



INTRO TO SPATIAL ANALYSIS WORKSHOP

WORKSHOP MATERIALS

SPRING 2020



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Introduction

QGIS is an Open Source Geographic Information System (GIS) option. QGIS is an part of the Open Source Geospatial Foundation (OSGeo) and can run on Linux, Unix, Mac OSX, Windows and Android and supports numerous vector, raster, and database formats and functionalities.

QGIS provides users the functionality to analyze and edit spatial information, in addition to map creation. QGIS supports both raster and vector layers; vector data is stored as either point, line, or polygon features. Multiple formats of raster images are supported, and the software can georeference images.

QGIS supports shapefiles, coverages, personal geodatabases, dxf, MapInfo, PostGIS, and other formats. Web services, including Web Map Service and Web Feature Service, are also supported to allow use of data from external sources.

QGIS integrates with other open-source GIS packages, including PostGIS, GRASS GIS, and MapServer. Plugins written in Python or C++ extend QGIS's capabilities. Plugins can geocode using the Google Geocoding API, perform geoprocessing functions similar to those of the standard tools found in ArcGIS, and interface with PostgreSQL/PostGIS, SpatiaLite and MySQL databases.

https://qgis.org/en/site/index.html

Tutorial Data

1. Download the data here:

https://drive.google.com/drive/folders/1rWy1f4_XTdIYUhD2OXpSIZDYjeFcnyZF

- 2. Save to your C: drive or main drive that you can easily locate
- 3. Unzip the folder
- 4. You will see two folders VectorData and RasterData
- 5. You will also see a file ending in .csv

Text Delimited Table

School_Demographics.csv – taken from data.nashville.gov (Nashville Open Data Portal). Shows Current student enrollment and demographic information for Metro Nashville Public Schools (MNPS) locations.

Vector Data (Shapefiles)

Vector data is split into three types: polygon, line (or arc) and point data. Polygons are used to represent areas such as the boundary of a city (on a large-scale map), lake, or forest.

Polygon features are two dimensional and therefore can be used to measure the area and perimeter of a geographic feature. Polygon features are most commonly distinguished using either a thematic mapping symbology (color schemes), patterns, or in the case of numeric gradation, a color gradation scheme could be used. Line (or arc) data is used to represent linear features. Common examples would be rivers, trails, and streets.

Line features only have one dimension and therefore can only be used to measure length. Point data is most commonly used to represent nonadjacent features and to represent discrete data points. Points have zero dimensions; therefore, you can measure neither length or area with this dataset. Examples would be schools, points of interest, and in the example below, bridge and culvert locations. Point features are also used to represent abstract points. For instance, point locations could represent city locations or place names.

Polygons:

<u>School_Districts.shp</u> – taken from data.nashville.gov (Nashville Open Data Portal). Contains outlines for Davidson County School Districts.

<u>Buildings.shp</u> - Nashville, Tennessee Building Footprints: Metropolitan GIS taken from koordinates.com

Lines:

<u>Street_Davidson.shp</u> – Nashville, Tennessee Road Centerlines: Metropolitan GIS taken from koordinates.com

Points:

<u>Potholes.csv</u> – delimited text file taken from data.nashville.gov (Nashville Open Data Portal). Service requests to hubNashville (311) from residents and visitors.

Raster Data

Raster data consists of cells which represent values. The resolution of a raster dataset is determined by the size of the cells. For example, a 2.5m resolution DEM, like the ones used in this exercise, means that each cell that makes up that raster is 2.5m by 2.5m. There are two major types of raster data, discrete and continuous. Discrete raster data tends to be categorical, whereas continuous raster data is representative of a surface.

In this exercise we will look at continuous raster data in the form of digital elevation models (DEMs) and digital surface models (DSMs). Data for this exercise was downloaded from the TN State data repository at: <u>https://tnmap.tn.gov/.</u>

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Getting to Know the QGIS Interface

- 1. Menu bar: Access to various QGIS features using a standard hierarchical menu.
- 2. Toolbars: For interaction with the map, layers, attributes and selections.
- 3. Browser Panel: A spatial file browser allowing drag and drop content into the map frame.
- 4. Layer Panel: Controls the map layers, their order, and visibility.
- 5. Map View: View spatial data
- 6. CRS/Coordinate Bar: Change coordinate reference system on the fly and coordinate display

Vector Data

Adding data

Navigate to VectorData folder in the browser panel (If the browser panel is not visible right click the top menu and select the Browser Panel.)

- 1. Select **Zipcodes.shp** and drag to the main view or to the layer panel
- 2. Select School_Demographics.csv and add to the map

Projection of Layers and Project

QGIS automatically reads projection information (i.e., the Coordinate Reference System [CRS]), if available, from respective layer files. For shapefiles, it relies on the ".prj" file; for raster data, it is often embedded in the file. If you load data without built-in projection information (e.g., a Delimited Text File), it generally assumes a geographic coordinate system (Lat/Long), and uses the World Geodetic Survey 1984 (WGS84) datum, or may use the Project CRS the user to specify. It is always a good idea to check that the projection information is interpreted correctly by QGIS.

By default, QGIS uses "Projection on the Fly" – for visualization (but not necessarily analysis) of multiple layers in different CRSs, they are automatically transformed to be in the same coordinate space.

Look to the bottom right corner of your viewer. Notice the EPSG (coordinate system

designation code). To change the CRS of your map, click the world icon a next to the designation code.

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Then select EPSG: 4326 (WGS84)

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Working with Attribute Tables

Open Attribute Table for School_Demographics.csv by right clicking the layer →
 Open Attribute Table

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3	19-20	Middle School	130	Bellevue Mid	40	37221
4	19-20	High School	615	John Overto	395	37220
5	19-20	Elementary S	235	Crieve Hall El	145	37220
6	19-20	Elementary S	500	Robert E. Lill	420	37218
7	19-20	Elementary S	152	Ivanetta H. D	7010	37218
8	19-20	Middle School	783	Creswell Mid	700	37218
9	19-20	Elementary S	240	Cumberland	150	37218
10	19-20	Elementary S	735	Una Element	655	37217
11	19-20	Charter	668	Rocketship U	8070	37217
12	19-20	Elementary S	122	Lakeview Ele	430	37217
13	19-20	Elementary S	345	Glenview Ele	265	37217
14	19-20	Elementary S	335	Glengarry Ele	255	37217
15	19-20	High School	705	Stratford STE	620	37216

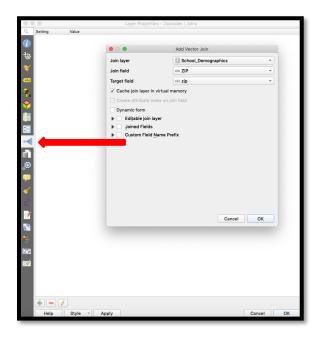
- 2. Close attribute table.
- 3. Open the attribute table for **Zipcodes.**

