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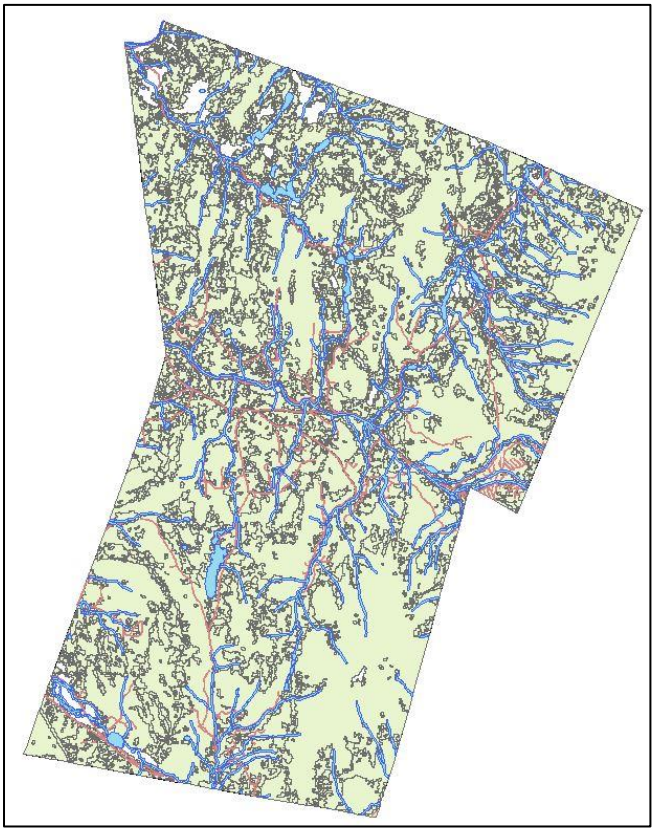
Version: ArcMap 10.x

EXERCISE 2
Refinement Data Processing



Introduction

Now that you have generated the sink outputs, you will need to do some basic processing of the vector data provided to you. The vector files you modify in this exercise will be used in the final exercise to eliminate depressions/sinks that do not meet essential parameters for a vernal pool certification. In this exercise, you will be focusing on clipping, buffering, selecting by attribute and, in one case, merging shapefiles. The resulting vector files will be used in the next exercise to eliminate sinks that do not qualify as vernal pools.

Objectives

- Process vector data that will be used to refine sink outputs

Required Data

- **StudyArea.shp** –Shapefile outlining your study area

- **NHD.shp** –Hydrography data from USGS
- **Roads.shp** –New Hampshire roads shapefile
- **NLCD.tif** –Land cover dataset from the USGS (2011)
- **ELT.shp**—Ecological Land Type (ELT) dataset

Prerequisites

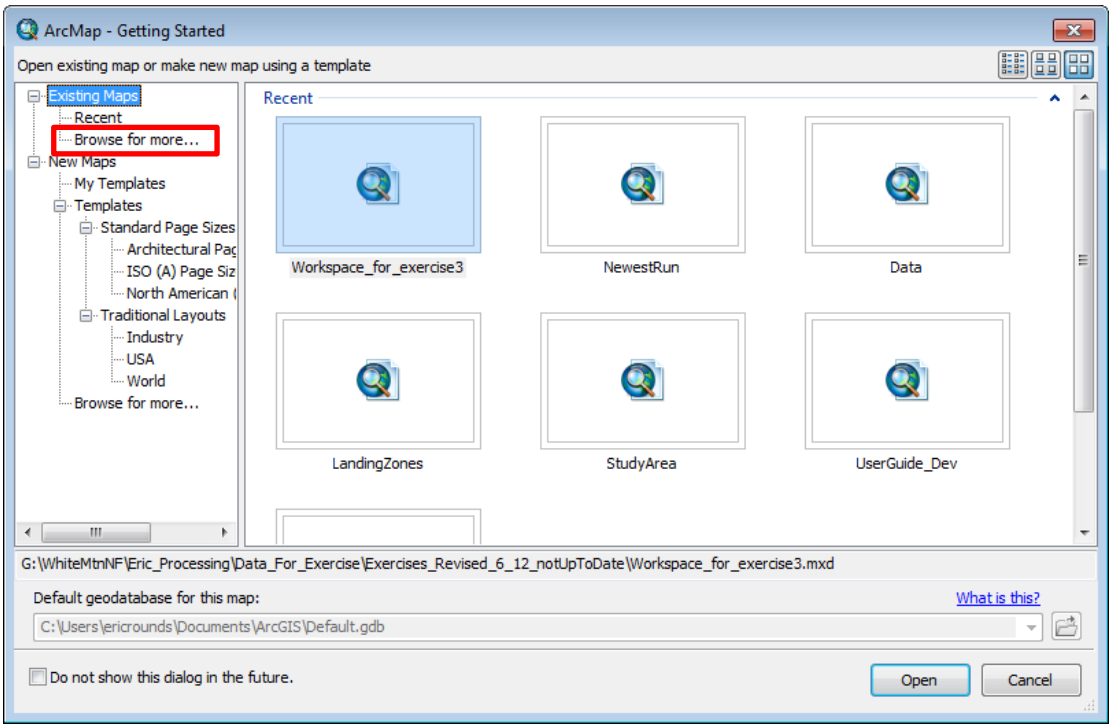
- **Install Esri ArcMap on computer and have basic understanding of how to use the software.**
- **Completion of Exercise 1**

