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Version: ArcMap 10.x

EXERCISE 3
Refine Sink Outputs

Introduction

Although you have a dataset that identifies sinks, many of those sinks are either connected to permanent water sources, are artifacts of roads caused by the topographic DEM, or are in areas where functional vernal pools are unlikely to be (e.g. urban or residential areas). To eliminate detected sinks in such areas, this exercise will walk you through the steps to select only the sinks that match the defined criteria to be classified as a **potential vernal pool (PVP)**. Once the final dataset of PVPs is created, researchers or land managers can go out into the field in the spring to validate whether or not the PVPs can be labelled as confirmed vernal pools **(CVPs)** based on the presence of indicator species.

Objectives

- Use selection tools to extract sinks
- Edit and delete sinks in undesirable areas
- Refine your sinks dataset to include only potential vernal pools

Required Data

- **SinkContour_01_50_3048.shp**
- **NHD_30mbuff_merge.shp**
- **Roads_30mbuff.shp**
- **NLCD_veg_clip.shp**
- **ELT_clip_selection.shp (optional)**

Prerequisites

- **Completion of Exercise 1 & 2**
- **Install Esri ArcMap on computer and have basic understanding of how to use the software.**

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Part 1: Set up ArcMap

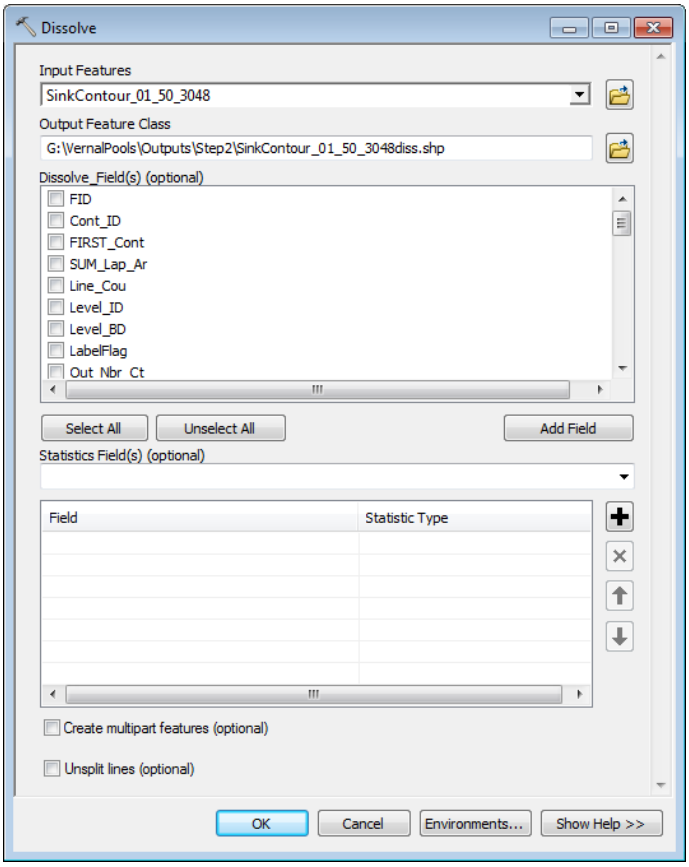
A. Open VernalPools.mxd

1. If it is not still open, navigate to the **VernalPools** folder and double click **VernalPools.mxd** to open the ArcMap session you worked in for exercises 1 and 2.
2. Ensure that all of the following files are loaded into the ArcMap session.
   - **i. SinkContour_01_50_3048.shp**
   - **ii. NHD_30mbuff_merge.shp**
   - **iii. Roads_30mbuff.shp**
   - **iv. NLCD_veg_clip.shp**
   - **v. ELT_clip_selection**

Part 2: Dissolve Polygons for Refinement Workflow

Since you need to identify where detected sinks overlap with roads, permanent hydrology features, certain land cover classes and ecological land types, you will need to dissolve the polygons that were the outputs from exercise 1. This will allow you to eliminate entire sinks without missing some of the smaller, nested sinks that may not directly overlap with the road, river, etc., but are clearly connected to the larger sink that overlaps with these features.

1. At the top of your ArcMap window, click the **Geoprocessing** menu and select **Dissolve**.
2. Select **SinkContour_01_50_3048.shp** as the input features.
3. Click the folder icon next to **Output Feature Class** and navigate to the **Step2** output folder.
4. Name the output **SinkContour_01_50_3048diss.shp** and click **Save**.
5. Deselect **Create multipart features**.
   i. By removing the checkbox from this parameter, you are ensuring that each separate polygon will maintain a unique ID.
6. Leave all of the other parameters as their default and click **OK** (see below).



7. Check the attribute table of the new dissolved sink output. You should now have a total of **1,226** features in the shapefile as opposed to the **3,042** you had prior to the dissolve.

Part 3: Delete Sinks That Overlap With Roads and NHD

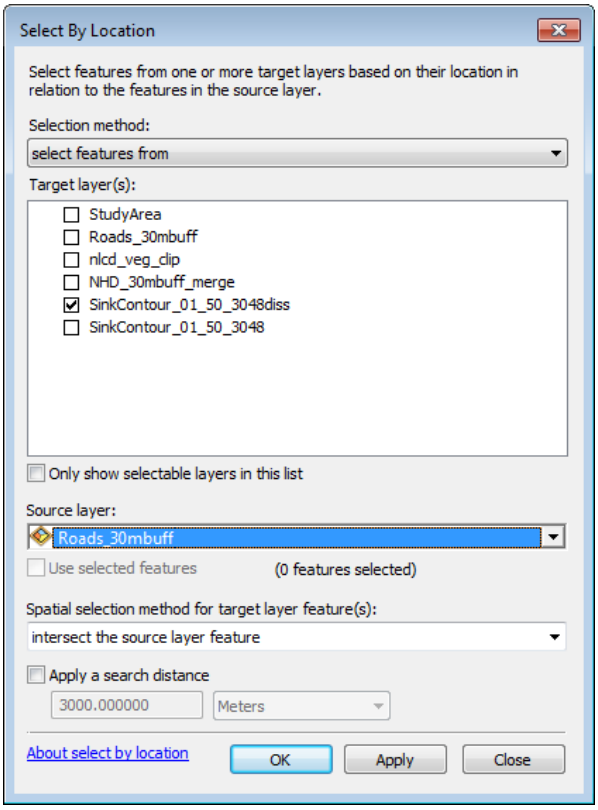
A. Edit and Delete Selected Features

1. Add the **Editor** toolbar to your ArcMap if it is not already there (Customize menu, Toolbars, and then select Editor).
2. Click the **Editor** menu in the Editor toolbar and click **Start Editing.**
3. In the Start Editing window, select **SinkContour_01_50_3048diss** and click **OK**.

B. Select and Delete Sinks Adjacent to Roads

1. Click on the **Roads_30mbuff** layer and compare that with the sinks output you just dissolved.
2. To better distinguish between the two, set the symbology of each to a distinct color (Properties, Symbology).
   i. Notice that many of these polygons are currently near or overlapping with this buffered road shapefile. You want to delete the sinks that overlap with the buffered roads.
3. Click the **Selection** menu at the top of your ArcMap window and click **Select By Location**.
4. Ensure the **Selection method** is set to **select features from**.

5. In the **target layers:** section, click the box next to **SinkContour_01_50_3048diss** to check it.
6. Set the Source layer: to **Roads_30mbuff**.
7. Ensure that the **Spatial selection method for target layer feature(s):** is set to **intersect the source layer feature**.
8. Click **OK** (see below).

