TUTORIAL 2 | TOPOGRAPHY AND CLIP

Goals

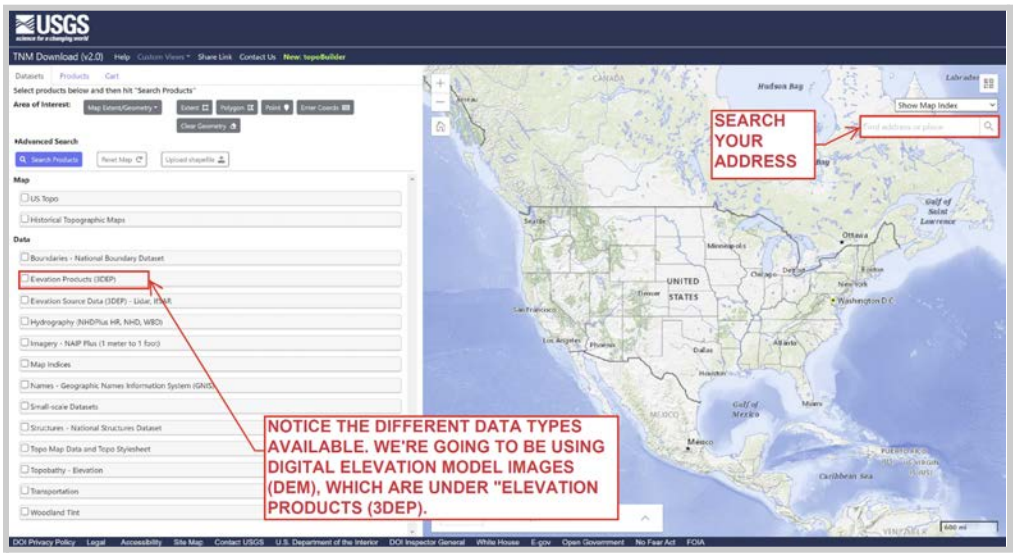
- Add topography to your city map.
- Learn where to find topographic data online.
- Extract topography lines from DEM.
- Use buffer and clip tools to reduce data scope.

Introduction

Using the base map from Tutorial 1, in Tutorial 2 you will download USGS topographic data and use a simple QGIS tool to extract contour lines from it. From there, you will crop the topography lines to Roanoke's administrative boundary. You will also practice graphic design and map export skills, as in Tutorial 1.

Step 1: Download DEM data for your city from USGS (note: if USGS website is not working, please skip to Step 1c)

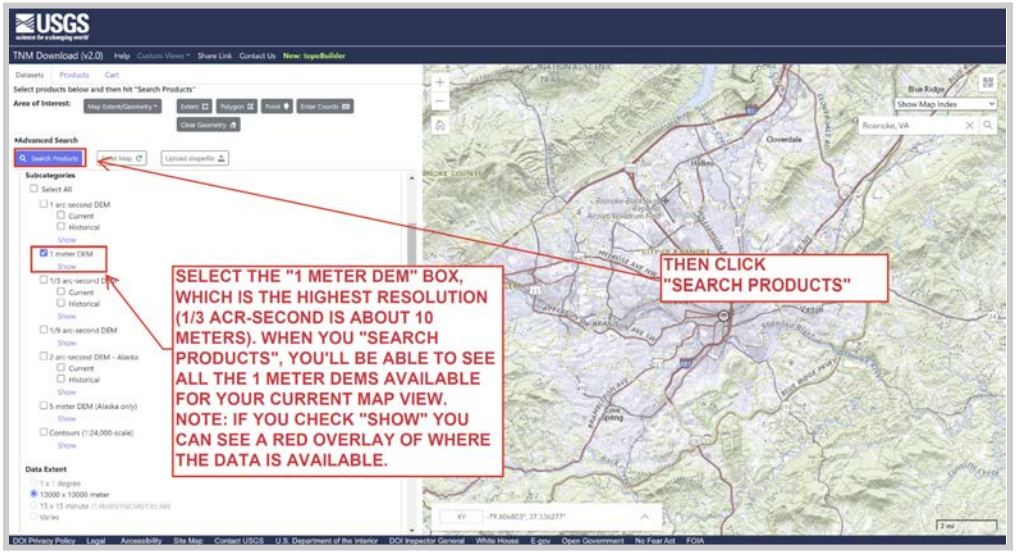
1a Visit the USGS earthexplorer site: https://apps.nationalmap.gov/downloader/#/. Search for Roanoke, VA.



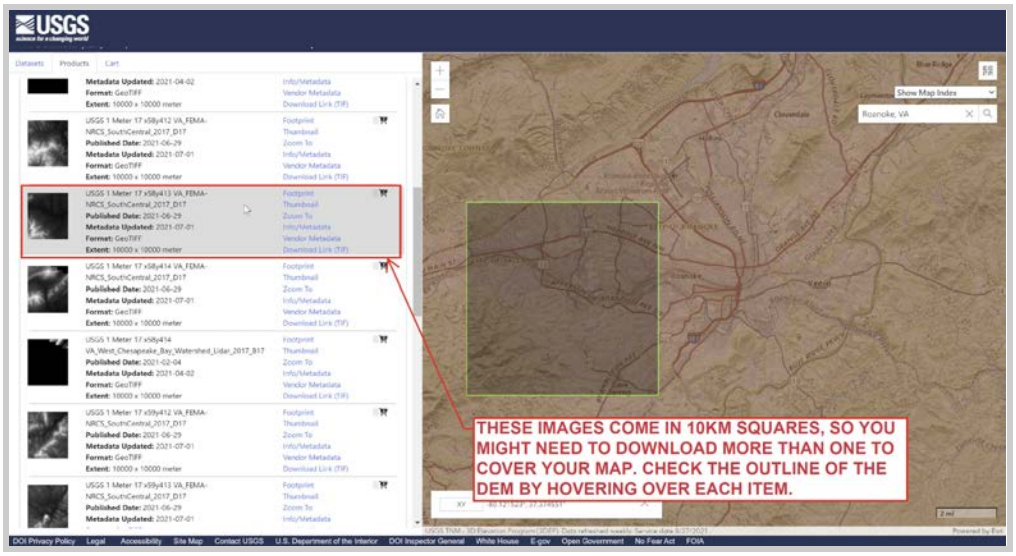
s

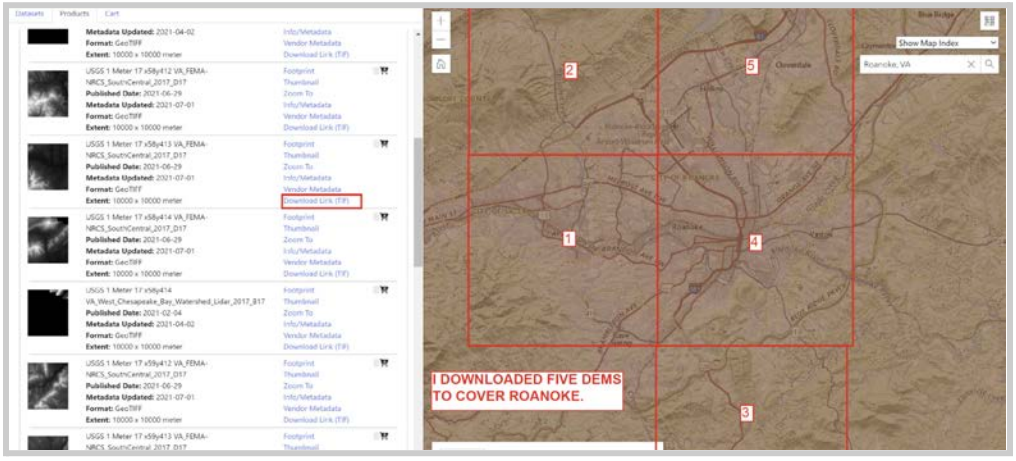
1b On the left panel, check "**Elevation Products**", and then "**1 meter DEM**". "Search Products" to see a list of the DEMs in the area on the map.

A **Digital Elevation Model** (DEM) is a raster image of the bare land surface (excluding trees, buildings, or other surface objects) drawn only in black and white, where each pixel color corresponds to a specific topographic height. We will be using GeoTIFF DEMs, which are TIFFs (image file) with embedded geographic information.



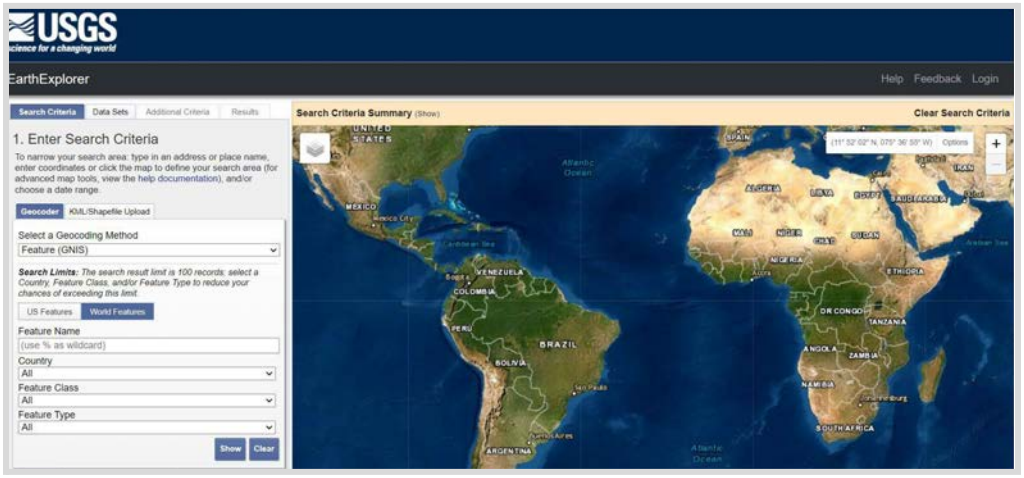
Hover over "**Thumbnail**" to see each DEM's outline on the map. Note: ignore the DEMs from "Chesapeake Bay Watershed", and instead use the "NRCS-South Central" ones. Download the 5 DEMs which overlap Roanoke by clicking **"Download Link**" in the left panel.



