An introduction to GIS using ArcGIS Pro

Module 5 - Working with Raster Data

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Last updated: September 2,, 2021

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Start with

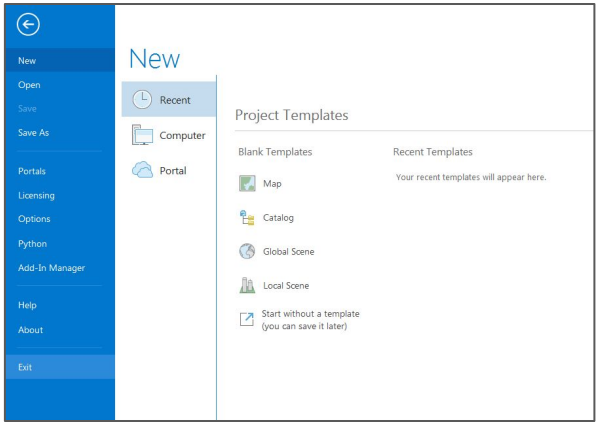
Downloading

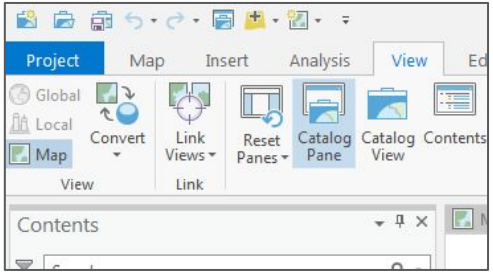
https://maps.library.utoronto.ca/workshops/ArcGISProWorkshop/2020/landsat8.tar

Working with raster data

1 - start a new project with a blank map

2 - select the catalog pane

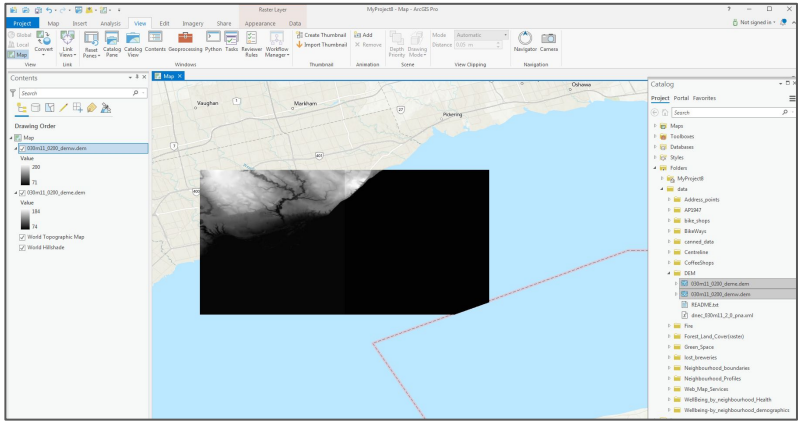


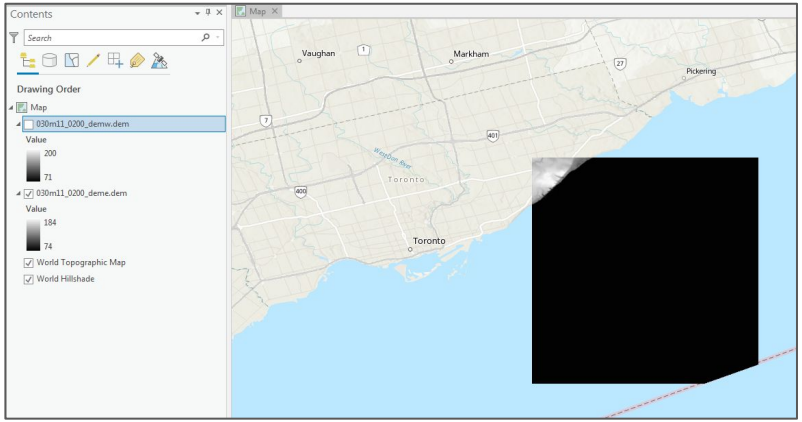


Loading digital elevation data

1 - in the catalog pane, navigate to the DEM folder within the data folder

2 - drag and drop the two “.dem” files into your map



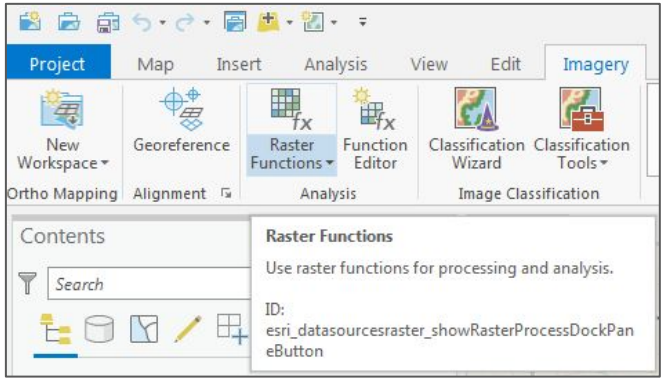


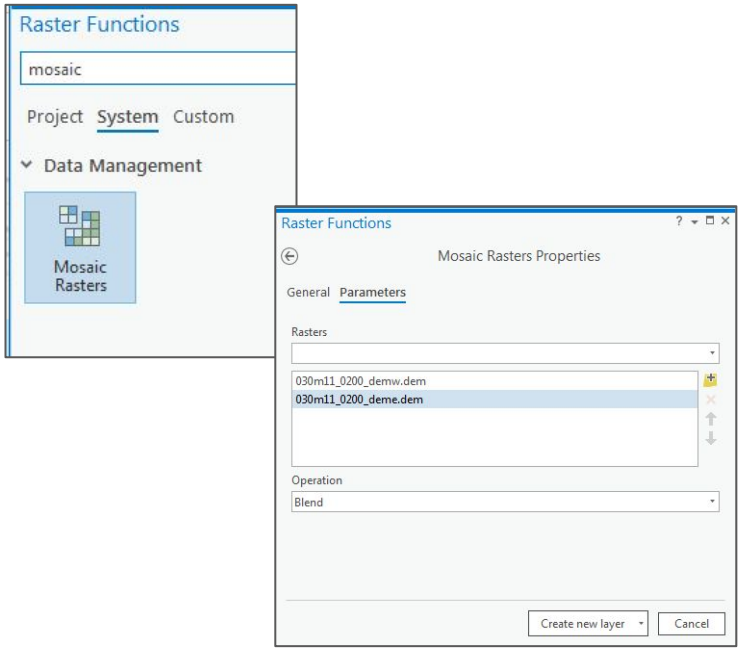
Creating a mosaic

1 - under “Imagery” select “Raster Functions”

2 - in the search box type “mosaic” and click on the “Mosaic Rasters” icon

3 - select the two .dem files, select the “Operation”, “Blend” and click on “Create new layer”



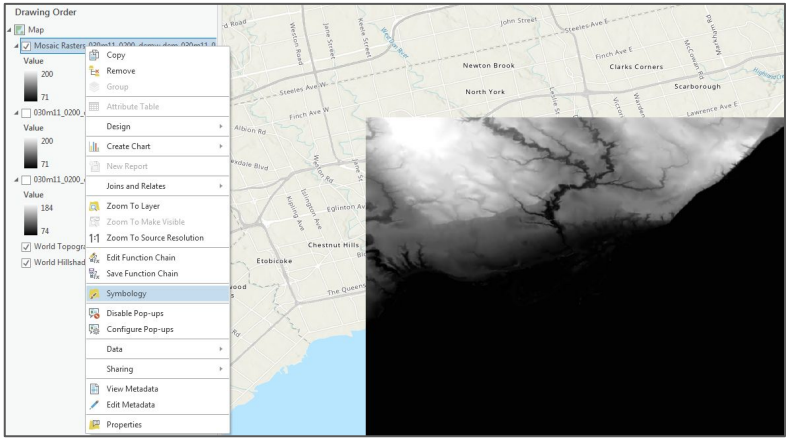


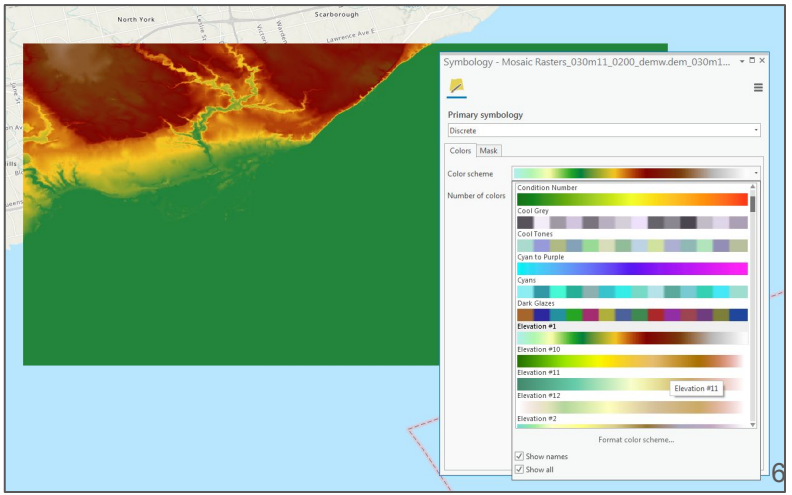
Mosaics

1 - a new mosaiced image of the two .dem files will appear

2 - right-click on the new mosaic image and select Symbology

3 - select a color scheme (you can find Elevation schemes by making sure you click on “Show names” and “Show all” in the “Color Scheme” drop down





Contours - Method 1

* note that this method creates a raster image of contours only. Skip to page 8 to export contours to vector format

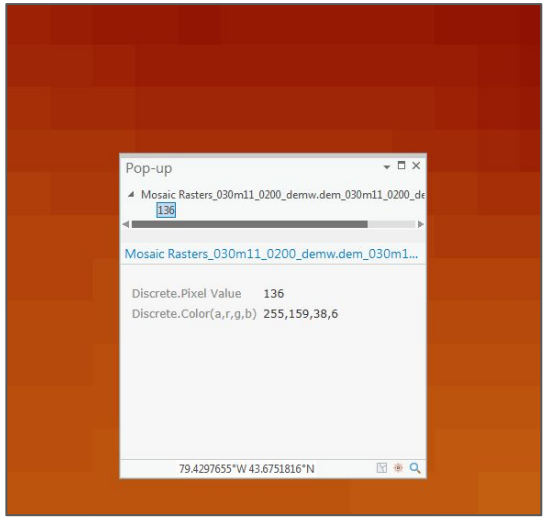
1 - zoom closely into the image until you see the pixels or cells (squares)

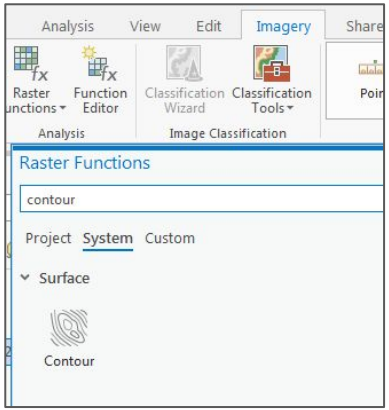
2 - click on any pixel/cell

3 - the “Pixel Value” represents that cell’s elevation. In this example, the elevation of that area is 136 metres above sea level

4 select “Imagery” and type in “contour” in the search box

5 - select the “Contour” icon





Contours - Method 1

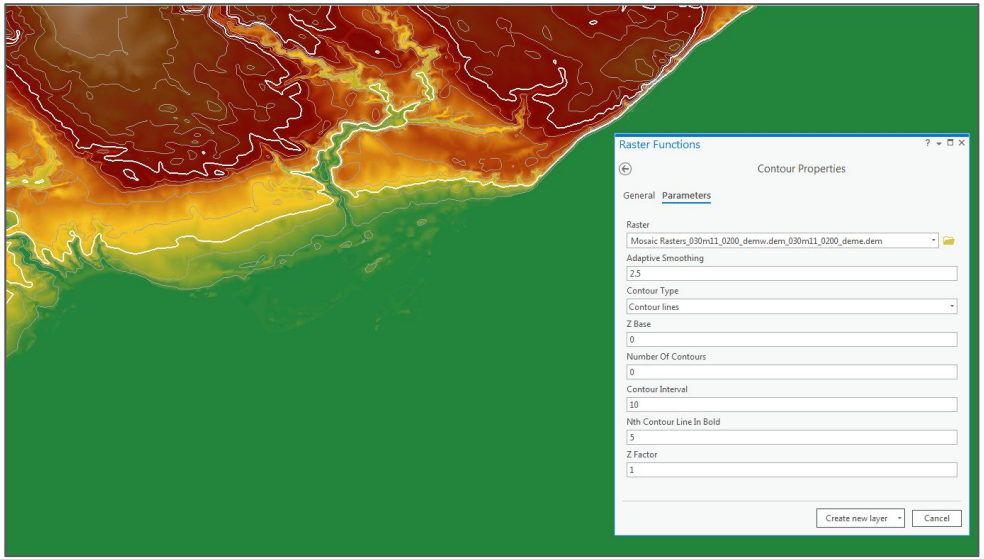
1 - select the mosaic dem as the “Raster”