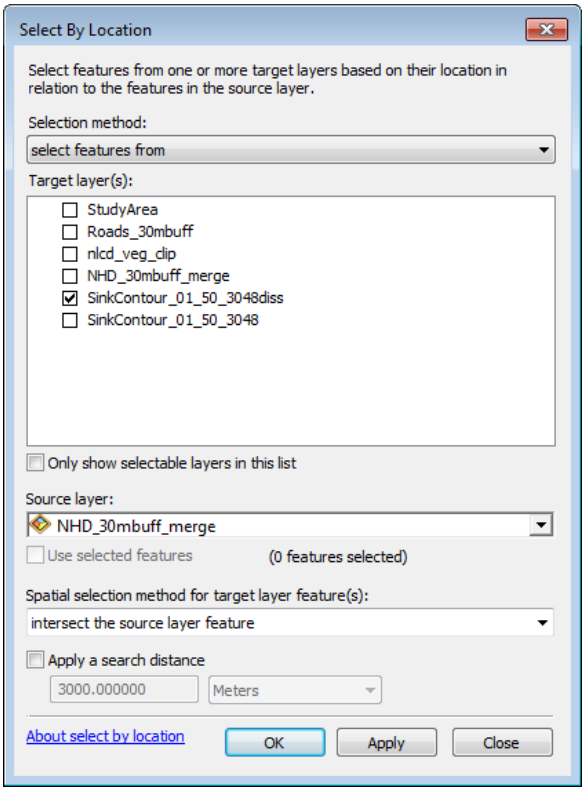


9. Zoom in to examine the polygons that are now highlighted. Notice that all polygons from the sinks shapefile that overlapped at all with the roads layer have now been selected.
10. Now all you need to do is simply press the **Delete** key on your keyboard.
    i. Click the **Editor** menu and click **Save Edits.** Don't stop editing yet, as you will need to continue editing **SinkContour_01_50_3048diss** in the next step.
    ii. This leaves you with a total of **960** sinks.

C. Select and Delete Sinks Connected to NHD

1. Like you did in Part 3-B, turn on **NHD_30mbuff_merge** and examine the overlap of remaining sinks with the merged and buffered NHD layer.
2. Click the **Selection** menu at the top of your ArcMap window and click **Select By Location**.
3. Ensure the Selection method is set to **select features from**.
4. In the **target layers:** section, click the box next to **SinkContour_01_50_3048diss** if there isn't a check next to it already.
5. Set the Source layer: to **NHD_30mbuff_merge**.

6. Ensure that the **Spatial selection method for target layer feature(s):** is set to **intersect the source layer feature**.
7. Click **OK** (see below).
    i. This will select all sink polygons that overlap wth the buffered NHD.



8. Next, click the **Delete** key on your keyboard. This will delete all of those selected polygons.
    i. You should now have a total of **636** features in **SinkContour_01_50_3048diss**.
9. Click the **Editor** menu, click **Save Edits** then **Stop Editing.**

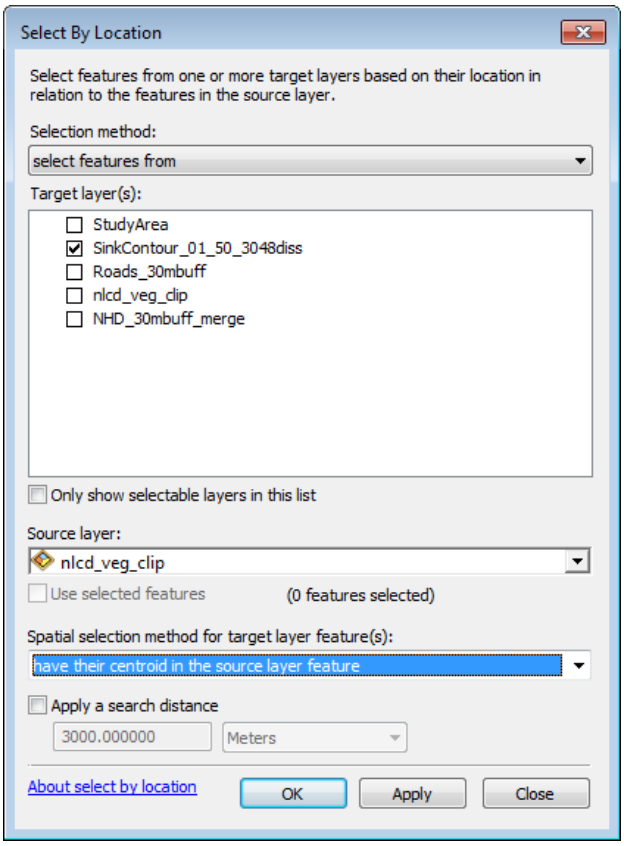
Part 4: Extract Sinks From Target NLCD Classes

At this point, you have deleted sinks that overlap with roads and permanent water features. Next, you will use the NLCD shapefile you created in Exercise 2 to cut down the sinks output even further to exclude sink polygons with the majority of the polygon located in developed areas, agricultural land, wetlands, and open water. You will use the Select By Location tool again in this section because using the Clip tool would cut off sinks that are partially in the NLCD_veg_clip polygon.

A. Select Sinks That Intersect NLCD

1. Click the **Selection** menu at the top of your ArcMap window and click **Select By Location**.
2. Set the Selection Method to **SinkContour_01_50_3048diss** by checking the box next to it**.**
3. Set the Source Layer to **NLCD_veg_clip.**
4. Ensure that the **Spatial selection method for target layer feature** is set to **have their centroid in the source layer feature** (bottom of the list).

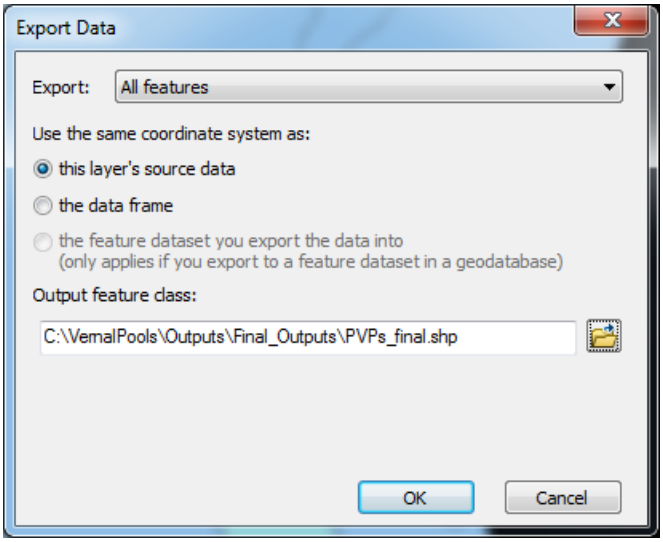
5. Click **OK** (see below).



   i. This will select all sinks with their geometric center located in the NLCD layer. Per Wu (2014), only those sinks with the majority of their area within the target land cover classes are retained as PVPs.

B. Export Remaining Sinks

1. Next, you will need to use **Export Data** to create a new shapefile from these selected features. Right-click **SinkContour_01_50_3048diss**, hover over **Data** and click **Export Data.**
2. Click the folder icon next to the **Output feature class** and navigate to the **Final_Outputs** folder.
3. Name the output **PVPs_final.shp** and click **Save**.
4. Click "**Yes**" to add data to the map as layer.
5. Click **OK** (see below).
   i. This will leave you with a total of **486** sinks.



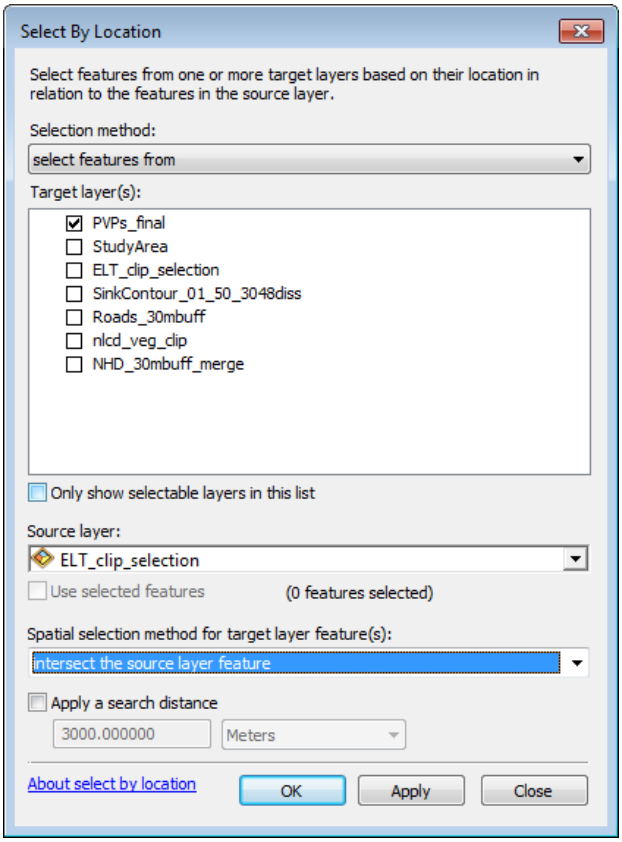
ii. Although you have narrowed down the total number of sinks, there are still many that are most likely not certifiable vernal pools (CVPs).