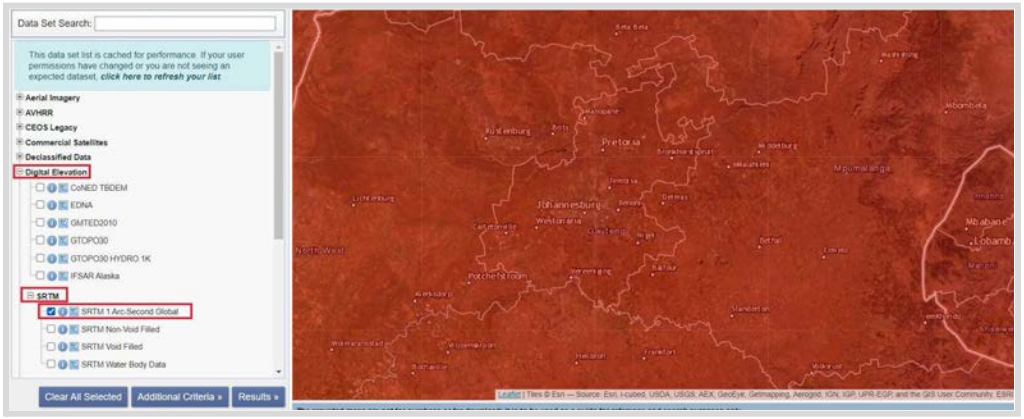


Note: follow steps 1c-1f only if the USGS website is not working

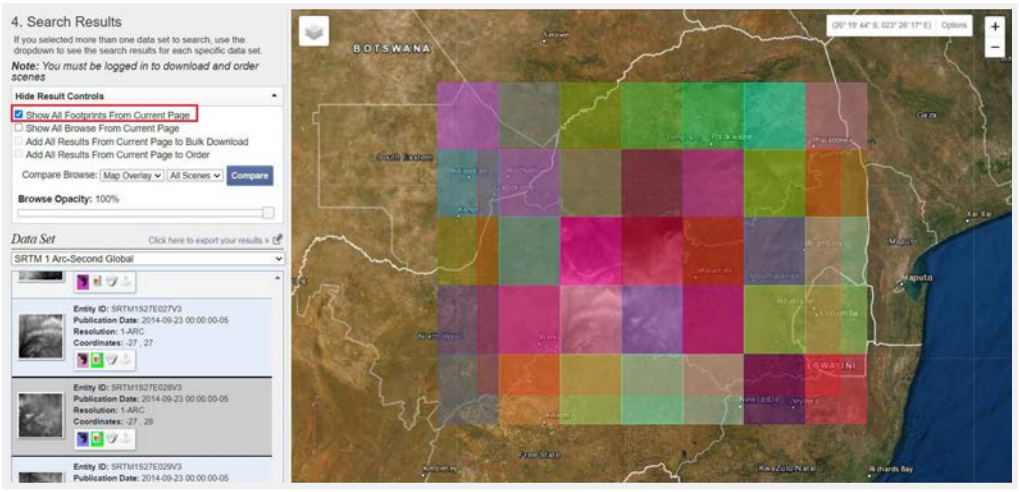
1c *If the USGS website is NOT working,* visit the USGS earthexplorer site: https://earthexplorer.usgs.gov/. You'll need to create a free account to download this data.

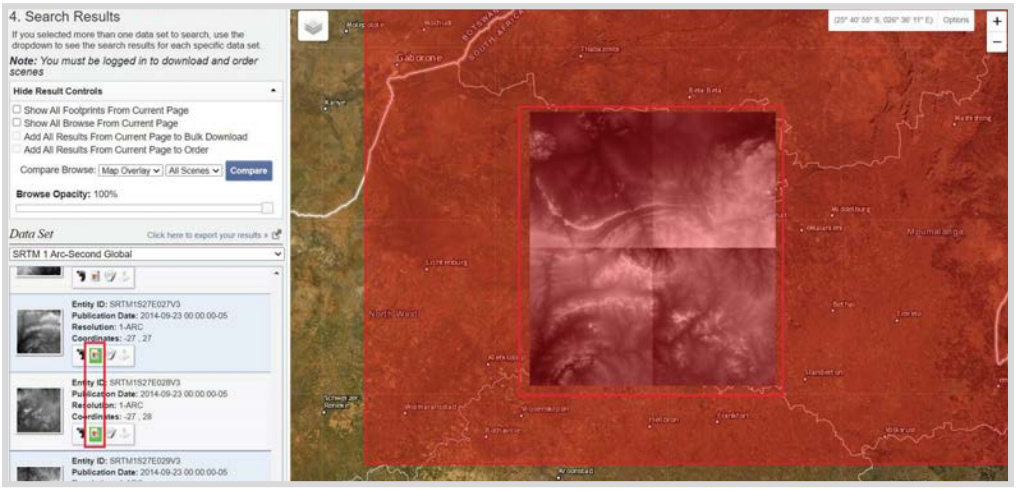


1d To define our “Search Criteria”, we’ll scroll down and select “Use Map”. Then, in the next tab “Data Sets”, open “Digital Elevation” and then **“SRTM”**. This stands for Space Shuttle Radar Topography Mission, which surveyed the entire planet down to **1-arc second** resolution (about 30 meters).



1e Now, check "**Show All Footprints**" to see the results on your map. You can click the Image icon (beside the foot) in the Data Set results to see the image in the map.

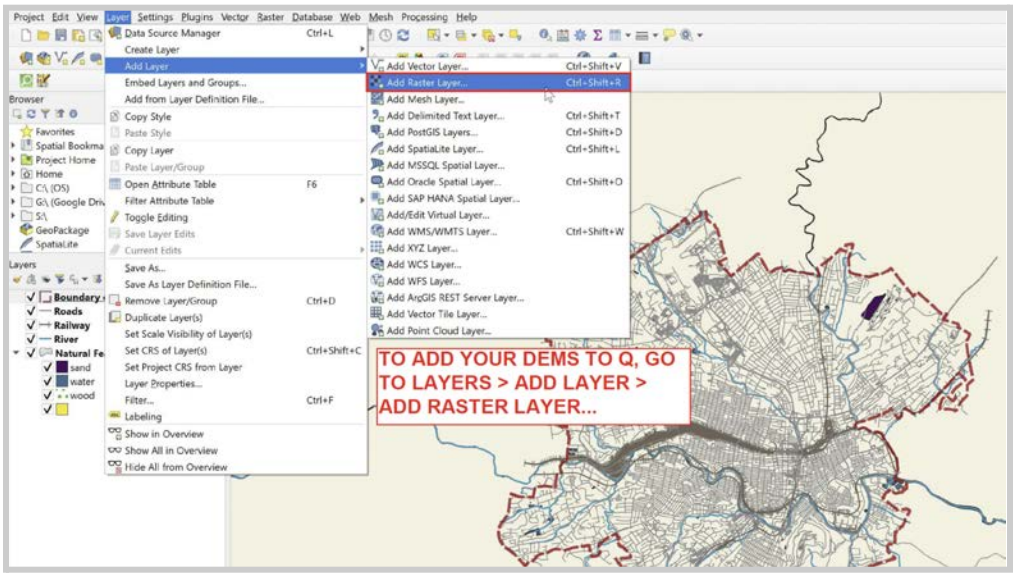




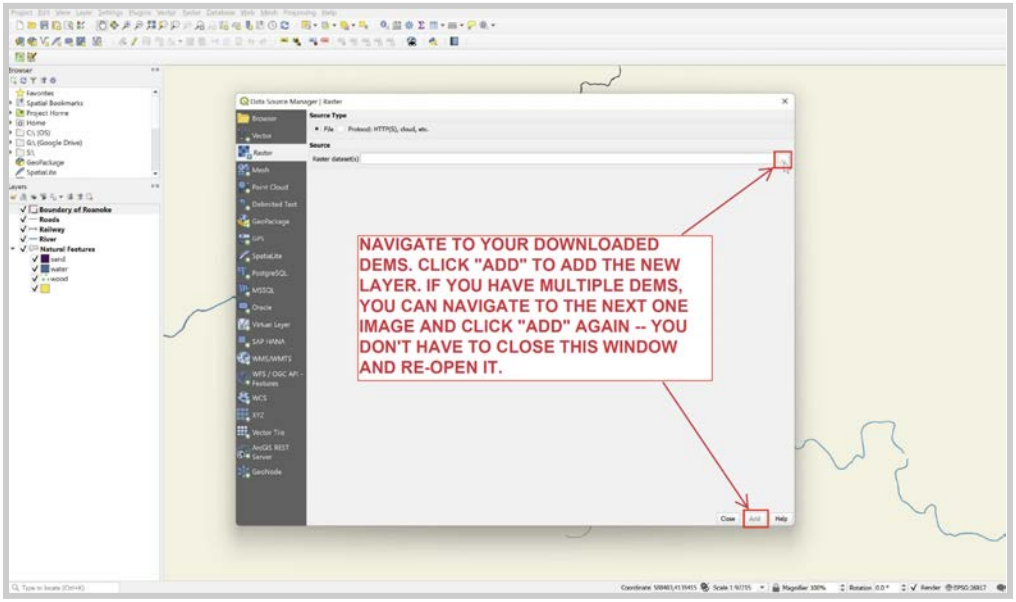
1f Download the DEMs that you need from your free account.