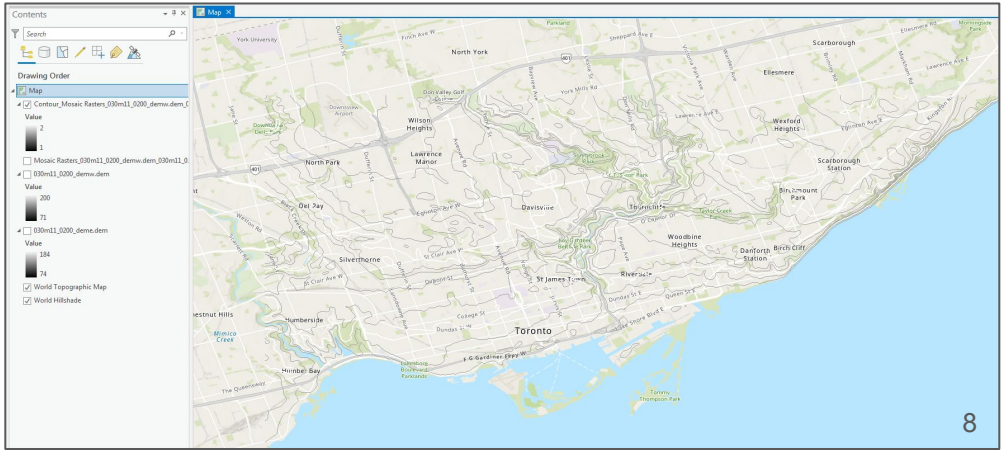
2 - select “Contour lines” for “Contour Type”

3 - select “10” as “Contour Interval” (this refers to contours at 10 metre intervals

4 - click on “Create new layer”

* note that the contours are in raster format. This result may not be as useful for many uses or for exporting to other modeling, CAD or GIS software





Contours - Method 2

*this method creates vector format contours

1 - zoom closely into the image until you see the pixels or cells (squares)

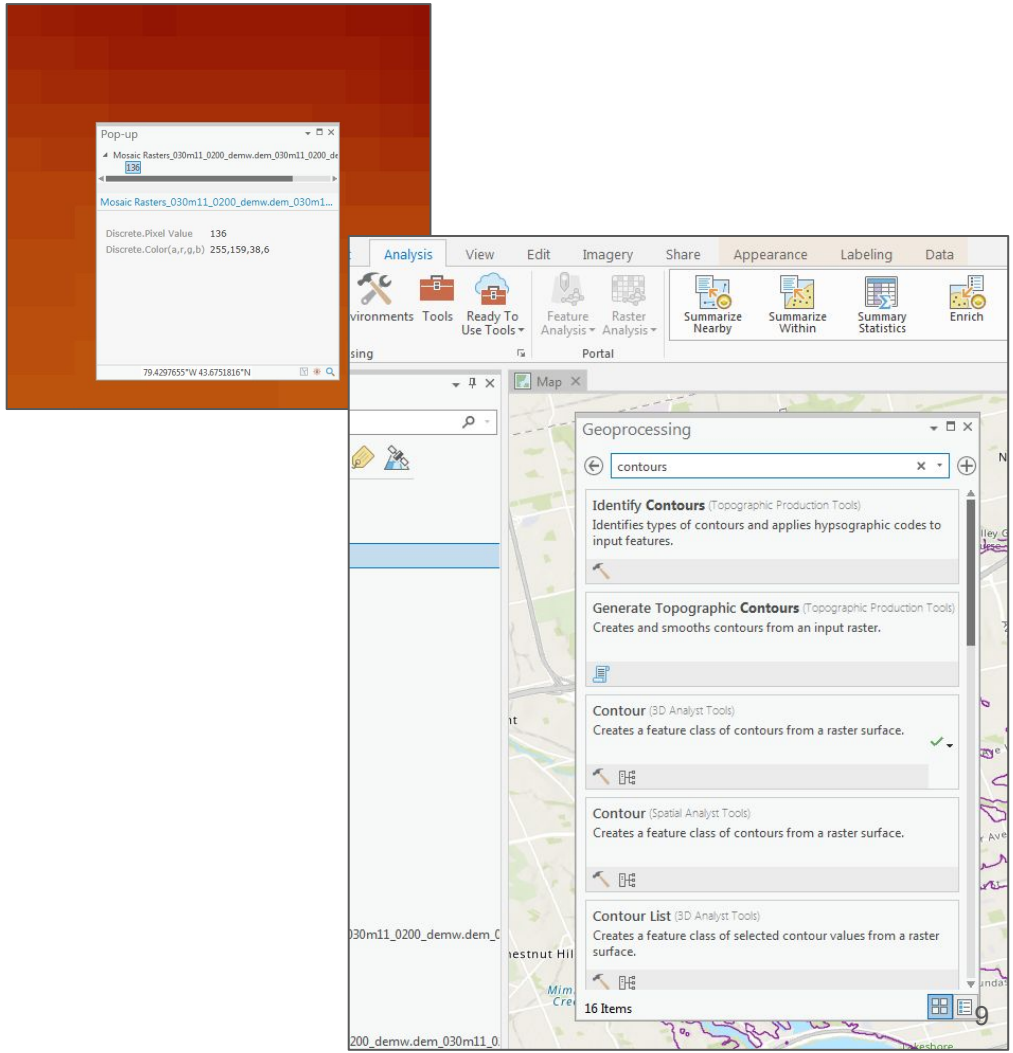
2 - click on any pixel/cell

3 - the “Pixel Value” represents that cell’s elevation. In this example, the elevation of the area is 136 metres above sea level

4 - under the “Analysis” menu, click on “Tools”

5 - in the “Geoprocessing” window, type “contours”

6 - click on “Contour (3d Analyst Tools)



Contours - Method 2

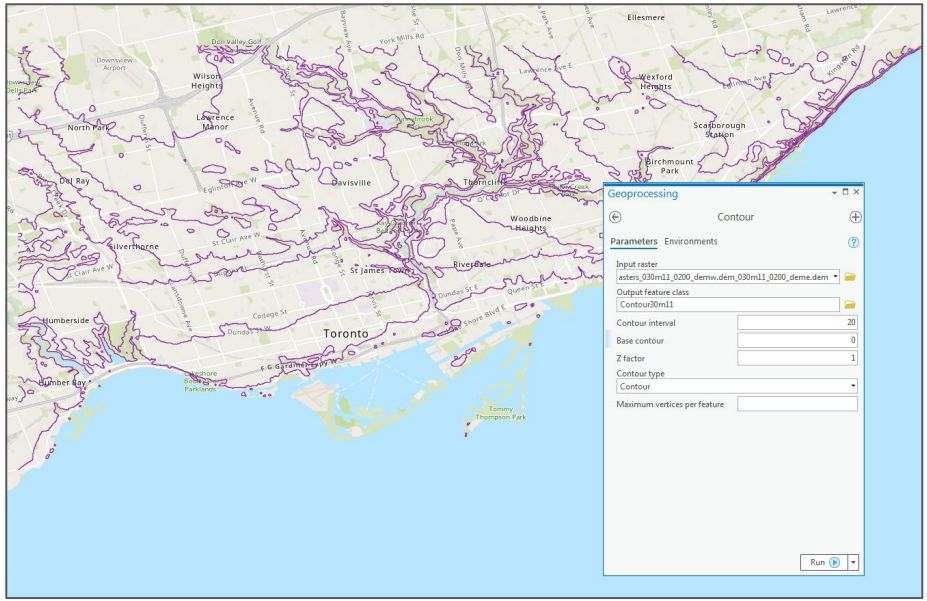
1 - select the mosaic .dem as your “Input raster”

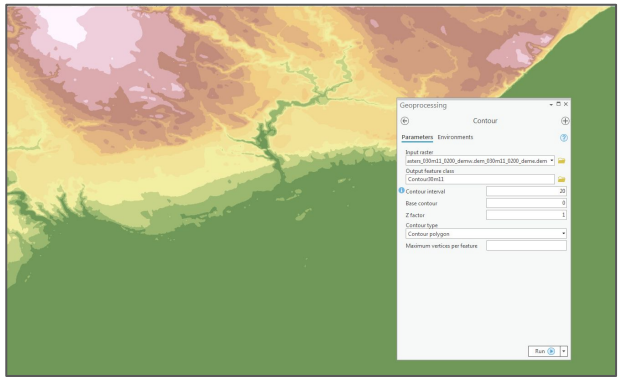
2 - provide a name for your contours under the “Output feature class”

3 - select your contour intervals “20” (this refers to the intervals in metres

4 - select “Contour” as “Contour type”

5 - Select a new “Output feature class” name and change the “Contour type” to “Contour Polygon”

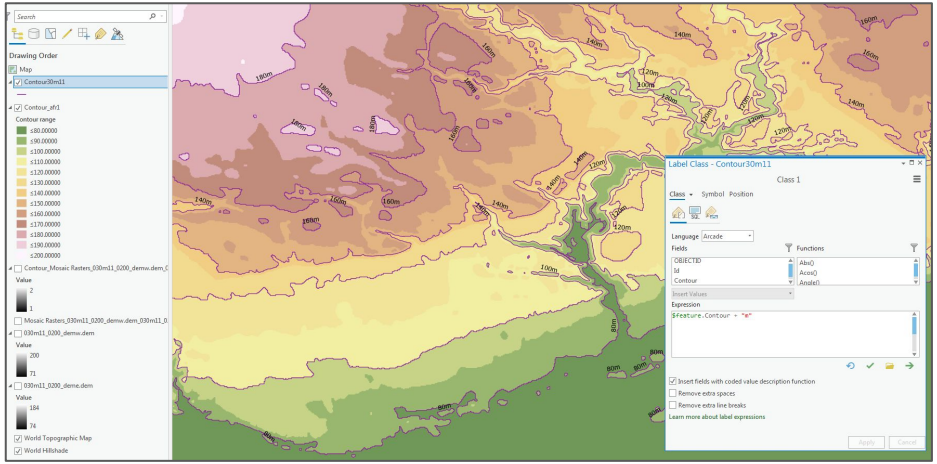


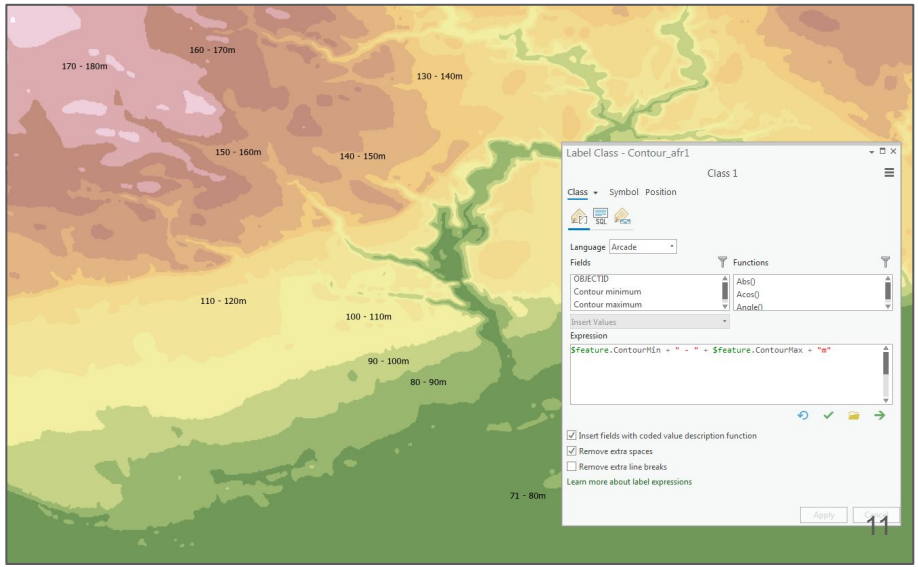


Contours - Method 2

1 - label your contour line layer using the “Contour” attribute

2 - label your polygon contour layer using the “ContourMin” and “ContourMax” attributes