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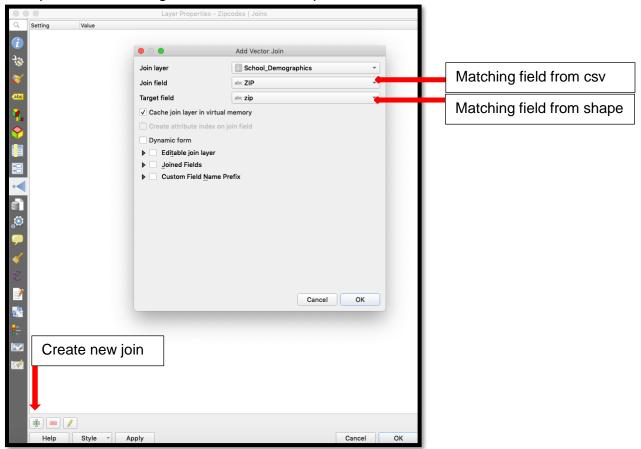
4. Note what field is the same in both datasets.

Creating a Join

1. Join the two tables based on their common field to view data from both tables simultaneously. Select **Zipcodes** and right click \rightarrow Properties \rightarrow Join \checkmark



Click the green plus button to create a new join. The 'Add Vector Join' screen will appear. This screen will recognize that join is being performed between the shapefile and the **School_Demographics** table. Select the ZIP field as the Join Field and the and the zip field as the Target Field from the shapefile.



2. Click Apply to execute the join and then OK to close Layer Properties.

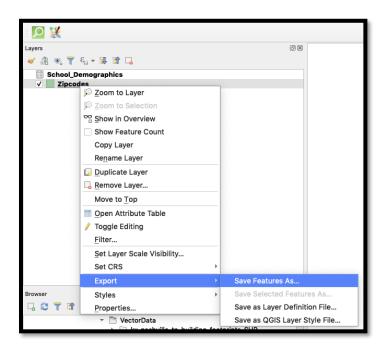
3. Check the attribute table for Zipcodes

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2	2.00000000	NASHVILLE	221537063.5	75782.86211	37206	19-20	Elementary S	755	Warner Elem	675
3	10.0000000	NASHVILLE	1001364029	310224.9134	37209	19-20	Alternative L	116	W.A. Bass Alt	126
4	45.0000000	GOODLETTS	3337338.44	9724.506184	37072	19-20	Elementary S	610	Old Center El	535
5	30.0000000	BRENTWOOD	24460979.9	30401.64961	37027	19-20	Elementary S	370	Granbery Ele	290
6	54.000000	NASHVILLE	73920091.14	58759.2436	37212	19-20	Special Educ	397	Harris-Hillma	302
7	47.0000000	GOODLETTS	1094968706	225242.454	37072	19-20	Elementary S	610	Old Center El	535

4. What do you notice? Scroll across to see more data.

Export to New File

1. Right click **Zipcodes** layer → Save Features As



2. Make sure you click the ... to locate the data file folder for this exercise and save to that folder.

								_	
ormat	ESRI S	hapefile						•	
le name									
ayer name									
RS	EPSG:	4326 - WGS 8	4				•		
ncoding				UTF-8			,	-	
] Save onl	y select	ed features							
Add save									
Select f	ields to	export and t	heir expo	rt options					
Nam	ne	Туре							
✓ objec	tid	Real							
✓ po_na	me	String							
✓ shape	e_star	Real							
✓ shape	_stle	Real							
✓ zip		String							
✓ Schoo	ol_Dem	String					-		
	S	elect All			Desele	ct All			
Geomet	try								
Geometry	type			Automatic			*		

	Save As: Joined_Demo
	Tags:
< > m · E	VectorData Q Search
avorites	RasterData
Applications	 Ortho Peabody Colle Undated.tif VectorData QGISWorkshop.docx
	Peabody-USN_aerial.tif
Desktop	Personal Streets_Davidson.cpg
Documents	Presentation Templates
	Presentation4 optx
Downloads	Bresentations Streets_Davidson.qpj
iCloud Drive	Professional
GitHub	PROJECTS
	☐ Zipcodes.cpg ☐ QGIS_Data ► Zipcodes.dbf
Creative Clou	QGIS_exercisct2019.docx
ocations	ggis-example
erebus's Mac	R P Zincodes shp
erebus's Mac	RS Resources
📃 Box Tools ≜	S263.kmz
New Folder	Cancel Save

3. Call the new file **Joined_Demo**. Make sure the format is *ESRI Shapefile* and the CRS (Coordinate Reference System) remains at EPSG: 4326-WGS84.

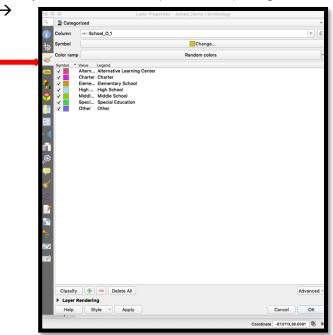
Format	ESRI Shapefile			
File name)/Events/QGIS Workshop/V	ectorData/Vector_Data/Joir	ned_Demo.shp	•
Layer name				
CRS	EPSG:4326 - WGS 84			-
Encoding		UTF-8		•
Save onl	v selected features			
✓ Add save	d file to map			
▼ Select f	ields to export and their ex	port options		
	Name		Type	
√ object	id		Real	
✓ po_na	me		String	
	star		Real	
✓ shape				
✓ shape ✓ shape	-		Real	
	-		Real String	
✓ shape ✓ zip	-	ar		*
✓ shape ✓ zip	_stle	ar Desele	String String	•
✓ shape ✓ zip	_stle I_Demographics_School Yea Select All		String String	•

4. Turn off the original zipcodes layer by unchecking it's box in the layer pane or remove it by right clicking the layer and choosing 'Remove Layer'.

Symbolizing by Unique Values

1. Make sure the original zipcodes layer is unchecked (not visible)→ right click **Join_Demo** layer → Properties →

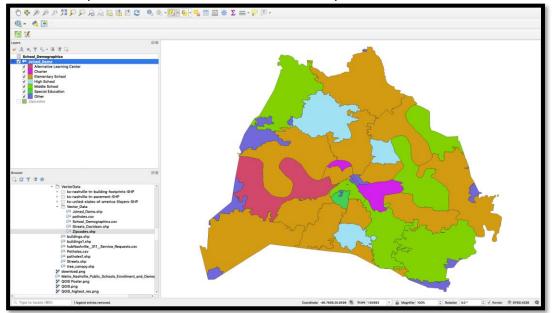
Symbology 🐳



2. Drop down the top menu and change the symbol type to Categorized. Set the Column drop down to School D_1 attribute, which corresponds to the type of school. Select the Classify button at the bottom left of the toolbox. Select Apply and OK.