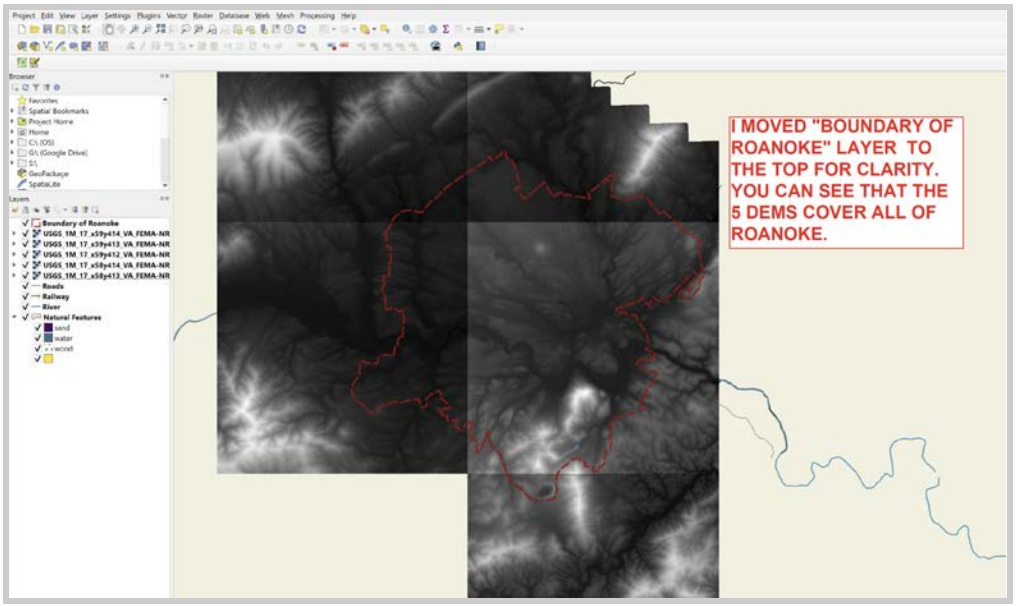
Step 2: Import the DEM into QGIS as a Raster Layer.

2a In your QGIS file from Tutorial 1, go to **Layer > Add Layer > Add Raster Layer**…



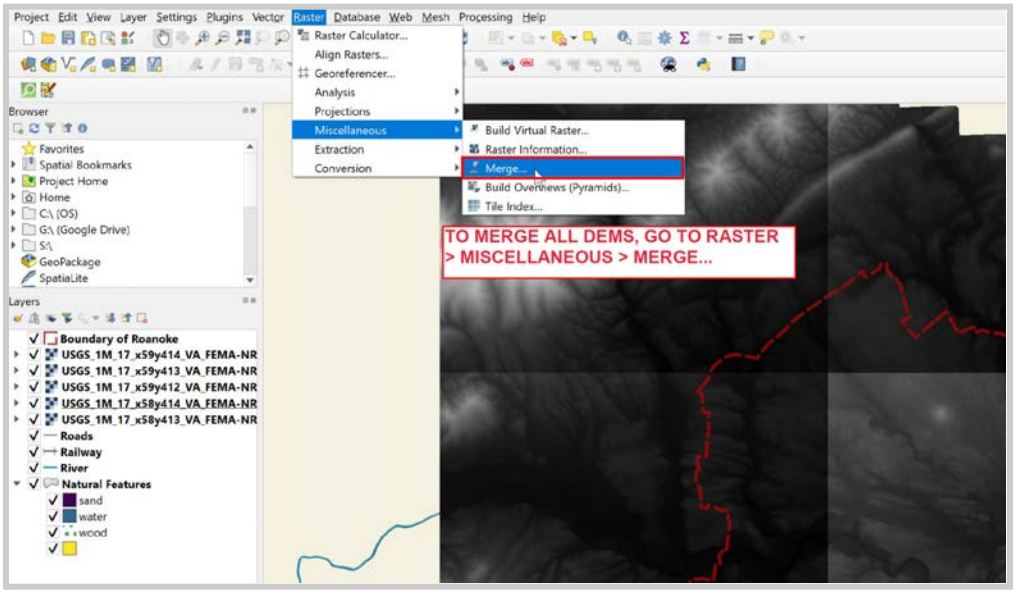
2b Click the ellipses (...) and navigate to your downloaded DEM image. Click "**Add**" to add the layer to your map. You can add multiple DEM layers by changing the Source location without closing the Data Source Manager window.

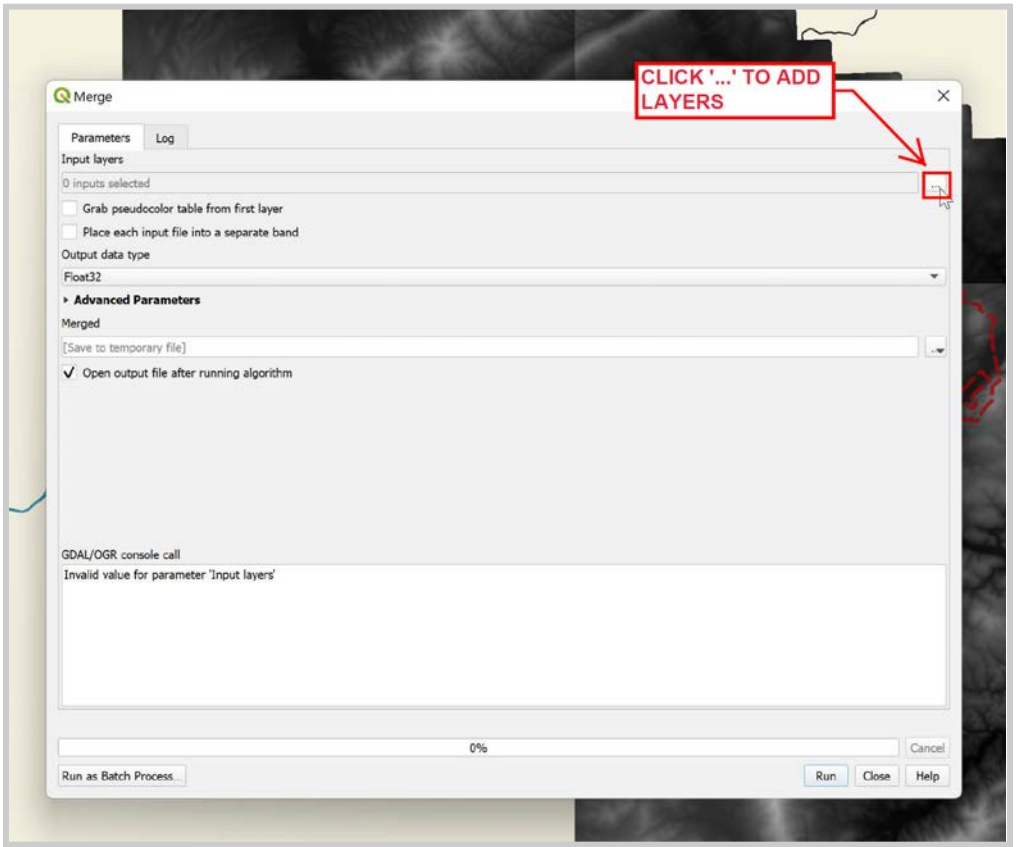


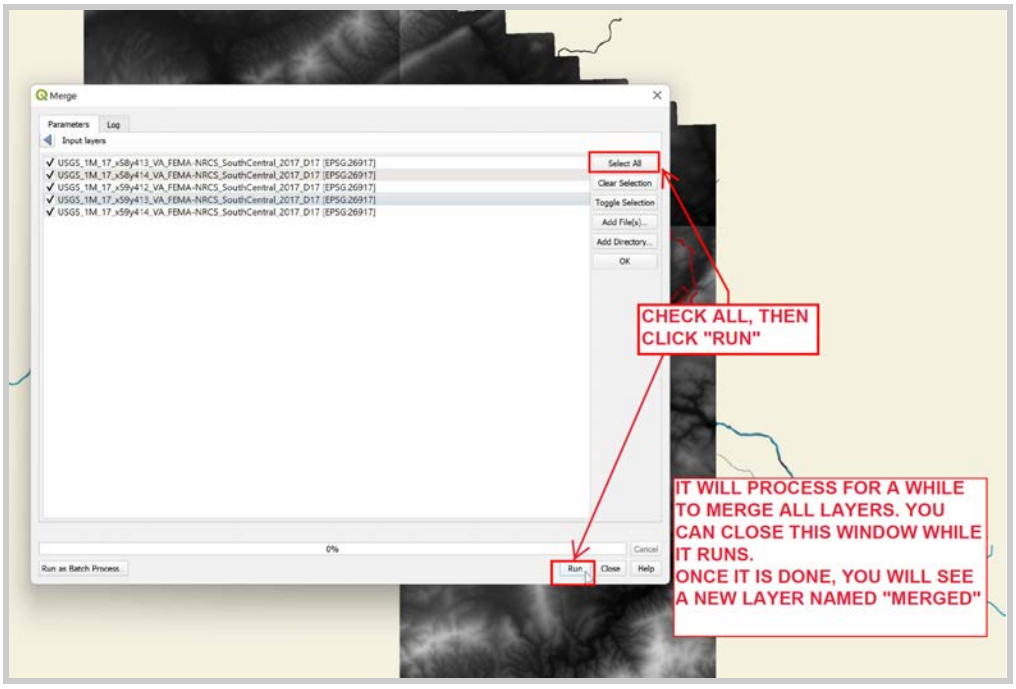

I MOVED "BOUNDARY OF ROANOKE" LAYER TO THE TOP FOR CLARITY. YOU CAN SEE THAT THE 5 DEMS COVER ALL OF ROANOKE.

Step 3: Extract topography lines with Raster > Extraction > Topography.