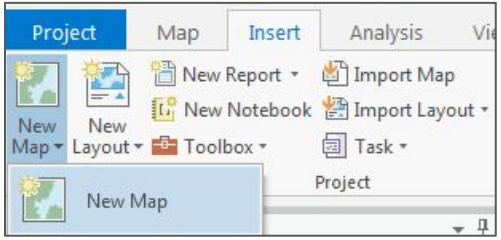


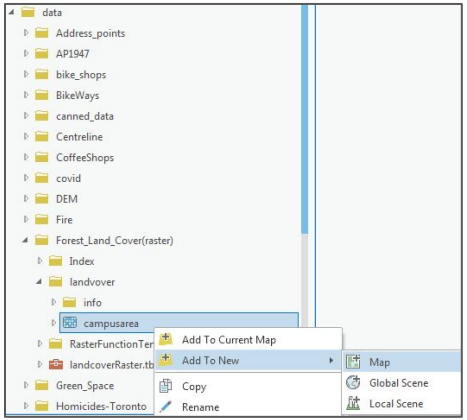
Land Classification Data

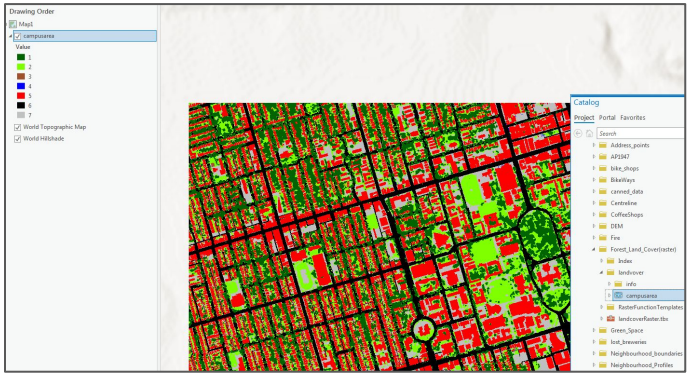
1 - using the “Catalog” pane, find the “Forest_Land_Cover(raster)/landvover” folder

2 - Right-click on the “campusarea” raster and select “Add to New” → “Map”

*Note that this is only a subset of the full data available on the City of Toronto’s open data portal for the entire city.







Land Classification Data

1 - examine the image closely

2 - you will notice that there are two types of greens “1” and “2”. If you examine the metadata for this dataset in the “xml” file, you will see that 1 = tree canopy and 2 = grass/shrub