Catego		
Column	abc School_D_1 ~	3
Symbol	Change	
Color ramp	Random colors	
✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓	Iulue Legend Vitrm. Alternative Learning Center Charter Charter Elementary School Viddl Midalle School Special Education Other Other	
		_
Classify	Advance Advance	ed *
Layer R Help	Style - Apply Cancel OK	
Help	Cancel OK	

The new map should look as below, with some potential color variations.



Select by Expression

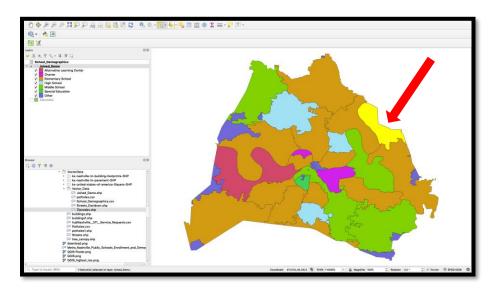
1. On the top menu bar find the Selection tool, drop down the selection box→Select by Expression



2. In the Expression box expand the Fields and Values sections to browse for the zip value. Click 'All Unique' to pull up a list of all the possible zip code options. Create an expression that is zip = pick a zipcode \rightarrow click select features to make your selection.

Expression Function Editor				
= + - / * ^ () n "zip" = '37138	Q Search Aggregates Arrays Color Conditionals Conversions Date and Time Fields and Values NULL 1.2 objectid abc po_name 1.2 shape_star 1.2 shape_stle abc zip abc School_Demographic	cs_Schoo cs_Schoo cs_Schoo	Double-click to add field to expression string. Right-Click on field nam open context menu sam value loading options. Loading field values fron layers isn't supported, b	ne to aple Notes m WFS
Output preview: 0	abc School_Demographic	cs_State 👻	27205	•
Help		Zoom to Fea	atures 🔓 Select Feature	es 🔻 <u>C</u> lose

3. The selection will be highlighted in yellow

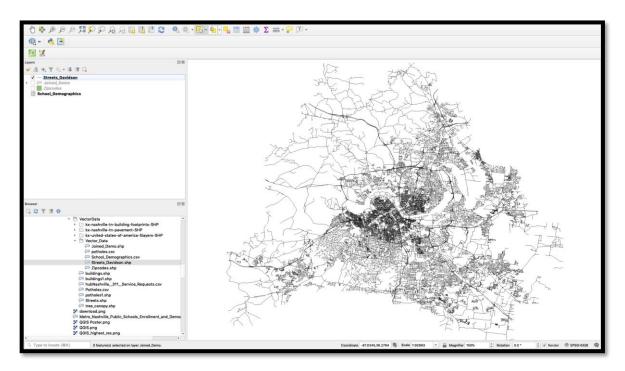


Start a new project

1. Project \rightarrow New

Clipping

1. Add **Streets_Davidson.shp** (drag file) to map view.

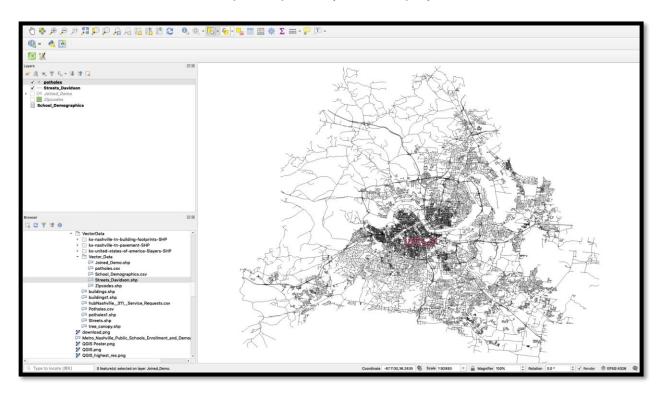


2. Add the **Potholes.csv** as a delimited text layer by choosing Layer \rightarrow Add Layer \rightarrow Add Delimited Text Layer.



3. This will open the 'Data Source Manger' window. Browse to your file and choose CSV as the format. Make sure to set the x and y fields with Longitude and Latitude accordingly and then click Add.

88 • • •	Data Source Manager Delimited Text
Browser	File name nssc5/Documents/Spring_2020/Events/QGIS Workshop/VectorData/Vector_Data/potholes.csv 🚳 💶
Vector	Layer name potholes Encoding UTF-8 -
Raster	▼ File Format
Mesh	CSV (comma separated values)
P_ Delimited Text	O Regular expression delimiter
🚰 GeoPackage	O Custom delimiters
📕 SpatiaLite	▼ Record and Fields Options
PostgreSQL	Number of header lines to discard 0 Decimal separator is comma
MSSQL	✓ First record has field names Trim fields
DB2 DB2	✓ Detect field types Discard empty fields
Virtual Layer	▼ Geometry Definition
Reference with the second seco	Point coordinates X field Longitude
🕂 🕰 wcs	Well known text (WKT) Y field Latitude
🗘 wfs	O No geometry (attribute only table) DMS coordinates
ArcGIS Map Server	Geometry CRS EPSG:4326 - WGS 84 🔹 💿
ArcGIS Feature Server	· · · · · · · · · · · · · · · · · · ·
av# 	Help Add Close
GeoNode	



The data should add to the map as a point layer, as displayed below.

3. Right click the new potholes layer \rightarrow zoom to layer

Clipping

Let's clip Davidson county street layer (**Streets_Davidson**) There are several ways to clip, but we are going to clip by selection.

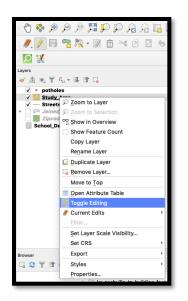
1. Create a new polygon layer to represent the area of interest (AOI) for our study of potholes by going to Layer \rightarrow Create Layer \rightarrow New Shapefile Layer



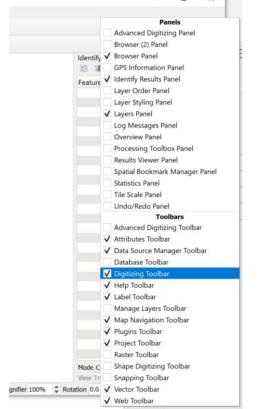
3. In the 'New Shapefile Layer' window, navigate to the vector data folder and name the new shapefile **Study_Area**. Change Geometry type to polygon. Name new field as Area.