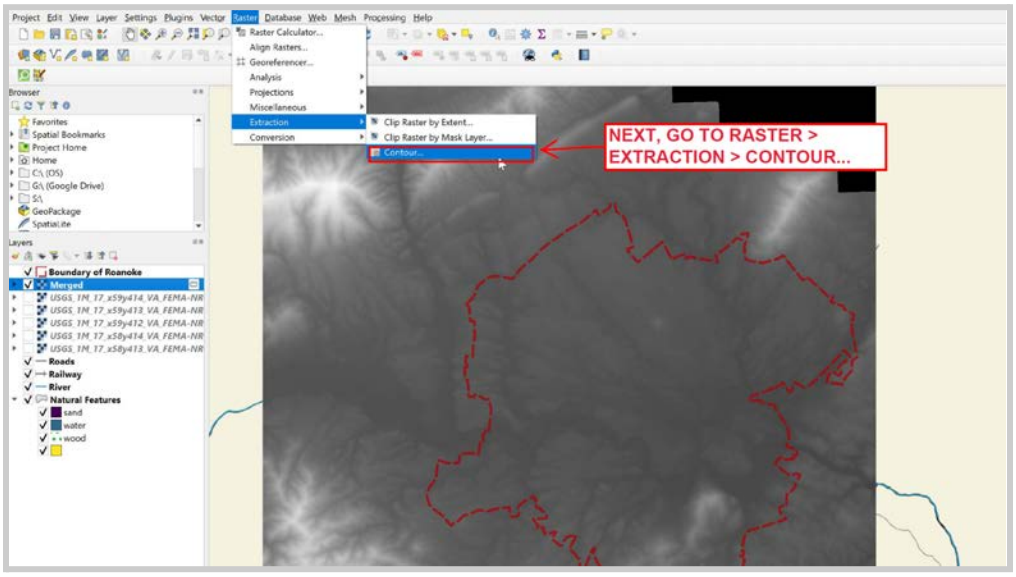
3a First, combine your four DEMs into one layer by going to **Raster > Miscellaneous > Merge**. Select your DEM layers and click “Run” to output a single layer. You can then remove the individual rasters from your project.



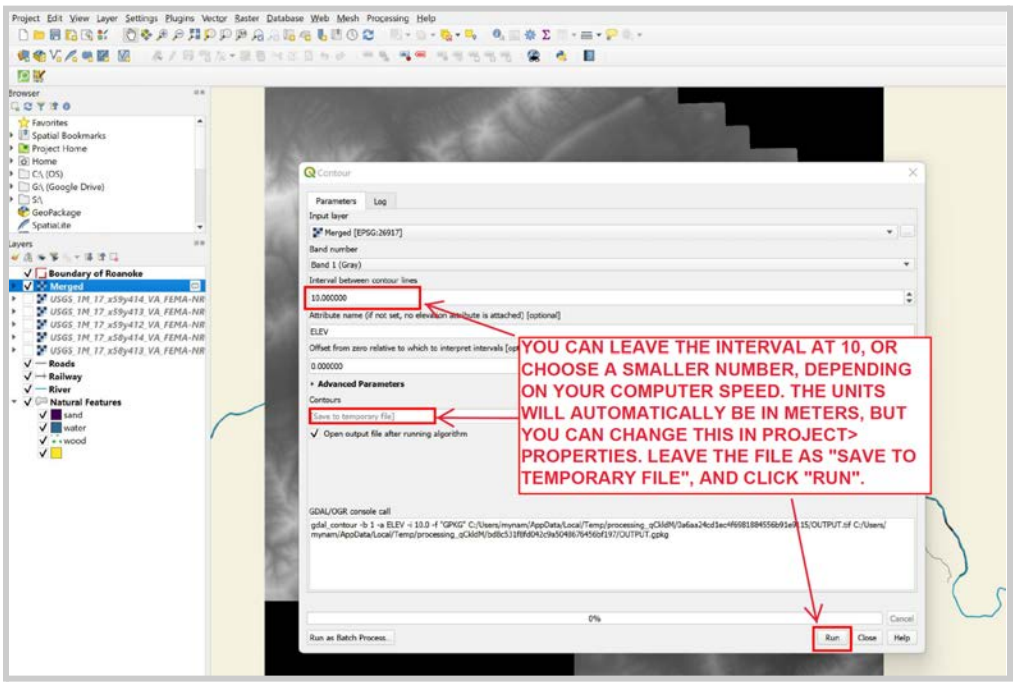



Merge
Parameters
Log
Input layers
USGS_1M_17_x58y413_VA_FEMA-NRCS_SouthCentral_2017_D17 [EPSG:26917]
USGS_1M_17_x58y414_VA_FEMA-NRCS_SouthCentral_2017_D17 [EPSG:26917]
USGS_1M_17_x59y412_VA_FEMA-NRCS_SouthCentral_2017_D17 [EPSG:26917]
USGS_1M_17_x59y413_VA_FEMA-NRCS_SouthCentral_2017_D17 [EPSG:26917]
USGS_1M_17_x59y414_VA_FEMA-NRCS_SouthCentral_2017_D17 [EPSG:26917]
Select All
Clear Selection
Toggle Selection
Add File(s)...
Add Directory...
OK
0%
Cancel
Run as Batch Process...
Run
Close
Help
CHECK ALL, THEN CLICK "RUN"
IT WILL PROCESS FOR A WHILE TO MERGE ALL LAYERS. YOU CAN CLOSE THIS WINDOW WHILE IT RUNS.
ONCE IT IS DONE, YOU WILL SEE A NEW LAYER NAMED "MERGED"

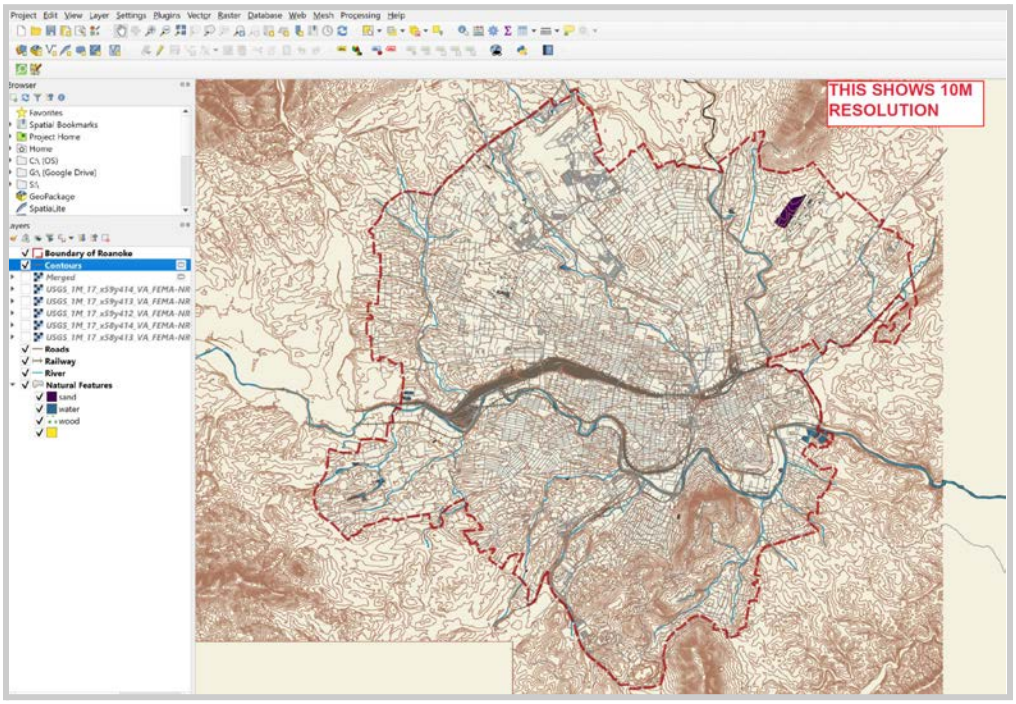
3b In the top menu, go to **Raster > Extraction > Contour**…



3c For "**Input Layer**", select your DEM layer. Choose an interval for your contour lines. Since each DEM is 10 kilometers wide, it can take a long time to draw contour lines at small intervals. For the sake of this exercise, you can leave the interval at 10 (meters), or make it smaller (5 meters; you could go down to 1 meter, since the data we downloaded is 1 meter resolution – but this will look busy in the hilly area, take a long time, and be data-heavy). Finally, click "**Run**" to create the contours layer. **This may take several minutes**.



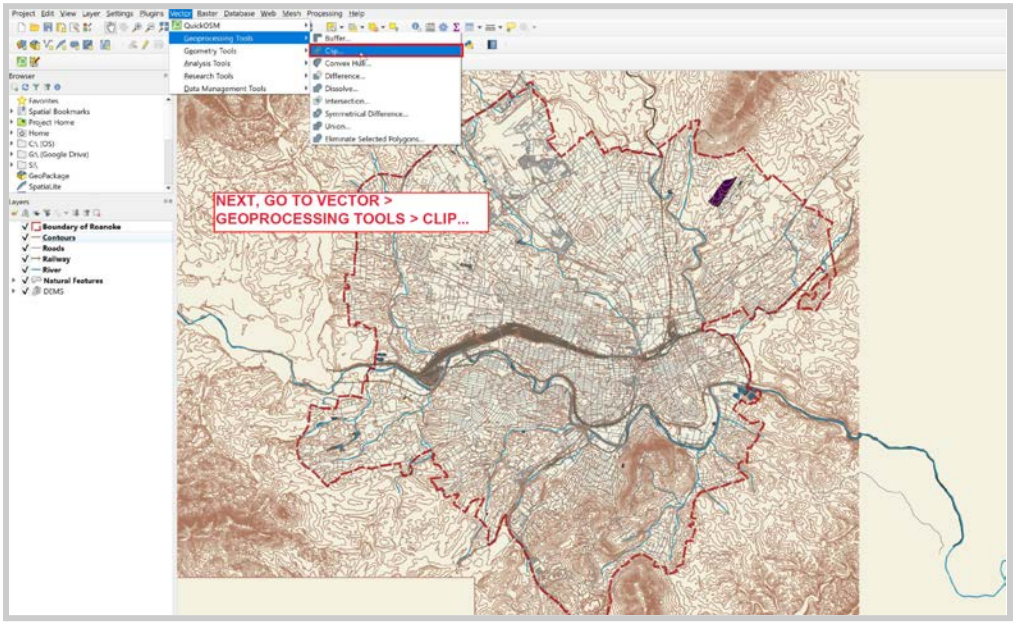
Here you can see the 10 meter contour intervals:



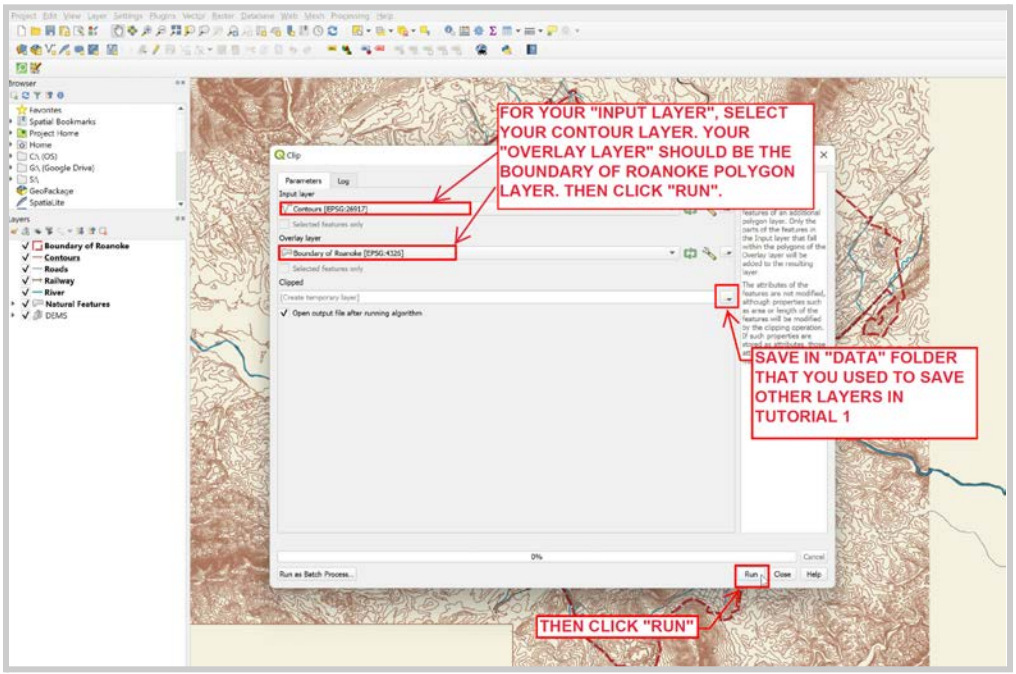
Step 4: Use the Roanoke City boundary to clip your contour lines.

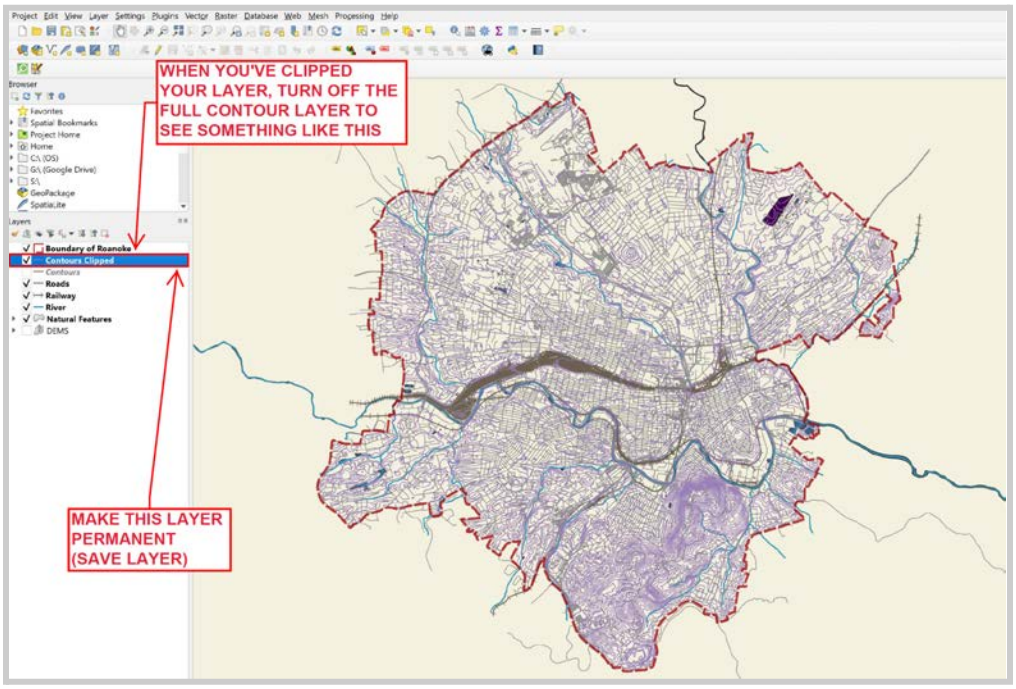
Note: use the administrative boundary **polygon layer**, not a polyline layer, since Q searches for overlap.

4a In the "**Vector**" menu, select "**Geoprocessing Tools" > "Clip**…"



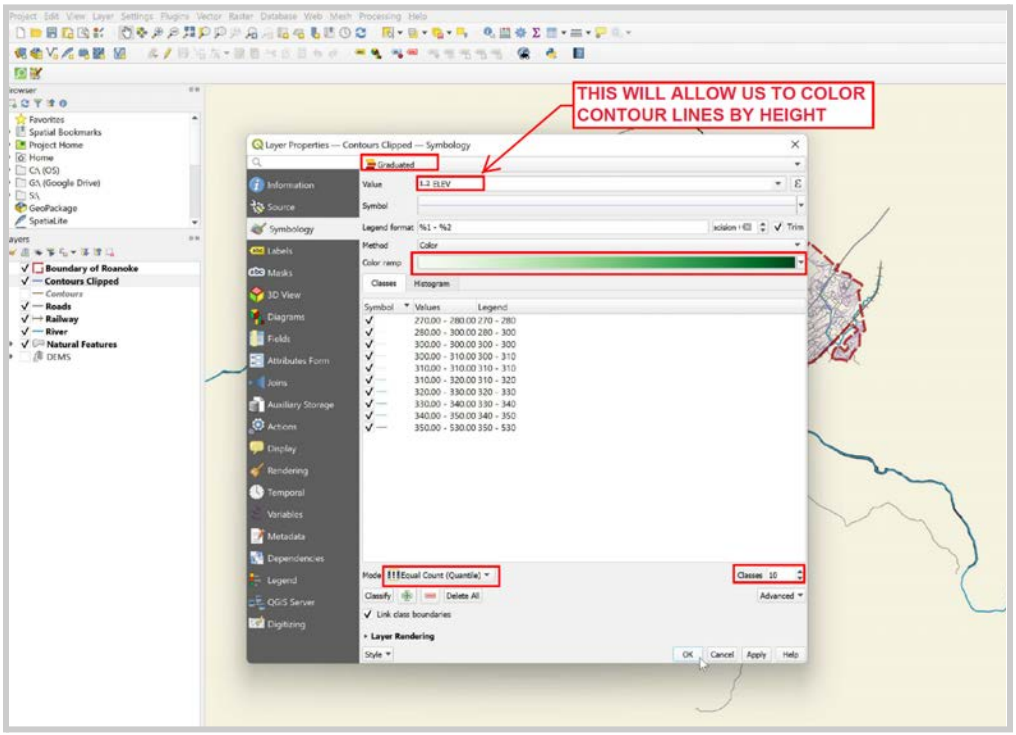
4b Add the contour layer for "**Input Layer**", and the Roanoke administrative boundary for "**Overlay Layer**". Click the **ellipses (...) right of "Clipped**" and name your new layer, and save it in your data folder. Click "**Run**".

