FE 257 LAB 7

The Geodatabase
Working with Spatial Analyst
Calculating Elevation and Slope Values for Forested Roads, Streams, and Stands

In this lab you will work with the Spatial Analyst extension. The data for this lab come from McDonald Forest and will build upon our earlier data. We will be working with spatial data from the shapefiles we manipulated in Lab 6: McDonald Forest boundary, streams, roads, and stands.

Open Windows Explorer and navigate to the t:\teach\classes\fe257\gislab7 location on the forestry network. Right click on this folder and choose Copy from the menu that appears. Use Explorer to navigate to your workspace folder. For most of you this will be located on the N:\ drive and will have the same name as your user name- for me it's N:\nicolatk. Right click on your workspace folder and choose Paste from the menu that appears. This should copy the gislab7 folder and all enclosed data files into your workspace.

Importing Raster Files

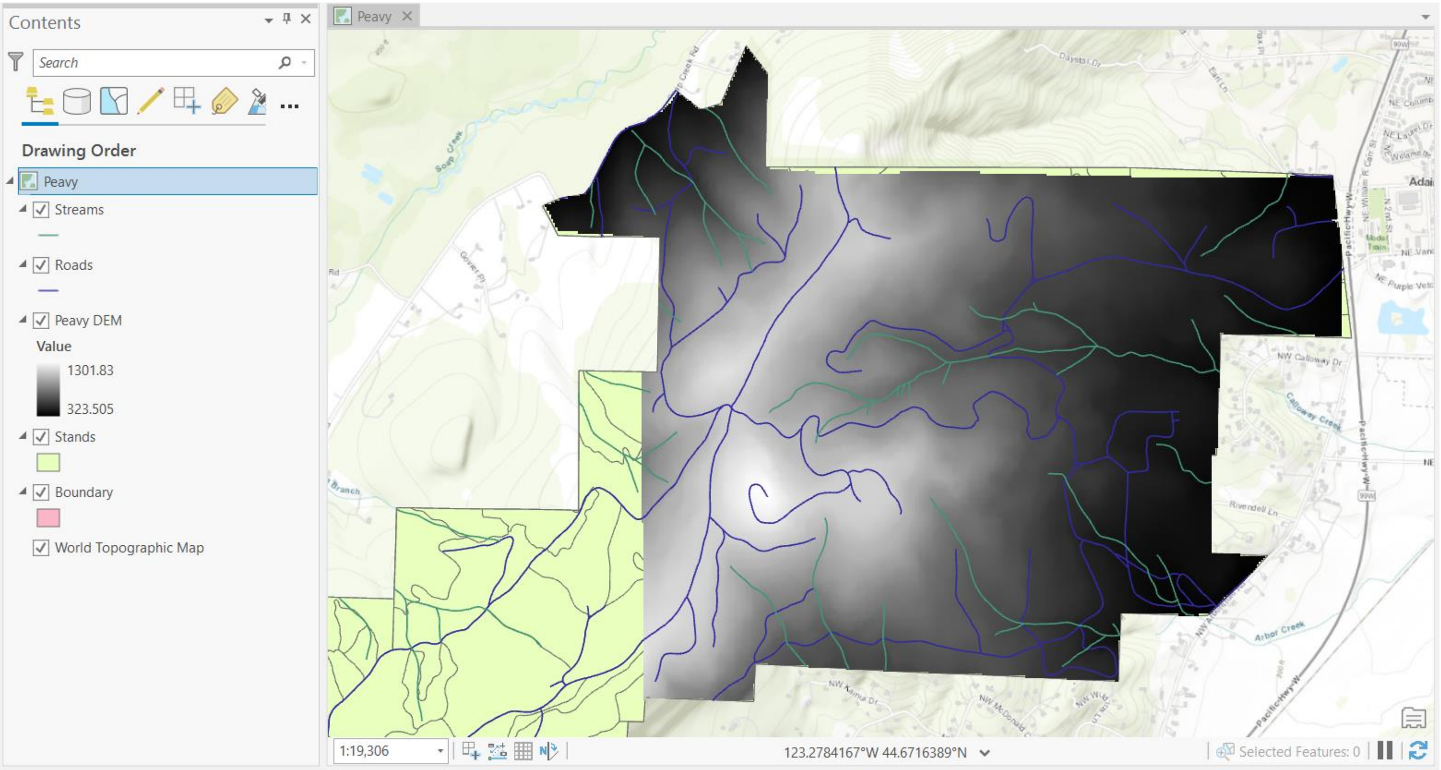
The DEM we will work with is from Peavy Arboretum in the McDonald Forest. It contains elevation values for the forest at a 10 m per cell side raster resolution. Measurement units within the layers you will work with are US survey feet.

Open ArcGIS Pro and start a new blank Map. Save it as Lab7.aprx in your gislab7 workspace.

If necessary, go to the Insert menu and choose the Add Folder button to establish a connection to your gislab7 folder.

Use the Add Data button to add boundary, roads, stands, streams and peavygrid to the data frame. Rename your data frame "Peavy" and the layers Boundary, Roads, Stands, Streams, and Peavy DEM.

Zoom to the extent of the layers you added. Reorder the layers so that Roads and Streams are overlaid on Peavy DEM.



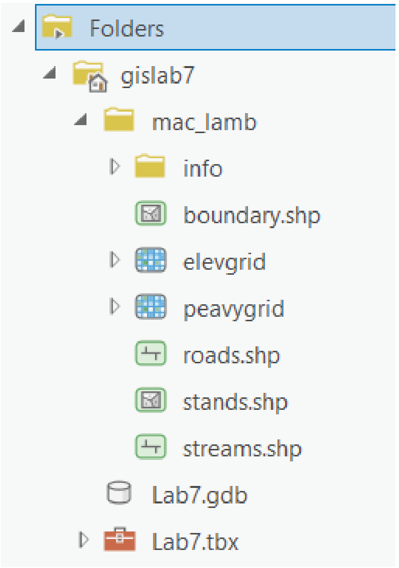
Using a Geodatabase

In this lab we will work with the ArcGIS spatial data structure called a geodatabase. The geodatabase is a multiuser relational database system and the primary format for spatial data editing and management (ESRI). A geodatabase acts as a container for all the files in your project. It is compatible with many different file types like shapefiles, tables, and rasters. The geodatabase also keeps track of relationships between these files and improves compatibility between datasets. Therefore, geodatabases increase geoprocessing and spatial modeling capabilities. Overall it is best practice to create a geodatabase for each project and fill it with your required files, perform spatial analyses within geodatabase, and save output files to the geodatabase.

ArcGIS Pro automatically creates an accompanying geodatabase for new projects. When you saved Lab7.aprx earlier, the program created a number of files associated with the project, for example a Toolbox (.tbx) file. You can view these files by opening Windows Explorer and browsing to your gislab7 folder. One of the accompanying files created with the Lab 7 project was Lab7.gdb. This is the geodatabase for Lab7.aprx. The geodatabase file extension is .gdb.

The Catalog module is the ArcGIS interface for working with geodatabases. Even though we will ultimately use the geodatabase Lab7.gdb, it is still important to know how to create a new geodatabase, so we will practice this process.

Make sure your Catalog window is visible on the right; if not, go to View > Catalog Pane. Browse to and expand the Folders list and find your gislab7 folder (it should automatically show up; if not, go to the Insert menu > Add Folder and connect to it). When you expand your gislab7 folder, Lab7.gdb, the mac_lamb folder and its enclosed files should appear in the folder, similar to the graphic below.



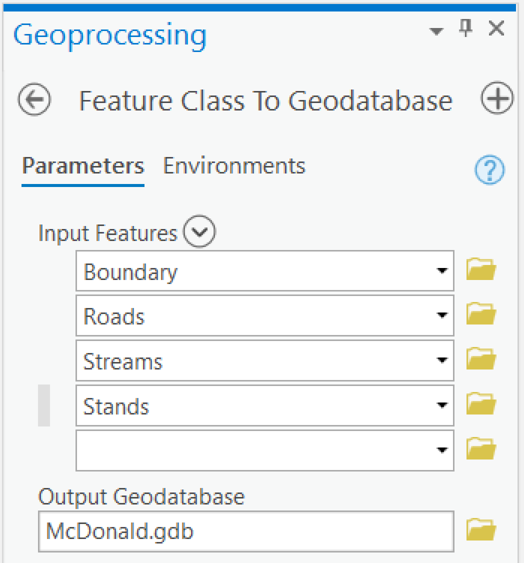
To practice creating a new geodatabase, right click on the gislab7 folder and select New > File Geodatabase. This will create a new geodatabase in the gislab7 folder that you can rename. However, we will use the premade Lab7.gdb for our project, so you can right click and Delete the new one you created since it was just for practice.

Rename Lab7.gdb to McDonald.gdb. Save your project.

Converting Shapefiles to Geodatabases

In the Catalog pane, right click on the boundary shapefile, choose Export, and select "Feature Class(es) to Geodatabase."

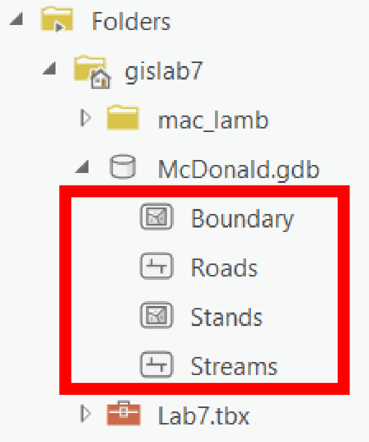
This will open a dialog box for converting multiple files into a geodatabase at the same time. Make the Input Features the four shapefiles in the mac_lamb folder: Boundary, Roads, Streams and Stands. Make the Output Geodatabase the McDonald geodatabase. Click Run.



Input Features
Boundary
Roads
Streams
Stands

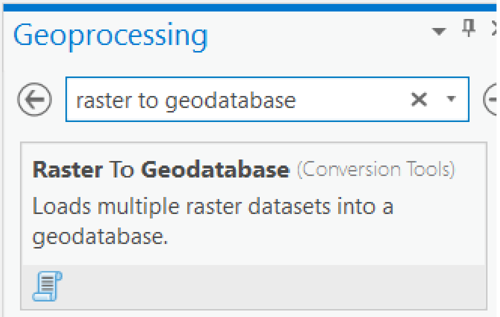
Output Geodatabase
McDonald.gdb

Save your project, close out of ArcGIS Pro, restart the program and reopen your project. In the Catalog pane you should now see the four shapefiles in the McDonald geodatabase. If you do not restart the program, you likely won't see the change in locations.