Table of Contents

Part 1: Set up ArcMap

A. Start ArcMap and Load Data

1. Navigate to the VernalPools folder and double click **VernalPools.mxd**.
   i. This will open the ArcMap session that you saved in Exercise 1. Recognize that this is different than adding data, as you cannot simply double click data layers to open them in ArcMap. An alternative way to open the .mxd is to open ArcMap and then navigate to the saved .mxd by clicking **Browse for more…** in the **ArcMap – Getting Started** window that automatically pops up (see below).



2. Click the **Add Data** button and navigate to the **Refinement_Data** folder.
3. Add the following data files (**\Data\Refinement_Data\...**):
   i. From the **ELT** folder: **ELT.shp**
   ii. From the **NHD Folder**: **nhd24kar_a_nh009.shp, nhd24kst_l_nh009.shp, and nh24kwb_a_nh009.shp**
   iii. From the **NLCD** Folder: **NLCD.tif**
   iv. From the **Roads** Folder: **Roads.shp**

B. Symbolize NHD Shapefiles

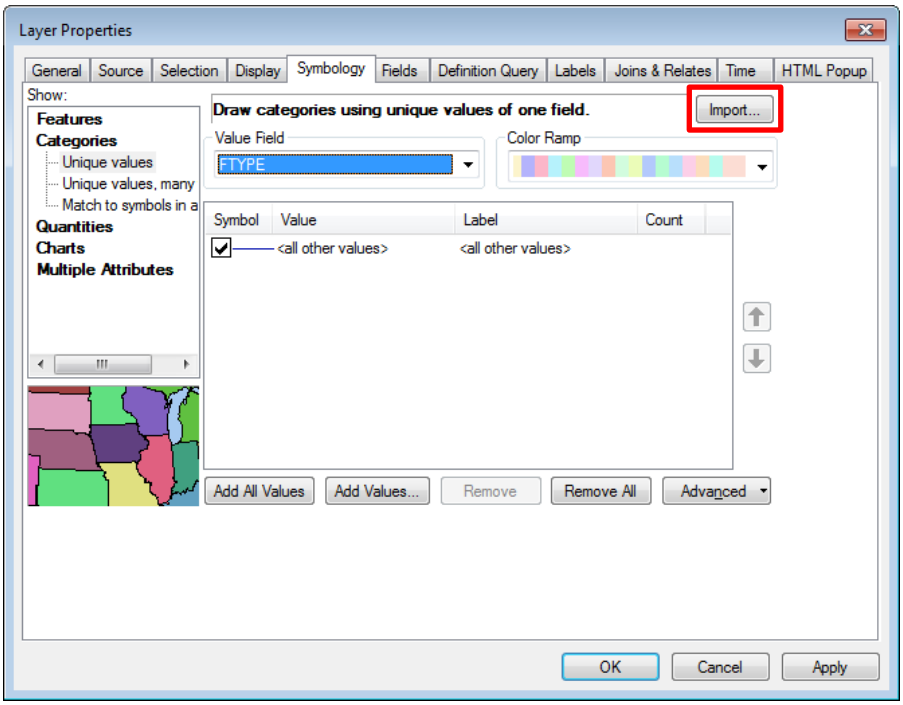
Although the following steps aren't critical to the completion of this workflow, symbolizing the NHD data will help understand the type of information contained within these datasets.

1. Next, you will use .LYR files to symbolize the NHD data: **nhd24kar_a_nh009.shp**, **nhd24kst_l_nh009.shp**, and **nhd24kwb_a_nh009.shp**. The .LYR files contain specific symbology for each shapefile.

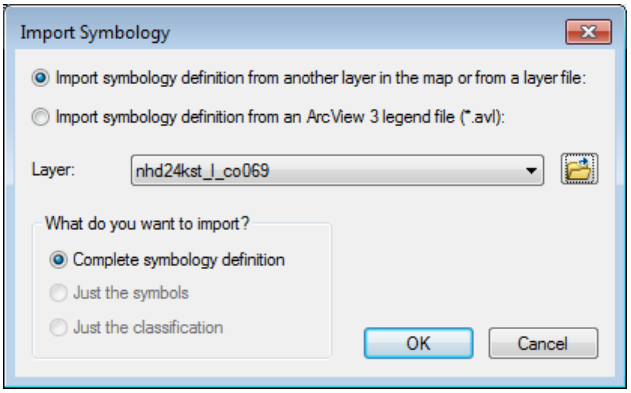
i. The key identifiers for this data are the two letters following "nhd24k." These three files represent NHD Area(ar), NHD Stream (st) and NHD Water Body (wb).

ii. Nhd24k stands for National Hydrography Dataset & 24 thousand (meaning it was mapped at a scale of 1:24,000).