6. The **PVPs_final.shp** should look similar to the image below.

7. At this point, you have the option of clipping this final dataset to the ELT Polygons (see Part 5, which is optional) or moving on to Part 6. In addition, if you would like to integrate an elevation cut off into this workflow, see **Appendix 2** before moving on to Part 6. Some may find this useful because often times higher elevation PVPs are not threatened by logging activities.

Part 5: Select Sinks That Intersect With ELT Polygons (Optional)

1. Click the **Selection** menu at the top of your ArcMap window and click **Select By Location**.
2. Set the Target Layer to **PVPs_final**.
3. Set the Source Layer to **ELT_clip_selection.**
4. For the Spatial selection method for target layer feature(s), select **intersect the source layer feature**.
5. Click **OK** (see below).



   i. In order to take these selected features and create a new sinks shapefile, you will need to utilize the Export Data function to export the selected features.

6. Now that the sinks that overlap with ELTs are selected, right-click **SinkContour_01_50_3048diss_NLCD**, hover over **Data** and click **Export Data.**
7. Click the folder icon next to Output feature class and navigate to your workspace.

8. Name the output **PVPs_final_ELT.shp** and click **Save.**
9. Click '**Yes'** to add the data to map as layer.
10. Click **OK.**
    i. This will leave you with a total of **132** sinks, or PVPs.

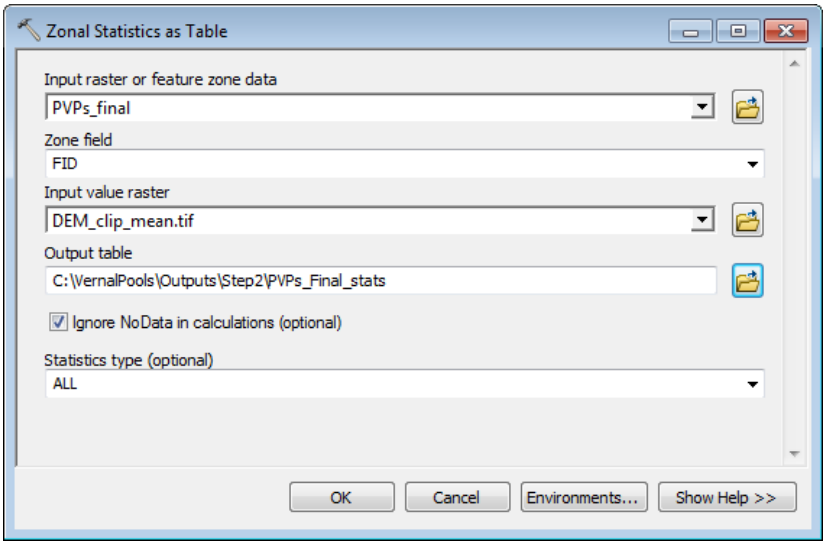
Part 6: Final Statistics for PVPs

The Identify Depression Hierarchy tool output (step 2 of the Contour Tree tool) contains a variety of zonal statistics related to the nested sinks that were identified by the tool. However, the attribute table is unintuitive and it contains unnecessary information, as well as a plethora of NoData values. For that reason, this section will show you how to generate valuable statistics for the final sinks layer using the DEM and the Zonal Statistics as Table tool in ArcMap. You will then add X and Y coordinates to the attribute table and export it so that it can be viewed in Excel. If you are interested in linking the original attribute data from step 2 with you PVPs_final layer, see **Appendix 1** for instructions.

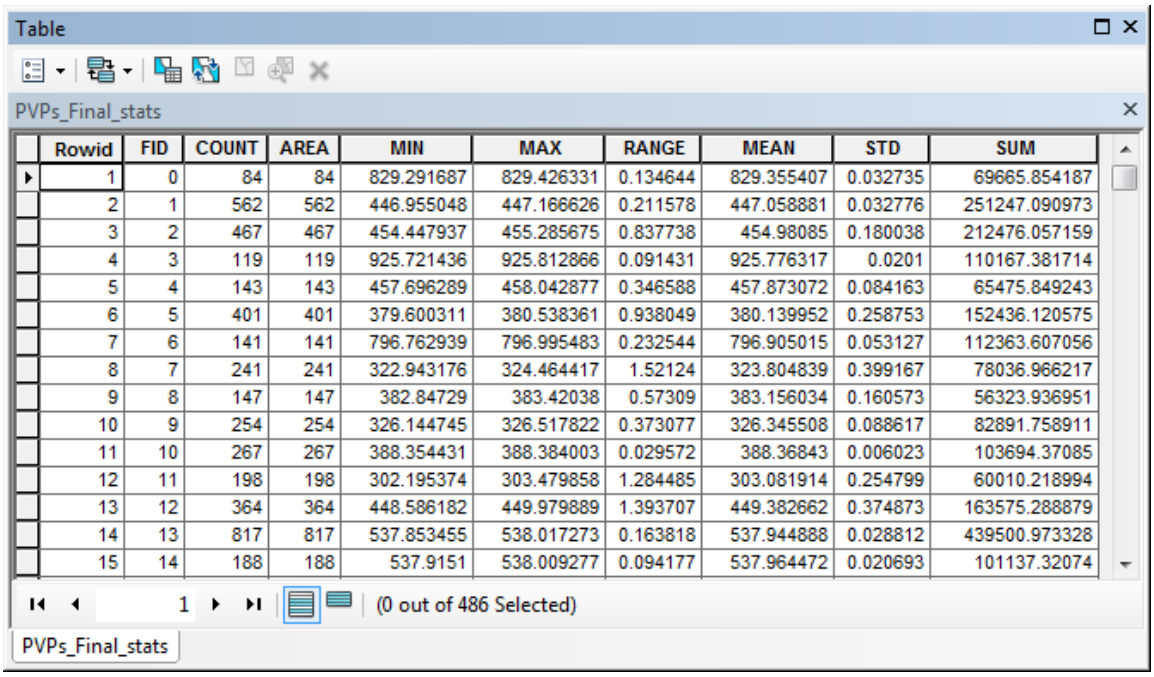
A. Generate Zonal Statistics

Zonal statistics tools will work properly with either a floating point (decimal) or integer raster. However, several statistics will not be computed if you use a floating point raster as the input; those statistics that won't be computed include majority, median, minority and variety. For the purpose of this workflow, the floating point raster that you have been working with will work fine because those statistical fields aren't necessarily critical.

1. Click the **Add Data** button and navigate to the **DEM** output folder where you saved **DEM_clip_mean.tif**. Click **Add** to load it in your ArcMap
2. Open the **Zonal Statistics as Table** tool within ArcToolbox by expanding **Spatial Analyst Tool** and then **Zonal**.
3. Set the **Input raster or feature zone data** to **PVPs_final.shp** (or **PVPs_final_ELT.shp** if you applied the ELT data during the optional Part 5).
4. Set the **Zone field** to **FID** (ID is unpopulated and will result in a table with a single statistics row).
5. Set the **Input value raster** to **DEM_clip_mean.tif**.
6. Click the folder icon next to **Output table** and navigate to your **Outputs** folder. Name the output **PVPs_Final_stats** (or **PVPs_Final_ELT_stats)**.
7. Ensure that the **Statistics type** is set to **ALL**
8. Leave the **Ignore NoData in calculations** box checked. This will exclude NoData values from your statistical output.
9. Click **OK** to run Zonal Statistics (see below).