Converting Rasters to Geodatabases

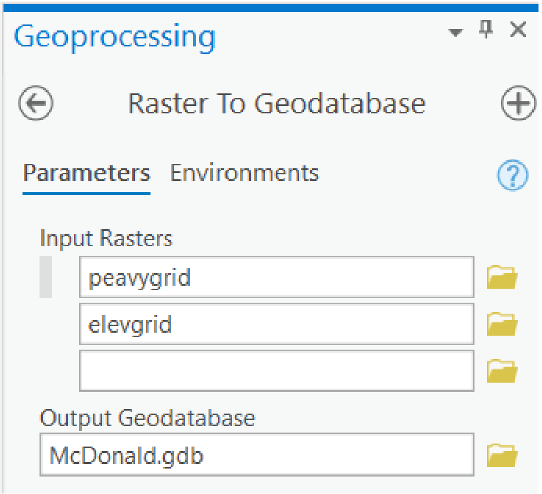
The raster peavygrid is in a different data format than the shapefiles and will need to be converted into the geodatabase separately. Unfortunately, the function to right click on the raster and convert it directly does not exist in ArcCatalog. Instead, search for the Raster to Geodatabase tool in the Geoprocessing window.



raster to geodatabase

Raster To Geodatabase (Conversion Tools)
Loads multiple raster datasets into a geodatabase.

In the dialog box that appears, browse to your mac_lamb folder and make peavygrid and elevgrid the Input Rasters. Browse to McDonald.gdb as the Output Geodatabase. Click Run.



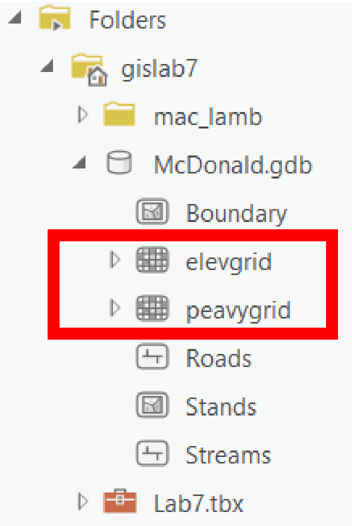
Geoprocessing

Raster To Geodatabase

Input Rasters: peavygrid
elevgrid

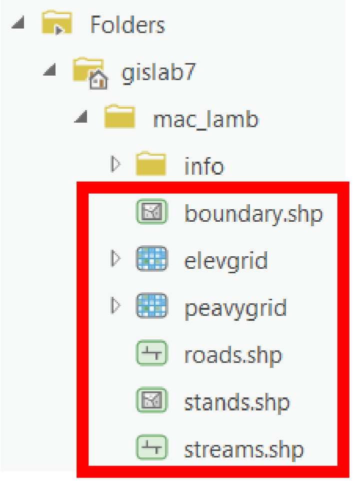
Output Geodatabase: McDonald.gdb

Save your project, close out of ArcGIS Pro, restart the program and reopen your project. In the Catalog pane you should now see the two rasters in the McDonald geodatabase. If you do not restart the program, you likely won't see the change in locations.



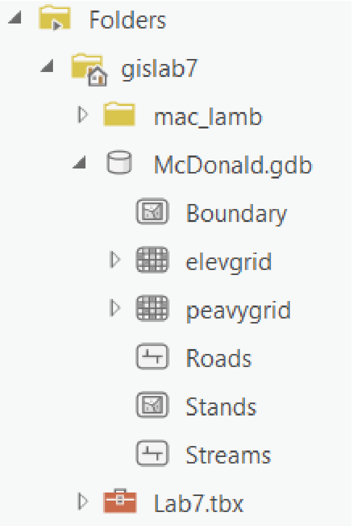
- Folders
  - gislab7
    - mac_lamb
    - McDonald.gdb
      - Boundary
      - elevgrid
      - peavygrid
      - Roads
      - Stands
      - Streams
    - Lab7.tbx

Delete the rasters and shapefiles from your mac_lamb folder. They should disappear from your Contents window.



- Folders
  - gislab7
    - mac_lamb
      - info
      - boundary.shp
      - elevgrid
      - peavygrid
      - roads.shp
      - stands.shp
      - streams.shp

You should now have a file structure that looks like the graphic below. We will work strictly within McDonald.gdb for the rest of the lab.

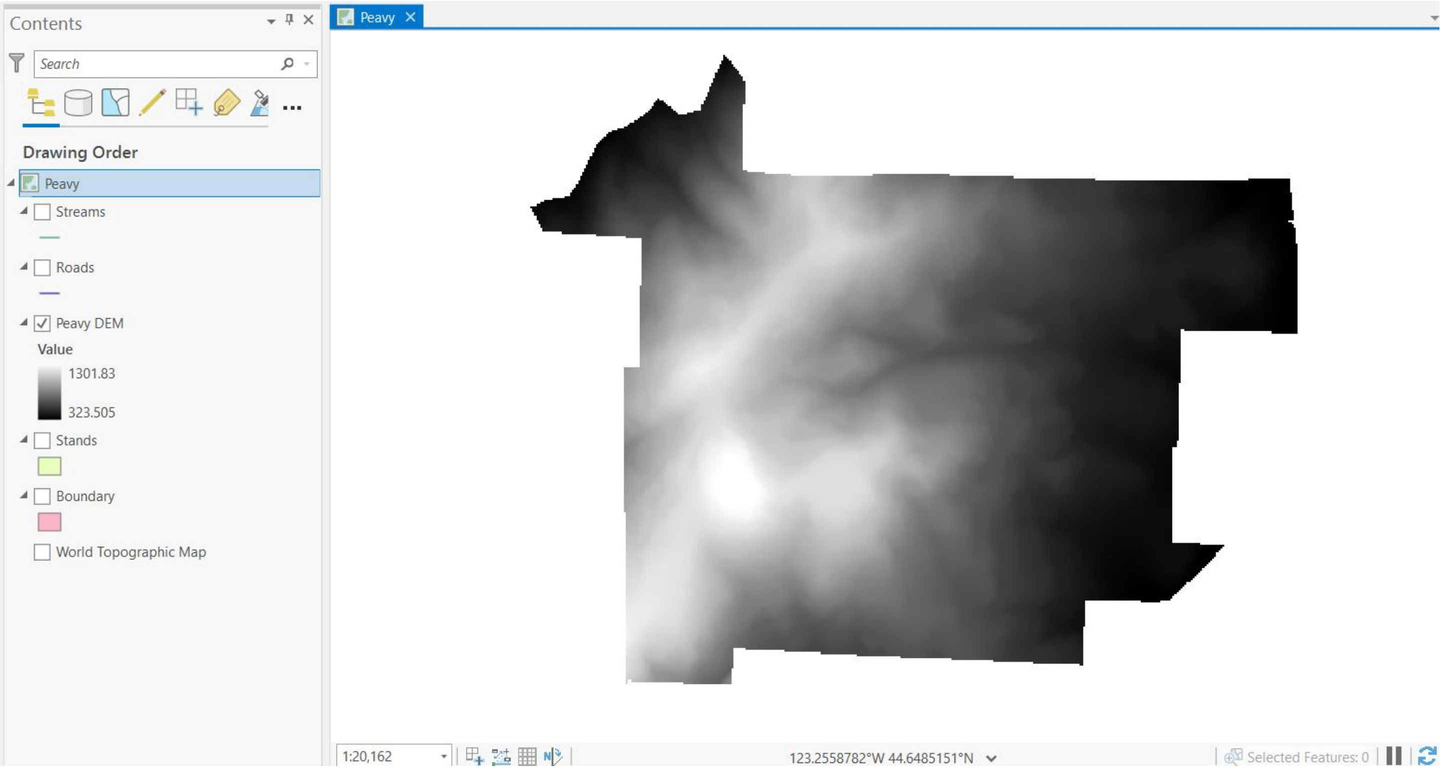


- Folders
  - gislab7
    - mac_lamb
    - McDonald.gdb
      - Boundary
      - elevgrid
      - peavygrid
      - Roads
      - Stands
      - Streams
    - Lab7.tbx

Go to Insert > Add Folder to connect to McDonald.gdb. Use the Add Data button to navigate to your McDonald geodatabase and add Boundary, Roads, Stands, Streams, and peavygrid to your Peavy data frame. **Don't worry about elevgrid for now; this file is for the homework.** Your data frame should look the same as before when you pulled the files from the mac_lamb folder.

If necessary, rename the files as you did in the middle of Page 1. Zoom to the extent of Peavy DEM and turn off all other layers from view.

Save your map project.



Accessing the Spatial Analyst Extension

The Spatial Analyst extension allows us to work with rasters and perform advanced analyses. The extension comes packaged with ArcGIS Pro provided you have paid for the additional software. If you haven't, you can purchase the Spatial Analyst extension at any time and add it to an ArcGIS product. Let's view this extension under Project > Licensing.

Esri Extensions

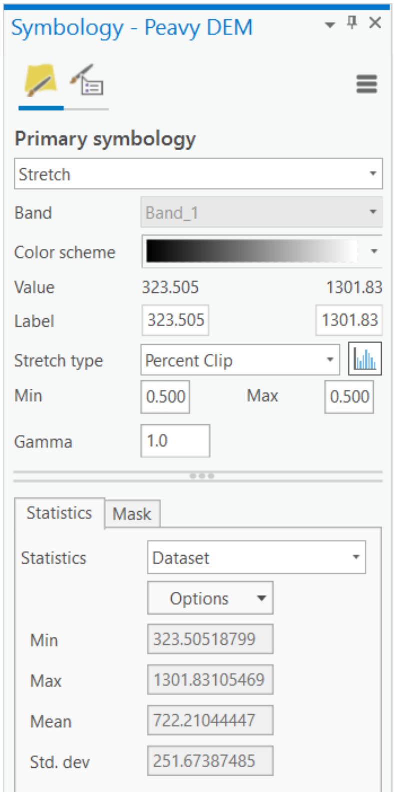
Name	Licensed	Expires
Location Referencing	Yes	8/1/2020
Maritime Bathymetry	No	N/A
Maritime Charting	Yes	8/1/2020
Network Analyst	Yes	8/1/2020
Production Mapping	Yes	8/1/2020
Publisher	Yes	8/1/2020
Spatial Analyst	Yes	8/1/2020
StreetMap Premium Asia Pacific	No	N/A
StreetMap Premium Europe	No	N/A

You can access the Spatial Analyst tools through the Geoprocessing window.

Examining DEMs

Similar to the way ArcGIS Pro displays shapefiles, a default legend is created when you add a raster grid to your Contents. The grid we're examining (Peavy DEM) is a digital elevation model (DEM) with each raster cell coded as an elevation value. The units displayed in the Contents legend are the elevation values. The units are US survey feet- you can't tell what the units are by just looking at the legend and/or DEM map- you have to look at the metadata or projection information for Peavy DEM.

We can alter Peavy DEM's symbology by right clicking on it in the Contents window and selecting Properties > Symbology.