			New Snapetile Layer	
e name			nts/Spring_2020/Events/QGIS Workshop/VectorData/Vector_Data/Study_Area.shp 🚳	. –
e encod	ling		UTF-8	-
eometry	type		Polygon .	-
			Include Z dimension Include M values	
			EPSG:4326 - WGS 84	2
ew Field	1			
Name	Area			
Туре	abc Text data			
Length		Precision		
			Add to Fields List	
				_
ields Lis	t			-
Name id	Туре	Length 10	Precision	
	Integer			
			Remove Field	

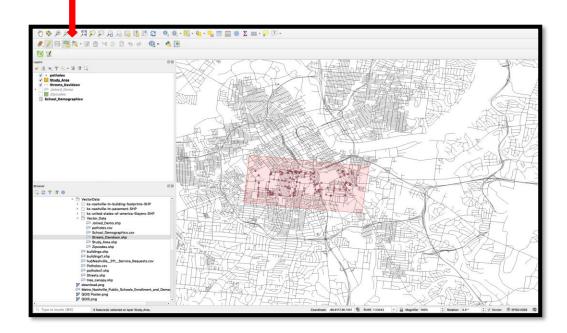
6. Draw your AOI around where the potholes are. Right click **Study_Area** \rightarrow Toggle editing

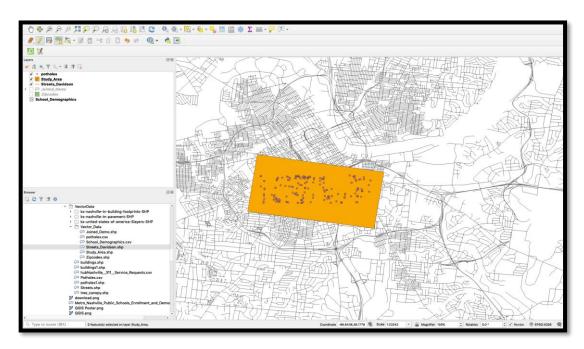


7. Right click in the tool bar area to open the toolbar and panel options. Check the digitizing toolbar to turn it on, and it will appear alongside the other toolbars.



8. Now select the Add polygon feature tool and draw a rectangle around the area where the potholes are.



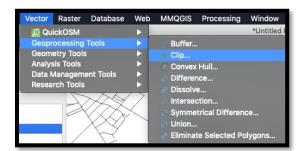


9. Once you draw your box right click and select ok to complete your drawing.

10. Turn off editing. \rightarrow right click **Study_Area** \rightarrow turn off editing \rightarrow Save changes to layer

Clip Streets to Area of Interest

1. Select **Streets_Davidson** layer \rightarrow Vector \rightarrow Geoprocessing tools \rightarrow Clip



Call the new clipped layer Clipped_Streets

Clip			
Parameters Log 4 nput layer V Streets_Davidson [EPSG:3857] PUT * • • • • • • • • • • • • • • • • • •	Clip This algorithm the features o layer. Only the the input layer polygons of it added to the it added to the it modified, aith area or length authores, the be manually u	f an additiona a parts of the t that fall within the Overlay layer esulting layer. of the feature ough propertion of the feature e clipping op es are stored a base attributes	I polygon eatures in in the er will be es are not es such as es will be erration. If as
0%			Cancel
Help Run as Batch Process		Close	Run

2. Turn off all layers except Clipped_Streets and Potholes.

Change basic symbology

1. Right click clipped streets \rightarrow Properties \rightarrow Symbology. Select a color that is a good representative of a street

0.0	0		Layer Proper	ties - Clipped_St	reets Symbolog	Υ.		
Q,	🚍 Single symbo	1						-
î	* - Line - Simple	lee.						
	— simple	ine						
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	+							
٠.	Unit Millimete							
\diamond	Opacity	·					10	0.0 %
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	Width 0.66000							€.
•								
5	All Symbols							e • *
1			_	_				
	dash green	dash red	effect emboss	effect neon	gray 1 line	gray 2 line	gray 3 line	
*								
8		0000	-					
	gray 4 line	pattern circles	pointing arrow	simple black line	simple blue line	simple brown line	simple green li	
4								
2								
÷								
	simple orange line	simple pink line	simple purple line	simple red line	simple yellow line	topo foot	topo hydrolog	,
	—							
	topo main road	topo path	topo railway	topo road	topo steps			
	🔲 📰 simple bi	lue line					Save Symbol	Advanced -
	Layer Render							
	Help	Style - A	pply				Cancel	OK
						Coort	inate -86.8394,	36.1298 🖏 So

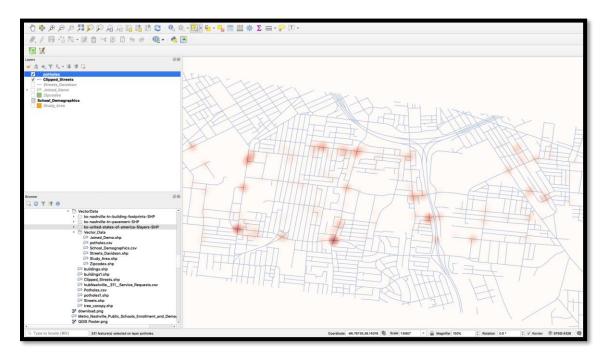
Note: You may to need to reorder layers

Creating a Heat Map

1. Right click **Potholes.shp** \rightarrow Layer Properties \rightarrow Symbology. Drop down to Heatmap symbology type. Change the color ramp to a red ramp and change the opacity (transparency) to 50%.

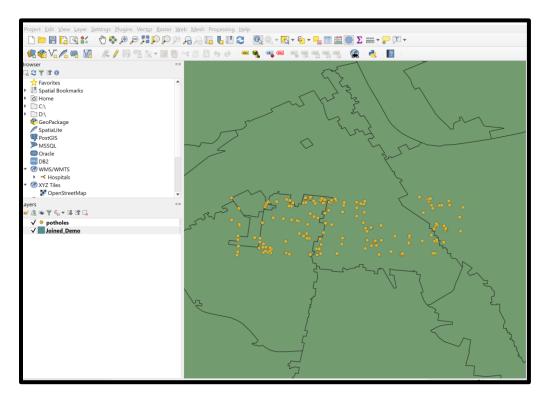
Color ramp				- 10	
Radius	10.00000			Millimeter	
Maximum value	Automatic				•
Weight points by Rendering quality			0	Fasi	3
▼ Layer Renderi	ng				
Opacity		c		50.0 % 🖾	•
Blending mode		Layer	Feature		
		Normal	* Normal		-
Draw effects	rendering order				命 24

The heat map should display as below.