10. The resulting table will look like the below image.



Rowid	FID	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
1	0	84	84	829.291687	829.426331	0.134644	829.355407	0.032735	69665.854187
2	1	562	562	446.955048	447.166626	0.211578	447.058881	0.032776	251247.090973
3	2	467	467	454.447937	455.285675	0.837738	454.98085	0.180038	212476.057159
4	3	119	119	925.721436	925.812866	0.091431	925.776317	0.0201	110167.381714
5	4	143	143	457.696289	458.042877	0.346588	457.873072	0.084163	65475.849243
6	5	401	401	379.600311	380.538361	0.938049	380.139952	0.258753	152436.120575
7	6	141	141	796.762939	796.995483	0.232544	796.905015	0.053127	112363.607056
8	7	241	241	322.943176	324.464417	1.52124	323.804839	0.399167	78036.966217
9	8	147	147	382.84729	383.42038	0.57309	383.156034	0.160573	56323.936951
10	9	254	254	326.144745	326.517822	0.373077	326.345508	0.088617	82891.758911
11	10	267	267	388.354431	388.384003	0.029572	388.36843	0.006023	103694.37085
12	11	198	198	302.195374	303.479858	1.284485	303.081914	0.254799	60010.218994
13	12	364	364	448.586182	449.979889	1.393707	449.382662	0.374873	163575.288879
14	13	817	817	537.853455	538.017273	0.163818	537.944888	0.028812	439500.973328
15	14	188	188	537.9151	538.009277	0.094177	537.964472	0.020693	101137.32074

i. Although there are still many PVPs remaining in this dataset (486 in above example), these statistics can aid wildlife biologists in the selection of PVPs that fit more specific geometric characteristics.

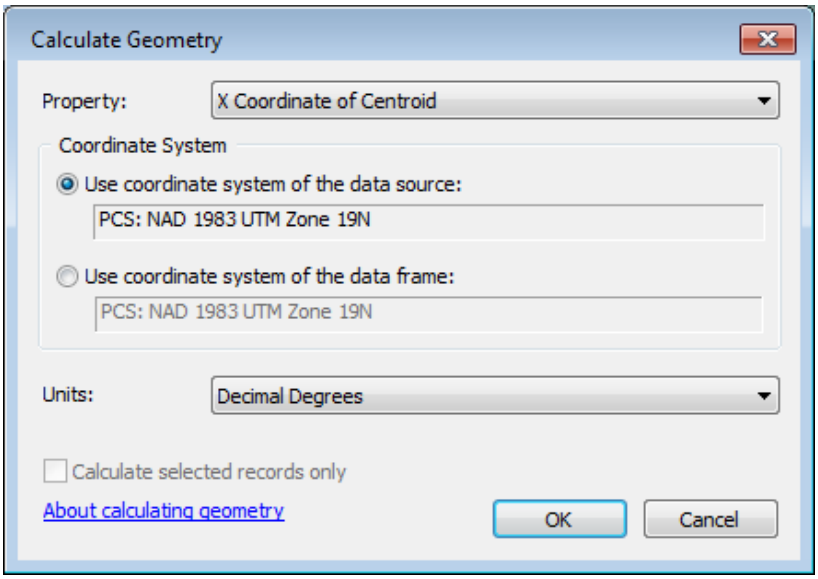
ii. An important thing to note here is that the **Rowid** column is a generic ID that is output during the generation of the zonal statistics. The **FID** column is the column that is related to the original PVPs_Final dataset.

B. Generate X,Y Coordinates

1. Open the attribute table for **PVPs_final** if it isn't already open.
2. Click the **Table Options** menu and select **Add Field**.

3. Type **X_Coord** as the name, select **Double** as the **Type** and click **OK** (see below)**.**

4. **Repeat steps 2 and 3** to create a second field named **Y_Coord.**
5. Next, right click the **X_Coord** column header and select **Calculate Geometry**.
   i. Click **Yes** to close the popup.
6. Click the **Property** menu and select **X Coordinate of Centroid**.
7. Deselect **Calculate selected record only** in case you have selected any rows.
8. Ensure that the Units are set to **Decimal Degrees** and click **OK** (see below).

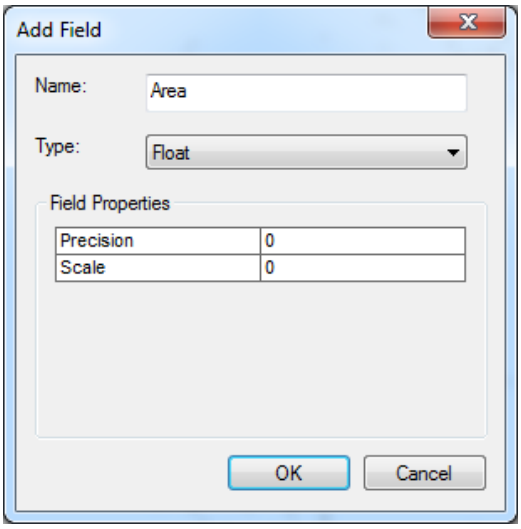


9. Repeat steps 5-7 for the **Y_Coord**, but set the property to **Y Coordinate of Centroid.**

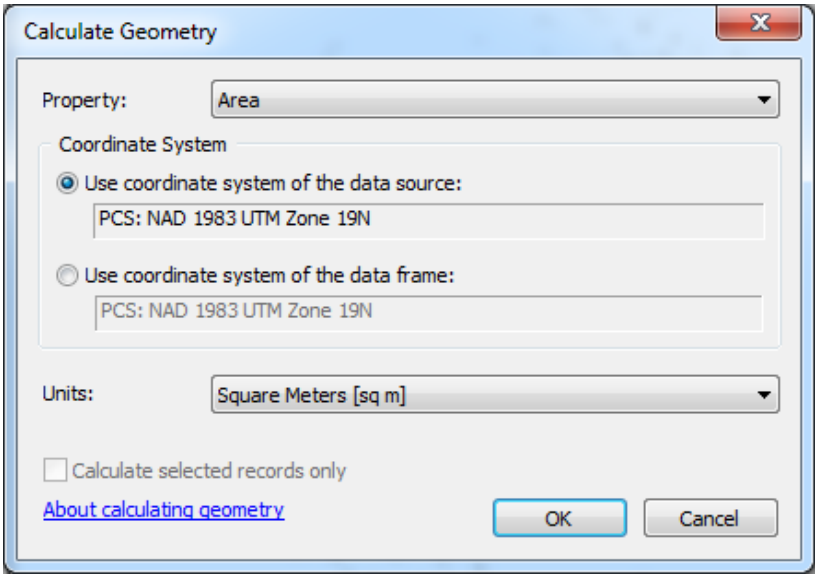
C. Add Area Statistic

1. The Area category in the **PVPs_Final_Stats** table is a simple count of pixels (1-meter). To be more precise with the Area statistics, you will create a new field and calculate area using decimal values
2. Click the **Table Options** menu in the **PVPs_Final** attribute table and click **Add Field**.

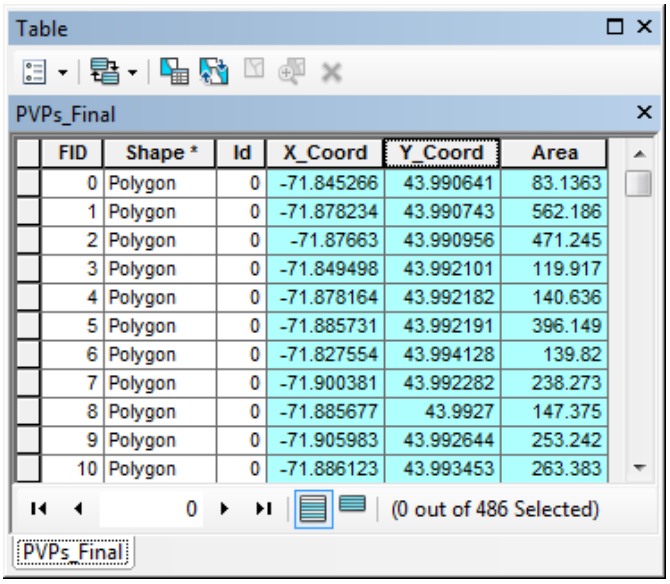
3. Type **Area** into the Name category, set the **Type** to **Float** and click **OK** (see below).