Symbology - Peavy DEM

Primary symbology

Stretch

Band: Band_1

Color scheme

Value: 323.505 1301.83

Label: 323.505 1301.83

Stretch type: Percent Clip

Min: 0.500 Max: 0.500

Gamma: 1.0

Statistics Mask

Statistics: Dataset

Options

Min: 323.50518799

Max: 1301.83105469

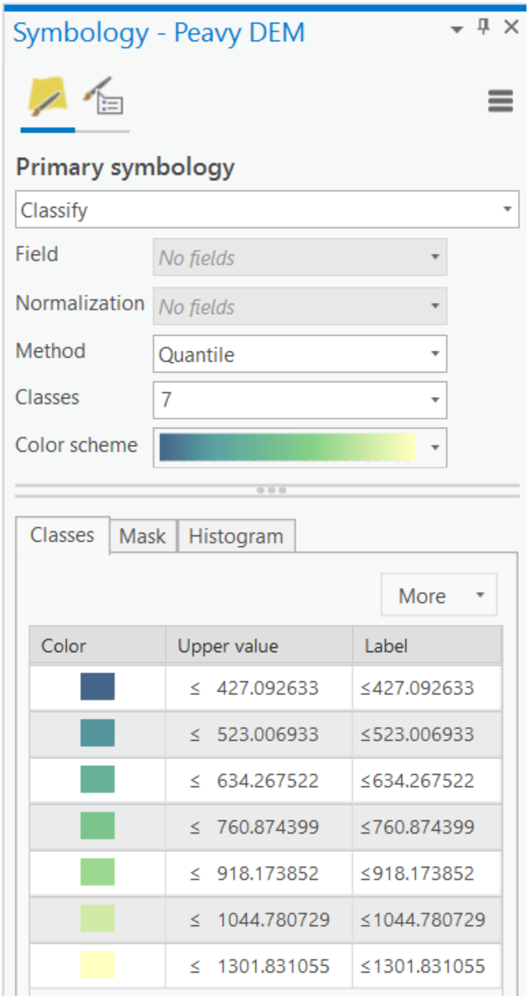
Mean: 722.21044447

Std. dev: 251.67387485

By default, ArcMap uses a continuous ("stretched") grayscale to represent the elevation values. By looking at the information in the Symbology tab, we can see that high elevation values are shaded lightly while low values are dark. In addition, we see the minimum and maximum elevation values.

We can use the Symbology interface to alter the raster grid's display. In the Primary Symbology box, choose Classify. This will allow us to split the elevation values into categories rather treating them continuously.

Set the number of classes to 7 and change the Method from Natural Breaks to Quantile. This should create seven categories, organized from low to high, each with an equal number of observations (pixels per class). Choose a color ramp from the Color Scheme drop down that effectively communicates the elevation gradient across quantiles.



Primary symbology: Classify

Field: No fields

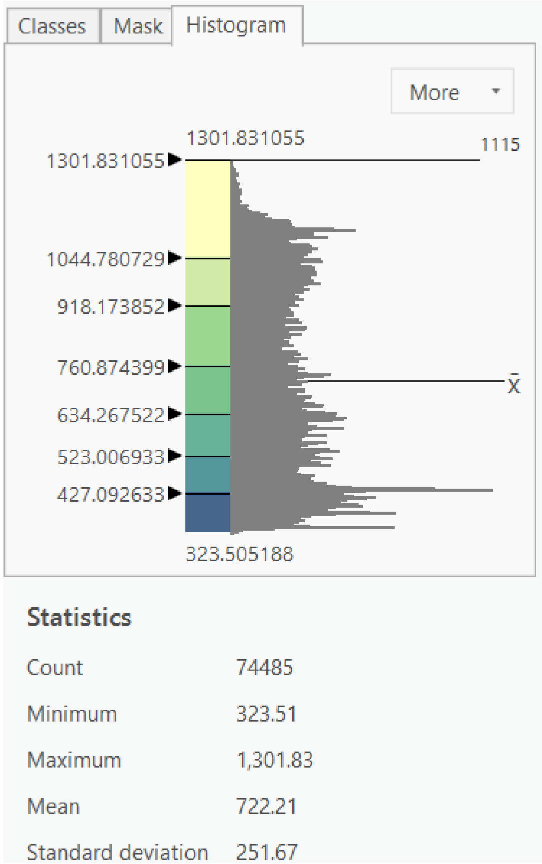
Normalization: No fields

Method: Quantile

Classes: 7

Color	Upper value	Label
🟦	≤ 427.092633	≤427.092633
🟦	≤ 523.006933	≤523.006933
🟩	≤ 634.267522	≤634.267522
🟩	≤ 760.874399	≤760.874399
🟩	≤ 918.173852	≤918.173852
🟩	≤ 1044.780729	≤1044.780729
🟨	≤ 1301.831055	≤1301.831055

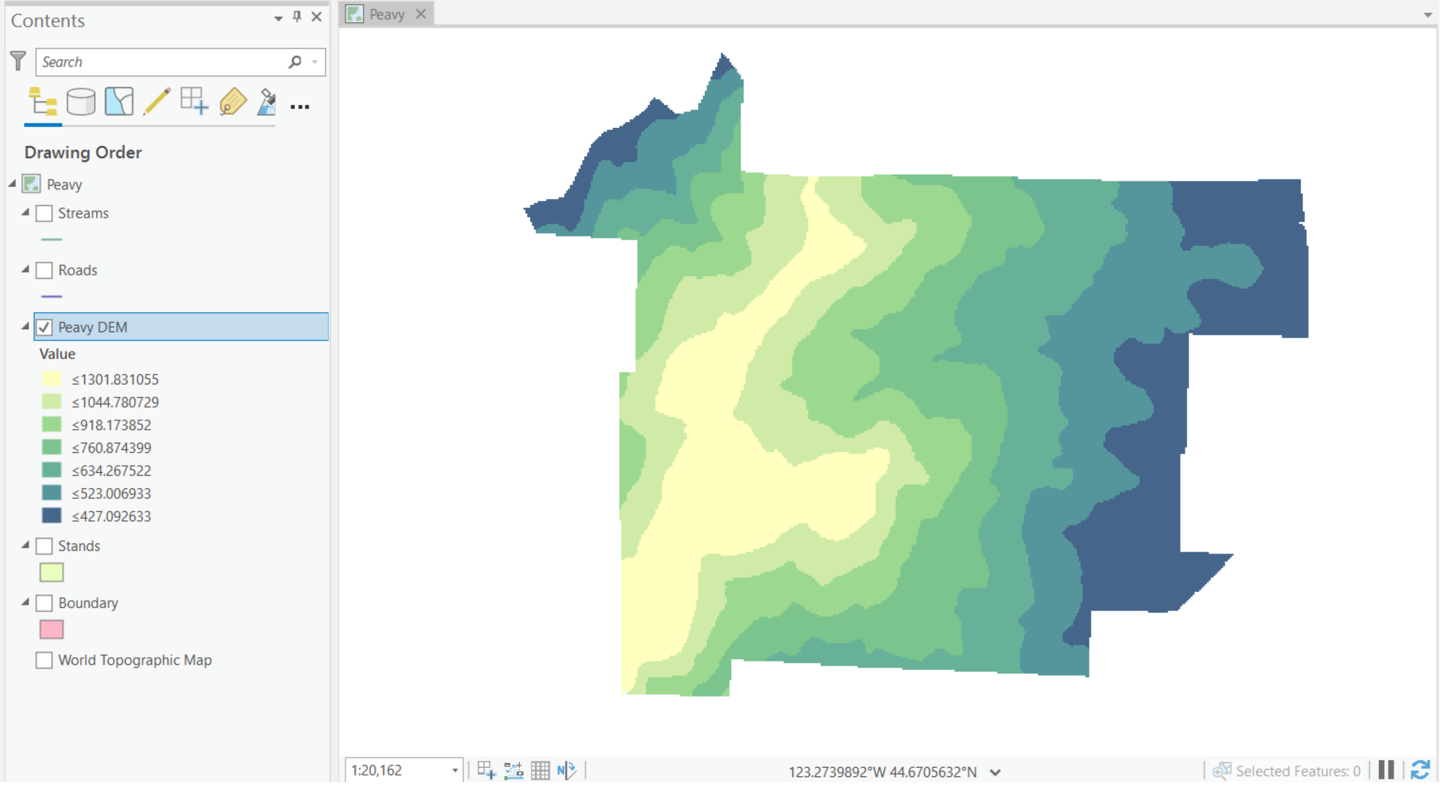
One of the unique features of this dialog box is being able to see the distribution of cell values under the Histogram tab. You can experiment with the "More" drop down menu to show statistics, reverse symbol order and reverse values according to your display preferences.



Statistics

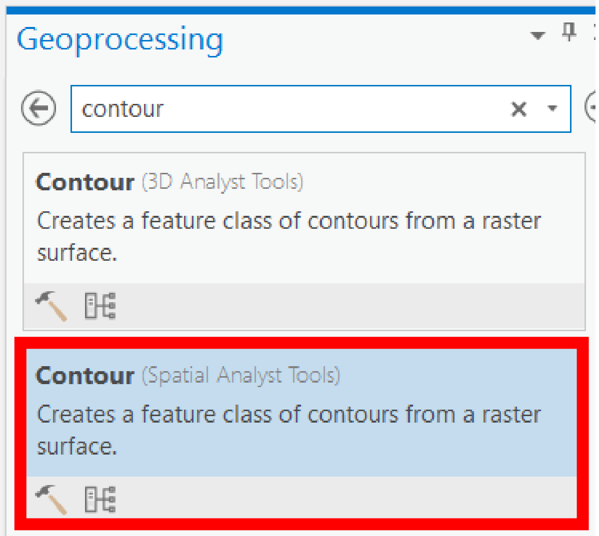
Count	74485
Minimum	323.51
Maximum	1,301.83
Mean	722.21
Standard deviation	251.67

When finished your interface should resemble the graphic below.



Creating Elevation Contours

Let's create elevation contours that approximate the 40-foot intervals used by the USGS 7.5-minute quadrangle series maps. We'll need to access Spatial Analyst functions through the Geoprocessing window. Search for Contour and select the Spatial Analyst Tools option.

