



NMFMA Spring 2019 QGIS Workshop

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#### <u>1. QGIS</u>

- QGIS is a free and open source cross-platform (Windows, Mac OS, Linux, BSD, and Android) Desktop Geographic Information System (GIS)
- o QGIS can help users create, edit, visualize, analyze, and publish geospatial data
- QGIS integrates with other open source GIS packages, including but not limited to PostGIS, GRASS GIS, and MapServer
- QGIS supports shapefiles, coverages, <u>personal and file geodatabases (only feature class)</u>, many raster formats, and many other formats

#### 2. QGIS vs. ArcGIS

- 0 QGIS free and open source software, more stable, less analysis tools, multi-platform
- ArcGIS commercial software, less stable, more analysis tools, single-platform

#### 3. Start to Learn QGIS

- Cutts, A., and Graser, A. 2018. *Learning QGIS*, 4th ed. Packt Publishing, Birmingham, UK.
- Menke, K., Smith, R. Jr., Pirelli, L., and Van Hoesen, J. 2016. *Mastering QGIS*, 2nd ed.
   Packt Publishing, Birmingham, UK.
- Graser, A., Mearns, B., Mandel, A., Ferrero, V. O., and Bruy A. 2017. *QGIS: Becoming a GIS Power User*. Packt Publishing, Birmingham, UK.
- o Website
  - QGIS Workshop http://maps.cga.harvard.edu/qgis/
  - QGIS Tutorials and Tips <u>http://qgistutorials.com</u>
- o Online Education
  - Udemy Introduction to GIS <u>https://www.udemy.com/gis-for-everyone/</u>
  - Udemy Learnt to use QGIS <u>https://www.udemy.com/draft/149366/</u>

#### Part B. Loading Web Services

QGIS supports the loading of Open Geospatial Consortium (OGC) compliant web services such as Web Map Services, Web Map Tile Services (WMTS), Web Coverage Services (WCS), and Web Feature Services (WFS). Loading a web services is similar to loading a database service, in that you have to first set up the connection to the service, and then connect to the service to choose which layers to add.

### 1. Adding WFS

(1) Click on the "Open Data Source Manager"



(2) Click on WFS

Q Data Source Manager   WFS	×
Raster	Server Connections
Mesh	· · · · · · · · · · · · · · · · · · ·
♥ Delimited Text	Connect New Edit Remove Load Save
🙀 GeoPackage	Filter
🌽 SpatiaLite	Title Vame Abstract Sql
PostgreSQL	
MSSQL	
📮 Oracle	
DB2 DB2	
Virtual Layer	
🤁 wms/wmts	
🕀 wcs	
WFS WFS	Use title for layer name
ArcGIS Map Server	✓ Only request features overlapping the view extent
ArcGIS Feature Server	Coordinate Reference System Change
GeoNode	Build query Close Add Help
· · · · · · · · · · · · · · · · · · ·	Sand data 1

(3) Click on "New"

(4) In the "Create a New WFS Connection" dialog, type in the Name and URL for the intended WFS as below and then click on "OK"

nection Details	nnection
Name New Mexico Hud	- 8
	nm.edu/apps/rgis/datasets/cae16e7f-c3d1-4264-b14b-f1
Authentication	
Configurations B	asic
Choose or create an a	authentication configuration
No authentication	- // = +
database.	
WFS Options	
WFS Options Version	Maximum 👻 Detect
-	
Version	res
Version Max. number of featur	res
Version Max. number of featur I Enable feature page Page size	res
Version Max. number of featur I Enable feature page Page size	res ging dition (WFS 1.1/WFS 2.0)

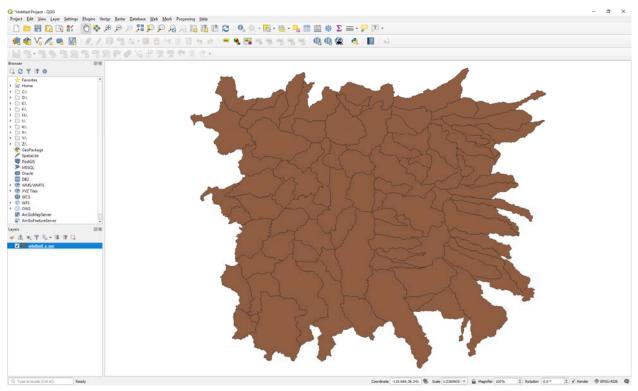
(5) Click on "Connect" in the Server Connections dialog

Server Connections						
New Mexico Huc 8						•
Connect	New	Edit	Remove		Load	Save