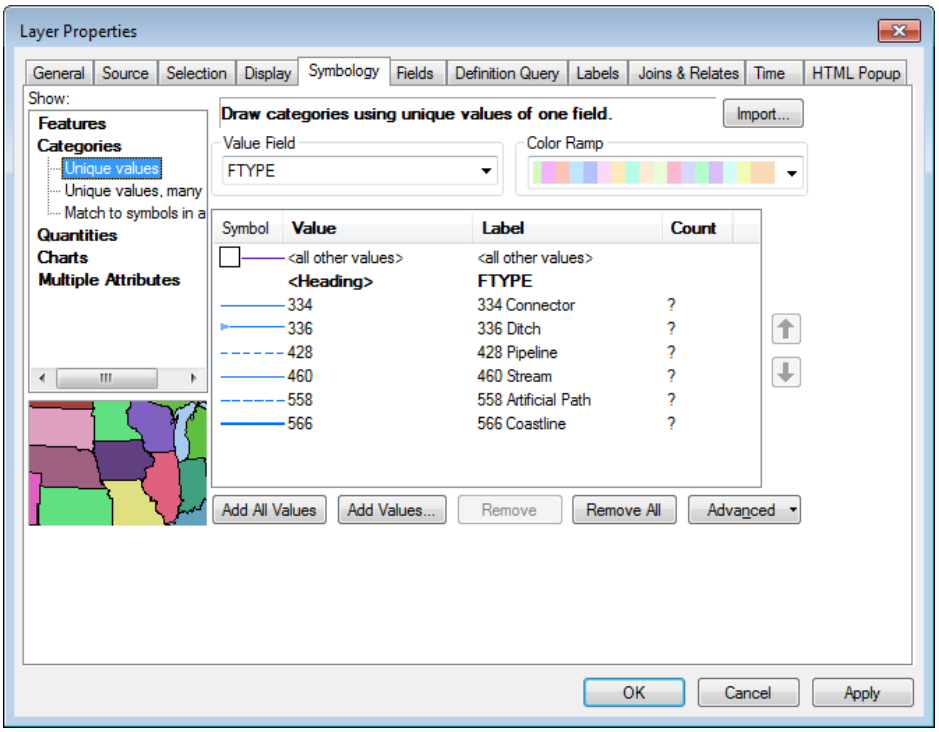
2. To link the shapefile to the .lyr file, open up the **Properties** of **nhd24kst_l_nh009.shp** and click the **Symbology** tab.
3. Click **Categories** on the left side of the Symbology window and change the **Value Field** to **FTYPE**.
4. Click the **Import** button in the top right to open the **Import Symbology** window (see below).



5. Ensure that '**Import symbology definition from another layer in the map or from a layer file'** radio button is selected.
6. Click the folder icon next to **Layer** and navigate to the **NHD** folder (**Data\Refinement_Data**).
7. Select **NHDSTREAM10.lyr** and click **Add.**
8. Click **OK** in the Import Symbology window (see below). In the Import Symbology Matching Dialog window that opens, ensure the Value Field is set to **FTYPE** and click **OK**.



i. This will populate the symbology of your shapefile with the predefined symbols in the .lyr file (see below).



9. Click **Ok** in the Layer Properties window to close it.
10. Repeat steps 4-8 for the other two NHD shapefiles using the appropriate .lyr files.
    i. Nhd24kwb_a_nh009.shp = NHDWATERBODY10.lyr
    ii. Nhd24kar_a_nh009.shp = NHDAREA10.lyr

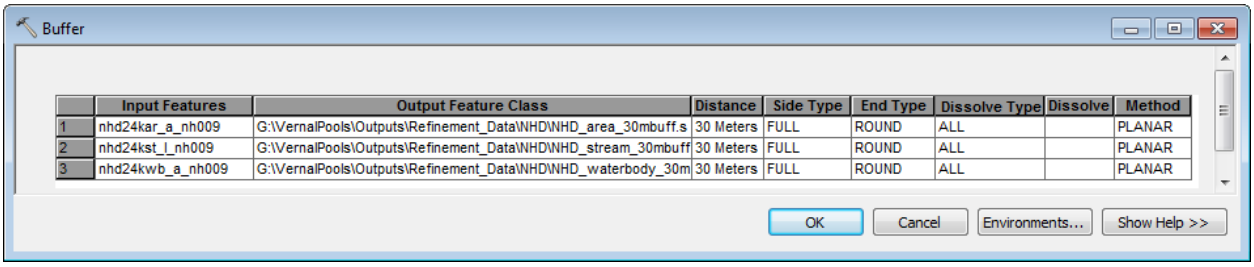
Part 2: Preprocess Hydrography Data

Vernal pools are ephemeral bodies of water that are isolated from permanent sources of water such as streams, rivers, lakes, or ponds. Therefore, it is important to have spatial data on water in order to eliminate sinks identified within a certain distance of these permanent sources of water. In this section,

you will buffer and merge NHD layers to create a single shapefile that can be used in exercise 3 to refine your outputs.