let’s combine all green layers together and omit the rest of the other represented features of bare earth, water, buildings, roads, etc.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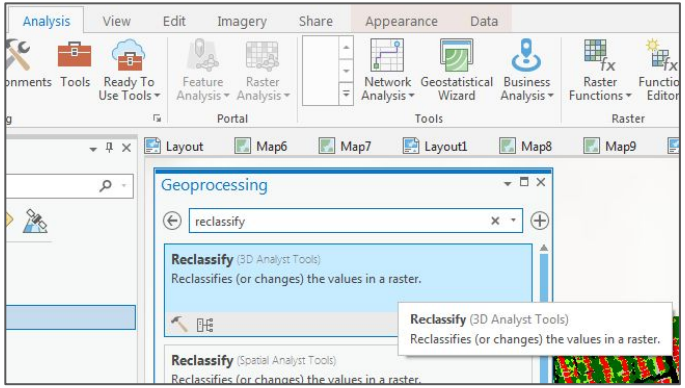
        grass/shrub, (3) bare earth, (4) water, (5) buildings, (6) roads, (7) other paved surfaces and (8). The primary
        sources used to derive this land cover layer were QuickBird satellite imagery (0.6m) acquired in 2007. Ancillary
```

Reclassify rasters

1 - using the “Analysis” tab, click on “Tools”

2 - in the “Geoprocessing” window, type “reclassify” in the search box



3 - select “Reclassify (3D Analyst Tools)

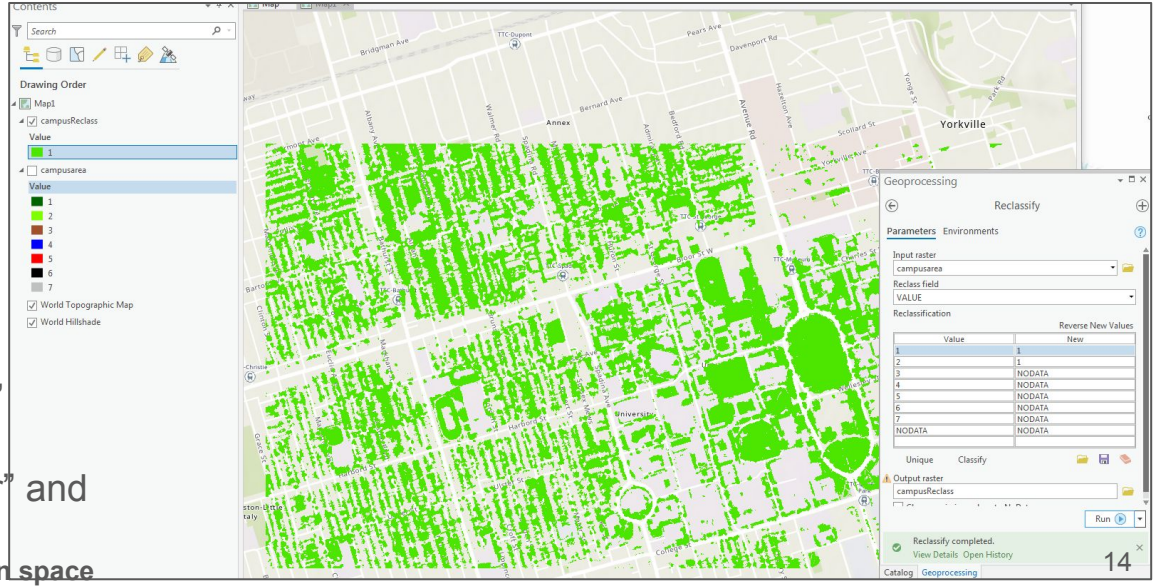
4 - select “campusarea” as your “Input raster”

5 - set “Value” “1” to “New” value “1” and “Value” “2” to “New” “1” as well

6 - change all other values to “NODATA”

7 - select a name for your “Output raster” and click on “Run”.

Note that you should now have a raster of only green space (you could also have created this new layer with two colours)



Vectorize (raster to vector)

You can convert your raster data to vector data

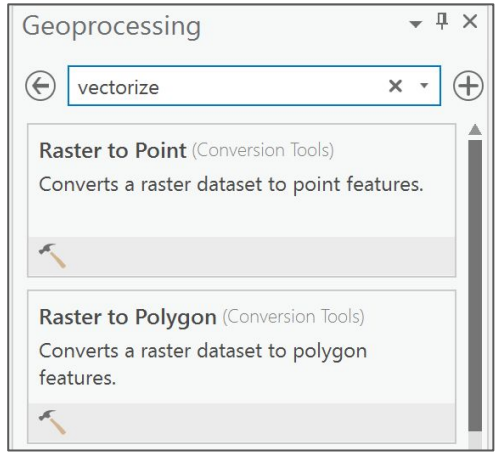
1 - in the Geoprocessing pane, search for “vectorize”

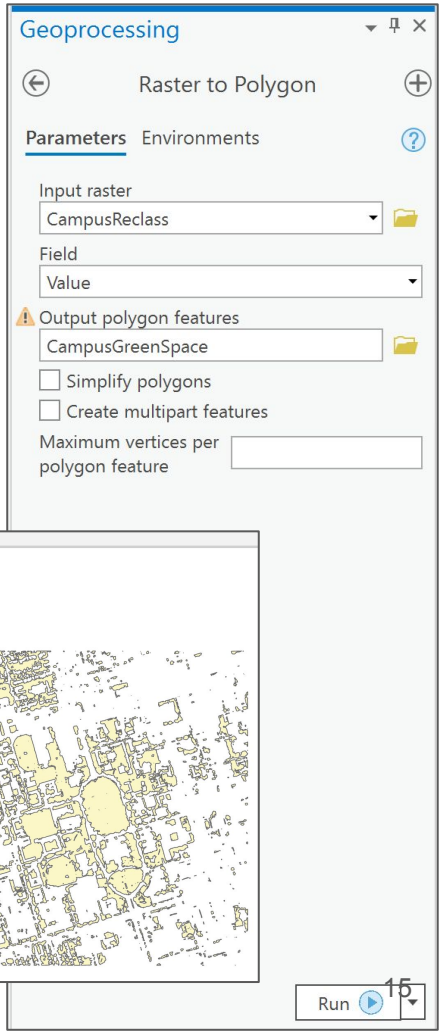
2 - click on the “Raster to Polygon” option

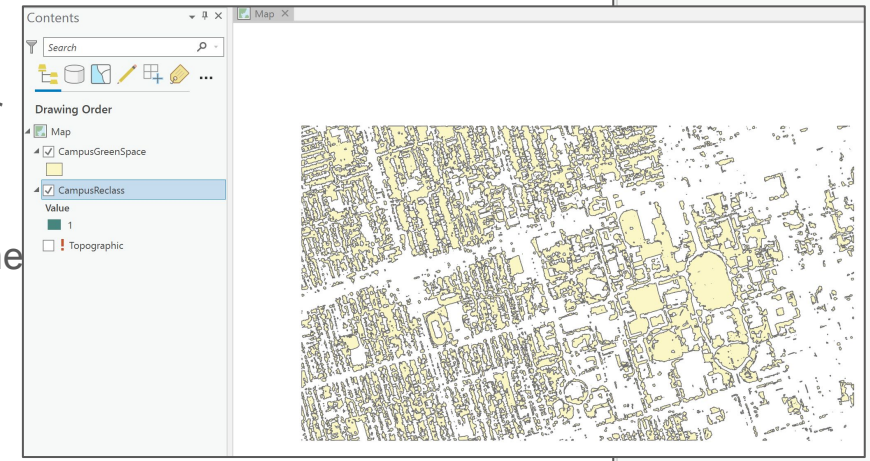
3 - make sure your input raster is your reclassified raster dataset, select “Value” under “Field”

4 - Give your new vector layer a name under the “Output polygon features”

5 - click on “Run”



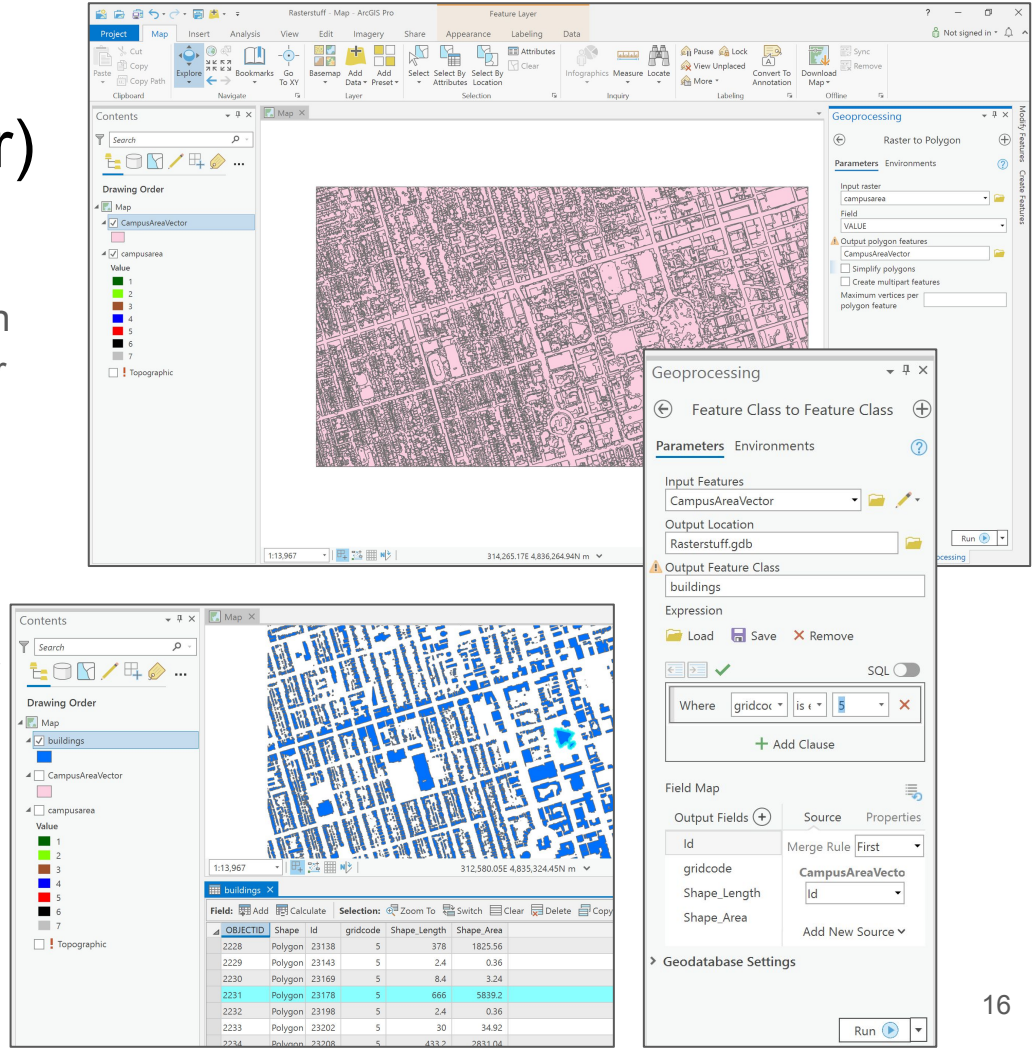




Vectorize (raster to vector)