(6) Click on "Add" in the Server Connections dialog

$\fbox{\sc v}$ Only request features overlapping the view extent			
Coordinate Reference System			
EPSG:4326			Change
	Build query Close	<u>A</u> dd	Help

(7) The WFS layer should be loaded as below; you may have a different color because QGIS will randomly choose a color when you add the layer



(8) In the Browser Panel, expand the XYZ Tiles, and then right-click on the XYZ Tiles, select New Connection, type in the name and URL for Google Satellite as below

<b>Q</b> XYZ Connection		×
Connection Details		
Name	Google Satellite	
URL	https://mt1.google.com/vt/lyrs=s&x={x}&y={y}&z={z}	
Authentication		
Configurations	Basic	
Choose or create a	n authentication configuration	
No authentication	• // = <b>+</b>	
Configurations stor	e encrypted credentials in the QGIS authentication database.	
✓ Min. Zoom Level	0	
✔ Max. Zoom Level	18 🜲	
Referer		
	OK Cancel	

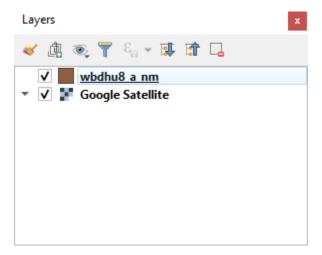
(9) https://mt1.google.com/vt/lyrs=s&x={x}&y={y}&z={z}

(10) Click on "OK"

(11) Google Satellite is added to the XYZ Tiles

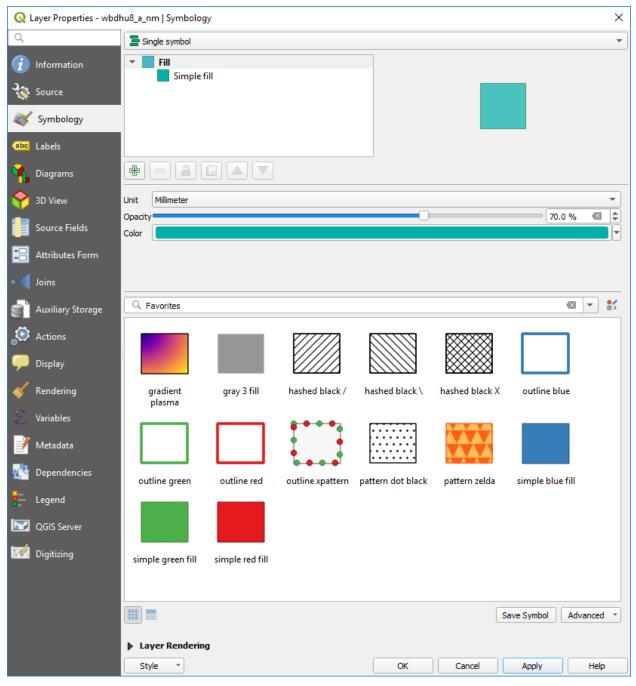
Browser ×
🗔 😂 🍸 🖆 🕖
☆ Favorites
Home
C:\
▶ D:\
▶ 📄 E:\
▶ 🛄 F:\
▶ 🛅 H:\
▶ <u></u> I:\
▶ 🛄 K:\
▶ <u>P:\</u>
▶ 📄 Y:\
▶ 🗋 Z:\
🍄 GeoPackage
🖉 SpatiaLite
PostGIS
MSSQL
Oracle
OB2 DB2
WMS/WMTS
👻 🛞 XYZ Tiles
Google Roads
Google Satellite
OpenStreetMap
WCS WCS
► 🐨 WFS
• () OWS

(12) Drag the Google Satellite layer under the New Mexico HUC 8 layer

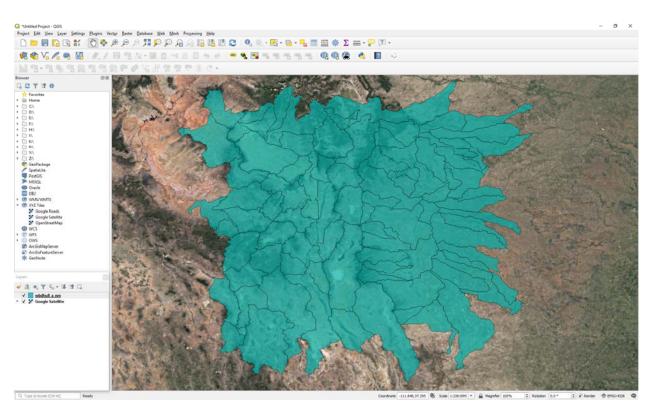


(13) Right-click on the New Mexico HUC 8 layer, and then select "Properties"

(14) In the Symbology Tab, click on the Opacity and change it to 70%; you can also change the color; if you decide to change the color, you need to change the color first and then assign the opacity to the new color