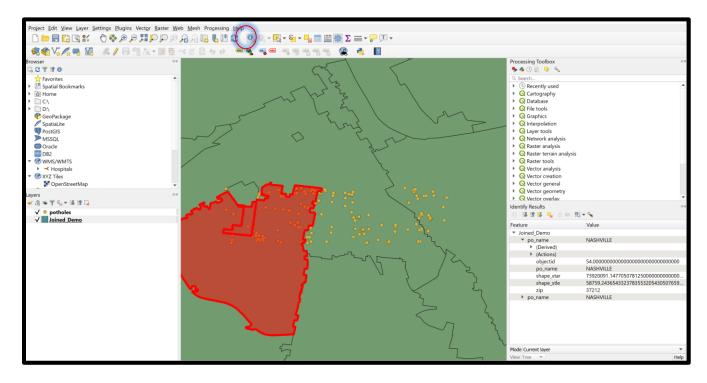


Select by Location

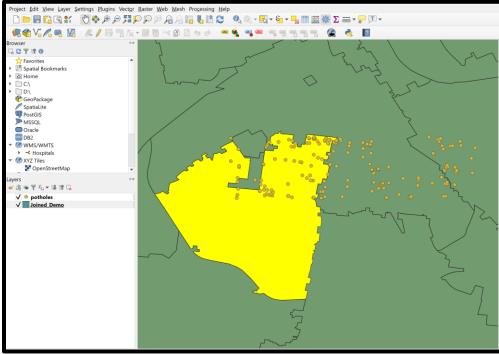
Add the **Joined_Demo** layer back into the map using the 'Add Data' button. Change the symbology of the **Potholes** layer back to a single symbol. Examine the distribution of potholes within the various zip code boundaries.



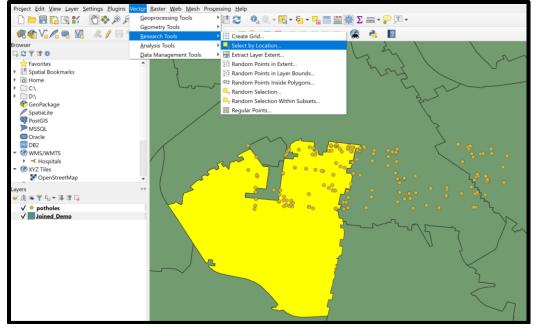
1. Click on the **Joined_Demo Layer** in the layers pane to set it as the active layer for selections. Click the Identify tool in the main toolbar and use it to identify each of the zipcodes in which a pothole falls.



2. Use the Select Features by single click or area tool to select the 37212 zipcode shape. The selected area will show up in yellow.



3. We are going to select all the potholes that are within the 37212 zip code. Confirm **Joined_Demo** is selected \rightarrow Vector \rightarrow Research Tools \rightarrow Select by Location.



Select **potholes** as the layer to select features from, choose intersect as the geometric predicate, selected **Joined_Demo** as the comparing feature, and be sure to check the box that says 'Selected Features Only' under the comparing feature. This ensures we only select potholes in the 37212 zipcode.

Q Select by Location	×
Parameters Log Select features from ° * potholes [EPSG:4326]	Select by location
Where the features (geometric predicate) ✓ intersect touch contain overlap disjoint are within equal cross By comparing to the features from	in a vector layer. The criteria for selecting features is based on the spatial relationship between each feature and the features in an additional layer.
✓ Joined_Demo [EPSG:4326] ▼ > ✓ Selected features only Modify current selection by Creating new selection ▼	
0%	Cancel
Run as Batch Process	Run Close Help

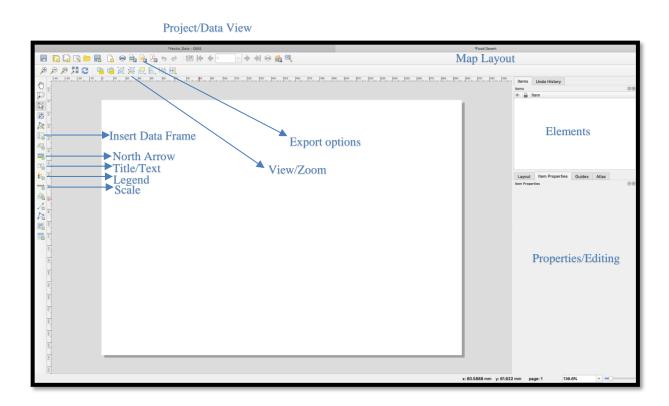
Creating a Map Layout

The map is complete and now to add the cartography and export it.

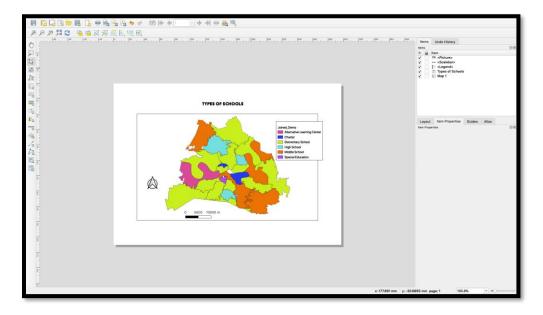
1. Create a new layout by navigating to Main menu \rightarrow Project \rightarrow New Project Layout

Project Edit View	Layer
New	ЖN
New from Template	
늘 Open	жo
Open From	
Open Recent	
Close	
📱 Save	жs
🖶 Save As	☆ ₩S
Save To	
Properties	<mark>ሰ</mark> ₩Р
Snapping Options	
Import/Export	
📸 New Print Layout	жP
🙀 New Report	
👒 Layout Manager	
Layouts	

2. Name the map **Layout1** and the screen will open to a new layout with the following elements.



3. Draw a new Data Frame in the middle of the layout and add Title, Scale Bar, Neatline and North Arrow



Raster Data

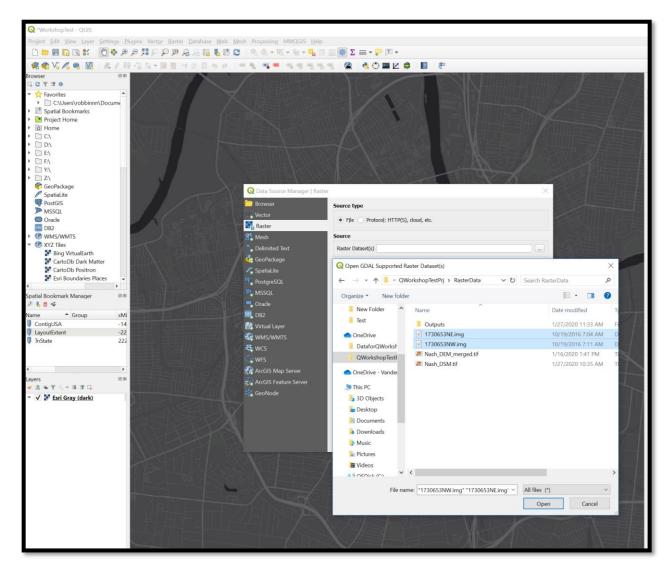
Adding and Merging Raster Data using Digital Elevation Models (DEM)