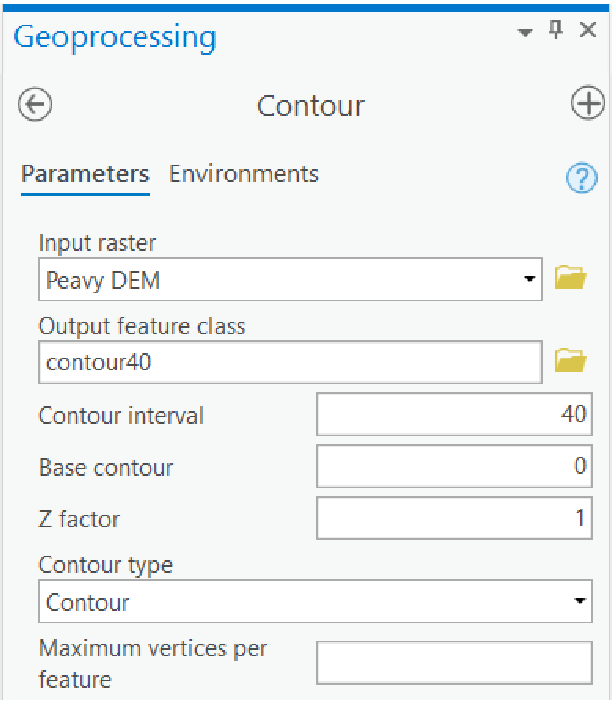


contour

Contour (3D Analyst Tools)
Creates a feature class of contours from a raster surface.

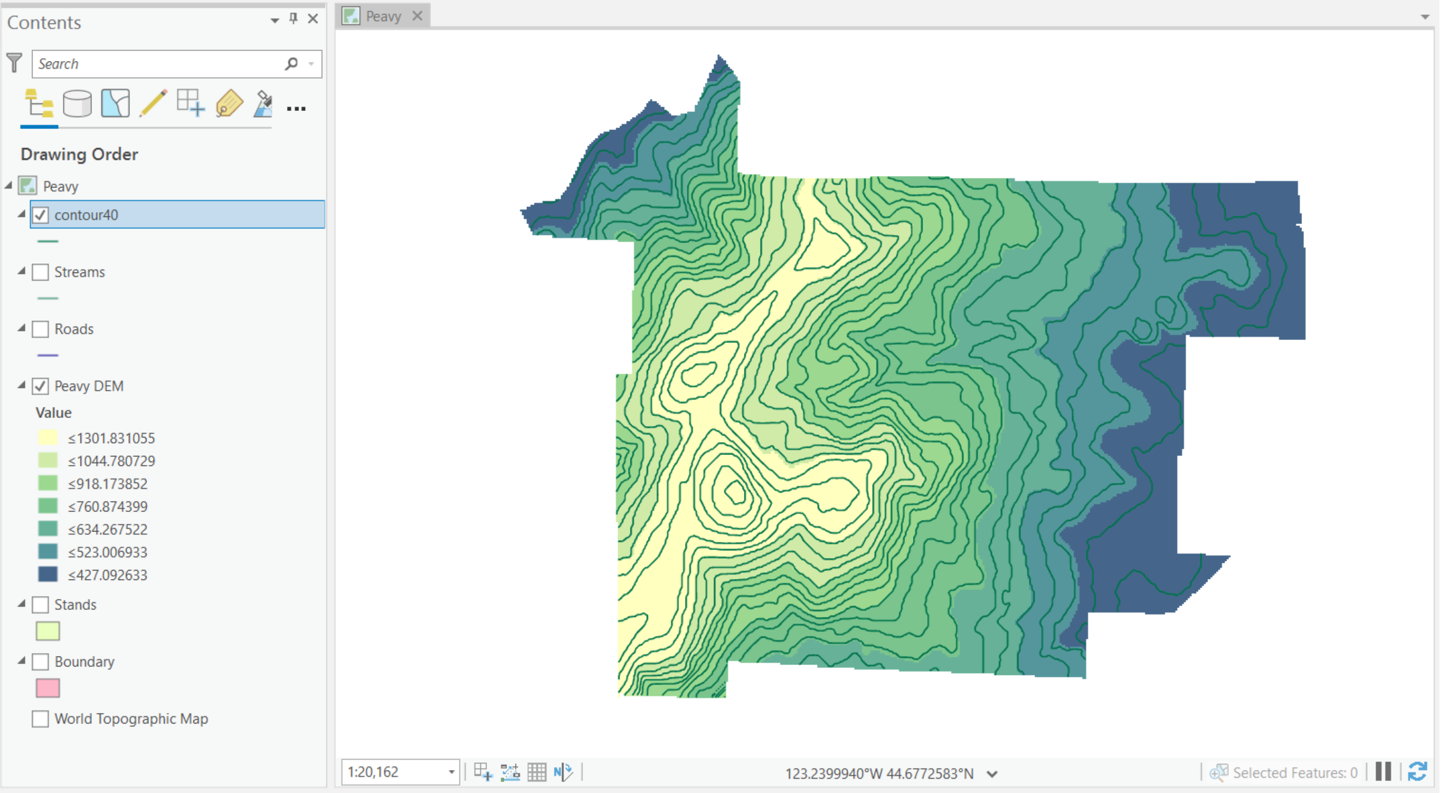
Contour (Spatial Analyst Tools)
Creates a feature class of contours from a raster surface.

The Input Surface is a reference to the dataset we are basing our contours on, Peavy DEM. Set the Contour Interval to 40 and direct the output to your McDonald geodatabase with the name contour40.

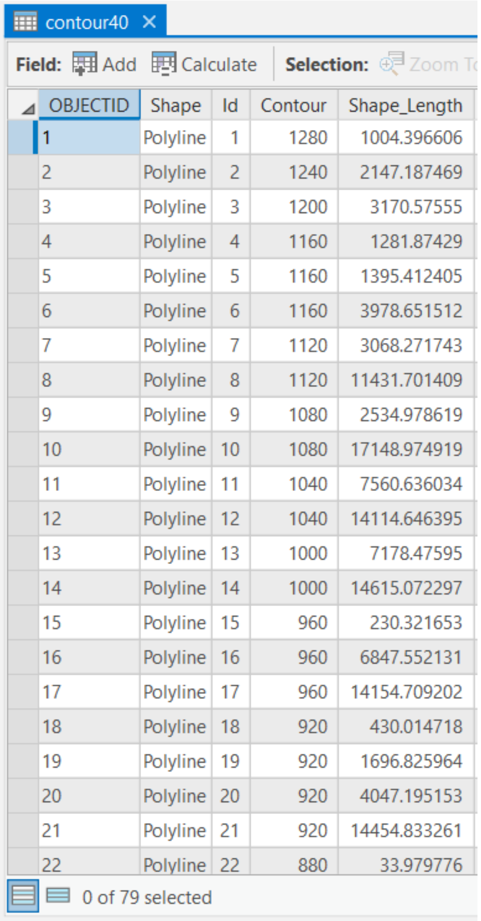


Input raster: Peavy DEM
Output feature class: contour40
Contour interval: 40
Base contour: 0
Z factor: 1
Contour type: Contour
Maximum vertices per feature:

A new layer from this process should be added to your Contents.



Open the attribute table for contour40 and notice that an elevation value (CONTOUR) was added to each row.



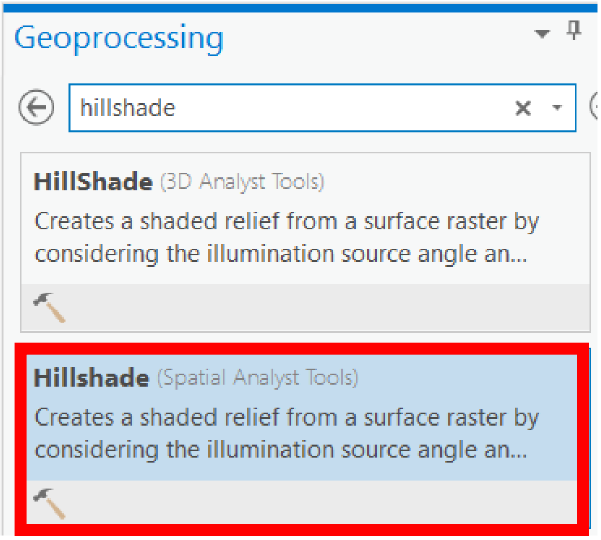
OBJECTID	Shape	Id	Contour	Shape_Length
1	Polyline	1	1280	1004.396606
2	Polyline	2	1240	2147.187469
3	Polyline	3	1200	3170.57555
4	Polyline	4	1160	1281.87429
5	Polyline	5	1160	1395.412405
6	Polyline	6	1160	3978.651512
7	Polyline	7	1120	3068.271743
8	Polyline	8	1120	11431.701409
9	Polyline	9	1080	2534.978619
10	Polyline	10	1080	17148.974919
11	Polyline	11	1040	7560.636034
12	Polyline	12	1040	14114.646395
13	Polyline	13	1000	7178.47595
14	Polyline	14	1000	14615.072297
15	Polyline	15	960	230.321653
16	Polyline	16	960	6847.552131
17	Polyline	17	960	14154.709202
18	Polyline	18	920	430.014718
19	Polyline	19	920	1696.825964
20	Polyline	20	920	4047.195153
21	Polyline	21	920	14454.833261
22	Polyline	22	880	33.979776

0 of 79 selected

Close the table and save your project.

Creating a Shaded Relief Map

A shaded relief map displays the landscape topography. The result approximates a 3D scene. You can create one of these by searching for Hillshade in the Geoprocessing window and choosing the Spatial Analyst Tools option.

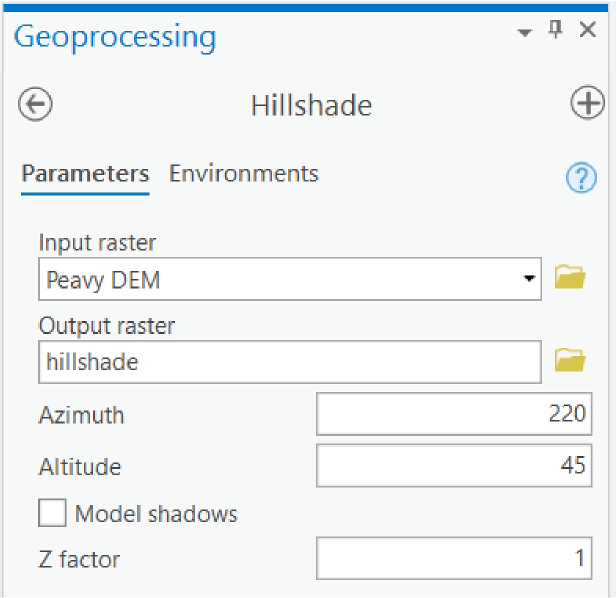


hillshade

HillShade (3D Analyst Tools)
Creates a shaded relief from a surface raster by considering the illumination source angle an...