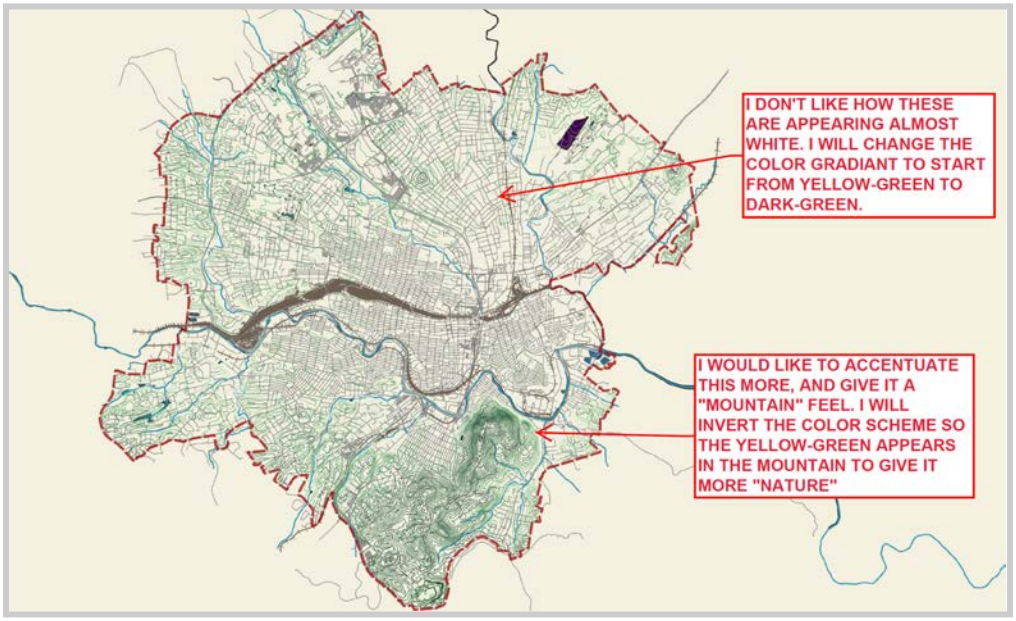


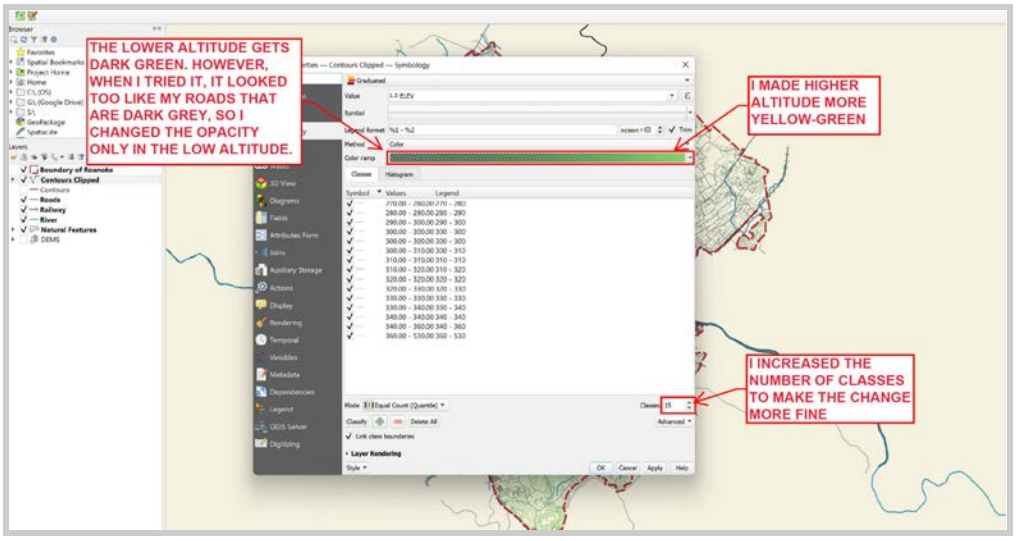

WHEN YOU'VE CLIPPED YOUR LAYER, TURN OFF THE FULL CONTOUR LAYER TO SEE SOMETHING LIKE THIS
MAKE THIS LAYER PERMANENT (SAVE LAYER)
Boundary of Roanoke
Contours Clipped
Contours
Roads
Railway
River
Natural Features
DEMS

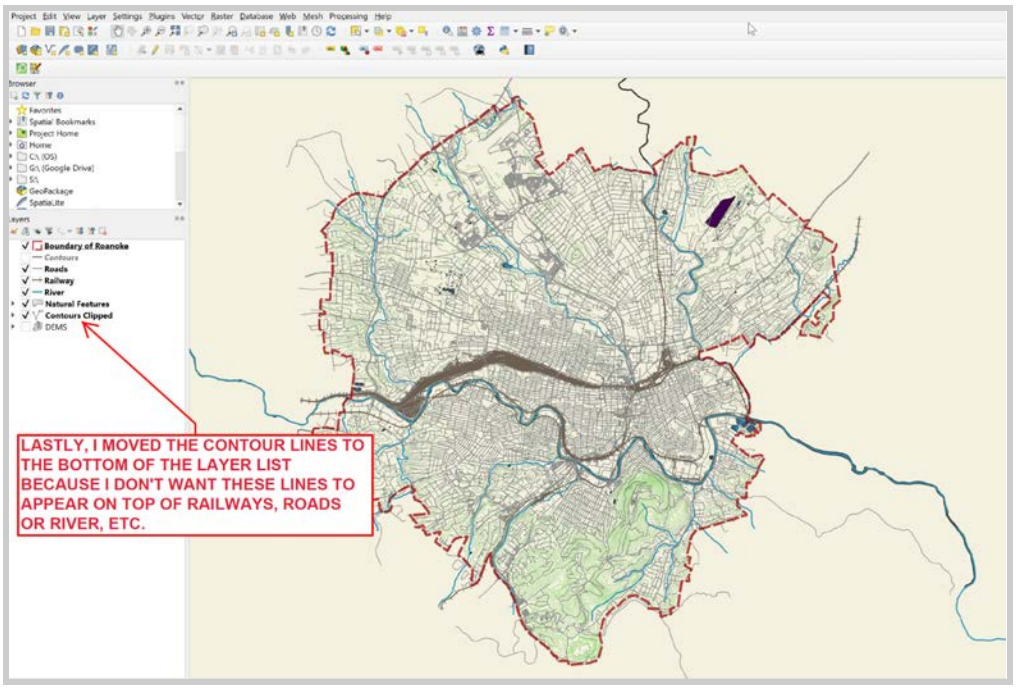
Step 5: Style contour lines. Try adding elevation labels.

5a Style contour lines based on their height using the **"Graduated" style** (which colors by a number property). Select **"ELEV" for Value**. Make sure your "Mode" (lower left) is set to "Equal Interval".

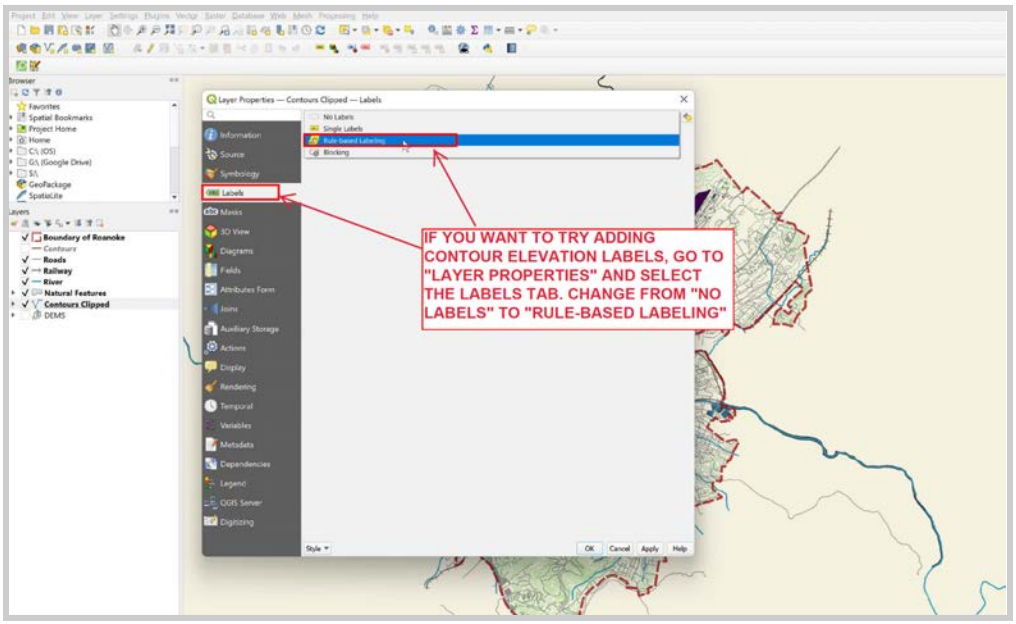




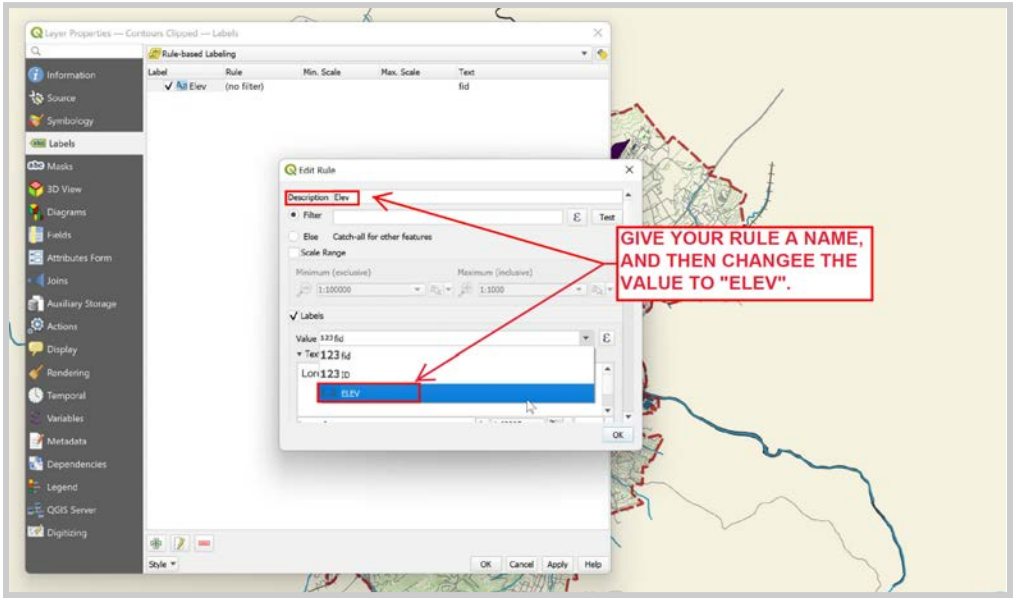

THE LOWER ALTITUDE GETS DARK GREEN. HOWEVER, WHEN I TRIED IT, IT LOOKED TOO LIKE MY ROADS THAT ARE DARK GREY, SO I CHANGED THE OPACITY ONLY IN THE LOW ALTITUDE.
I MADE HIGHER ALTITUDE MORE YELLOW-GREEN
I INCREASED THE NUMBER OF CLASSES TO MAKE THE CHANGE MORE FINE

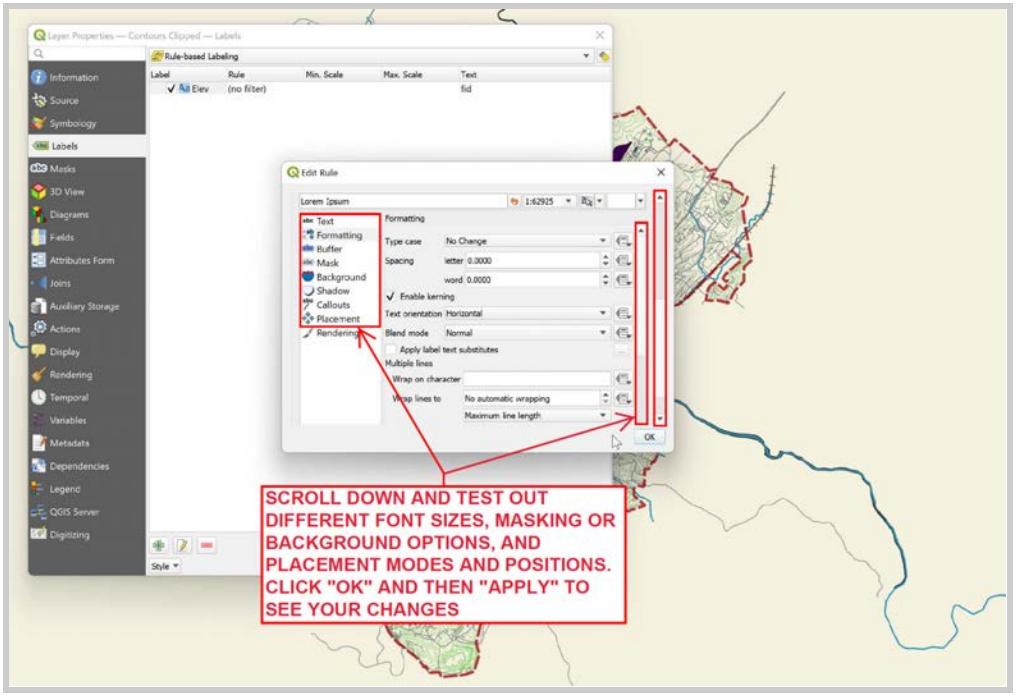

LASTLY, I MOVED THE CONTOUR LINES TO THE BOTTOM OF THE LAYER LIST BECAUSE I DON'T WANT THESE LINES TO APPEAR ON TOP OF RAILWAYS, ROADS OR RIVER, ETC.