A. Buffer the NHDs

1. Navigate to the **Buffer** tool in the Arctoolbox, which you can find by expanding **Analysis Tools** and **Proximity.**
2. However, instead of double clicking buffer, right-click **Buffer** and select **Batch**.
   i. This will allow you to run the buffer tool on multiple different shapefiles at once.
3. Holding down shift (or ctrl), left click all three NHD shapefiles in the TOC and drag them into the **Input Features** paramter.
4. Next, double-click the output feature class box for each NHD file and navigate to the **NHD** folder within **Outputs\Refinement_Data**.
5. Name each Output Feature Class **NHD_stream_30mbuff.shp**, adjusting the "stream" portion of the name based on the whether the NHD is "wb"(water body) or "ar" (area).
6. Double click the first box under **Distance [value or field]** and enter **30**, ensuring that the units are in **meters**. Click **OK** to close the window and repeat this for the other two NHD layers.
7. Lastly, change each dissolve type to **All.**
8. Once you completed these steps for each input feature (see image below), click **OK**.

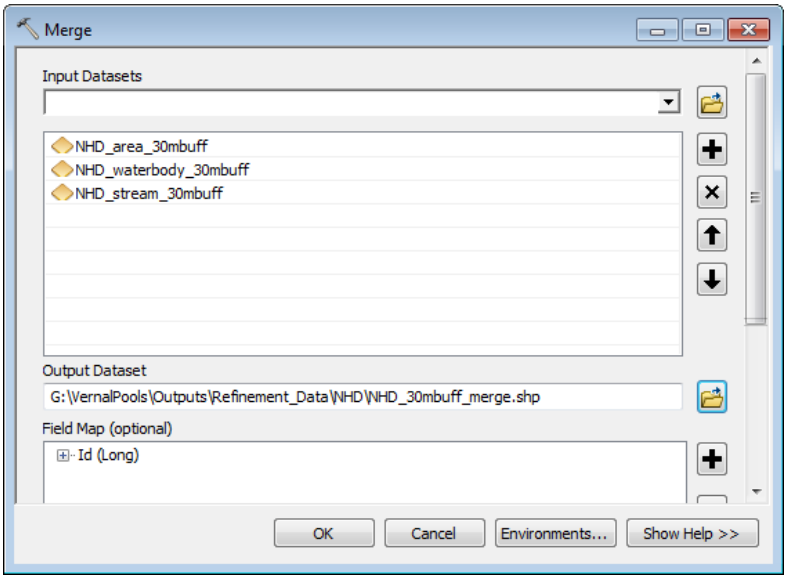


9. Once the tool is done, add all of these outputs to your TOC if they are not already added.

B. Merge the NHDs

We now want to merge the data so that we will only be working with a single NHD shapefile when refining the sink outputs. It is important to merge this data after using the buffer tool, because the buffer tool does not allow you to merge different types of vector data (e.g. line and polygon data).

1. Click the Geoprocessing menu from the top of the ArcMap window and select **Merge**.
2. Holding down shift (or ctrl), left click all three buffered NHD shapefiles and drag them into the **Input Datasets** paramter.
3. Navigate to the NHD output folder (**\Outputs\Refinement_Data\NHD**), name it **NHD_30mbuff_merge.shp** and click **Save**.
4. Click **OK** to run the **Merge** tool (see below).



i. You don't need to clip this merged NHD layer or the Roads layer because you will simply be identifying overlapping sinks and deleting them in Exercise 3. You will, however, need to clip some of the other refinement data layers.

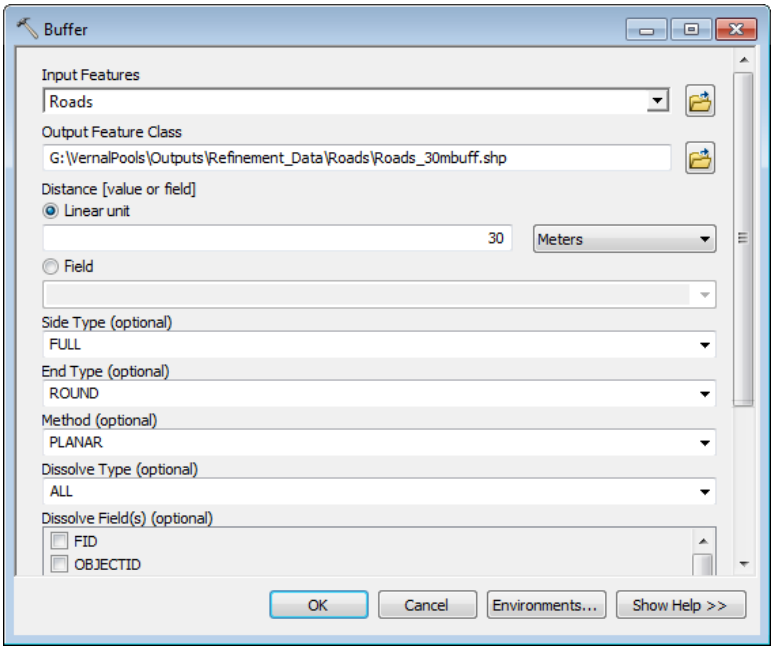
5. Right click the original NHD layers and the un-merged NHD buffered shapefile in the TOC and select remove. This will help avoid any confusion caused by too many layers being in the TOC.