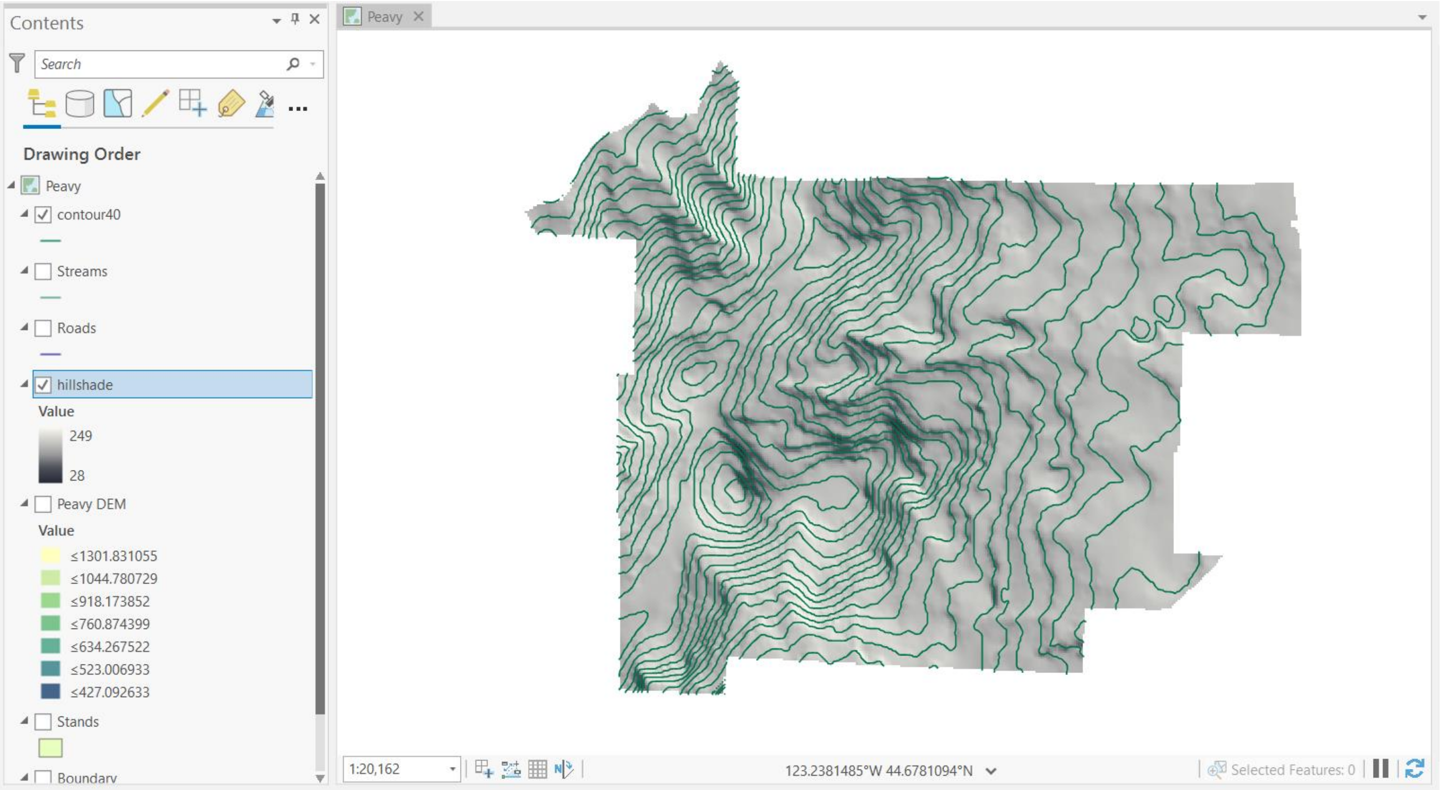
Hillshade (Spatial Analyst Tools)
Creates a shaded relief from a surface raster by considering the illumination source angle an...

A dialog box will open where you can manipulate the direction and height of the illumination source. The Azimuth describes the angle, relative to the landscape, from which the landscape will be illuminated. The Altitude describes the vertical angle of the sun- a low small angle would approximate morning or evening times whereas a large angle would be closer to noon. The z factor allows us to exaggerate the relief effect. Let's change the Azimuth to 220 but accept the other defaults. Direct the output raster to your geodatabase and title it hillshade. Click Run.



Input raster: Peavy DEM
Output raster: hillshade
Azimuth: 220
Altitude: 45
☐ Model shadows
Z factor: 1

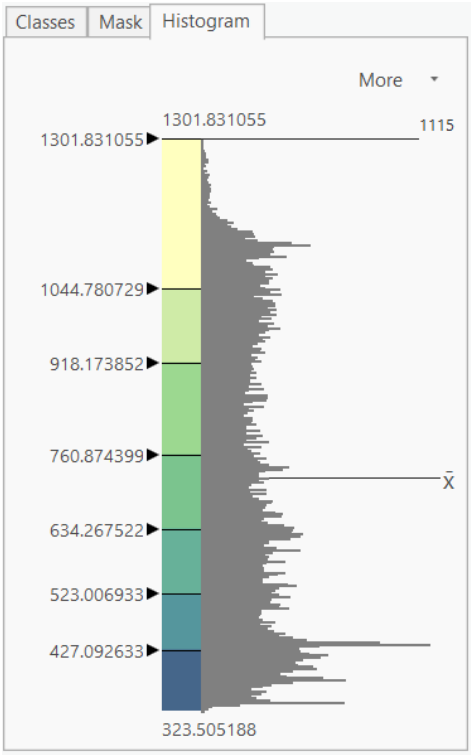
This should add a new layer to your Contents. Your map should look similar to the one below. You may want to toggle the contour layer off to get a closer look at your landscape surface.



Save your project.

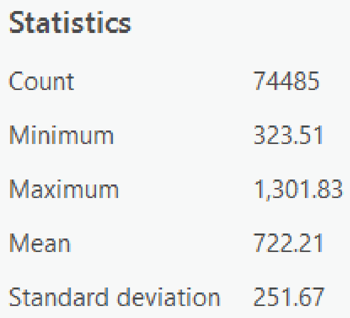
Examining Histograms

Let’s turn both of these new layers off (contour40 and hillshade) and find out more about the Peavy DEM layer. Right click on the Peavy DEM layer in the Contents window to reopen the Symbology tab. In the lower part of the Symbology window, click the Histogram tab to return to the image featured on Page 8. Click the More drop-down menu to experiment with reversing symbol order and values to your liking.



Our histogram tells us that we had seven elevation categories. Since we chose a quantile classification method, we should have an equal number of observations in each category. Bear in mind that if we changed the classification method, these results would change too.

Click on the More drop down and select Show Statistics to bring up the raster statistics.



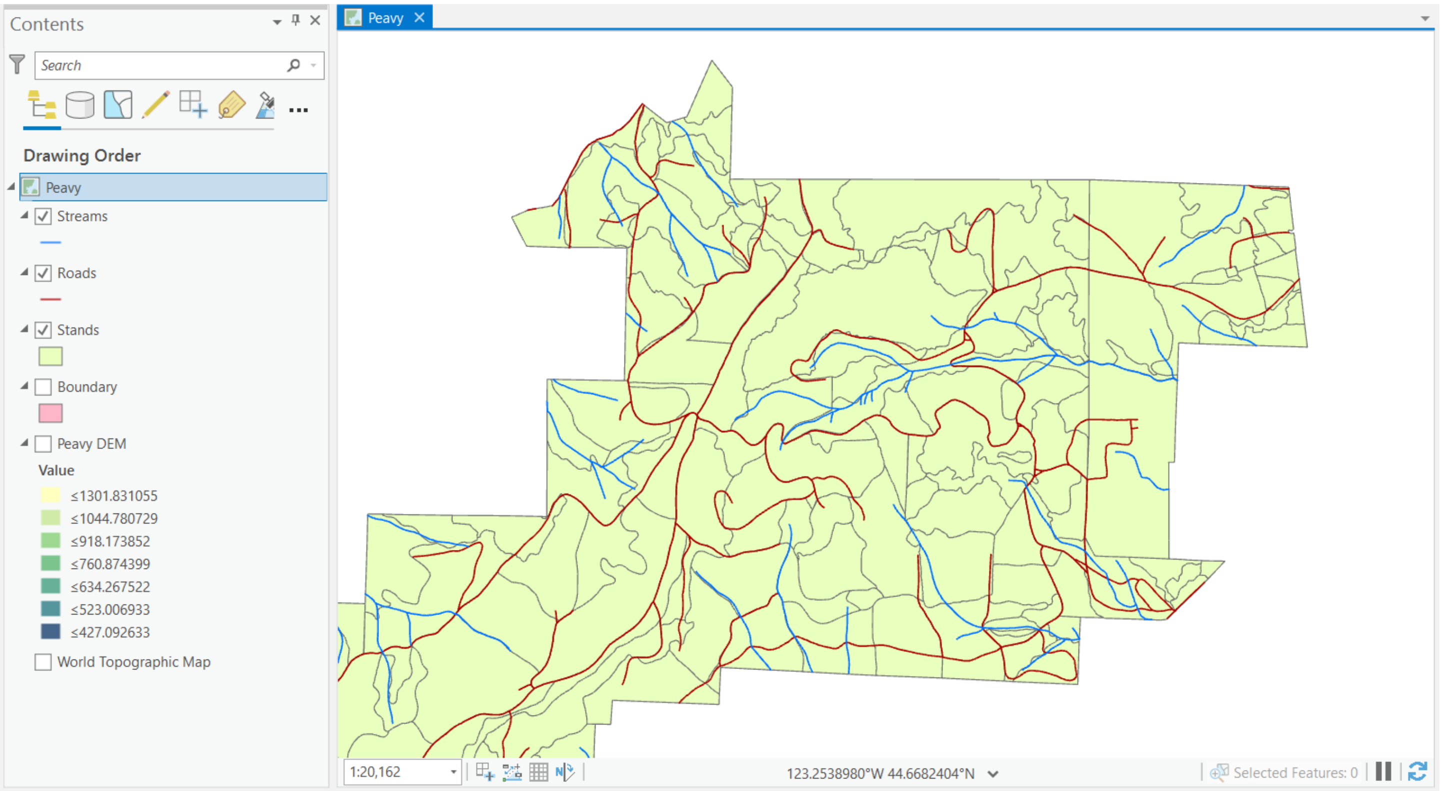
Statistics

Count	74485
Minimum	323.51
Maximum	1,301.83
Mean	722.21
Standard deviation	251.67

Close the Symbology window.

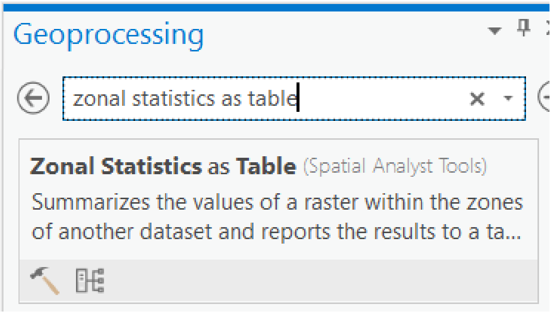
Let’s do some clean-up at this point. First delete the contour40 and hillshade layers by right clicking on them and choosing Remove. Make sure the Stands layer in your Contents is below the Streams and Roads layers but above the Peavy DEM layer. Make the Stands, Streams, and Roads visible.