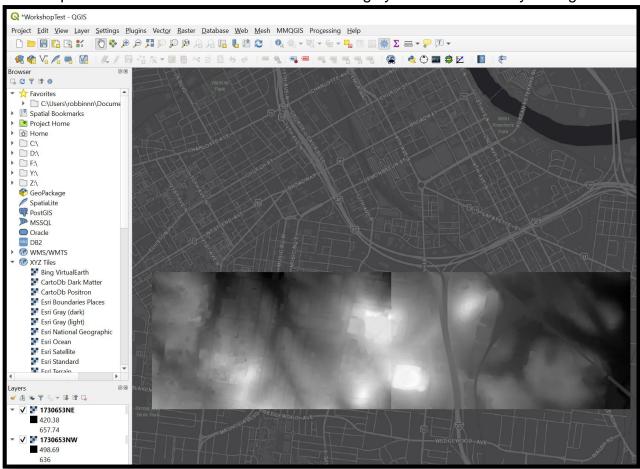
Step 1: Add the DEMs to the map.

Add the 2 DEM raster files to the QGIS project using the 'Open Data Source Manager'



Choose Raster, and browse the directory to the file path _____ and select the two .img files, 1730653NE.img & 1730653NW.img. Select Open and then Add.

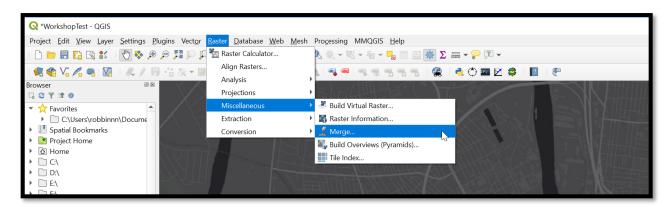




Your map should have two rasters over the Fort Negley area and Peabody College.

Step 2: Merge the two images into one continuous raster DEM.

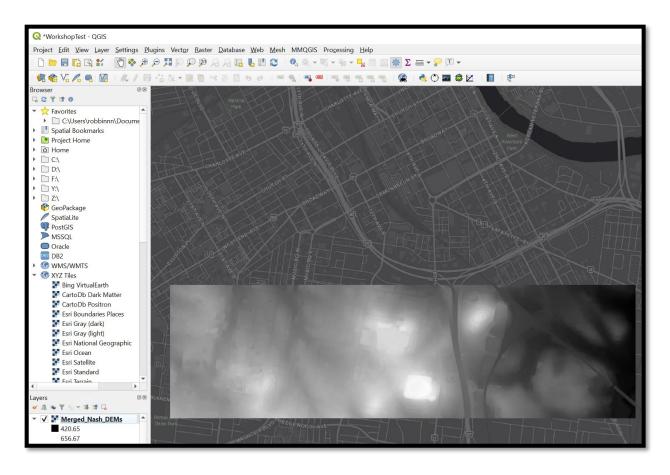
Open the 'Merge' (GDAL) tool by browsing the Raster tab-> Miscellaneous-> Merge or by searching for 'Merge' in the Processing Toolbox pane.



In the 'Merge' tool window, select the two .img files you added to the project as your input layers, keep output data type as Float32 (same as the input .img files) and set an output location to your local C drive and call this Merged_Nash_DEMs. Run the tool.

🔇 Merge				×
Parameters Log				
Input layers				
2 elements selected				
Grab pseudocolor table from first	ayer			
Place each input file into a separat	e band			
Output data type				
Float32				•
 Advanced parameters 				
Input pixel value to treat as "nodata	[optional]			
Not set				\$
Assign specified "nodata" value to o	utput [optional]			
Not set				*
Additional creation options [optiona]			
Profile Default				-
Name		Value		
Validate Help Additional command-line parameter	s [optional]			
Merged				
C:/Users/robbinnn/OneDrive/Datafor	Workshop/Test/Merged_Nash_DEMs.tif			•
	0%			Cancel
Run as Batch Process			Run Close	Help

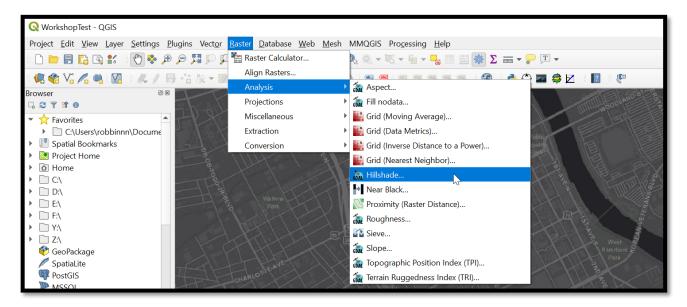
The output will be automatically added to the map and should looks as follows:



Creating a Hillshade

Step 1: Create a hillshade from the DEM.

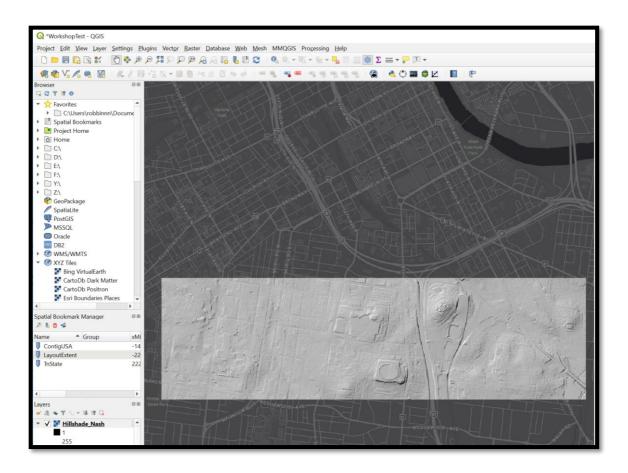
Find the 'Hillshade' (GDAL) tool by opening the Raster tab -> Analysis -> Hillshade or search for 'Hillshade' in the Processing Toolbox pane.



Set the input layer as the Merged_Nash_DEMs. Set the output location to your local C drive and name the new raster Hillshade_Nash. Leave the other presets and run the tool.