4. Next, righ-click the **Area** column header and select **Calculate Geometry**.
5. In the Calculate Geometry window, set the **Property** to **Area**, then set the **Units** to **Square Meters [sq m]** and click **OK** (see below).



i. The resulting attribute table should look like the below image.

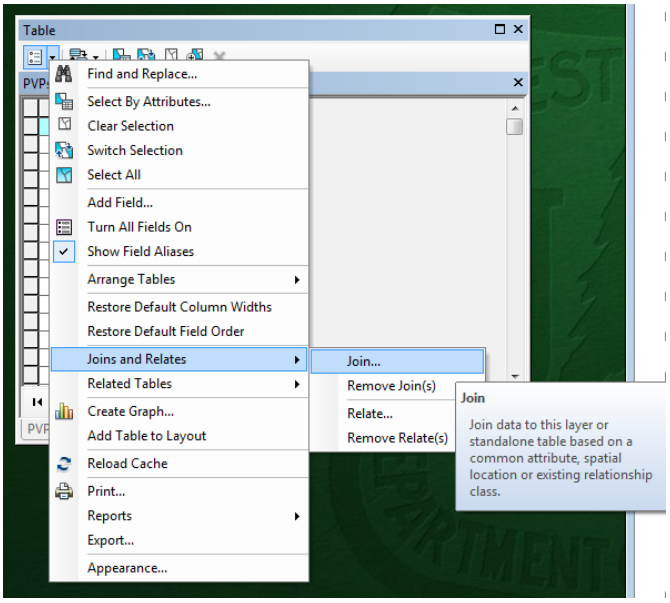


FID	Shape *	Id	X_Coord	Y_Coord	Area
0	Polygon	0	-71.845266	43.990641	83.1363
1	Polygon	0	-71.878234	43.990743	562.186
2	Polygon	0	-71.87663	43.990956	471.245
3	Polygon	0	-71.849498	43.992101	119.917
4	Polygon	0	-71.878164	43.992182	140.636
5	Polygon	0	-71.885731	43.992191	396.149
6	Polygon	0	-71.827554	43.994128	139.82
7	Polygon	0	-71.900381	43.992282	238.273
8	Polygon	0	-71.885677	43.9927	147.375
9	Polygon	0	-71.905983	43.992644	253.242
10	Polygon	0	-71.886123	43.993453	263.383

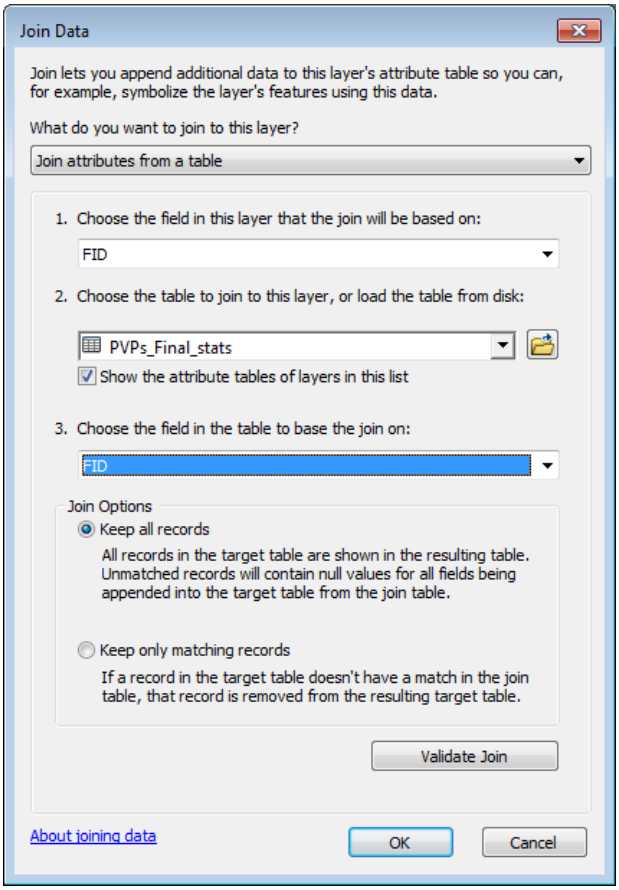
D. Join PVPs_Final With Statistics Table

The final step is to join the statistics table with the **PVPs_Final** shapefile so that you can view the statistics in ArcMap while simultaneously observing the location of each PVP.

1. Right click **PVPs_Final** and select **Open Attribute Table** if it isn't still open.
2. Click the **Table Options** menu, hover your cursor over **Joins and Relates** and select **Join.**

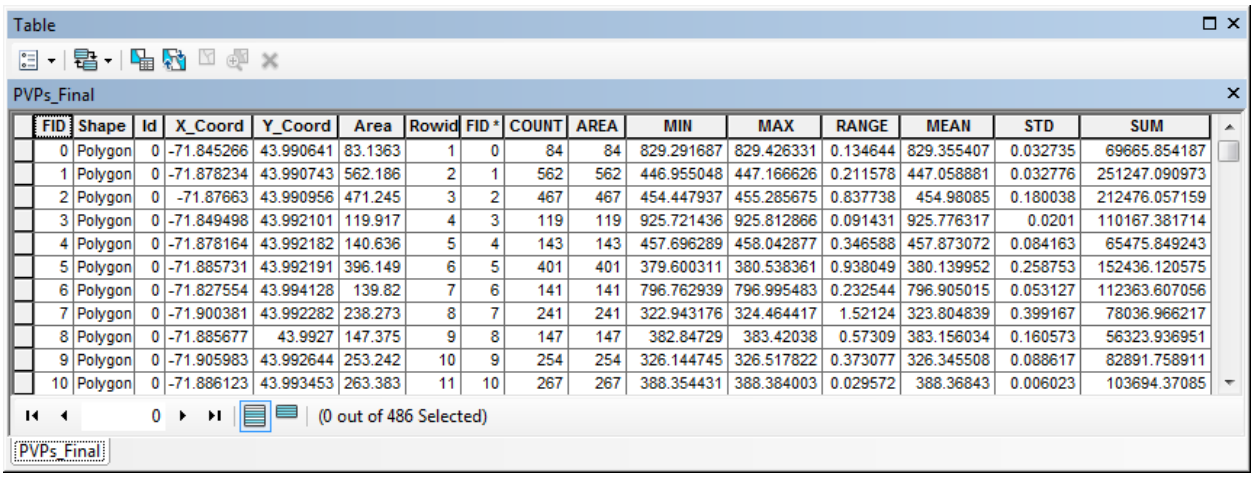


3. Set the **Choose the field in this layer that the join will be based on** parameter to **FID**.
4. Ensure the **PVPs_Final_stats** table is selected in section 2.
5. For the 3rd section that reads **Choose the field in the table to base the join on**, set it to **FID**.
6. Ensure that the **Keep all records** option is selected and then click **OK** (see below).



i. Click **Yes** in the **Create Index** window that appears.

7. Expand the attribute table to view all of the added statistical fields.
8. Your attribute table should look like the below image.