5b Try also adding **labels** to indicate contour elevation. In “Layer Properties” you’ll see a “Labels” tab. Select “**Rule Based Labeling**”.

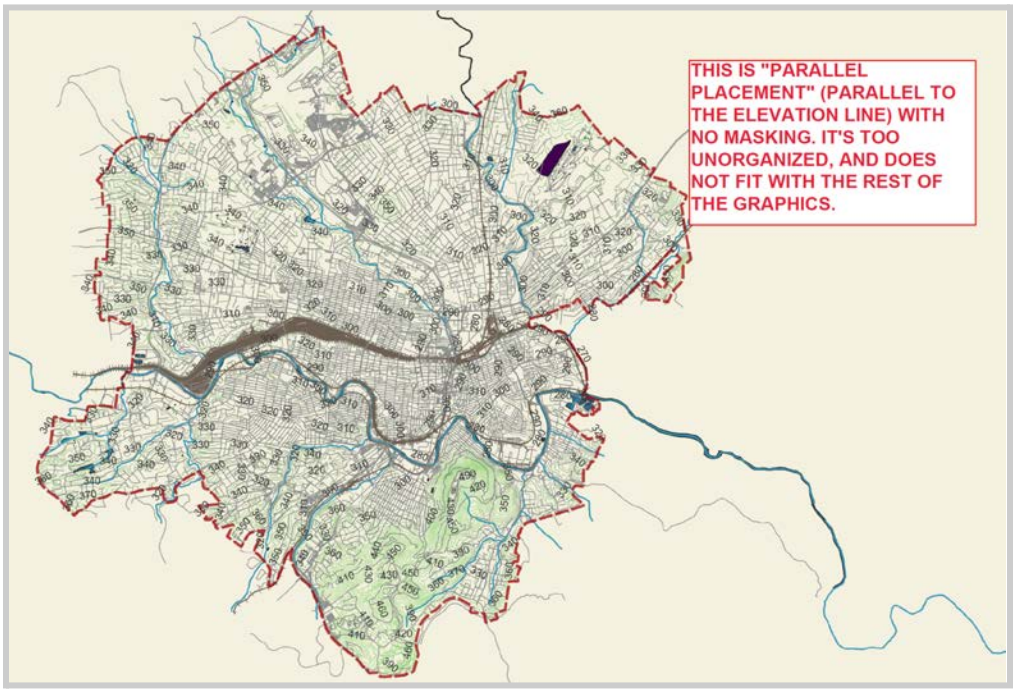


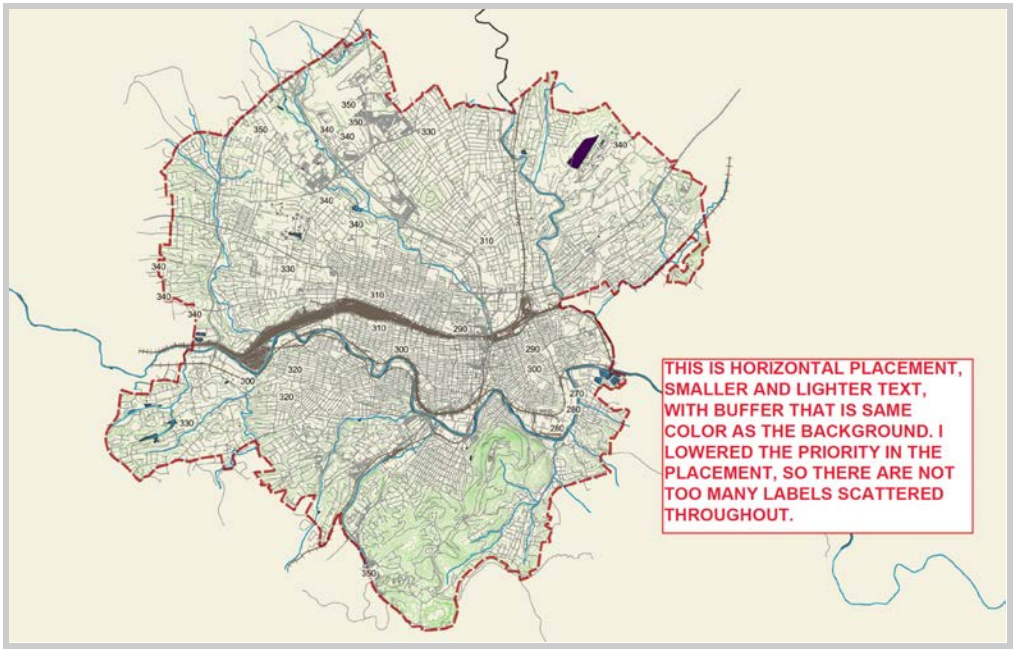
Click ‘+’ at the bottom to create a new rule. Name your rule and select “elev” as the “Value”. Try different appearances with “Text”, “Formatting”, “Placement”, “Mask”, and so on.





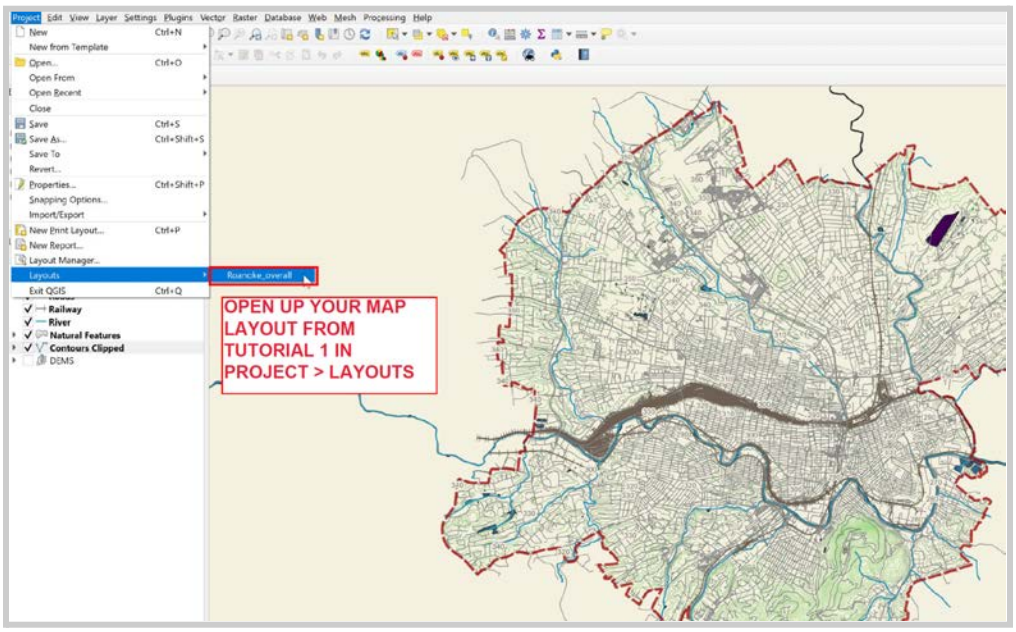
See a couple examples of label graphics:



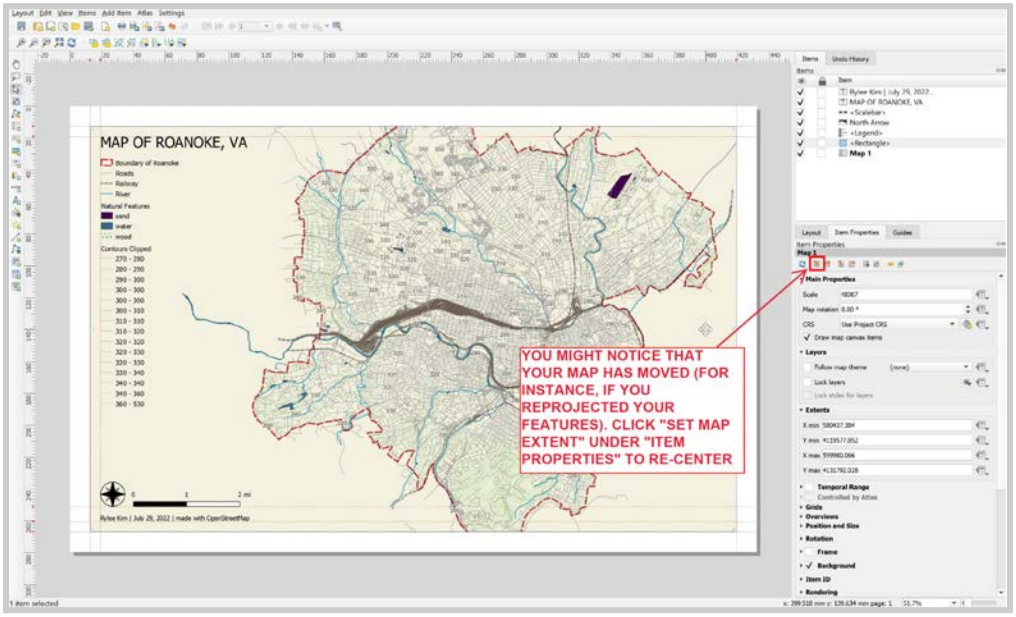

THIS IS HORIZONTAL PLACEMENT, SMALLER AND LIGHTER TEXT, WITH BUFFER THAT IS SAME COLOR AS THE BACKGROUND. I LOWERED THE PRIORITY IN THE PLACEMENT, SO THERE ARE NOT TOO MANY LABELS SCATTERED THROUGHOUT.