Part 3: Buffer New Hampshire Roads

Many of the sinks that are identified by the sink identification workflow are near roads and need to be removed because these are depressions that are caused by the high edge of roads. In most cases, this water would actually be flowing under the roads via a culvert, thus not constituting them as sinks.

A. Open the Buffer tool

1. Click the **Geoprocessing** menu from the top of the ArcMap window and select **Buffer**.
2. Select **Roads** as the Input Feature
3. Click the folder icon next to the **Output Feature Class** and name it **Roads_30mbuff.shp**
4. Set the Linear Unit Distance to **30 meters**.
   i. This threshold was chosen by looking at 3 data layers (NAIP [National Agriculture Imagery Program], roads, and sink outputs) and measuring the distance between roads and sinks that are located next to roads. NAIP is useful because the roads shapefile is only marked by lines that don't capture the actual width of roads. You can use the NAIP to see whether or not some sinks are immediately adjacent to roads or not. If working with your own data and study area, you may decide that different buffer distance is appropriate.
5. Set the Dissolve Type to **All.**
6. Click **OK** to run the Buffer tool (see below).



7. Right click **Roads.shp** in the TOC and click **Remove**.

Note: As a Forest Service employee, you have access to a suite of high resolution imagery such as NAIP that you can load to ArcMap without the hassle of storing so much data. The following steps explain how to connect to Image Services so you can access NAIP (National Agricultural Imagery Program).

1-Open ArcCatalog within your ArcMap Session

2-Find the GIS Servers folder and click the plus sign next to it to expand the list.

3-Double-click on Add ArcGIS Server. This will open a new window.

4-In the Add ArcGIS Server window, ensure Use GIS Services is selected and click Next.

5-In the Server URL dialog box, type in the following address: https://image-services.gtac.fs.usda.gov/arcgis. -If you have Arc 10.1 or earlier, use the following address instead: http://166.2.126.54/arcgis/services.

6-Leave the Authentication section blank and click Finish.

7-The service will be added to the list under GIS Servers as arcGIS on 166.2.126.54(user).

8-Click the plus sign next to this new service and scroll down until you find 'NAIP2016byState' and expand that folder as well. This is where you will find the 2016 composites of NAIP imagery. NAIP imagery from previous years for the continuous U.S. can be found in the 'NAIP' folder.

9-Simply click and drag the NAIP imagery you want into your TOC or map.

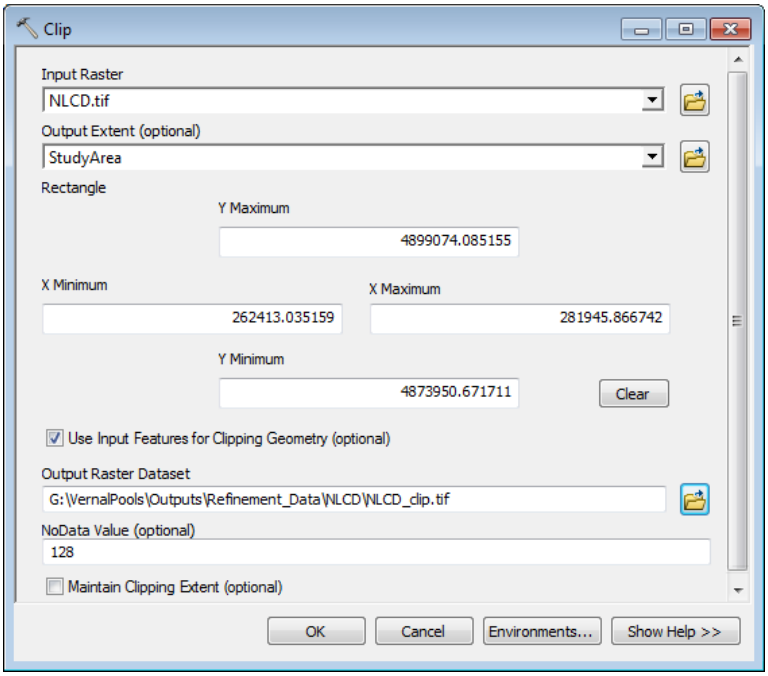
Part 4: Select Target NLCD Classes.

There are only a select number of classes within the National Land Cover Dataset (NLCD) that can reasonably support vernal pools, while many of the other classes could increase the number of

erroneous potential vernal pools in the outputs. In this section, you will be creating a shapefile that contains only the target land cover classes. Later, you will use this shapefile to to exclude sinks in areas where vernal pools are typically not located or are not of concern to the Forest Service.