We could have also simply converted the entire raster dataset and created the vectors based on all the grid values. But remember that the larger the raster, the more computing time and power the conversion will take

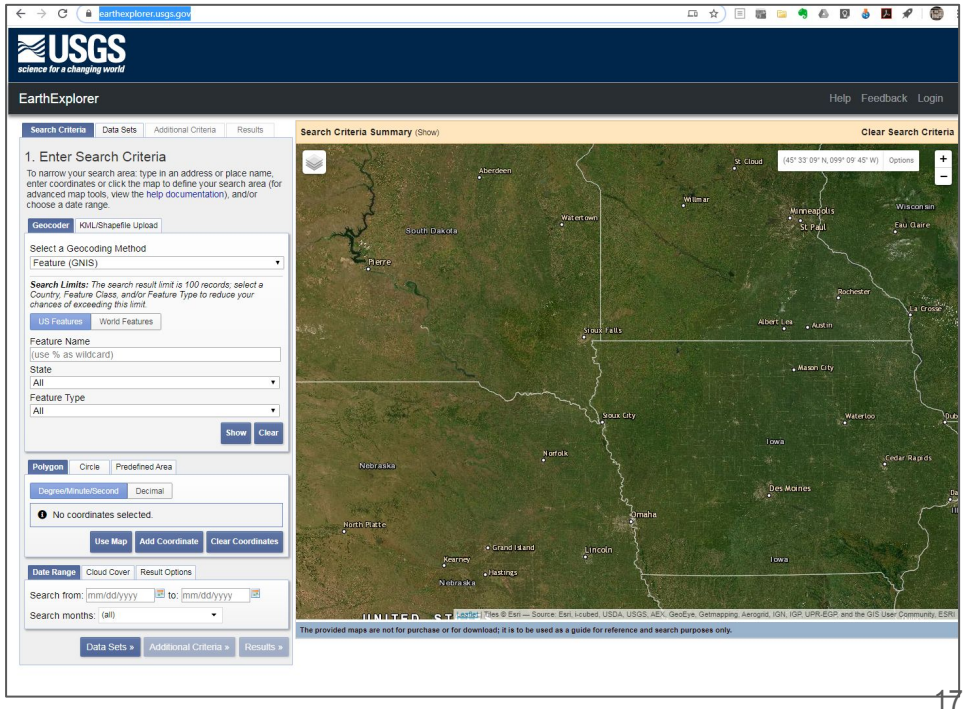
To extract only vegetation or buildings would then be required using a selection by attributes based on those grid codes. For instance, below on the right is the data extracted for buildings from the full converted dataset from raster to vector



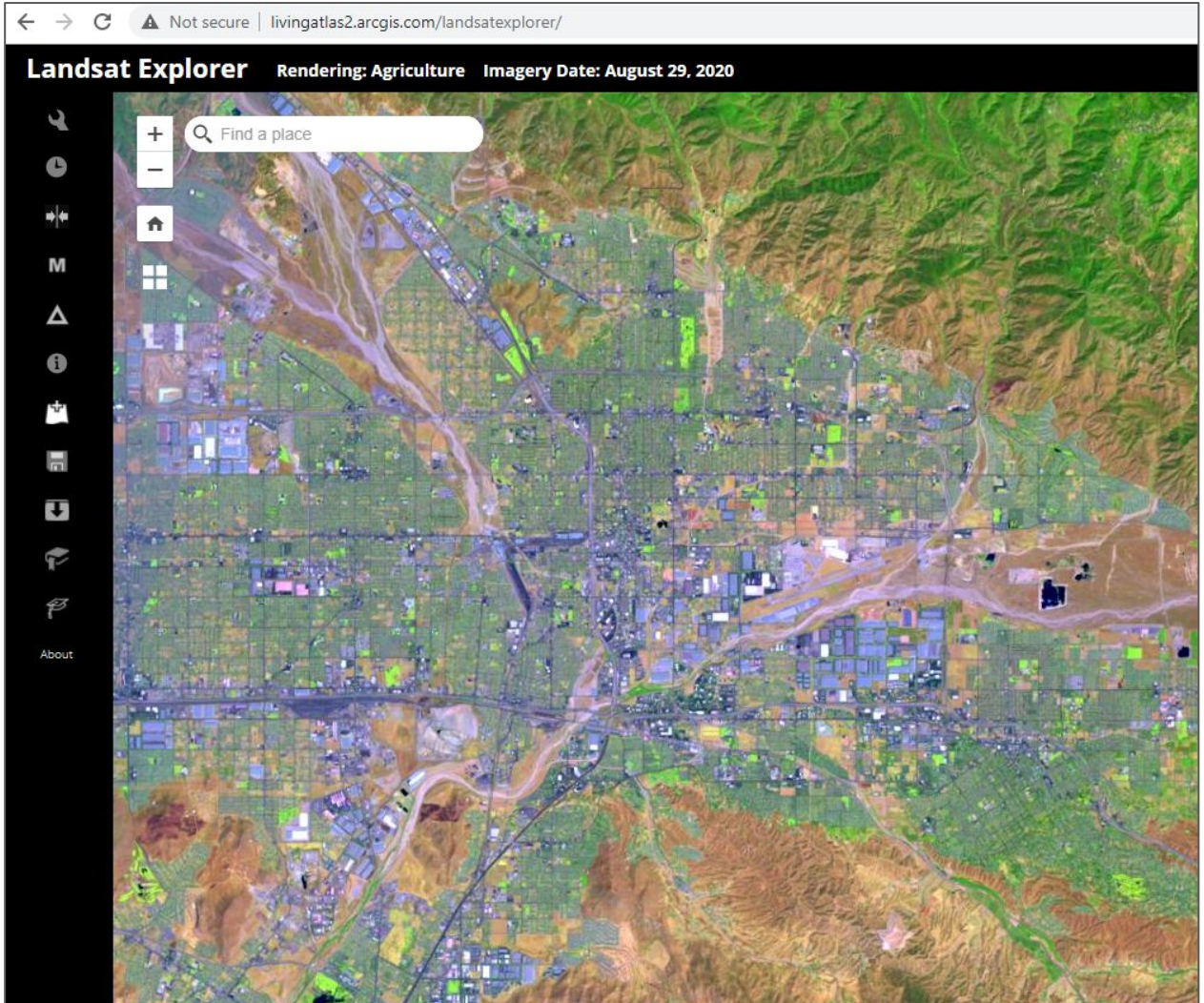
Normalized Difference Vegetation Index (NDVI) using Landsat 8 imagery

The data used for this exercise can be obtained from the USGS using the EarthExplorer tool at https://earthexplorer.usgs.gov/

For this exercise, please download the following file (Please note that this file is extremely large at 1.82 GBs) https://maps.library.utoronto.ca/workshops/ArcGISProWorkshop/2020/landsat8.tar



Landsat Viewer

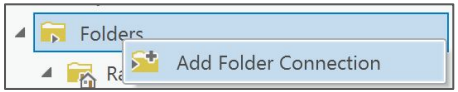


http://landsatexplorer.esri.com/

NDVI using Landsat 8 imagery

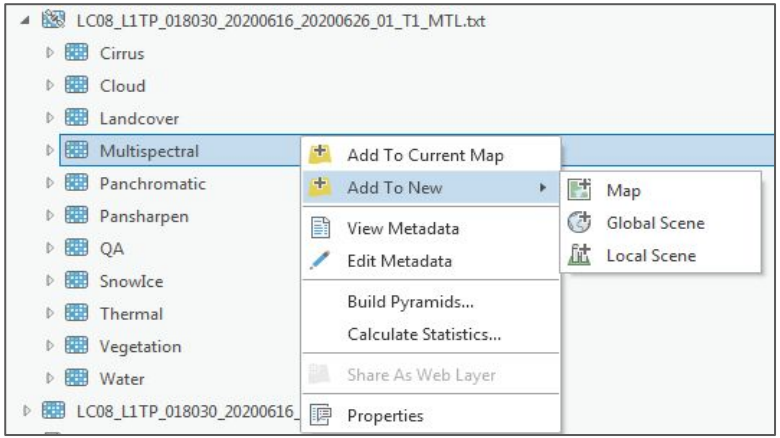
1 - Uncompress the .tar file using an application such as 7-zip (in Windows)

2 - in the catalog pane, connect to the Landsat8/ folder where you downloaded and extracted the .tar file.

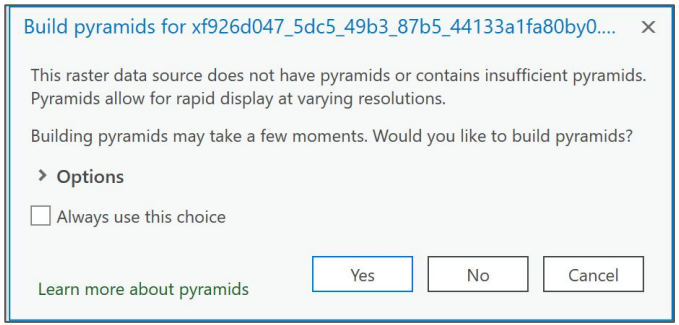


3 - Locate and expand the file "LC08_L1TP_018030_20200616_20200626_01_T1_MTL.txt"

4 - right-click on the "Multispectral" layer, select "Add To New" → "Map"



5 - Click yes to Build Pyramids*

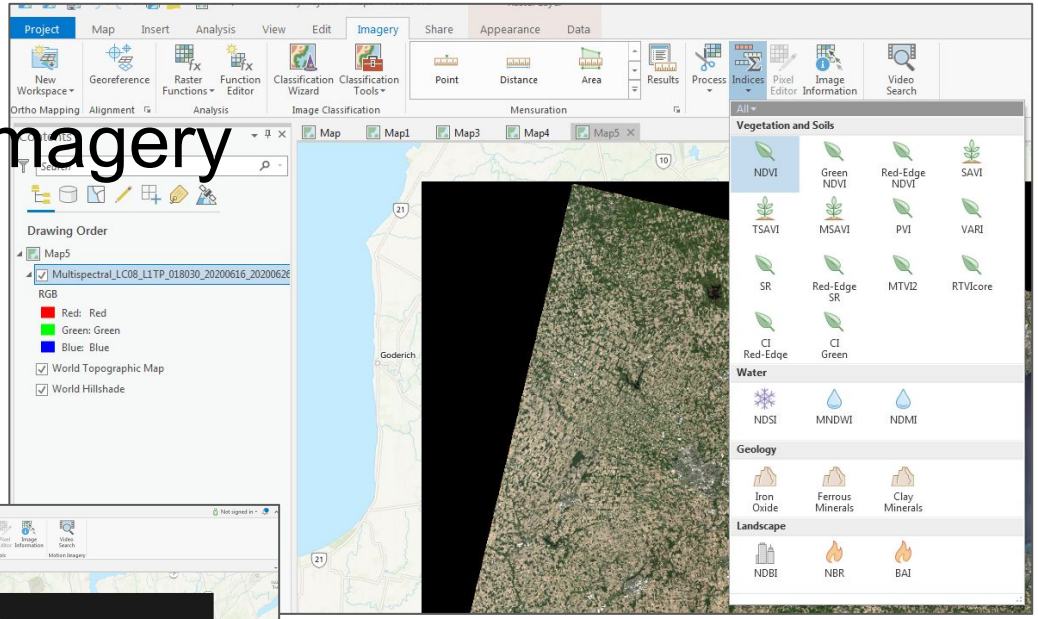


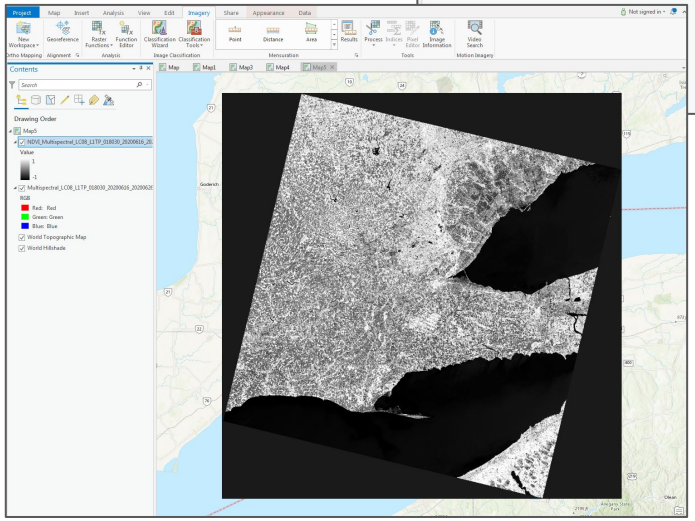
*Pyramids are a series of files that are created that allow for the quick zooming in and zooming out on raster images in your software

NDVI using Landsat 8 imagery