Step 6: Re-export your PDF map.

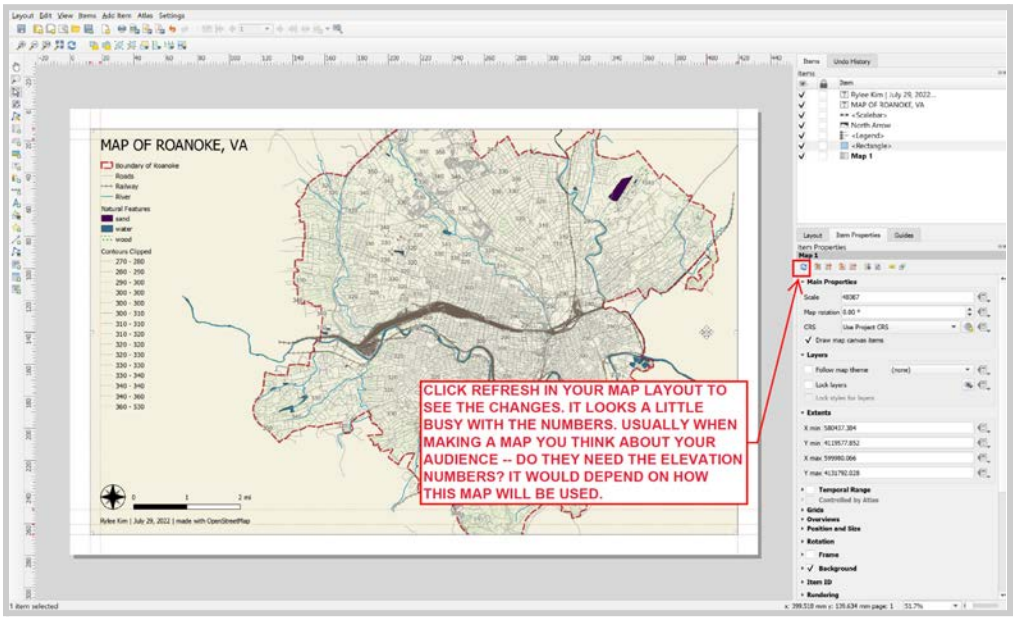
6a Open your Map Layout from last time (**“Project” > “Layouts”**)



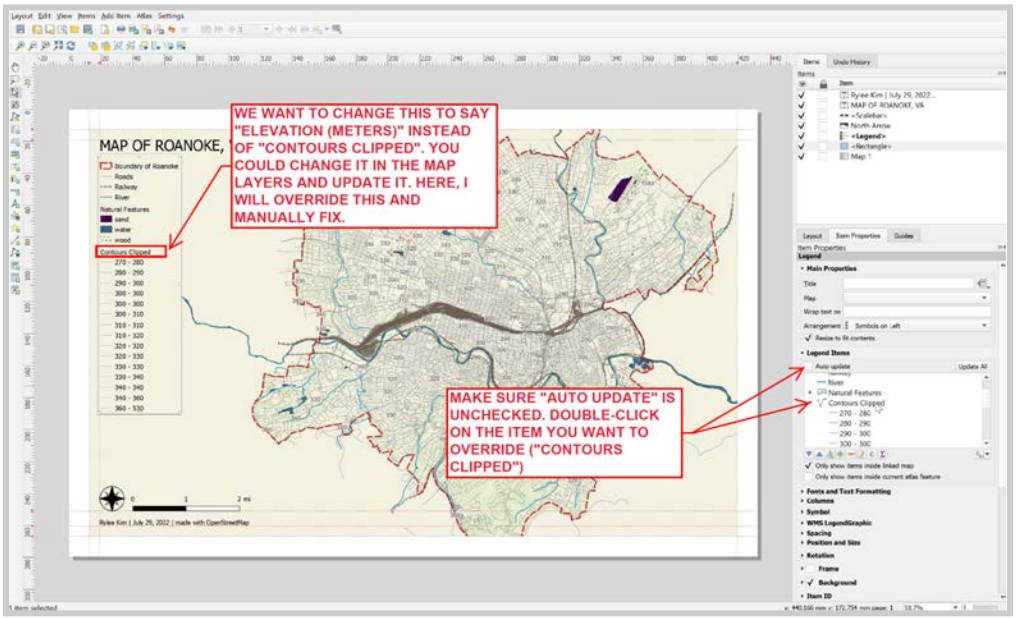
6b You may need to reset your map with the “**Set Map Extents to Match**” button in the “**Item Properties**” window.

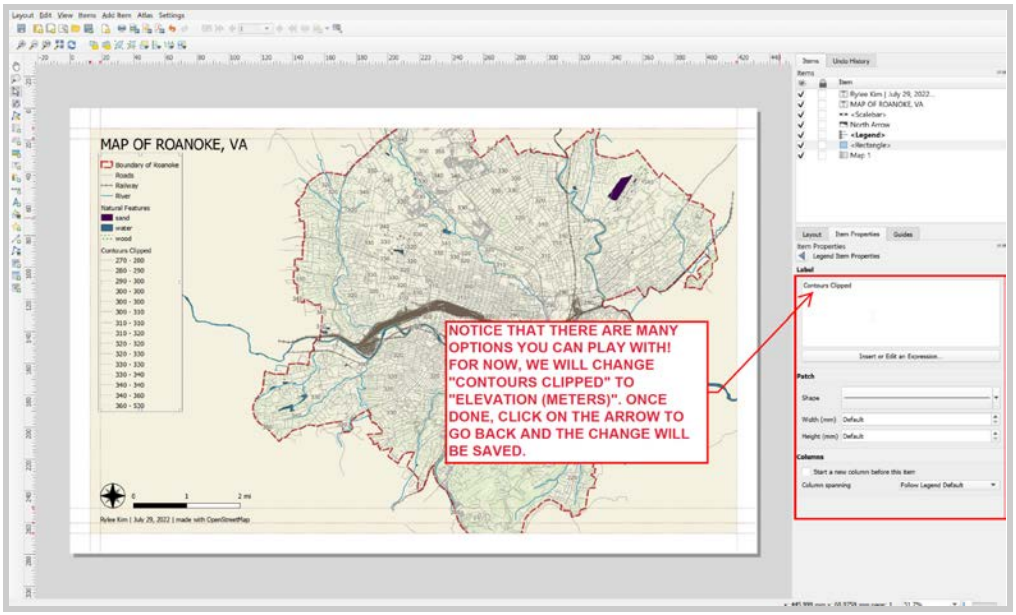


Try “Refresh” if you’ve made changes to your map that haven’t shown up.

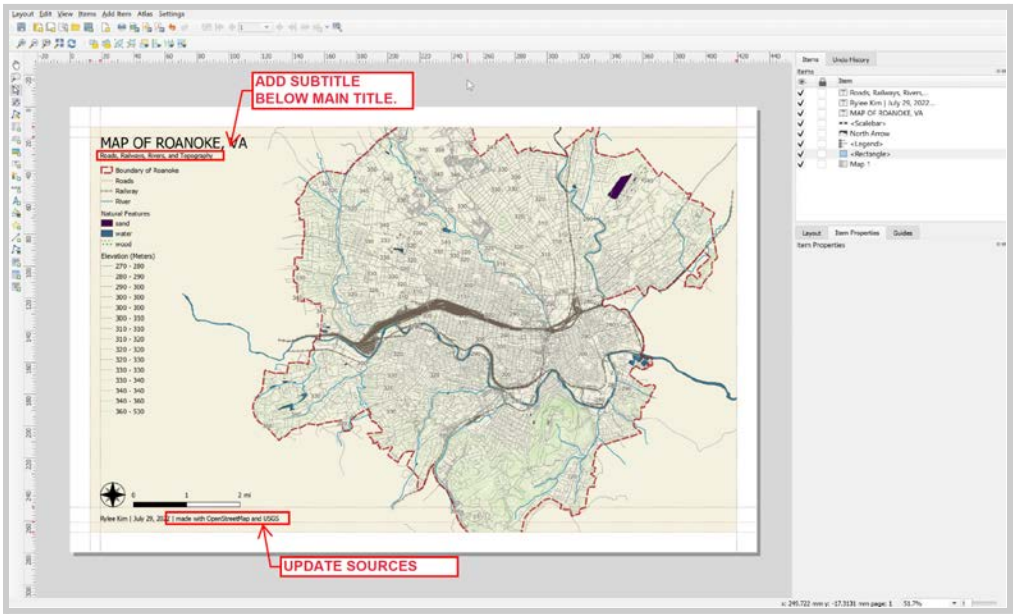


6c Check your updated **legend** and make sure each legend entry is clear and correct. Make sure that **units** in the topo legend are clearly labeled as meters. Manually edit it as needed.





6d Before exporting your new PDF, make sure to check the **scale, legend, title, and sources are updated**. The title for this map should reflect the new information (topo) that you've added. Add a **subtitle** to draw attention to relationships that you notice between the topography and the roads / natural features / other information in the map.



- **Bonus** -

Step 7: Examine how your previous data correlates to the topography. What kinds of road grids are on steeper or flatter ground? How do rivers relate to the topography? How does the railroad? **Visually identify** interesting topographical patterns.

Step 8: In a **new map layout**, add at least **three zoomed-in maps** showing the patterns you identified.

Step 9: Add a **key map** (context / inset map) that shows where in the city each zoomed-in map is located.

Step 10: Add a **short text description** below each map that describes the pattern you see. Make sure to include, as always, a north arrow, scale, title, subtitle, and byline.