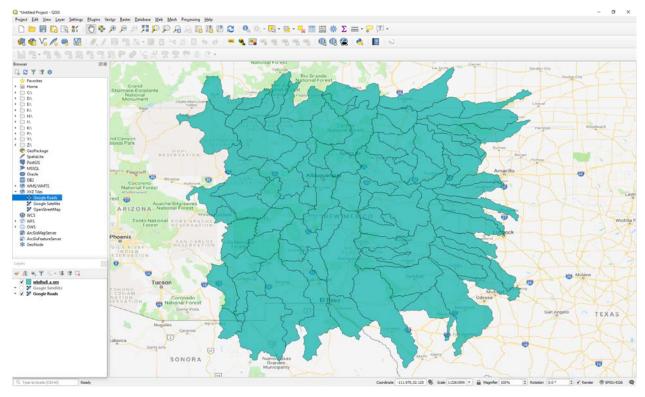


(15) A display as below will show up



(16) Add a Google Street layer to the XYZ Tile and then use it as the background layer

Note: the link for this is https://mt1.google.com/vt/lyrs=m&x={x}&y={y}&z={z}



### 2. Adding WMS

(1) Click on the "Open Data Source Manager"



Q Data Source Manager   Browser   WMS/WMTS			×
Erowser	Layers Layer Order Tilesets	Server Search	
V+ Vector	Test		•
Raster	Connect <u>N</u> ew	Edit Remove	Load Save Add Default Servers
Mesh	ID Name	Title Abstract	
P₊ Delimited Text			
🥰 GeoPackage			
🖉 🕂 SpatiaLite			
PostgreSQL	Image Encoding		
MSSQL			
📮 Oracle	Options		
DB2 DB2	Tile size		
Virtual Layer	Request step size		
R wms/wmts	Feature limit for GetFeatureInfo		10
ter wcs	WGS 84		Change
WFS			
	.ayer name Ready		
ArcGIS Feature Server			Close Add Help

(3) Click on New and type in the Name and URL for the intended WMS layer as below and then click on OK

🔇 Create	a New WMS/WMTS Connection	Х					
Connectio	on Details						
Name	Name Albuquerque East NE 2016 NAIP						
URL	URL 3193-67e7-463f-be1d-0e5f206b1bfb/services/ogc/wms?VERSION=1.1.1						
Authen	tication						
Con	figurations Basic						
Choo	se or create an authentication configuration						
No a	authentication 🔹 🥢 🚍 🖶						
Confi	gurations store encrypted credentials in the QGIS authentication						
Gata	Jase.						
WMS/V	VMTS Options						
<u>R</u> efer	er						
DPI-M	ode all						
	nore GetMap/GetTile URI reported in capabilities						
Ig	nore GetFeatureInfo URI reported in capabilities						
	nore axis orientation (WMS 1.3/WMTS)						
	ivert axis orientation						
Sr	nooth pixmap transform						
	OK Cancel Help						

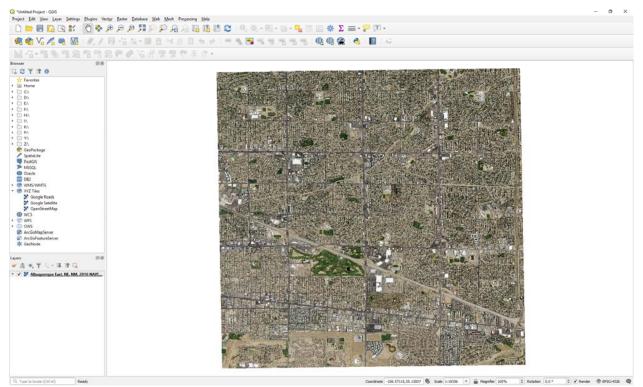
(4) Click on "Connect" and then click on the layer of "Albuquerque, East, NM, 2016 NAIP"

Data Source Manager   Browser   W	MS/WMTS	>
Browser	Layers Layer Order Tilesets Server Search	
Vector	Albuquerque East NE 2016 NAIP	•
Raster	Connect New Edit Remov	e Load Save Add Default Servers
Mesh	ID Name Title A	bstract
Delimited Text	1 m_3510660_ne Albuquerque Ea A	lbuquerque East, NE, NM, 2016 NAIP, m_3510660_ne_13_1_20160619
GeoPackage		
SpatiaLite	Image Encoding	
PostgreSQL	PNG      PNG8      JPEG      GIF      TIFF	
MSSQL	Options (0 coordinate reference systems available)	
	Tile size	
Oracle	Request step size	
DB2	Feature limit for GetFeatureInfo	10
/irtual Layer		Change
WMS/WMTS	Use contextual WMS Legend	
WCS	Layer name	
WFS	Select layer(s)	
		Close <u>A</u> dd Help