1 - under the “Imagery” ribbon, select the “Indices” drop down and select “NDVI”

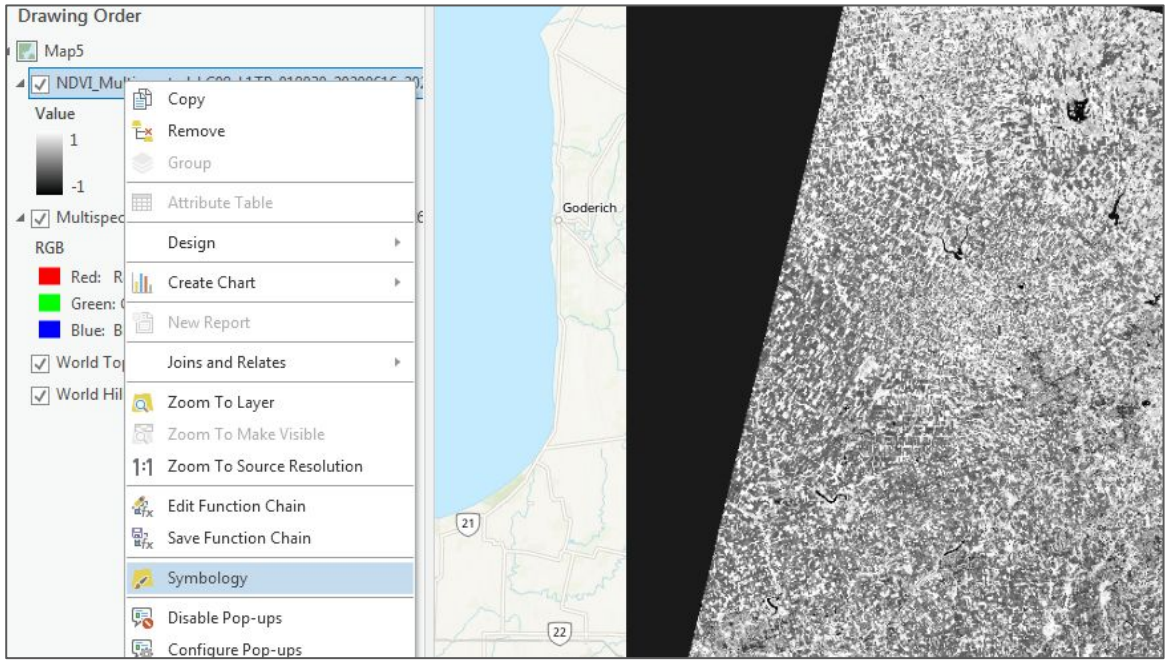
2 - A new black and white image will be created with values between 1 and -1





NDVI using Landsat 8 imagery

1 - right-click on the new image and select “Symbology”

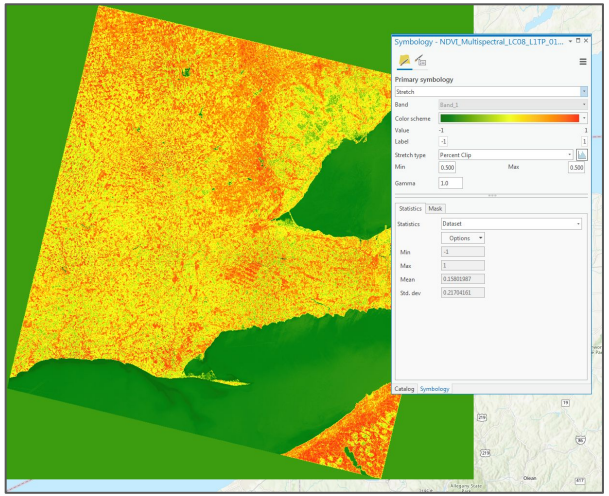


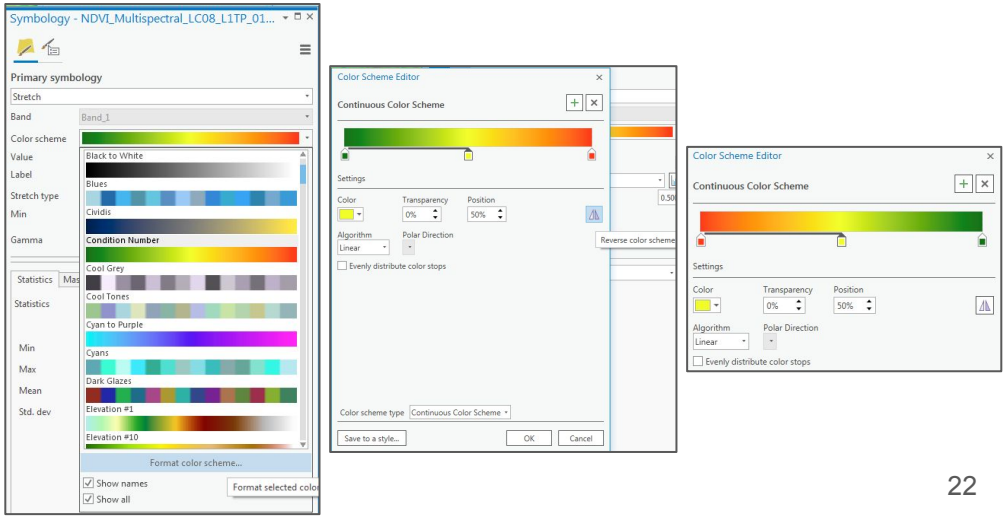
NDVI using Landsat 8 imagery

1 - Select the Red to Green “Color Scheme”

2 - Click on the “Color Scheme” again and select “Format color scheme…”

3 - click on the “Reverse Color Scheme” icon to change vegetation to green instead of red





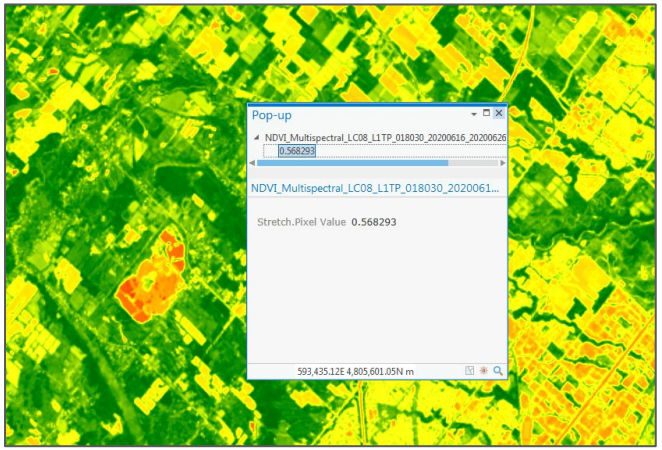
NDVI using Landsat 8 imagery

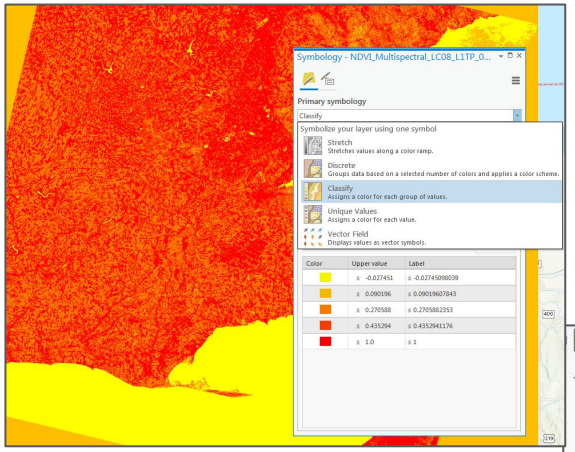
1 - zoom into any of the green areas and click on any pixels

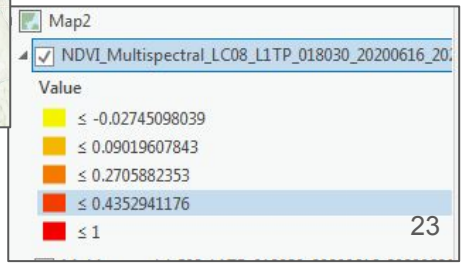
2 - You will notice that all values vary between -1 to +1 and all are fractions

3 - right-click on the NDVI layer and select “Symbology”

4 - In the Symbology window, select “Classify”. You will notice the numeric breakdown between the colours in the Contents pane

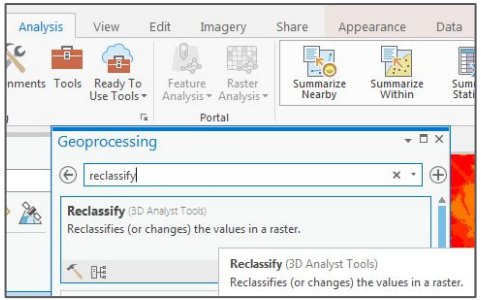






Vectorizing NDVI data

To vectorize a raster, all cell values must be integers. The NDVI image we created is made up of fractions. To convert the values, need to reclassify the NDVI image.



1 - using the “Analysis” ribbon, click on “Tools”

2 - search for the “reclassify” tool and click on “Reclassify (3D Analyst Tools)”

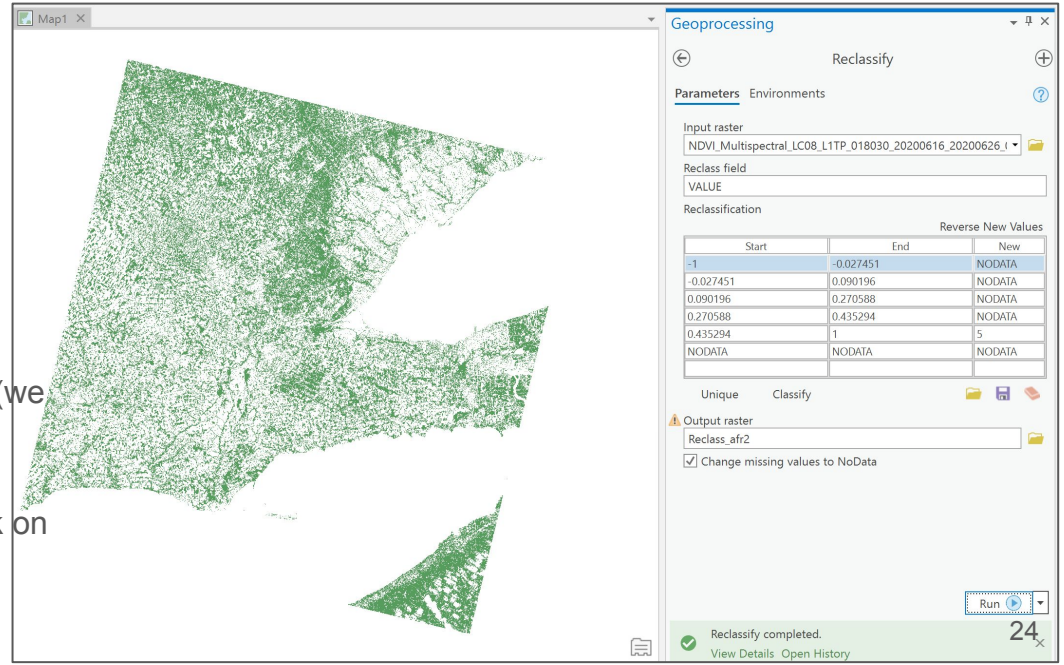
3 - select the NDVI image as your “Input raster”

4 - make sure the “Reclass field” is set to “VALUE”

5 - Type “NODATA” for all values except the last row (we only want “green space” for this exercise)

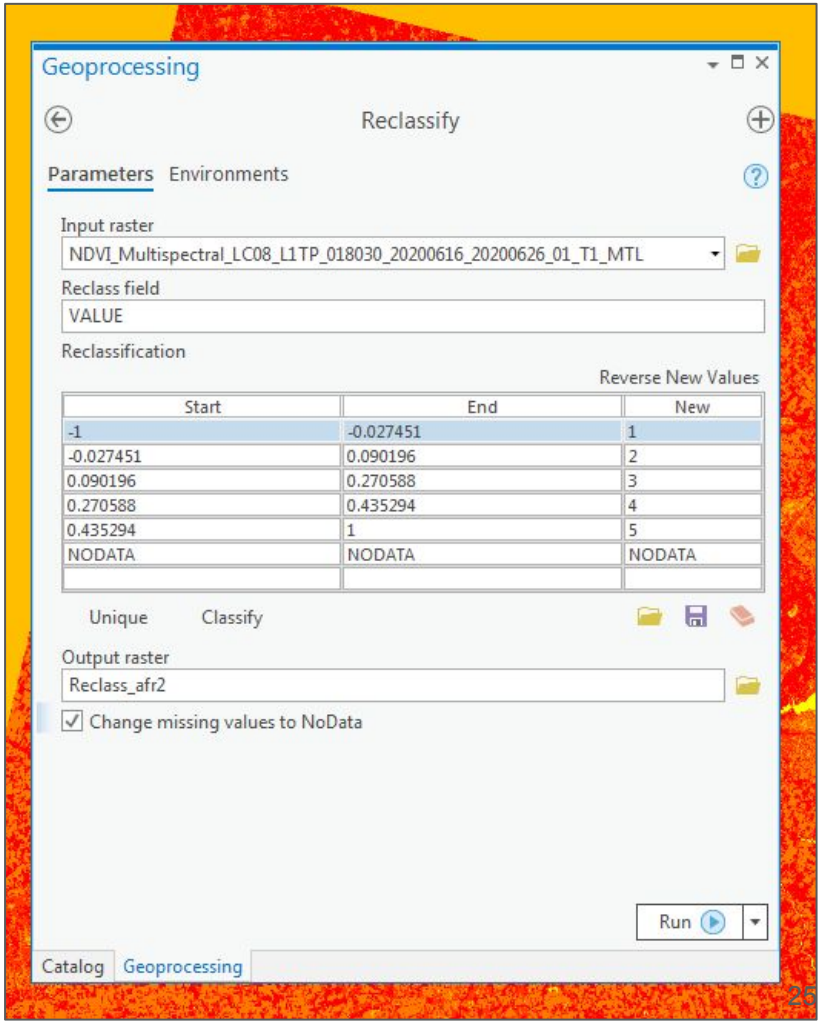