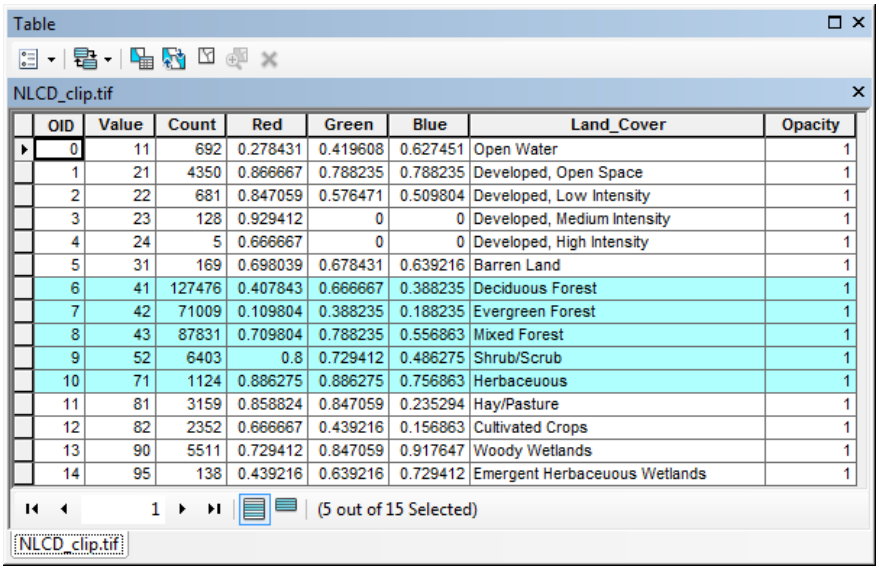
A. Clip NLCD to Study Area

1. Navigate to and open the **Clip** (raster) tool, which can be found by expanding **Data Management Tools**, **Raster,** and **Raster Processing**.
   i. Remember that this is not the same **Clip** that is found in the Geoprocessing dropdown.
2. Set the Input raster as **NLCD**.
3. In the Output Extent parameter, select **StudyArea.**
4. Check the box next to '**Use Input Features for Clipping Geometry**.'
5. Click the folder icon next to **Output Raster Dataset** and navigate to the output **NLCD** folder (**\Outputs\Refinement_Data\NLCD**).
6. Name the output **NLCD_clip.tif** and click **Save**.
7. Click **OK** (see below)**.**



B. Select Target Classes

1. The categories you ultimately want to extract are: **Deciduous Forest**, **Evergreen Forest**, **Mixed Forest**, **Shrub/Scrub**, and **Herbaceous**.
2. Open the **NLCD_clip** attribute table. You should see 16 different land cover classes.
3. To select the classes listed above, hold the shift key and click on the far left margin of the **Deciduous Forest** row, then click the **Herbaceous** row while still holding shift. This should highlight all rows between the two you selected (see below).

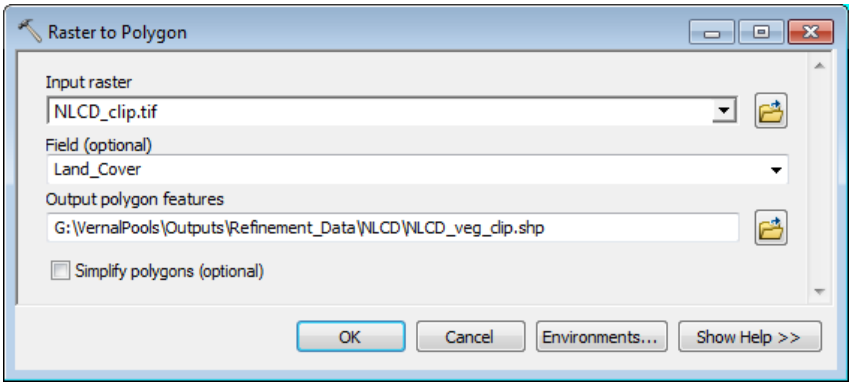


OID	Value	Count	Red	Green	Blue	Land_Cover	Opacity
0	11	692	0.278431	0.419608	0.627451	Open Water	1
1	21	4350	0.866667	0.788235	0.788235	Developed, Open Space	1
2	22	681	0.847059	0.576471	0.509804	Developed, Low Intensity	1
3	23	128	0.929412	0	0	Developed, Medium Intensity	1
4	24	5	0.666667	0	0	Developed, High Intensity	1
5	31	169	0.698039	0.678431	0.639216	Barren Land	1
6	41	127476	0.407843	0.666667	0.388235	Deciduous Forest	1
7	42	71009	0.109804	0.388235	0.188235	Evergreen Forest	1
8	43	87831	0.709804	0.788235	0.556863	Mixed Forest	1
9	52	6403	0.8	0.729412	0.486275	Shrub/Scrub	1
10	71	1124	0.886275	0.886275	0.756863	Herbaceuous	1
11	81	3159	0.858824	0.847059	0.235294	Hay/Pasture	1
12	82	2352	0.666667	0.439216	0.156863	Cultivated Crops	1
13	90	5511	0.729412	0.847059	0.917647	Woody Wetlands	1
14	95	138	0.439216	0.639216	0.729412	Emergent Herbaceuous Wetlands	1