Save your project.



Analyzing Vector and Raster Data Simultaneously

One of the useful features of Spatial Analyst is its ability to work with vector data and raster grids in the same analysis. The Roads, Streams, and Stands layers are all vector files but we can extract information from the Peavy DEM layer that relates to these vector layers. Let’s find out what the average elevation of the stand units in this area are. Search for Zonal Statistics as Table from the Geoprocessing window.

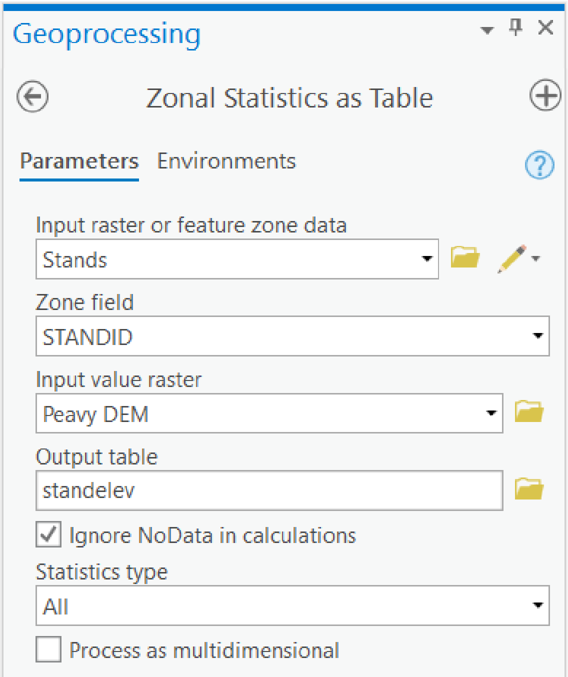

Geoprocessing

zonal statistics as table

Zonal Statistics as Table (Spatial Analyst Tools)

Summarizes the values of a raster within the zones of another dataset and reports the results to a ta...

Choose Stands as the Input Feature Zone Data. We need to pick a variable from the Stands attribute table that uniquely identifies each stand unit: STANDID. Make this selection for the Zone Field. By default, Peavy DEM should be the Value raster but make a change if something else is selected in your project. Direct the output to McDonald.gdb, name the output “standelev,” and click Run.


Geoprocessing

Zonal Statistics as Table

Input raster or feature zone data: Stands

Zone field: STANDID

Input value raster: Peavy DEM

Output table: standelev

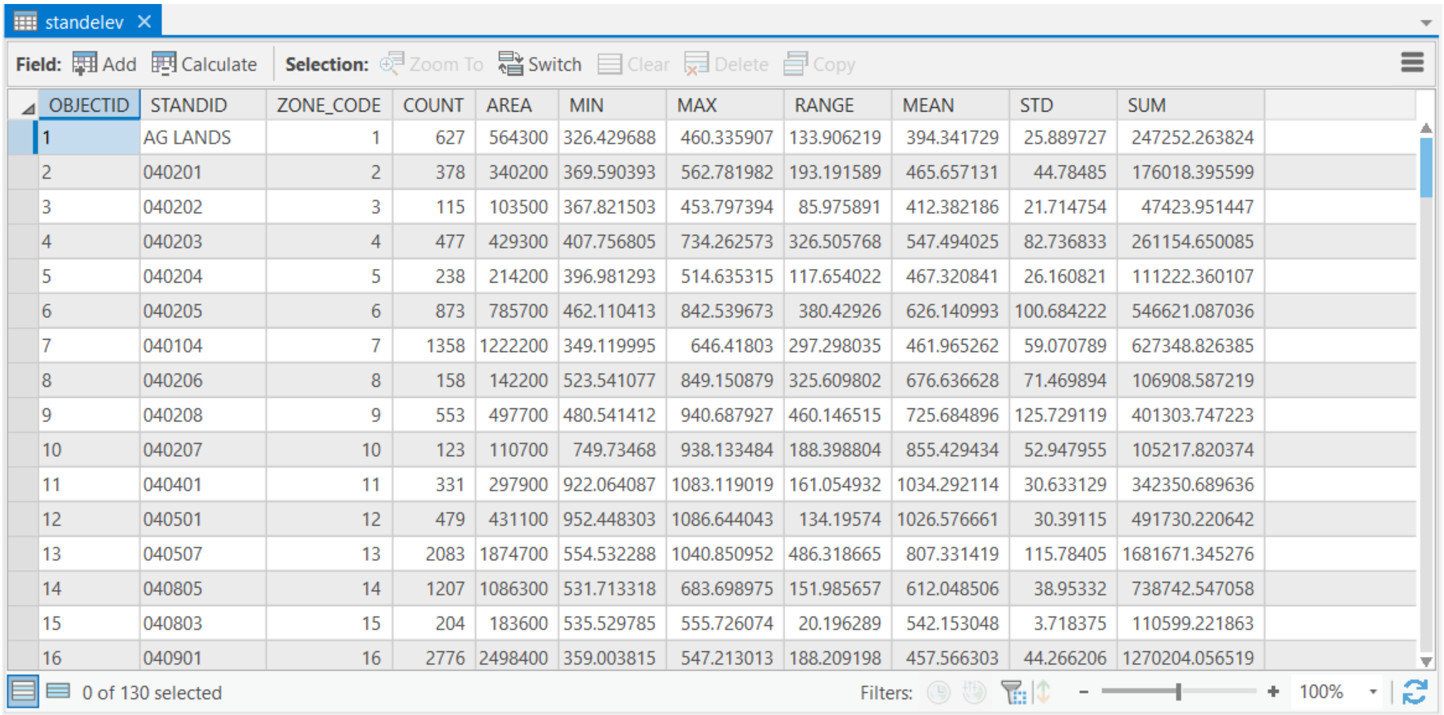
☑ Ignore NoData in calculations

Statistics type: All

☐ Process as multidimensional

Our operation above told the Spatial Analyst to look at each of the polygons in the Stands layer as identified by the field STANDID. If two polygons shared the same attribute for this field, they would be treated as a single polygon or zone. The values from the raster selected for the Input Value Raster Field (Peavy DEM) will be summarized for each of the polygons or zones that the raster cells overlap.

Open the standelev table you just created.



OBJECTID	STANDID	ZONE_CODE	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
1	AG LANDS	1	627	564300	326.429688	460.335907	133.906219	394.341729	25.889727	247252.263824
2	040201	2	378	340200	369.590393	562.781982	193.191589	465.657131	44.78485	176018.395599
3	040202	3	115	103500	367.821503	453.797394	85.975891	412.382186	21.714754	47423.951447
4	040203	4	477	429300	407.756805	734.262573	326.505768	547.494025	82.736833	261154.650085
5	040204	5	238	214200	396.981293	514.635315	117.654022	467.320841	26.160821	111222.360107
6	040205	6	873	785700	462.110413	842.539673	380.42926	626.140993	100.684222	546621.087036
7	040104	7	1358	1222200	349.119995	646.41803	297.298035	461.965262	59.070789	627348.826385
8	040206	8	158	142200	523.541077	849.150879	325.609802	676.636628	71.469894	106908.587219
9	040208	9	553	497700	480.541412	940.687927	460.146515	725.684896	125.729119	401303.747223
10	040207	10	123	110700	749.73468	938.133484	188.398804	855.429434	52.947955	105217.820374
11	040401	11	331	297900	922.064087	1083.119019	161.054932	1034.292114	30.633129	342350.689636
12	040501	12	479	431100	952.448303	1086.644043	134.19574	1026.576661	30.39115	491730.220642
13	040507	13	2083	1874700	554.532288	1040.850952	486.318665	807.331419	115.78405	1681671.345276
14	040805	14	1207	1086300	531.713318	683.698975	151.985657	612.048506	38.95332	738742.547058
15	040803	15	204	183600	535.529785	555.726074	20.196289	542.153048	3.718375	110599.221863
16	040901	16	2776	2498400	359.003815	547.213013	188.209198	457.566303	44.266206	1270204.056519

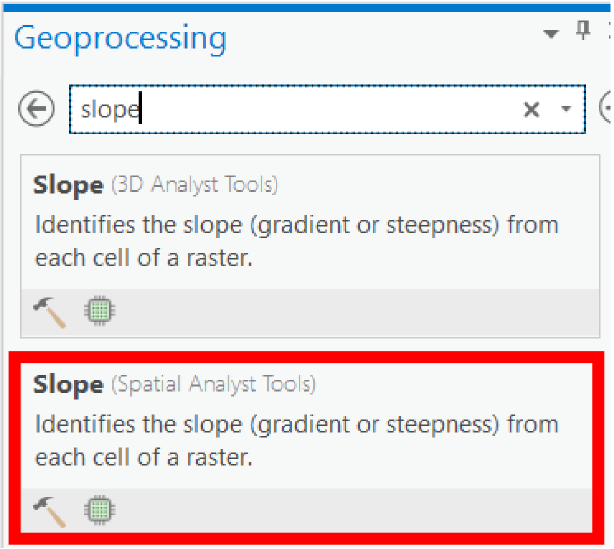
0 of 130 selected

The script at the bottom of the window tells us that we have 130 records represented.

The first column gives us the STANDID number or unique stand unit identifier. Subsequent columns display the number of raster grid cells per stand unit, the area of the unit in square feet, and some summary statistics of elevation ranges for each unit. For example, we know that stand unit 040201 (the second stand record in the display above) averages 466 feet in elevation. After you're done browsing through this table, close it.

Calculating and Analyzing Slope

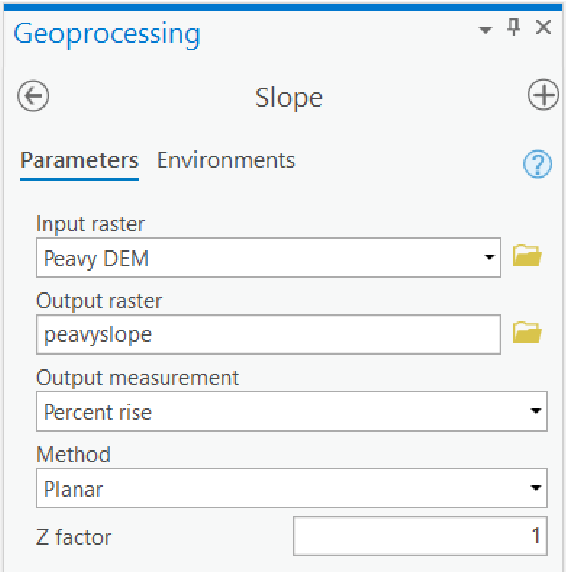
We can also use Spatial Analyst to create a slope surface from a DEM. In the Geoprocessing window, search for Slope and select the Spatial Analyst Tools option.



Slope (3D Analyst Tools)
Identifies the slope (gradient or steepness) from each cell of a raster.