5 - Change the name of your “Output raster” and click on the “Change missing values to “NoData”

6 - click “Run”



Vectorizing NDVI data

Note that if you wanted to reclassify all values of your raster and not just greenspace, you could keep all default values in the reclassify pane



Vectorizing NDVI data

1 - your new raster should now be classified with integers

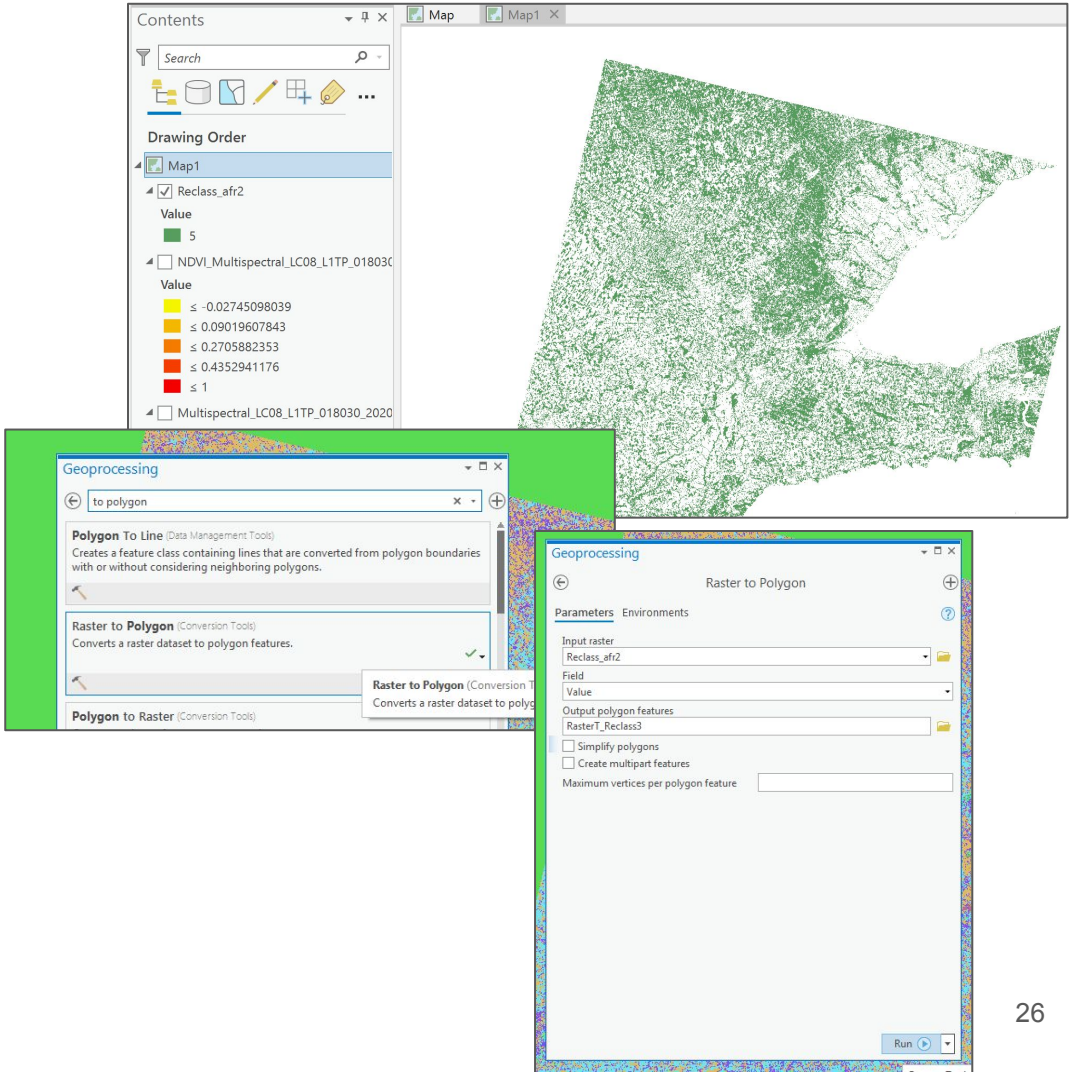
2 - In the geoprocessing window, search for “to polygon”

3 - click on “Raster to Polygon”

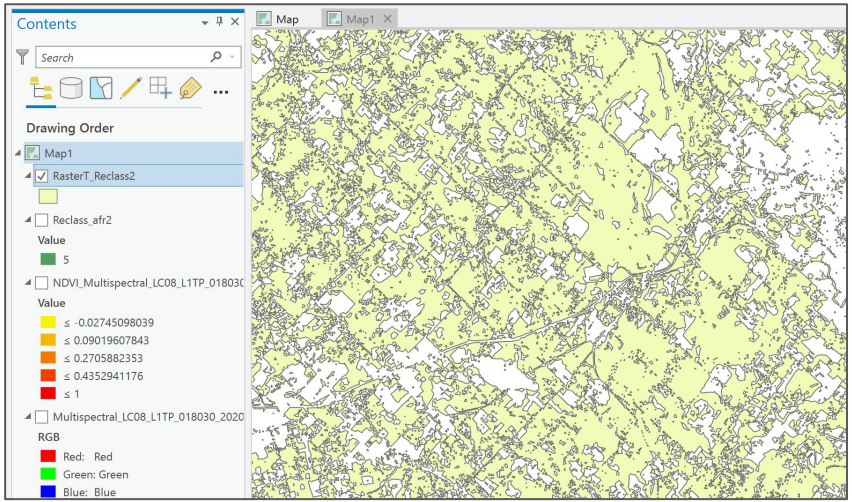
4 - select your reclassified image as your “input raster”; “Value” as the “Field”

5 - note or name your “Output polygon features”

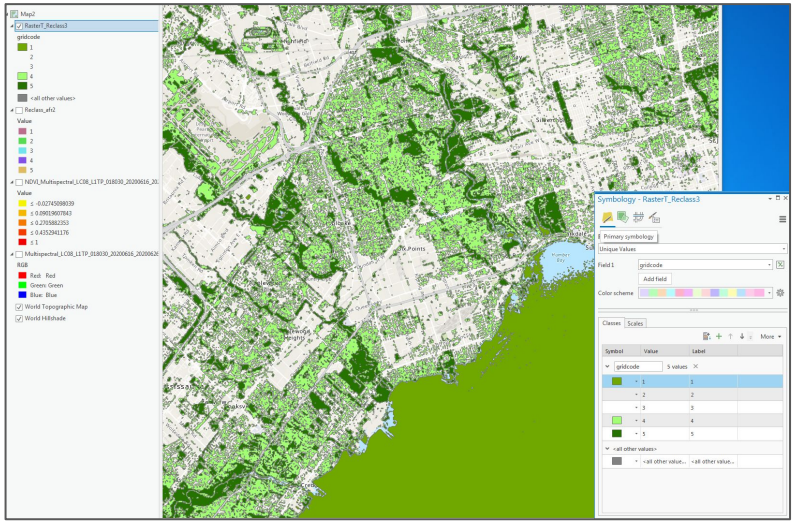
6 - click on “Run”



Vectorizing NDVI data

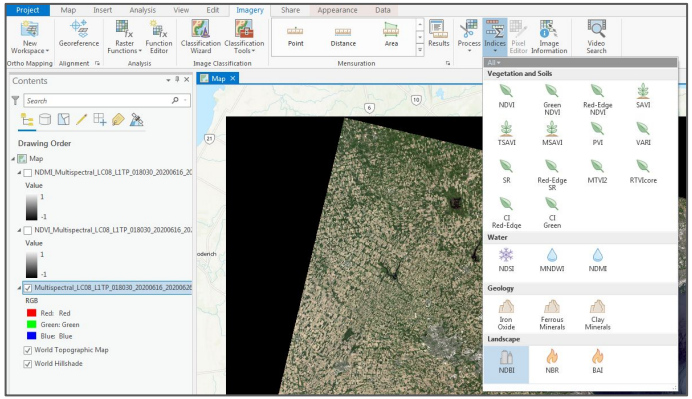


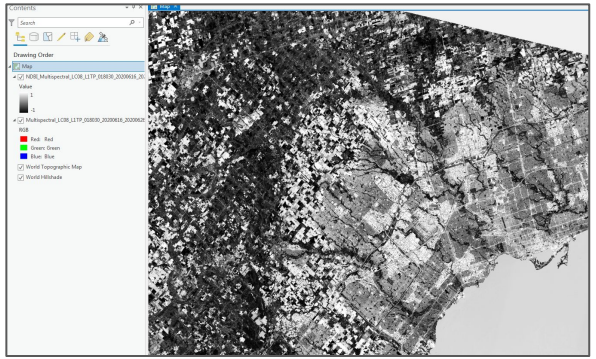
Vectorized Green Space

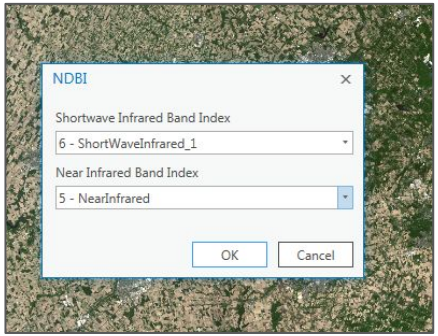


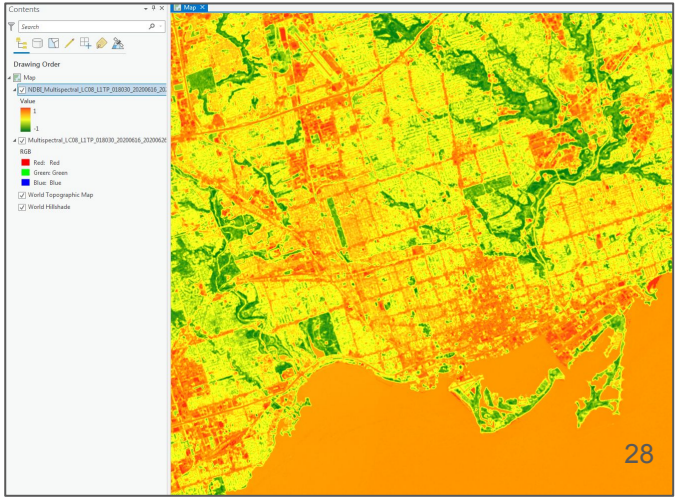
All colours vectorized and symbolized

Normalized Difference Built-up Index (NDBI) using Landsat 8 imagery



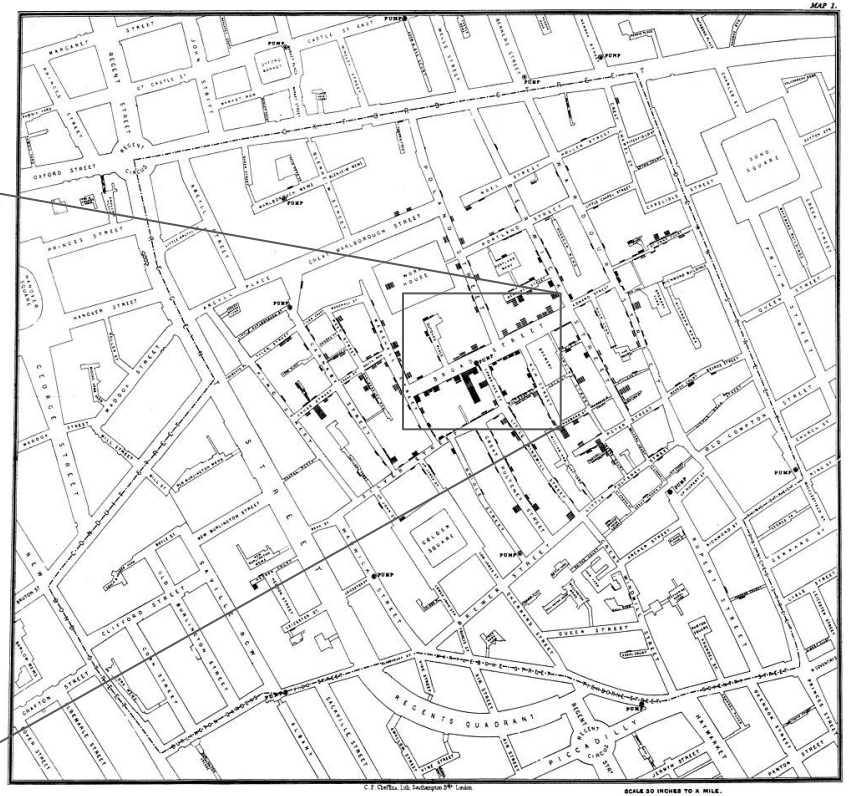






Density Calculations

Using John Snow's cholera data of London, we will investigate density calculations.



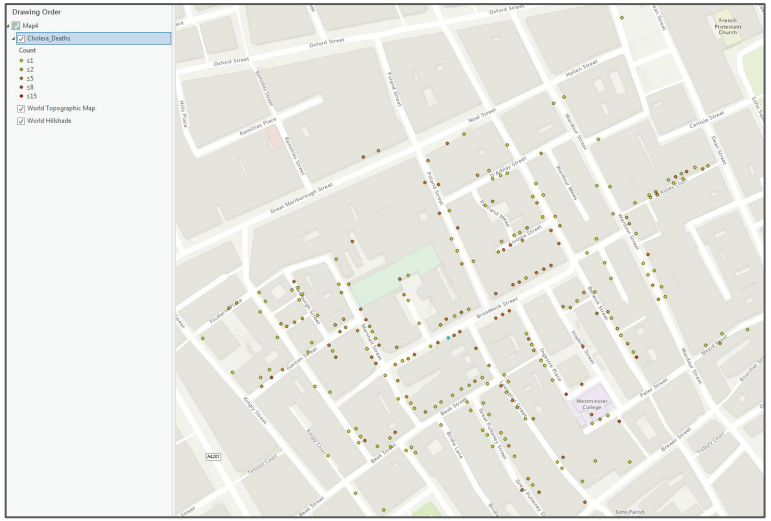
https://commons.wikimedia.org/wiki/File:Snow-cholera-map-1.jpg

Density Calculations

1 - In a new map, load the Snow Cholera_Deaths.shp and the Pumps.shp shapefiles from the SnowGIS_SHP/ folder

2 - Load the Snow_Map.tif file into your map and examine how Snow depicted the number of deaths

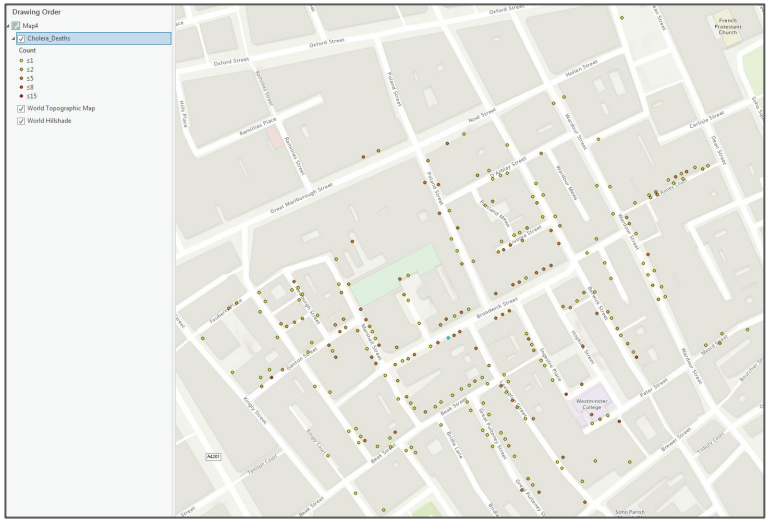
3 - Symbolize your pump layer

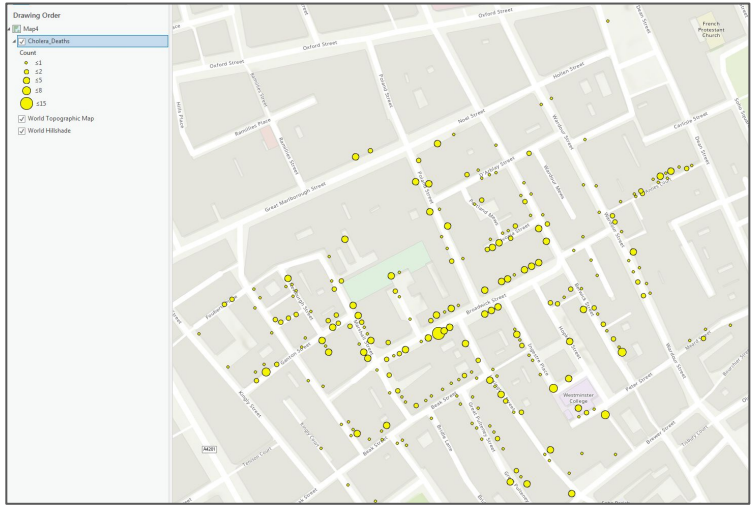


Density Calculations

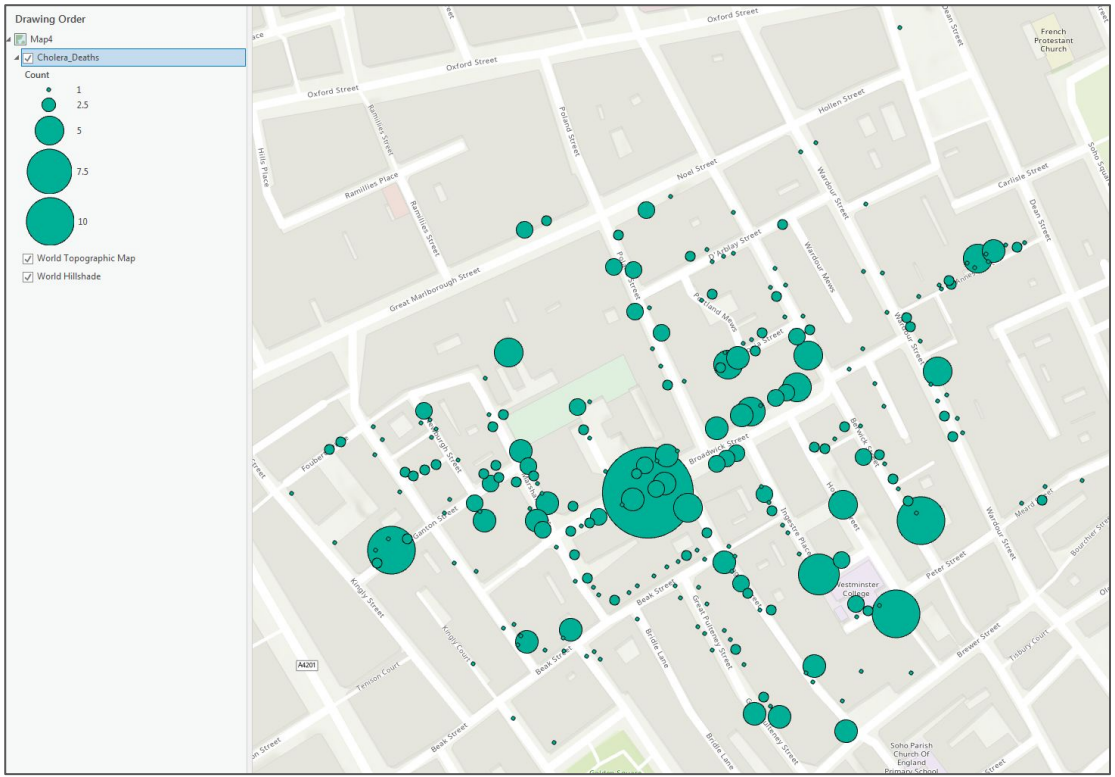
