                     |
                                     |- SS=Scrub-Shrub       1=Broad-Leaved
                                     |                         Deciduous
                                     |                       2=Needle-Leaved
                                     |                         Deciduous
                                     |                       3=Broad-Leaved
                                     |                         Evergreen
                                     |                       4=Needle-Leaved
                                     |                         Evergreen
                                     |                       5=Dead
                                     |                       6=Indeterminate
                                     |                         Deciduous
                                     |                       7=Indeterminate
                                     |                         Evergreen
                                     |
                                     |- FO=Forested          1=Broad-Leaved
                                     |                         Deciduous
                                     |                       2=Needle-Leaved
                                     |                         Deciduous
                                     |                       3=Broad-Leaved
                                     |                         Evergreen
                                     |                       4=Needle-Leaved
                                     |                         Evergreen
                                     |                       5=Dead
                                     |                       6=Indeterminate
                                     |                         Deciduous
                                     |                       7=Indeterminate
                                     |                         Evergreen
                                     |
                                     |- OW=Open Water/Unknown Bottom (used on older
                                                             maps)
```

```
SYSTEM              SUBSYSTEM       CLASS                   SUBCLASS

                                    |- RB=Rock Bottom        1=Bedrock
                                    |                        2=Rubble
                                    |
                                    |- UB=Unconsolidated Bottom  1=Cobble-Gravel
                                    |                        2=Sand
                    |--1=TIDAL--------|                      3=Mud
                    |                |                        4=Organic
                    |                |
                    |                |-*SB=Streambed          1=Bedrock
                    |                |                        2=Rubble
                    |                |                        3=Cobble-Gravel
                    |--2=LOWER       |                        4=Sand
                    |     PERENNIAL----|                      5=Mud
                    |                |                        6=Organic
                    |                |                        7=Vegetated
                    |                |
                    |                |- AB=Aquatic Bed        1=Algal
R=RIVERINE------|--3=UPPER          |                        2=Aquatic Moss
                    |     PERENNIAL----|                      3=Rooted Vascular
                    |                |                        4=Floating
                    |                |                          Vascular
                    |                |                        5=Unknown
                    |                |                          Submergent
                    |--4=INTERMITTENT-|                      6=Unknown Surface
                    |                |
                    |                |- RS=Rocky Shore        1=Bedrock
                    |                |                        2=Rubble
                    |                |
                    |                |- US=Unconsolidated Shore  1=Cobble-Gravel
                    |--5=UNKNOWN     |                        2=Sand
                    |     PERENNIAL----|                      3=Mud
                    |   (used on older |                      4=Organic
                        maps)         |                        5=Vegetated
                                    |
                                    |-**EM=Emergent          2=Nonpersistent
                                    |
                                    |- OW=Open Water/Unknown Bottom (used on older
                                    |                                 maps)
                                    |-*STREAMBED is limited to TIDAL and
                                    | INTERMITTENT SUBSYSTEMS, and comprises
                                    | the only CLASS in the INTERMITTENT SUBSYSTEM.
                                    |
                                    |-**EMERGENT is limited to TIDAL and LOWER
                                    | PERENNIAL SUBSYSTEMS.
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                              MODIFIERS

                              |- A=Temporarily Flooded
                              |- B=Saturated
                              |- C=Seasonally Flooded
                              |- D=Seasonally Flooded/Well Drained
                              |- E=Seasonally Flooded/Saturated
                              |- F=Semipermanently Flooded
            |--Non-Tidal------|- G=Intermittently Exposed
            |                 |- H=Permanently Flooded
            |                 |- J=Intermittently Flooded
            |                 |- K=Artificially Flooded
            |                 |- W=Intermittently Flooded/Temporary (used on
            |                 |                              older maps)
            |                 |- Y=Saturated/Semipermanent/Seasonal (used on
            |                 |                              older maps)
            |                 |- Z=Intermittently Exposed/Permanent (used on
            |                 |                              older maps)
WATER REGIME----|             |- U=Unknown
            |
            |
            |
            |
            |                 |- K=Artificially Flooded
            |                 |- L=Subtidal
            |                 |- M=Irregularly Exposed
            |                 |- N=Regularly Flooded
            |--Tidal----------|- P=Irregularly Flooded
                              |-*S=Temporary-Tidal
                              |-*R=Seasonal-Tidal
                              |-*T=Semipermanent-Tidal
                              |-*V=Permanent-Tidal
                              |- U=Unknown
                              |
                              |-*These water regimes are only used in
                              |  tidally influenced, freshwater systems.
```

```
                                     |- 1=Hyperhaline
                                     |- 2=Euhaline
                    |--Coastal       |- 3=Mixohaline (Brackish)
                    |  Halinity------|- 4-Polyhaline
                    |                |- 5=Mesohaline
                    |                |- 6=Oligohaline
                    |                |- 0=Fresh
                    |
                    |
                    |
WATER CHEMISTRY-|
                    |                |- 7=Hypersaline
                    |--Inland        |- 8=Eusaline
                    |  Salinity------|- 9=Mixosaline
                    |                |- 0=Fresh
                    |
                    |
                    |
                    |
                    |
                    |--pH Modifiers   |- a=Acid
                       for all        |- t=Circumneutral
                       Fresh Water----|- i=Alkaline




SOIL----------------------------|- g=Organic
                                 |- n=Mineral




                                     |- b=Beaver
                                     |- d=Partially Drained/Ditched
SPECIAL MODIFIERS----------------|- f=Farmed
                                     |- h=Diked/Impounded
                                     |- r=Artificial Substrate
                                     |- s=Spoil
```

Name:_____

Suggestions for Improvement: NWI/DEM Lab

Please help me improve this lab. As incentive, any improvements incorporated (or major errors removed) will gain you a point on your final grade total.

What didn't work in this lab, and how would you fix it?

What was the best part of this lab exercise?