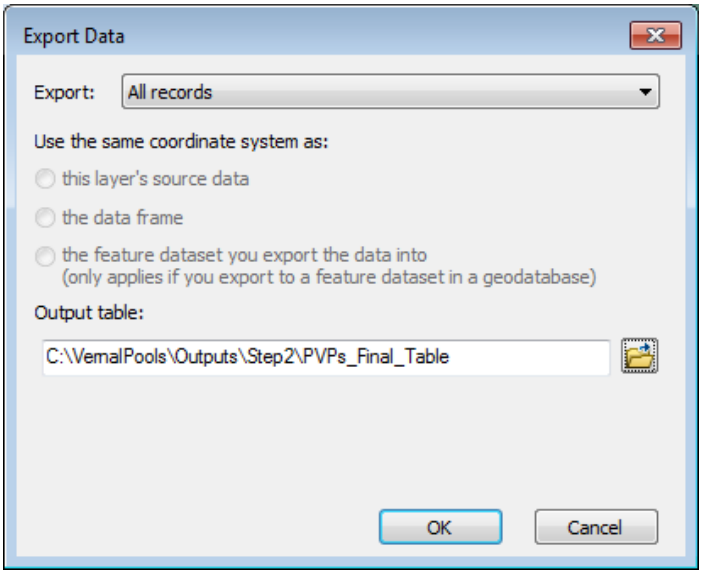


FID	Shape	Id	X_Coord	Y_Coord	Area	Rowid	FID *	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
0	Polygon	0	-71.845266	43.990641	83.1363	1	0	84	84	829.291687	829.426331	0.134644	829.355407	0.032735	69665.854187
1	Polygon	0	-71.878234	43.990743	562.186	2	1	562	562	446.955048	447.166626	0.211578	447.058881	0.032776	251247.090973
2	Polygon	0	-71.87663	43.990956	471.245	3	2	467	467	454.447937	455.285675	0.837738	454.98085	0.180038	212476.057159
3	Polygon	0	-71.849498	43.992101	119.917	4	3	119	119	925.721436	925.812866	0.091431	925.776317	0.0201	110167.381714
4	Polygon	0	-71.878164	43.992182	140.636	5	4	143	143	457.696289	458.042877	0.346588	457.873072	0.084163	65475.849243
5	Polygon	0	-71.885731	43.992191	396.149	6	5	401	401	379.600311	380.538361	0.938049	380.139952	0.258753	152436.120575
6	Polygon	0	-71.827554	43.994128	139.82	7	6	141	141	796.762939	796.995483	0.232544	796.905015	0.053127	112363.607056
7	Polygon	0	-71.900381	43.992282	238.273	8	7	241	241	322.943176	324.464417	1.52124	323.804839	0.399167	78036.966217
8	Polygon	0	-71.885677	43.9927	147.375	9	8	147	147	382.84729	383.42038	0.57309	383.156034	0.160573	56323.936951
9	Polygon	0	-71.905983	43.992644	253.242	10	9	254	254	326.144745	326.517822	0.373077	326.345508	0.088617	82891.758911
10	Polygon	0	-71.886123	43.993453	263.383	11	10	267	267	388.354431	388.384003	0.029572	388.36843	0.006023	103694.37085

E. Export Final Table

1. Click the **Table Options** dropdown and select **Export**.

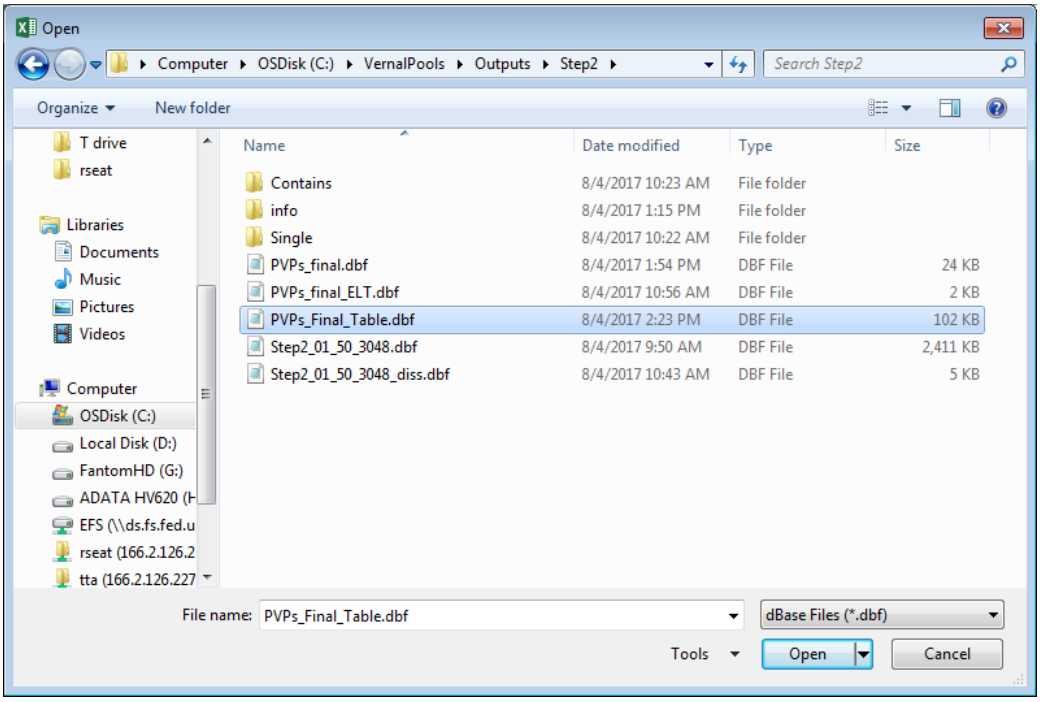
2. In the Export Data window, click the folder icon next to **Output table** and navigate to the **Step2** folder.
3. Name the output **PVPs_Final_Table** and set the **Save as Type** to **dBASE Table**.
4. Click **Save** and then **OK** in the Export Data window (see below).



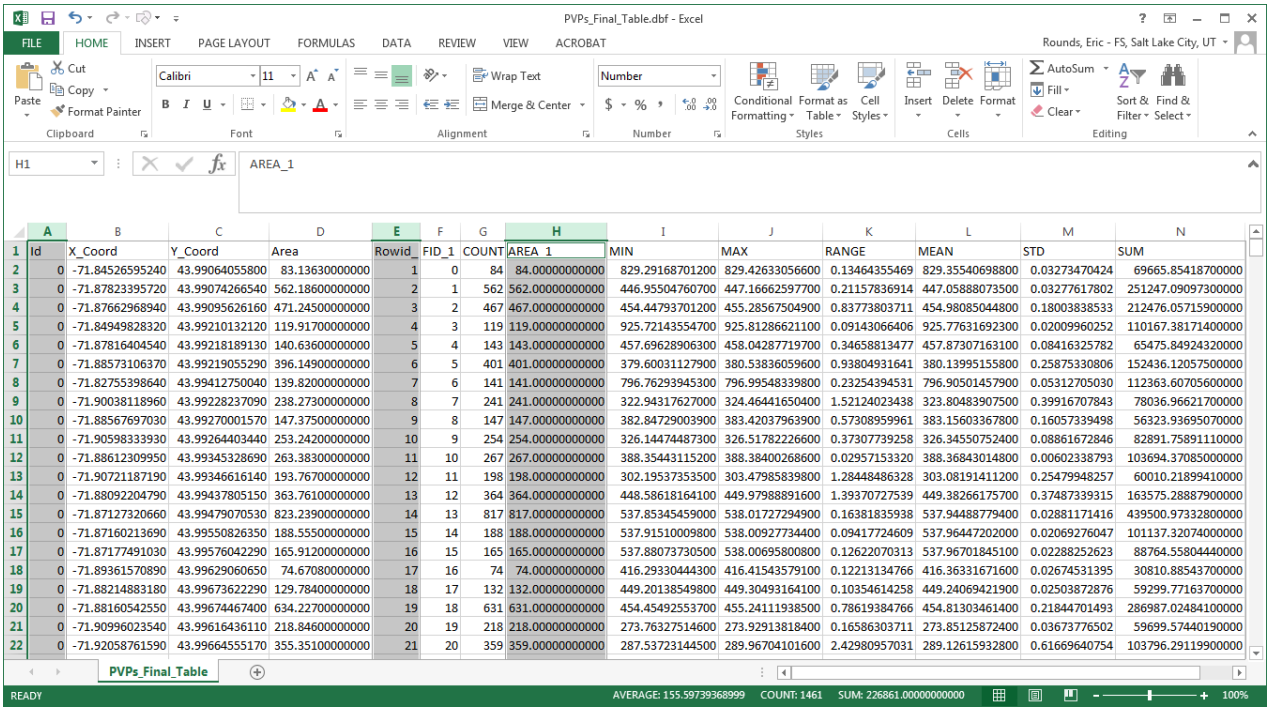
i. Click **No** when prompted to add the output to the ArcMap session.