Slope (Spatial Analyst Tools)
Identifies the slope (gradient or steepness) from each cell of a raster.

The Input Raster is Peavy DEM. Direct the output to McDonald.gdb and name it peavyslope. Change the Output measurement to Percent Rise - this will give us slope values as a percent rather than degrees. Click Run.



Input raster: Peavy DEM

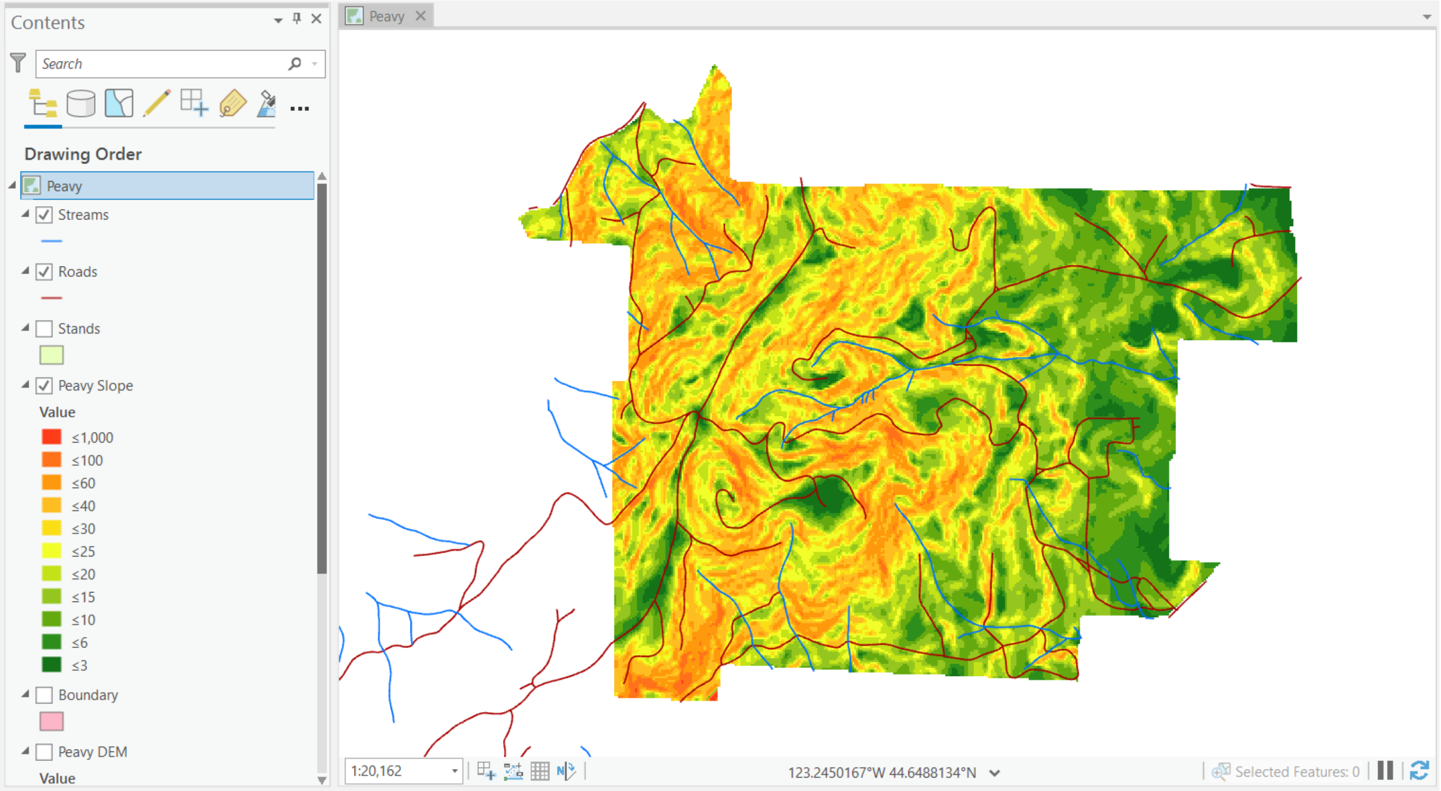
Output raster: peavyslope

Output measurement: Percent rise

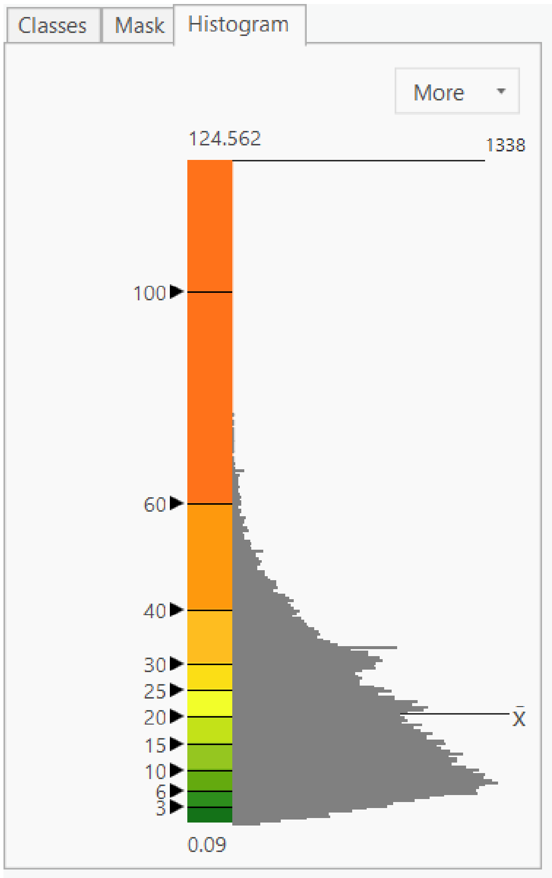
Method: Planar

Z factor: 1

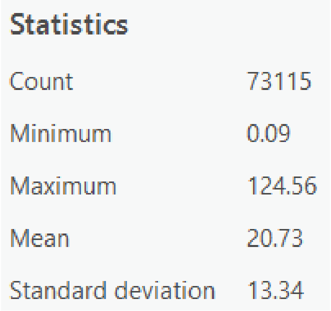
Rename the new layer Peavy Slope. Take a look at the new layer (you may have to turn the Stands layer off to see it). The legend automatically gives us eleven slope categories.



We can use a histogram to better understand the distribution of slope values. Right click on Peavy Slope > Symbology. In the lower part of the Symbology window, click the Histogram tab. Click the More drop-down menu to experiment with reversing symbol order and values to your liking.



The histogram tells us that the majority of the area contains slopes in the first few categories (the lowest percent rise, therefore the lowest slope gradient). What would happen if we only had 9 percent rise categories, or 5? Click on the More drop down and select Show Statistics to bring up the raster statistics.



Statistics

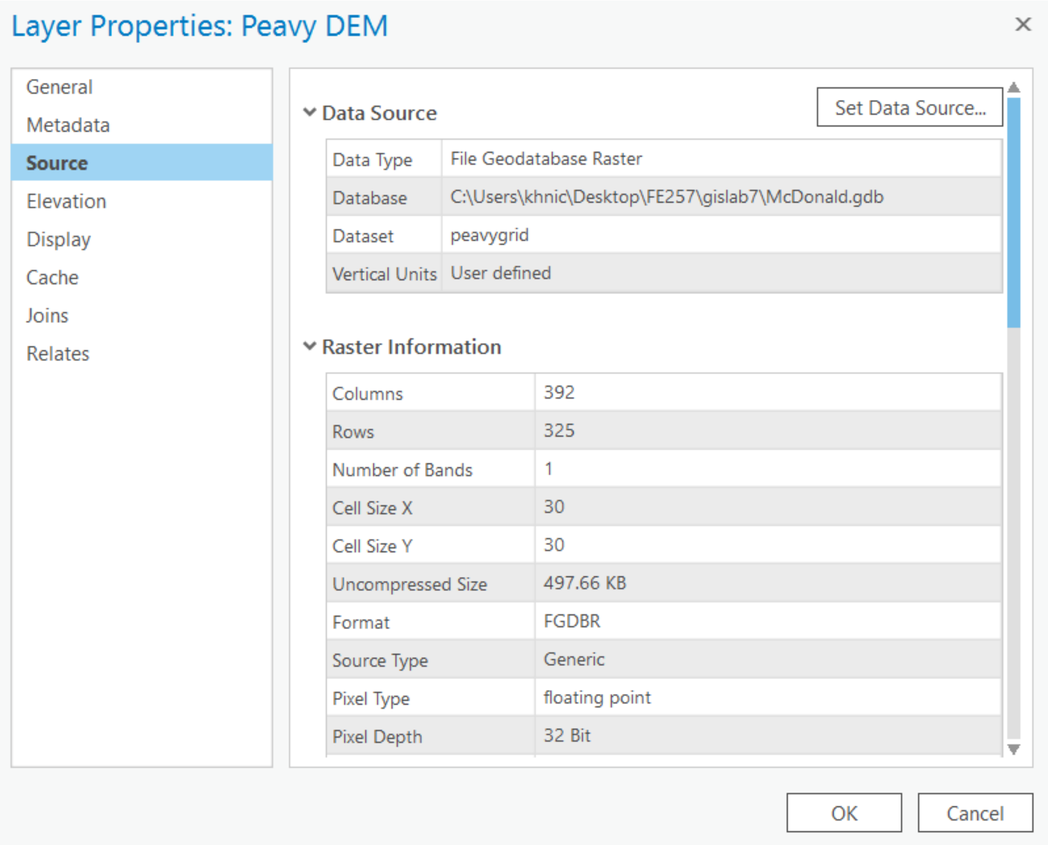
Count	73115
Minimum	0.09
Maximum	124.56
Mean	20.73
Standard deviation	13.34

Close the Symbology window.

Save your project.

Raster Properties

From the Contents, right click Peavy DEM > Properties > Source tab. This opens a window telling you more information about the raster construction. The Source window tells you where this raster is stored, its resolution, coordinate system, and much more.



Layer Properties: Peavy DEM

Data Source

Data Type	File Geodatabase Raster
Database	C:\Users\khnic\Desktop\FE257\gislab7\McDonald.gdb
Dataset	peavygrid
Vertical Units	User defined

Raster Information

Columns	392
Rows	325
Number of Bands	1
Cell Size X	30
Cell Size Y	30
Uncompressed Size	497.66 KB
Format	FGDBR
Source Type	Generic
Pixel Type	floating point
Pixel Depth	32 Bit

We can also tell that this is a permanent raster. When we use the Spatial Analyst to create new rasters without specifying an output location and file name, temporary rasters are usually created. Temporary rasters will typically be erased when you close your ArcGIS Pro session.