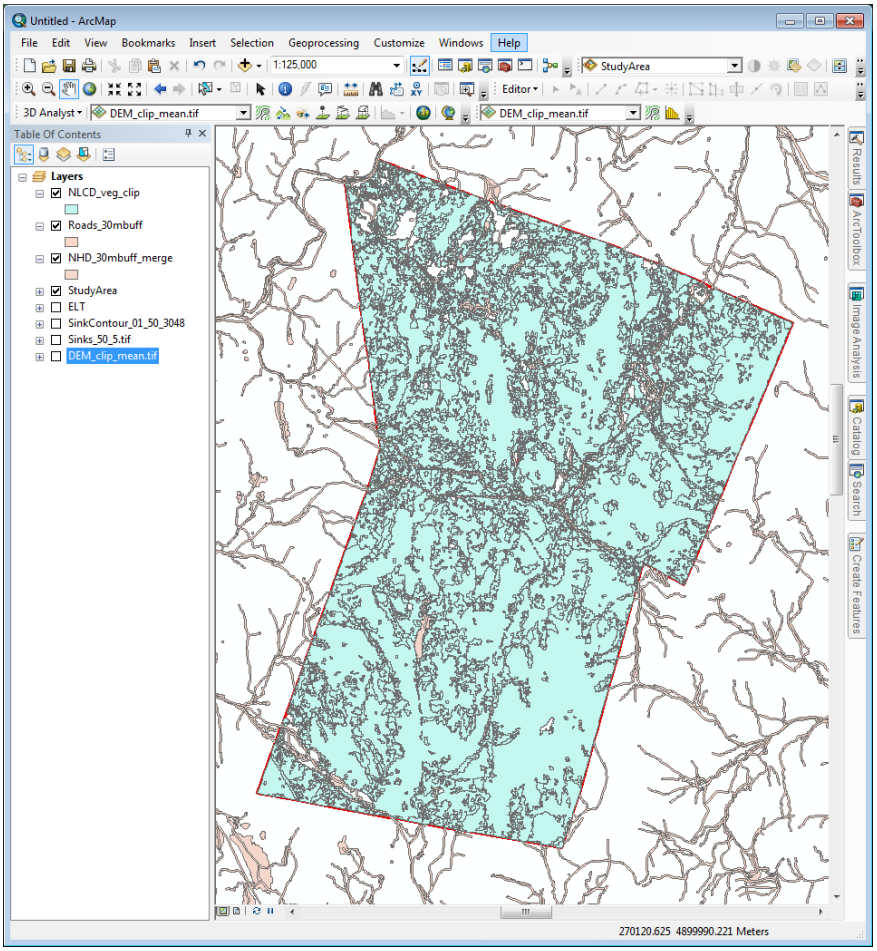
4. **Close** the Select by Attributes window.

C. Convert the NLCD Tiff to a Shapefile

1. Since you have the desired land cover classes selected, any process you run on the TIFF will only be drawing on those selected classes.
2. Navigate to the **Raster to Polygon** tool in the arctoolbox, which you can find by expanding **Conversion Tools** and then **From Raster.**
3. Select **NLCD_clip** as the Input raster.
4. Set the **Field** as **Land_Cover**.
5. Click the folder icon next to **Output polygon features** and navigate to the **NLCD** output folder (**\Outputs\Refinement_Data\NLCD)**.
6. Name the output **NLCD_veg_clip.shp** and click **Save.**
7. **Uncheck Simplify polygons**. If left on, this will alter the polygon edges and the output will no longer follow the true edges of the raster cells.
8. Ensure that your window looks similar to the below image and click **OK**.



9. Right click **NLCD_clip.tif** and **NLCD.tif** in the TOC and click **Remove**.
10. Your workspace should look similar to the below image.



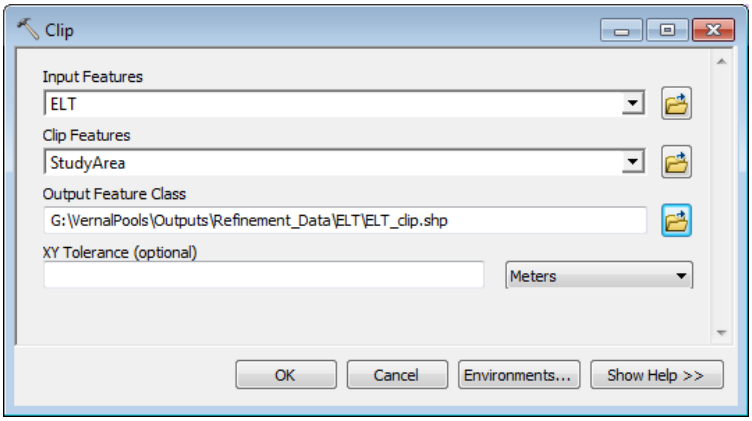
Part 5: Select Ecological Land Types (Optional)

The Ecological Land Types (ELT) shapefile contains information about ecological land types in the White Mountain National Forest. This data is used to enhance decision making on the forest by providing pertinent information relating to the ecological characteristis of the landscape. There is a word document in the ELT Data folder that provides more detailed information on the shapefile and its contents. You will use it here to pull out only those ELTs that are likely to support vernal pools. However, since research on which ELTs support vernal pools is incomplete, this section is optional and is not necessary to generate the final outputs from this workflow.