F. Open Table in Excel

1. Now you can open **Excel**, click **Open Other Workbooks** and navigate to the **Step2** folder by clicking **Computer**, then **Browse**.
2. Change the **All Files (*,*)** dropdown to **dBase Files (*.dbf),** then select the **PVPs_Final_Table.dbf** file and click **Open** (see below)**.**



3. Once the table is open, you can clean it up a bit by deleting superfluous columns, such as the **ID, Rowid_** and **Area_1** columns (see below). You may find it useful to delete some of the other columns that don't offer important information. The columns that may prove the most useful are the **AREA** and **RANGE** statistics, which can be analyzed to understand the size and depth of the PVPs.



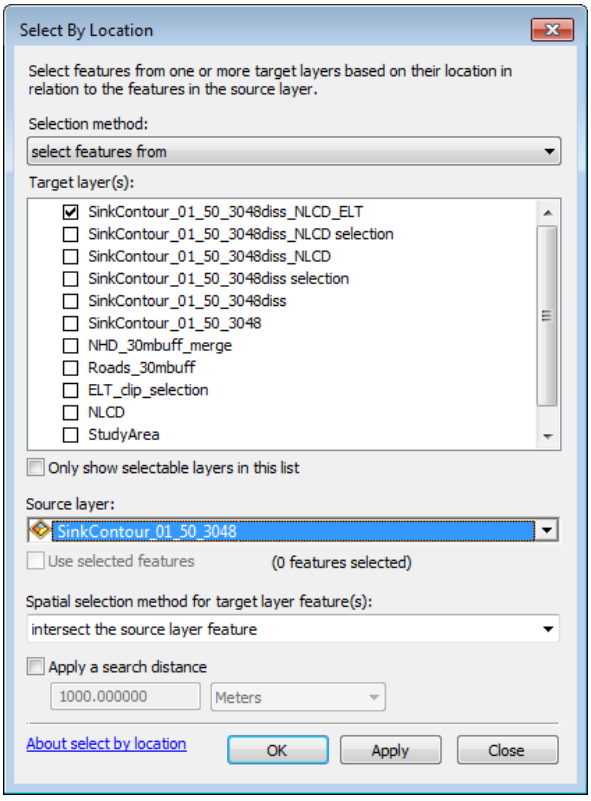
	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Id	X_Coord	Y_Coord	Area	Rowid_	FID_1	COUNT	AREA_1	MIN	MAX	RANGE	MEAN	STD	SUM
2	0	-71.84526595240	43.99064055800	83.13630000000	1	0	84	84.00000000000	829.29168701200	829.42633056600	0.13464355469	829.35540698800	0.03273470424	69665.85418700000
3	0	-71.87823395720	43.99074266540	562.18600000000	2	1	562	562.00000000000	446.95504760700	447.16662597700	0.21157836914	447.05888073500	0.03277617802	251247.09097300000
4	0	-71.87662968940	43.99095626160	471.24500000000	3	2	467	467.00000000000	454.44793701200	455.28567504900	0.83773803711	454.98085044800	0.18003838533	212476.05715900000
5	0	-71.84949828320	43.99210132120	119.91700000000	4	3	119	119.00000000000	925.72143554700	925.81286621100	0.09143066406	925.77631692300	0.02009960252	110167.38171400000
6	0	-71.87816404540	43.99218189130	140.63600000000	5	4	143	143.00000000000	457.69628906300	458.04287719700	0.34658813477	457.87307163100	0.08416325782	65475.84924320000
7	0	-71.88573106370	43.99219055290	396.14900000000	6	5	401	401.00000000000	379.60031127900	380.53836059600	0.93804931641	380.13995155800	0.25875330806	152436.12057500000
8	0	-71.82755398640	43.99412750040	139.82000000000	7	6	141	141.00000000000	796.76293945300	796.99548339800	0.23254394531	796.90501457900	0.05312705030	112363.60705600000
9	0	-71.90038118960	43.99228237090	238.27300000000	8	7	241	241.00000000000	322.94317627000	324.46441650400	1.52124023438	323.80483907500	0.39916707843	78036.96621700000
10	0	-71.88567697030	43.99270001570	147.37500000000	9	8	147	147.00000000000	382.84729003900	383.42037963900	0.57308959961	383.15603367800	0.16057339498	56323.93695070000
11	0	-71.90598333930	43.99264403440	253.24200000000	10	9	254	254.00000000000	326.14474487300	326.51782226600	0.37307739258	326.34550752400	0.08861672846	82891.75891110000
12	0	-71.88612309950	43.99345328690	263.38300000000	11	10	267	267.00000000000	388.35443115200	388.38400268600	0.02957153320	388.36843014800	0.00602338793	103694.37085000000
13	0	-71.90721187190	43.99346616140	193.76700000000	12	11	198	198.00000000000	302.19537353500	303.47985839800	1.28448486328	303.08191411200	0.25479948257	60010.21899410000
14	0	-71.88092204790	43.99437805150	363.76100000000	13	12	364	364.00000000000	448.58618164100	449.97988891600	1.39370727539	449.38266175700	0.37487339315	163575.28887900000
15	0	-71.87127320660	43.99479070530	823.23900000000	14	13	817	817.00000000000	537.85345459000	538.01727294900	0.16381835938	537.94488779400	0.02881171416	439500.97332800000
16	0	-71.87160213690	43.99550826350	188.55500000000	15	14	188	188.00000000000	537.91510009800	538.00927734400	0.09417724609	537.96447202000	0.02069276047	101137.32074000000
17	0	-71.87177491030	43.99576042290	165.91200000000	16	15	165	165.00000000000	537.88073730500	538.00695800800	0.12622070313	537.96701845100	0.02288252623	88764.55804440000
18	0	-71.89361570890	43.99629060650	74.67080000000	17	16	74	74.00000000000	416.29330444300	416.41543579100	0.12213134766	416.36331671600	0.02674531395	30810.88543700000
19	0	-71.88214883180	43.99673622290	129.78400000000	18	17	132	132.00000000000	449.20138549800	449.30493164100	0.10354614258	449.24069421900	0.02503872876	59299.77163700000
20	0	-71.88160542550	43.99674467400	634.22700000000	19	18	631	631.00000000000	454.45492553700	455.24111938500	0.78619384766	454.81303461400	0.21844701493	286987.02484100000
21	0	-71.90996023540	43.99616436110	218.84600000000	20	19	218	218.00000000000	273.76327514600	273.92913818400	0.16586303711	273.85125872400	0.03673776502	59699.57440190000
22	0	-71.92058761590	43.99664555170	355.35100000000	21	20	359	359.00000000000	287.53723144500	289.96704101600	2.42980957031	289.12615932800	0.61669640754	103796.29119900000

Congratulations! You have successfully completed this exercise. You now know all of the steps required to create a dataset of potential vernal pools. This data can now be validated by assessing the PVPs in the spring when ephemeral vernal pools are active and indicator species are present.

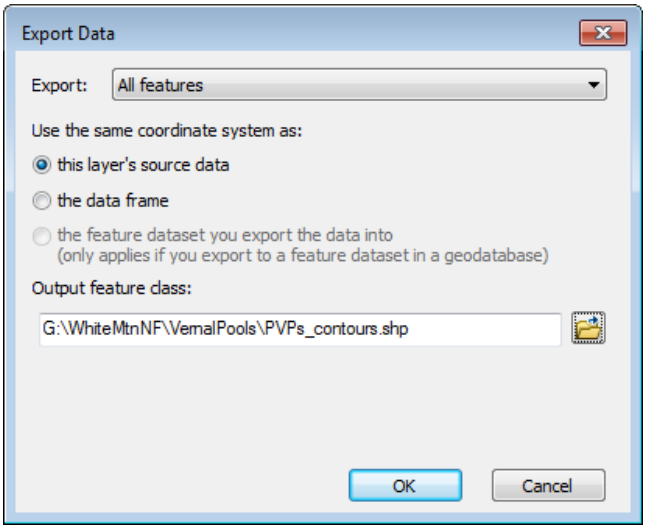
Appendix 1: Link Final Sinks Layer to Contour Output

If you are interested in the attribute data that in contained in the output from step 2 of the workflow, then you can use the instructions in this section to learn how to link the

1. Click the **Selection** menu and click **Select By Location**.
2. Set the **Target Layer** to **SinkContour_01_50_3048**.
3. Select **SinkContour_01_50_3048_diss_NLCD_ELT** as the Source Layer.
4. Ensure that the **Spatial selection method for target layer feature** parameter is set to **intersect the source layer feature**.
5. Click **OK** (see below).