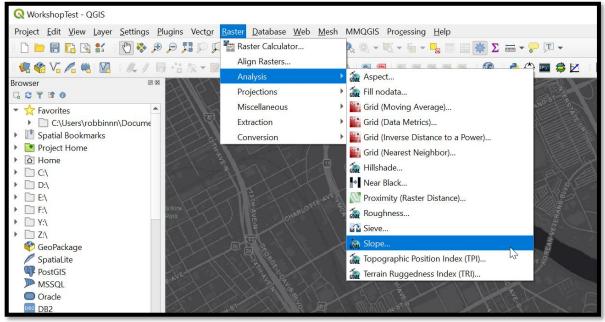
	×
Parameters Log	
Input layer	×
Merged_Nash_DEMs [EPSG:6576]	*
Band number	•
Band 1 (Gray) Z factor (vertical exaggeration)	
	•
1.000000	v
Scale (ratio of vertical units to horizontal)	
1.00000	\$
Azimuth of the light	
315.000000	\$
Altitude of the light	
45.000000	•
Multidirectional shading Advanced parameters Additional creation options [optional]	
Profile Default	•
	· · · · · · · · · · · · · · · · · · ·
Profile Default	•
Profile Default Name Value Value Value Validate Help Additional command-line parameters [optional] Hillshade	· · · · · · · · · · · · · · · · · · ·
Profile Default Name Value Image: Second	
Profile Default Name Value Image: Second s	
Profile Default Name Value Image: Second	

The output will be directly added to the map and should looks like below:



Analyzing the DEM

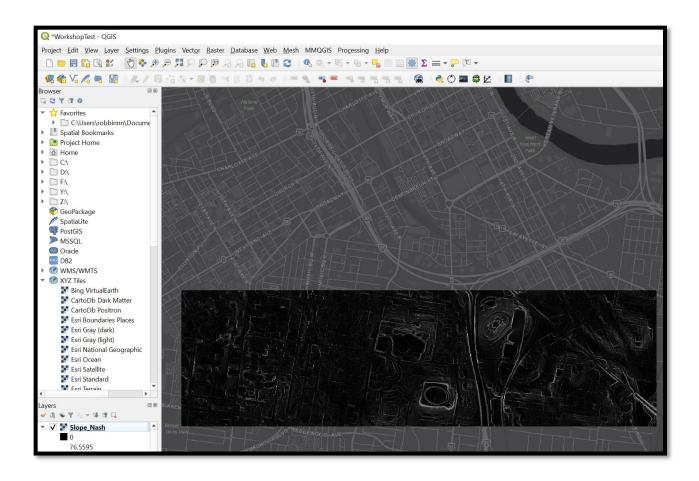
Step 1: Derive a slope raster from the DEM. Find the 'Slope' (GDAL) tool by browsing to the Raster tab -> Analysis -> Slope, or search for 'Slope' in the 'Processing Toolbox' pane.



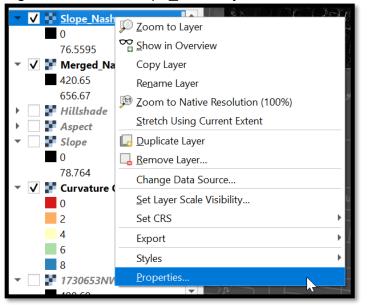
Set the Merged_Nash_DEMs as the input raster and set an output location to the Raster folder. Call the new raster **Slope_Nash**. Leave all other tool parameters the same and run.

Q Slope				>	×
Parameters Log Input layer					
Merged_Nash_DEMs [EPSG:6576]					-
				·	
Band number					
Band 1 (Gray) Ratio of vertical units to horizontal				•	
1,000000				\$	
				*	
Slope expressed as percent instead of degrees					
Compute edges					
Use Zevenbergen <u>Thorne</u> formula instead of the H	orn's one				
 Advanced parameters 					
Additional creation options [optional]					
Profile Default				•	
Name		Value			
		Value			
🖶 🥅 Validate Help					
Additional command-line parameters [optional]					
Slope					
C:/Users/robbinnn/OneDrive/DataforQWorkshop/Tes	t/Slope Nash.tif				
✓ Open output file after running algorithm	gorope_reamen				
Open Surput me alter funning algolitim					٢
	0%			Cancel	
Run as Batch Process			Run Close	Help	

The slope raster will be added to the display and should look like below:



Step 2: Find the average slope of the area. Right click on the Slope_Nash layer and choose 'Properties.'

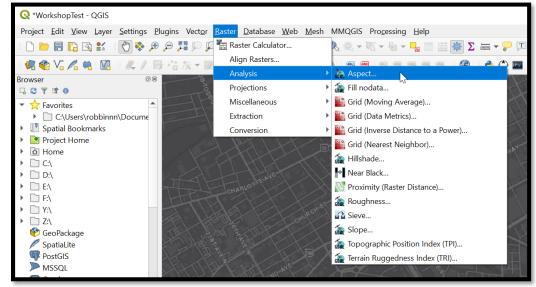


In the Information section of the Properties, look at the statistics to determine the average slope.

Q Layer Propertie	s - Slope_Nash Information	×
Q information	Information from provider	^
🗞 Source	Name Slope_Nash Path C:Userstrobbinnn\OneDrive\DataforQWorkshop\Test\Slope_Nash.tif	
Symbology	CRS EPSG:6576 - NAD83(2011) / Tennessee (ftUS) - Projected Extent 1730503.000000000000000.657378.0000000000000000 : 1744503.0000000000000.661378.0000000000000000	
Transparency	Unit feet Width 5500	
🗠 Histogram	Height 1600	
 Rendering Pyramids 	Data type Float32 - Thirty two bit floating point GDAL Driver GTiff Description	
Metadata	GDAL Driver GeoTIFF Metadata	
E Legend	Dataset C:/Users/robbinnn/OneDrive/DataforQWorkshop/Test/Slope_Nash.tif Description	
QGIS Server	Compression Band 1 STATISTICS_APPROXIMATE=YES STATISTICS_MAXIMUM=76.559478759766 STATISTICS_MEAN=4.9503193490948 STATISTICS_MINIMUM=0 STATISTICS_TODEV=5.7126298388719 STATISTICS_TOLEV=5.7126298388719 STATISTICS_VALID_PERCENT=97.47	
é.	More information • AREA_OR_POINT=Area	
	Dimensions X: 5600 Y: 1600 Bands: 1 Origin 1.7305e+06.661378 Pixel Size 2.5,-2.5	
	Identification	
		•
	Style OK Cancel Apply	Help

Step 3: Generate an aspect raster.