A. Clip ELT to Study Area

1. Click the **Geoprocessing** menu at the top of the ArcMap window.
2. Select the **Clip** tool.
3. Use **ELT.shp** as the Input Feature.
4. Set the Clip Features to **Study Area.**
5. Click the folder icon next to **Output Feature Class** and navigate to the **ELT** output folder (**\Outputs\Refinement_Data\ELT)**.

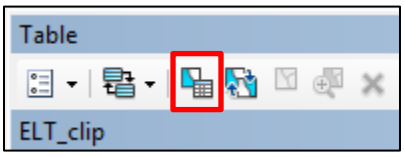
6. Name the output **ELT_clip.shp** and click **Save.**
7. Click **OK** to run the Clip tool (see below).



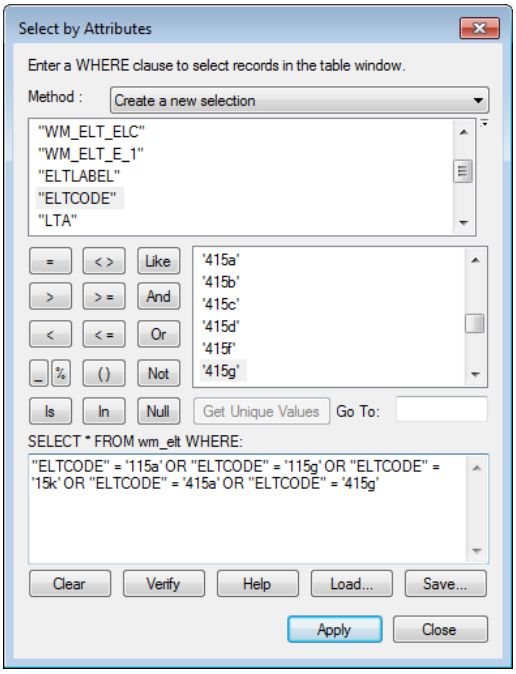
8. When the tool is done running, right click **ELT.shp** in the TOC and select **Remove**.

B. Select ELTs That Support Vernal Pools

1. Right-click **ELT_clip** in your TOC and click **Open Attribute Table.**
    i. The field (column) that you will be focusing on is the **ELTCODE**, which provides the most specific information on landscape ecology.
2. Click the **Select by Attribute** button above the attribute table (see below).



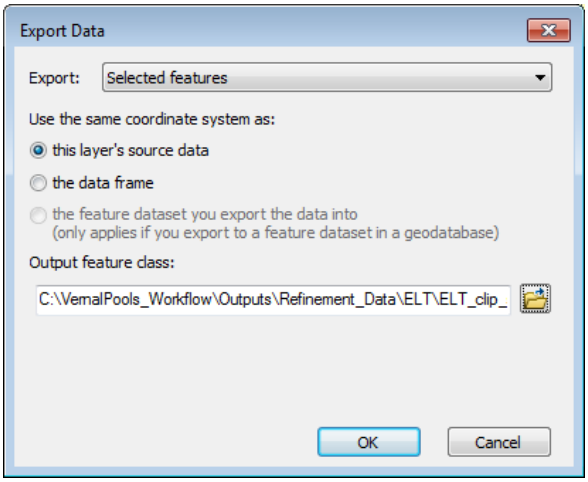
3. In the window that pops up, double-click **ELTCODE** in the upper portion of the window, select the equals sign, click **Get Unique Values**, and then double-click **'115a'** in the Unique Values list. This will provide you with the following syntax:
    i. "ELTCODE" = '115a'
4. To add multiple ELTCODES to the same syntax, click the **Or** button after each individual expression and repeat the previous step using the rest of the target ecological land types (115g, 15k, 415a and 415g). Your syntax should look the same as the following:
    i. "ELTCODE" = '115a' OR "ELTCODE" = '115g' OR "ELTCODE" = '15k' OR "ELTCODE" = '415a' OR "ELTCODE" = '415g'
        (a) In other areas of White Mountain NF, you will want to add the 315a and 315g ELTCODEs, but they are not present in this study area.
5. Click **Apply** (see below) and then **Close**.



i. The result is that the target ELTCODES have been highlighted in the map and in the Attribute Table. Close the Attribute Table.

C. Export Data

1. Right-click **ELT_clip**, hover over **Data** and then click **Export Data**.
2. In the Export Data window that opens up, click the folder icon to the right of the **Output feature class** and navigate to the **ELT** output folder (**\Outputs\Refinement_Data\ELT**).
3. Name the output as **ELT_clip_selection.shp** and change the **Save as type:** to Shapefile**.**
4. Click **Save.**
5. In the **Export Data** window, click **OK** (see below)**.**



6. Click “Yes” to add to map as layer.
7. Right click **ELT_clip** in the TOC and select **Remove**.

8. At the top of ArcMap, click **File** and **Save** to Save your ArcMap session.

Congratulations! You have successfully completed this exercise. You now have the necessary shapefiles to refine the sinks output from exercise 1 to exclude sinks that do not fit within this project's definition of a vernal pool.