6. Right-click **SinkContour_01_50_3048**, hover over **Data** and click **Export Data**.
7. Navigate to your workspace and name the output **PVPs_contours.shp**.
8. Click **OK** (see below).



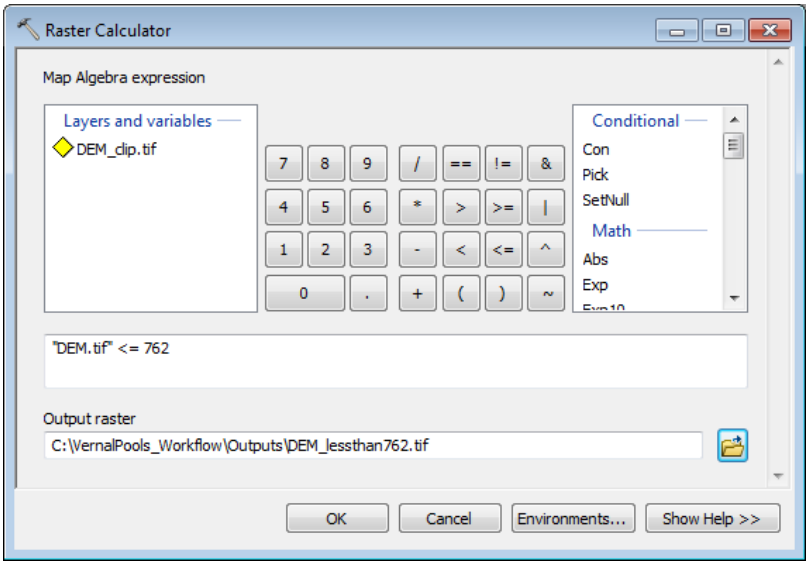
9. Click **Yes** when the alert pops up asking if you want to add the exported layer to the map.
    i. You now have reconnected the dissolved sinks output with the original output from step 2 of Exercise 1, leaving you with all of the contours and geometric attributes provided by the **Identify Depression Hierarchy** tool.
10. Repeat steps 6-8 using **SinkContour_01_50_3048diss_NLCD_ELT** as the data to export and name it **PVPs**.
    i. This will leave you with two final datasets, one that contains all of the contour/geometric information from Step 2, and one that has the location information and zonal statistics for each PVP that you generated in this exercise.

Appendix 2: Applying an Elevation Cutoff

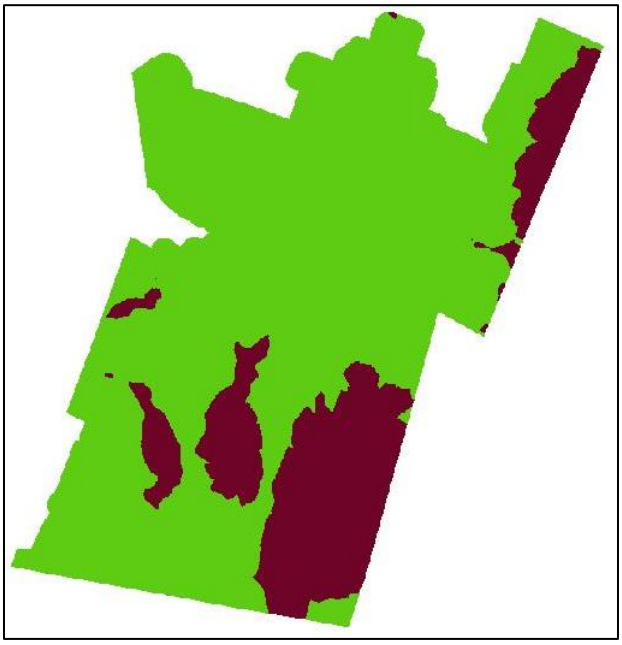
In some instances, you may want to exclude areas you are uninterested in due to their high elevation. This part walks you through how to further refine your output by eliminating points above a 2500ft theoretical threshold. However, there will be no points deleted from the final output because there were no points remaining above 2500 ft. after completing all of the above steps.

A. Generate Height Threshold Layer

1. Click the **Add Data** button and add the **DEM_clip.tif.**
2. Open the **Raster Calculator** tool, which can be found in the ArcToolbox under **Spatial Analyst Tools** and **Map Algebra**.
3. Double click **DEM_clip.tif** in under Layers and Variables. This adds it to the Algebra Expression.
4. Click the 'less than or equal to' symbol (<=).
5. Since the DEM is in meters and we have a threshold defined in feet, you'll need to do a basic conversion of feet to meters. Enter 762 at the end of the Map Algebra Expression.
6. In the Output raster field, navigate to your **refinement_data** folder within outputs and name the file **DEM_lessthan762.tif.**
7. Review the Raster Calculator expression below and click **OK.**

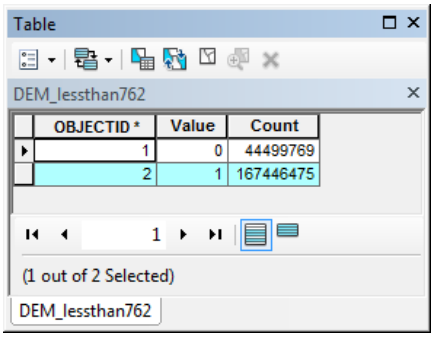


8. The output should look similar to the raster below.

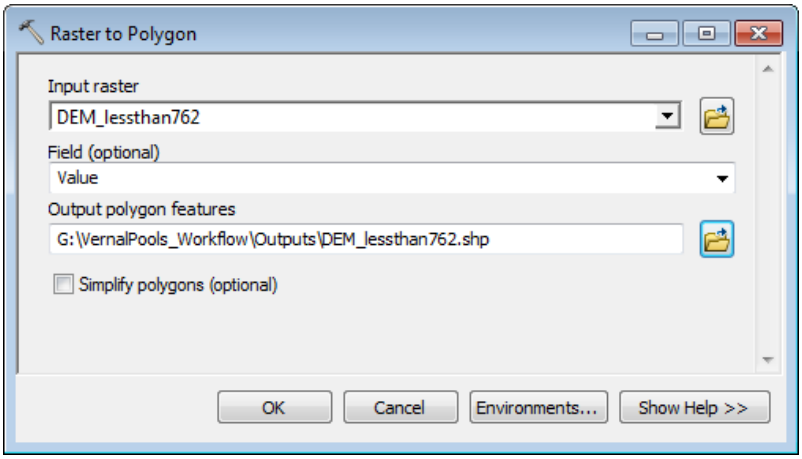


B. Select Sinks Based on Elevation Cutoff Raster

1. Right-click **DEM_lessthan762** in the TOC and click **Open Attribute Table**
2. Click on the far left of the second row to highlight it (see below)



3. Next, open the **Raster to Polygon** tool, which you can find in the ArcToolbox under **Conversion** and **From Raster**
4. Set DEM_lessthan762 as the **Input raster**.
5. Save the output in your outputs folder and name it **DEM_lessthan762.shp.**
6. Click **OK** (see below).



i. Now you have a polygon layer that contains only those areas less than or equal to 762 meters, or 2500 feet.

7. Click the **Geoprocessing** menu and select **Clip**
8. Set **PVPs_Final.shp** as the Input Feature.
9. Use the **DEM_lessthan762** shapefile as the Clip Feature.
10. Navigate to the Step2 folder and name the output **PVPs_Final_elev.shp**