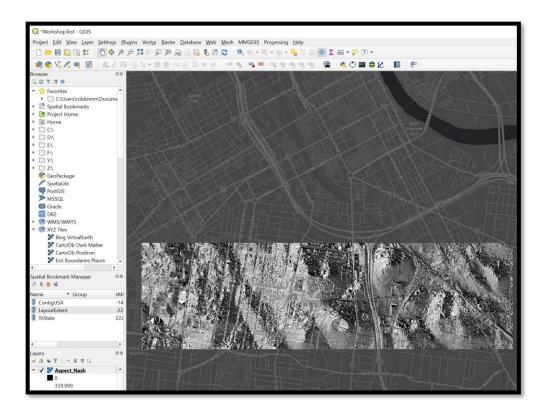
Find the 'Aspect' (GDAL) tool by opening the Raster tab -> Analysis -> Aspect or search for 'Aspect' in the Processing Toolbox pane.



Choose the Merged_Nash_DEMs as the input layer and set an output location to your local C drive. Name the new raster Aspect_Nash. Leave all other presents and run the tool.

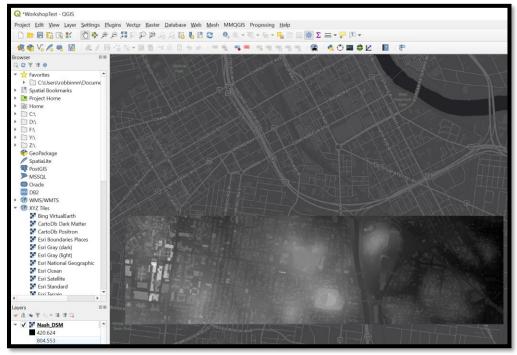
Q Aspect	×	
Parameters Log		
Input layer		
Merged_Nash_DEMs [EPSG:6576]		
Band number		
Band 1 (Gray)	•	
Return trigonometric angle instead of azimuth		
Return 0 for flat instead of -9999		
Compute edges		
Use Zevenbergen thorne formula instead of the Horn's one		
 Advanced parameters 		
Additional creation options [optional]		
Profile Default	~	
Name Value		
Validate Help Additional command-line parameters [optional]		
Aspect		
C:/Users/robbinnn/OneDrive/DataforQWorkshop/Test/Aspect_Nash.tlf		
✓ Open output file after running algorithm		
GDAL/OGR console call		
gdaldem aspect C:/Users/robbinnn/OneDrive/DataforQWorkshop/Test/Merged_Nash_DEMs.tif C:/Users/rob DataforQWorkshop/Test/Aspect_Nash.tif -of GTIff -b 1	bbinnn/OneDrive/	
0%	Cancel	
Run as Batch Process	Run Close Help	

The output should be added to the map and should appear as below:



Working with Raster Calculator

Raster calculator is an essential tool for manipulating raster data to create new rasters or reclassify rasters. In this example we will use our Nashville DEM and a LiDAR derived digital surface model (DSM) to create a canopy height model (CHM). **Step 1:** Add the Nash_DSM to the map from the file path:

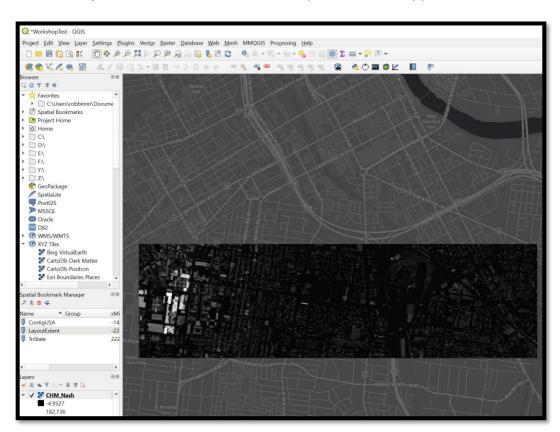


Step 2: Open the 'Raster Calculator' tool by going to the Raster tab -> Raster Calculator or search for 'Raster Calculator' in the Processing Toolbox pane.

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Step 3: Using the 'Raster Calculator' we are going to create a new raster layer that represents the CHM. The CHM is calculated as follows CHM=DSM-DEM. In the tool window, specify an output location and choose GeoTiff as the Output format. In the expression window, write "Nash_DSM@1"- "Merged_Nash_DEMs@1". The raster names have a @1 after them because they all contain only one band. If you wrote the expression correctly you should see it say 'Expression valid' at the bottom of the tool window. Click OK.

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Raster Bands	Result Layer		
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Merged_Nash_DEMs@1 Nash_DSM@1	Y min 657258.000		661488.00000
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- / ^ acos asin	atan In)	
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Raster Calculator Expression			
"Nash_DSM@1" - "Merged_Nash_DEMs@1"			
Expression valid		ОК	Cancel Help



The new layer should be added to the map and should appear as below:

Additional Material

Installation

Recommended: Download the most recent version of QGIS available, with the most recent features, or the most recent Long-Term Release (Stable), which is designed to be maintained with bug-fixes and such for the next three release cycles. Long term releases might not have the newest features found in the most recent version, but focus is broader stability across time.

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For Windows users:

Download and run the standalone installer, available here: <u>https://qgis.org/en/site/forusers/download.html</u> (QGIS Standalone Installer Version 3.4). Choose 64 of 32 bit based on your computer.

For Mac OS users:

Download and run the standalone installer, available here: <u>https://qgis.org/en/site/forusers/download.html</u> (QGIS Standalone Installer Version 3.4). Choose 64 of 32 bit based on your computer.

For Linux Users:

Follow instructions provided here: <u>https://qgis.org/en/site/forusers/alldownloads.html#linux</u>.

Add a Background Layer

When we import spatial data, we often like to visualize them over some sort of background layer, such as aerial imagery, or a simple map. This allows us to identify if layers are being displayed in approximately the right location, and it can help with some preliminary interpretation of data. For this exercise, we will utilize the QuickMapServices Plugin.

- Click on "Web" from the menu bar at top, navigate to "QuickMapServices Plugin"
 -> "Search QMS"; the search panel for this plugin will appear.
- By default, some Google layers will be available to load. If you click "Add" while selecting any specific layer, the newly added background layers will appear as the bottom-most layer.
 - You can also use the Search bar to find map services that are made available in this plug-in (e.g., search for Google, Bing, or Open Street Map).

Changing Projections (CRS)

For many operations it is necessary to have all layers in the same CRS; even if it is not necessary, it can help speed-up processing considerably. The DEM has elevation in meters, according the layer's metadata, and it is in a geographic projection (Lat/Long, NAD83). However, for computing some derivatives of elevation such as Slope, it is helpful to have the horizontal units the same as the units for elevation. Thus, we will work in a projection that is also defined in meters, the Albers Equal Area Projection. This projection may cause some distortion in shape, but maintains accurate area measurements. This is just a demonstration, and in doing your own work, it is important to consider how spatial distortions may manifest in different projections.

The steps for converting the CRS of raster and vector layers are somewhat different. Furthermore, when converting the CRS of raster layers, it is important to think about how resampling may cause distortion.