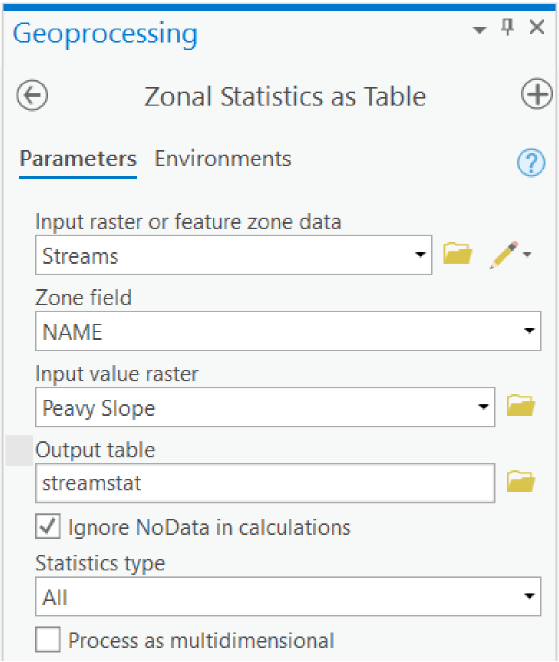
There is also much information in the area below the Raster Information box. Most importantly is the Pixel Type field that tells us this is a Floating Point (or decimal place) raster. This means that there is no attribute table available for us to edit because values are continuous. If this were an integer raster, such as you would find with a discrete nominal or character variable, we would have access to an attribute table (like a shapefile). Cell size lists the number of units, feet in this case, per cell, and rows and columns sizes convey information about the size of this raster. Click OK.

Save your map document before moving on.

Calculating Average Slope Gradient

As we just practiced, a unique Spatial Analyst feature is its ability to work with vector and raster layers in the same analysis. Let’s test this feature again by calculating the average slope for streams in the Peavy area. Search for Zonal Statistics as Table in the Geoprocessing Window.

The Input Feature Zone Data is Streams, the Zone Field should be NAME, and the Input Value Raster is Peavy Slope. Save the output to McDonald.gdb and name it “streamstat.”



Zonal Statistics as Table

Input raster or feature zone data: Streams

Zone field: NAME

Input value raster: Peavy Slope

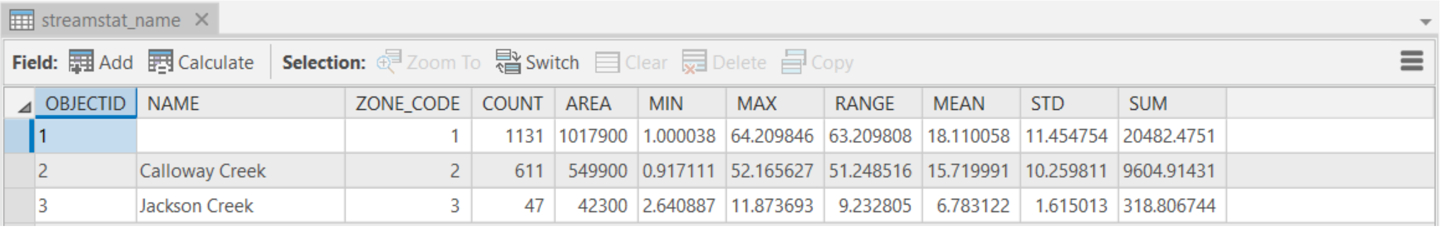
Output table: streamstat

☑ Ignore NoData in calculations

Statistics type: All

☐ Process as multidimensional

Open the streamstat table you just made. It should look like this:



OBJECTID	NAME	ZONE_CODE	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
1		1	1131	1017900	1.000038	64.209846	63.209808	18.110058	11.454754	20482.4751
2	Calloway Creek	2	611	549900	0.917111	52.165627	51.248516	15.719991	10.259811	9604.91431
3	Jackson Creek	3	47	42300	2.640887	11.873693	9.232805	6.783122	1.615013	318.806744

The results show that only two named streams exist in our current study area. Close this attribute table.

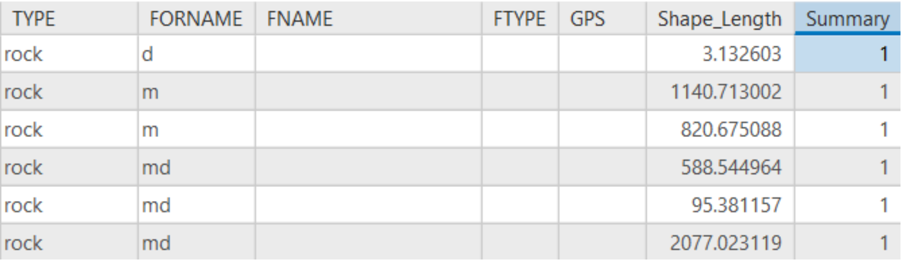
Now calculate slope values for all the roads in our study area to produce a single set of statistics for all roads. First we need to create a common field in the Roads dataset to summarize on. Open the attribute table for the Roads layer and choose Add Field from the Options button.

Enter “Summary” as the Field Name, change the Data Type to Short Integer and accept all other Defaults. Click Save in the Fields toolbar.

🟩	☑	☐	Summary	Short	☑	☐				🟦

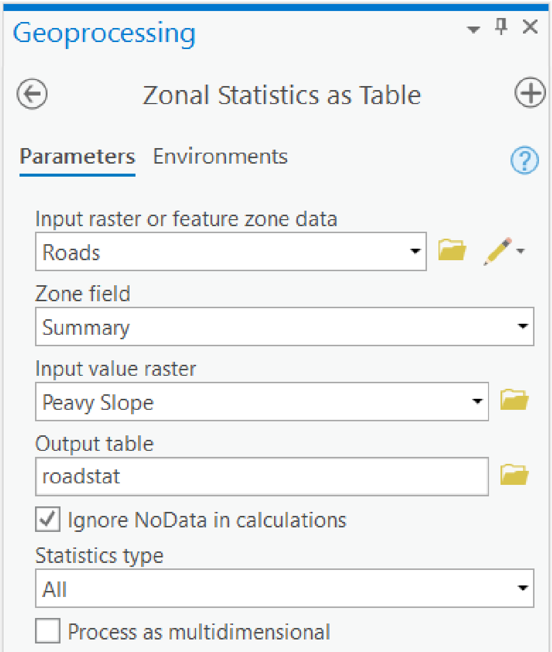
Open the Roads attribute table and scroll to the end to view the new Summary field. Right click on the field header and choose Field Calculator.

In the Calculate Field window, make Summary = 1 and click Run. All the cells in the Summary row should now display 1.



TYPE	FORNAME	FNAME	FTYPE	GPS	Shape_Length	Summary
rock	d				3.132603	1
rock	m				1140.713002	1
rock	m				820.675088	1
rock	md				588.544964	1
rock	md				95.381157	1
rock	md				2077.023119	1

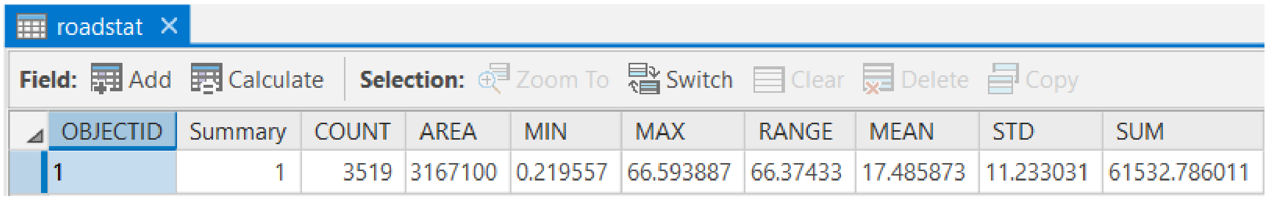
Close the Roads attribute table. Search for Zonal Statistics as Table in the Geoprocessing Window. The Input Feature Zone Data is Roads, the Zone Field is Summary and the Input Value Raster is Peavy Slope. Direct the output to McDonald.gdb with the name "roadstat."



Zonal Statistics as Table

Input raster or feature zone data: Roads
Zone field: Summary
Input value raster: Peavy Slope
Output table: roadstat
☑ Ignore NoData in calculations
Statistics type: All
☐ Process as multidimensional

Open the roadstat table from your Contents window after it appears. This table informs us that the average slope is over 17 percent and the maximum slope value is over 66 percent.



OBJECTID	Summary	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
1	1	3519	3167100	0.219557	66.593887	66.37433	17.485873	11.233031	61532.786011

Close this table and save your project.

GIS LAB 7 Application: Calculating Elevation and Slope values for forested roads, streams, and stands.

You will need to import a raster grid that represents elevation for all of McDonald Forest. **This is called "elevgrid" and should be located in your workspace\gislab7\McDonald.gdb space after following the steps on Pages 3-4.** If not, make sure it is imported into your McDonald geodatabase using the Raster to Geodatabase tool as we did earlier. Rename the raster McDonald DEM. The elevation units are in feet.

Create a new data frame called McDonald Forest and add the following layers from your McDonald Geodatabase: McDonald DEM, Roads, Streams, Stands, and Boundary.

All questions that follow refer only to areas within the borders of McDonald Forest.

Assignment 7. This is a team assignment. Please answer the following questions. Type your answers and turn in at the beginning of the next lab meeting. Be sure to include your names, lab day and time (e.g. Tuesday 10 AM), assignment number, and course title with your answers. **Create a table for questions with more than one response.**

Report measurements to the nearest whole unit only.

Assignment 7A. 12 points.

1. What is the average and standard deviation of elevation for areas within McDonald Forest?

2. Use the variable "standid" in the "Stands" layer to answer the following question. Which stand contains the third lowest elevation value and which stand contains the third highest?

3. What is the average slope in percent for Baker Creek (use the NAME field in the streams layer) in McDonald Forest? You'll need to derive a slope layer of McDonald Forest to answer this question.

4. What is the average slope, in percent, of rock roads in McDonald Forest? Use the field TYPE within the roads layer to determine where the rock roads are.

5. What is the average, minimum, and maximum elevation of stand 060710 (from the STANDID variable)? It may be helpful for you to create a shapefile that contains only the polygon(s) from this stand before running any statistical summaries.

6. What is the average, minimum, and maximum elevation of roads in stand 060710 (from the STANDID variable)? It may be helpful for you to create a shapefile that contains only the roads from this stand before running any statistical summaries.

Assignment 7B. Create a map of McDonald Forest that shows the DEM in a five-category quantile distribution and 400 ft vertical contour lines. Include a legend for each layer in your map. Your map should contain an inset map that shows the McDonald Forest boundary within an outline of the state of Oregon (you can use the Oregon layer from Lab 6). **All values on the map (DEM elevation categories and contour intervals) should not include decimals.** Your map should also have a scale bar, north arrow, overall title, authors, date, and neat line. 5 points.