1 - Using the “count” field, symbolize the Cholera_Deaths layer with :

- Unique Values
- Graduated Colors
- Graduated Symbols
- Proportional Symbols

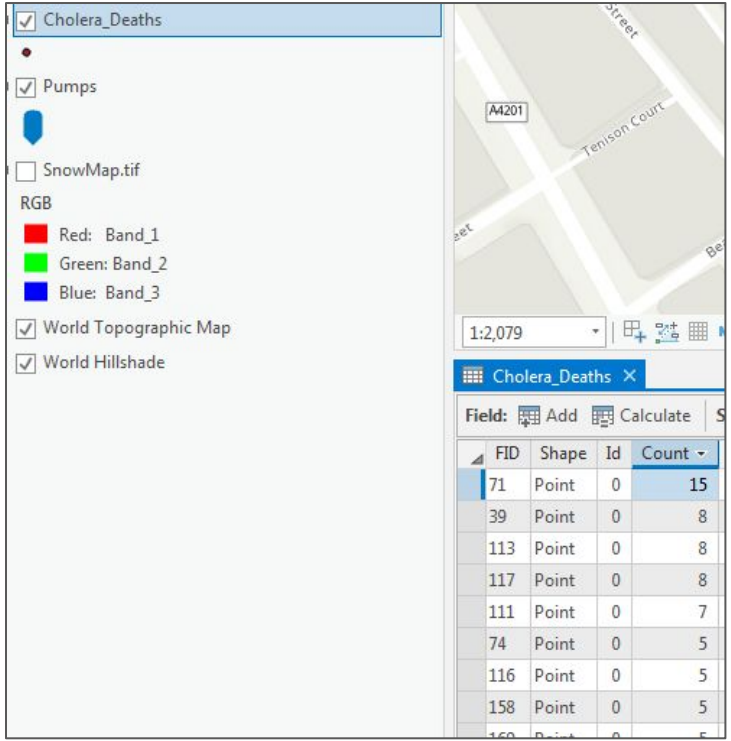




Density Calculations



Density Calculations

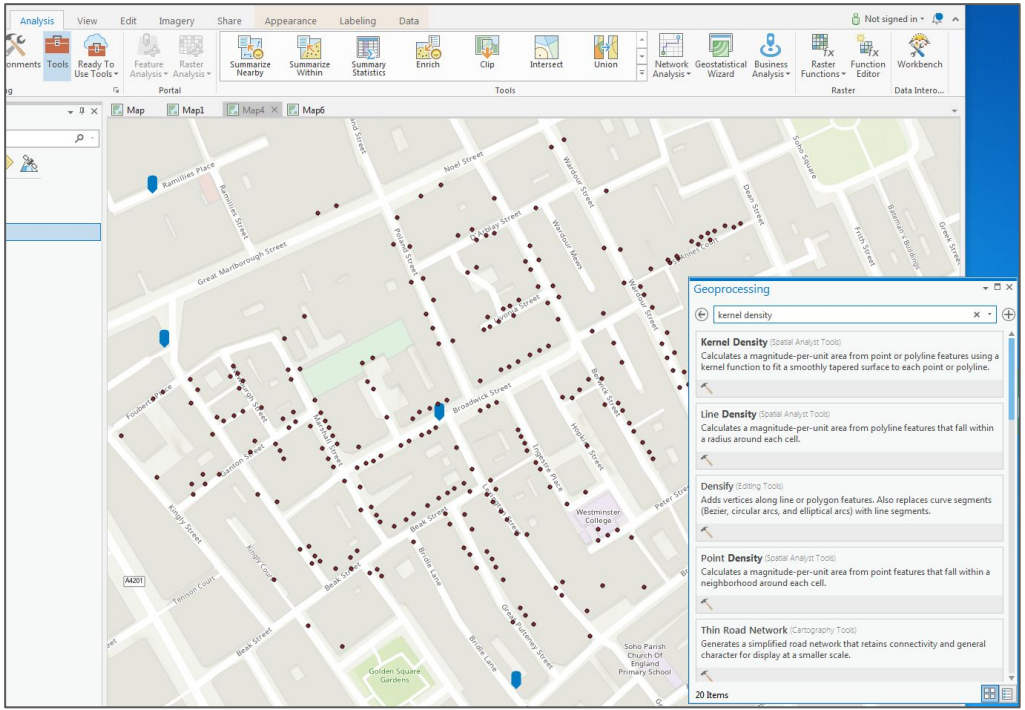


Density Calculations

1 - Return your cholera deaths layer to “Single Symbol” symbology

2 - Using the “Analysis” menu, select “Tools”

3 - search for “Kernel Density”



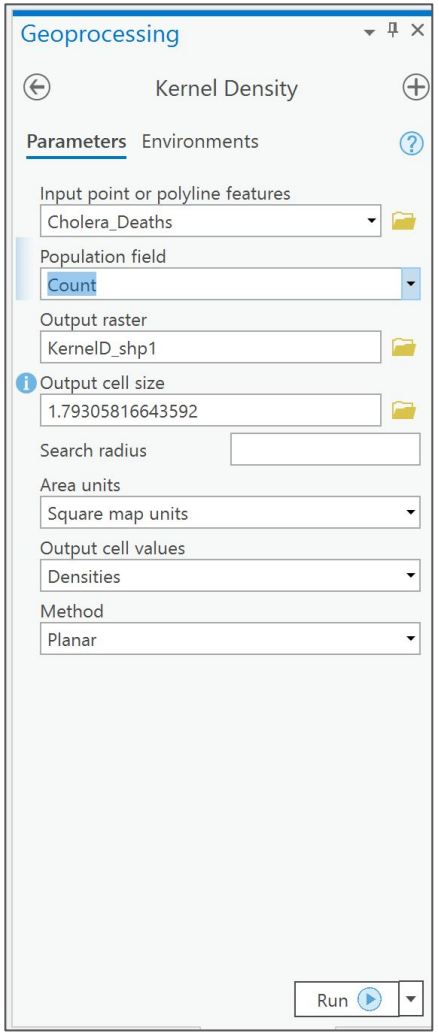
Kernel Density Calculations

1 - In the “Kernel Density” toolbox, select “Cholear_Deaths” as you Input Feature

2 - Select “Count” as your “Population field”

3 - keep the rest of the defaults

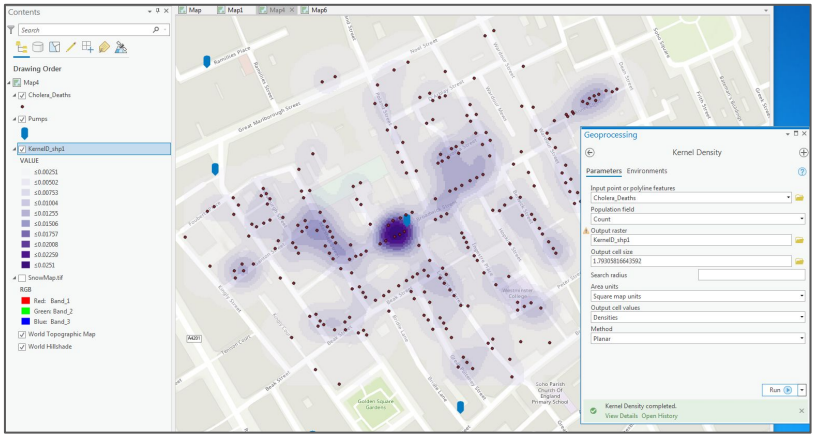
4 - Click on “Run”

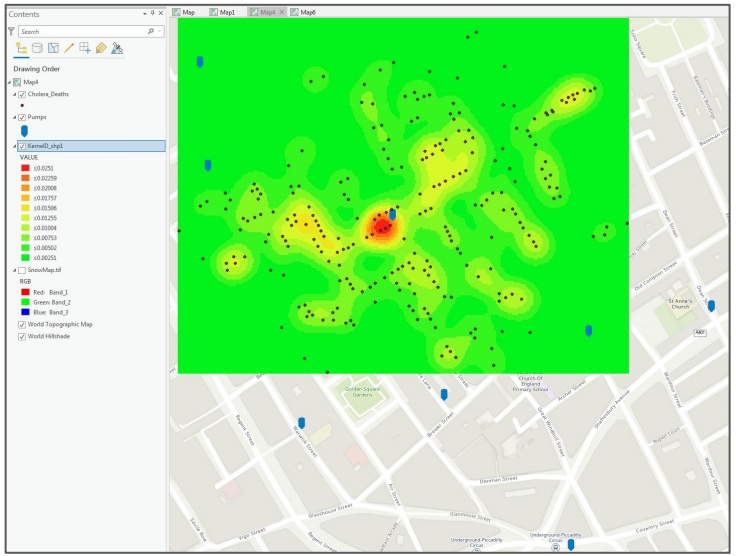


Kernel Density Calculations

1 - have a close look at the denser coloured areas and have a look at the locations of the pumps

2 - You can change the colour ramp to use a more intense colour for the higher incident values

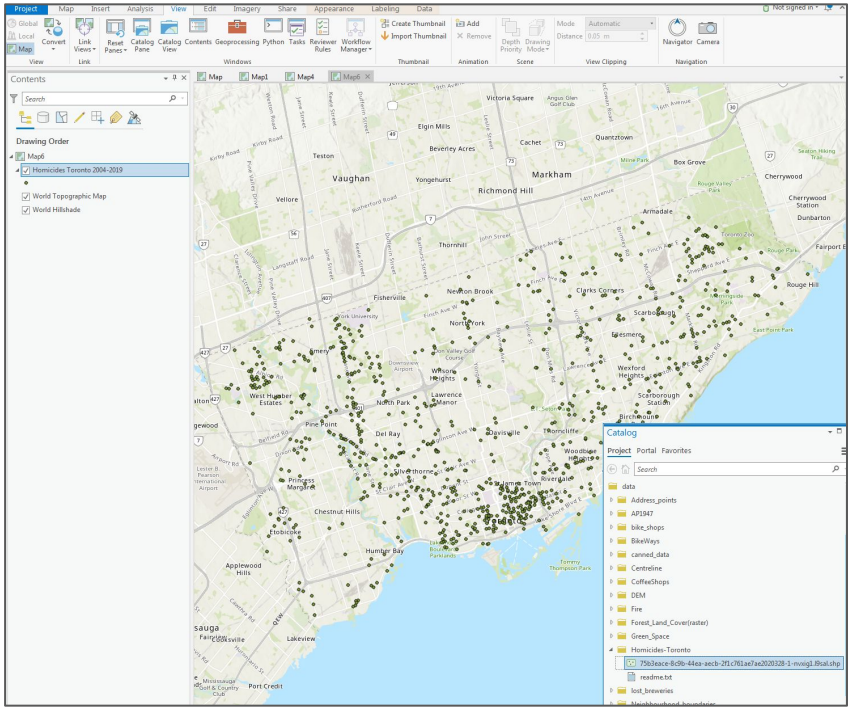




Density Calculations

1 - in a new map, load the Toronto Homicides data from “Homicides-Toronto” folder

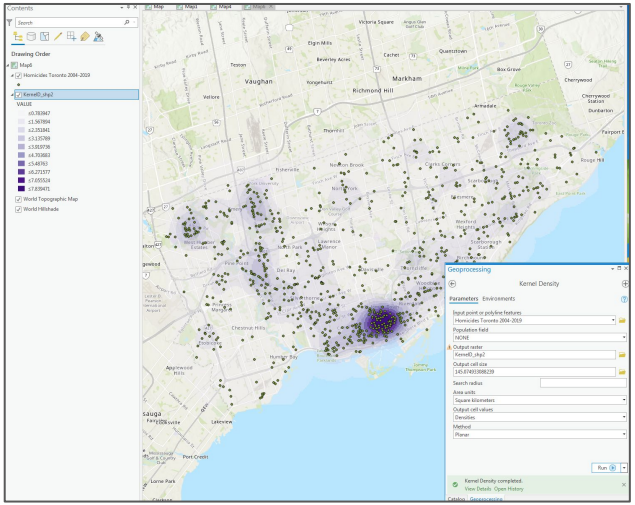
2 - this dataset covers the years 2004 until 2019. The homicides are also coded with the type of homicide in a column called “Homicide_T”

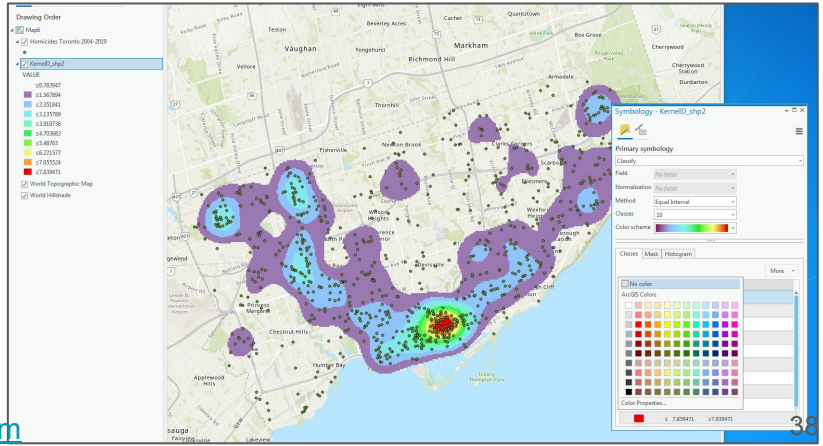


Density Calculations

1 - perform the same Kernel Density calculations on these Toronto Homicides

2 - we could of course conduct our calculations on just homicides of a certain type (eg. stabbings) or for just one year





https://pro.arcgis.com/en/pro-app/tool-reference/spatial-analyst/kernel-density.htm

End of Module 5