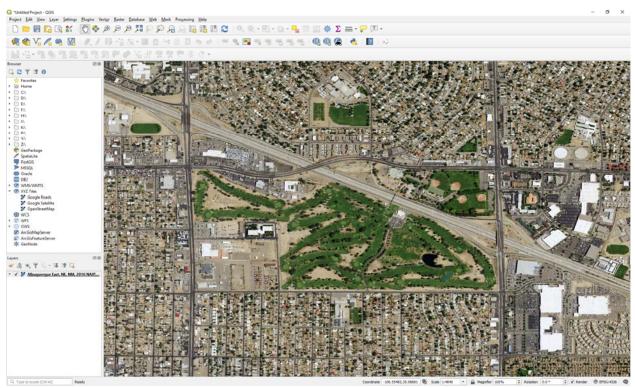
## (5) Click on "Add" and then click on "Close"

Q Data Source Manager   Browser   WMS/WMTS		×					
Browser	Layers Layer Order Tilesets Server Search						
V- Vector	Albuquerque East NE 2016 NAIP	•					
Raster	Connect New Edit Remove	Load Save Add Default Servers					
Mesh	ID         Name         Title         Abstract           ✓ 0         m_3510660_ne         m_3510660_ne         WMS Service for RGIS           1         m_3510660_ne         Albuquerque East, NE						
GeoPackage	Image Encoding						
<pre> //↓ SpatiaLite </pre>							
PostgreSQL	Coordinate Reference System (11 available)						
MSSQL	Tile size						
📮 Oracle	Request step size						
DB2 DB2	Feature limit for GetFeatureInfo	10					
Virtual Layer	WGS 84	Change					
	Use contextual WMS Legend						
ter wcs	Layer name Albuquerque East, NE, NM, 2016 NAIP, m_3510660_ne_13_1_20160619						
WFS	1 Layer(s) selected	Close Add Help					

(6) The Albuquerque East NE 2016 NAIP layer is added



### (7) Zoom in to an area of interest



# Practice:

https://hazards.fema.gov/gis/nfhl/services/public/NFHLWMS/MapServer/WMSServer?request=GetCapabilities&service=WMS

1. Vector Styling

- (1) Open QGIS Desktop application.
- (2) Click on the Open Data Source Manger button
- (4) Select the Vector option

Q Data Source Manager   Vector				×
🫅 Browser	Source Type			
V Vector	File Directory Database Protocol: HTTP(S), cloud, etc.			
Raster	Encoding	System		
Mesh	-			
₱ pelimited Text	Source Vector Dataset(s)			
GeoPackage	vector bataset(s)			
🗸 SpatiaLite				
PostgreSQL				
MSSQL				
Oracle				
DB2 DB2				
Virtual Layer				
💮 wms/wmts				
🚓 wcs				
💬 wFS				
RrcGIS Map Server				
ArcGIS Feature Server				
GeoNode				
			Close Add	Help

(5) Navigate to the folder of QGIS\_Workshop >>> Part\_C >>> FEMA\_NFHL

(6) Click on the S\_FLD\_HAZ\_AR.shp to add it to the map area; you can also drag and drop it into your map area; another option is using the Browser Panel to add data

Note: To quickly locate .shp files, use the file type filter.

QGIS now has one Data Source Manager button; therefore, you do not need to add different types of data with different buttons.

(7) Right-click on the S\_FLD\_HAZ\_AR layer and select properties

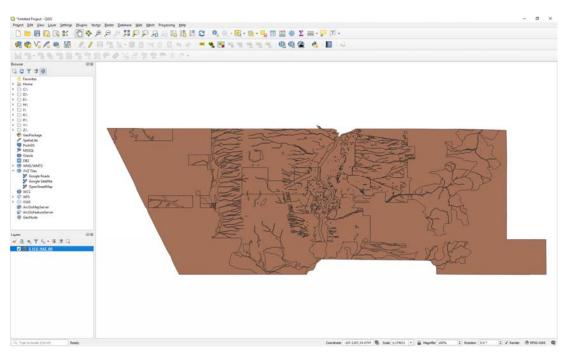
(8) Open the layer and get yourself familiar with the attributes

Q	🔇 S_FLD_HAZ_AR :: Features Total: 1429, Filtered: 1429, Selected: 0 —									
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	DFIRM_ID VERSION_ID FLD_AR_ID STUDY_TYP FLD_ZONE ZONE_SUBTY SFHA_TF STATIC_BFE V_DATUM								DEPTH	
1	35001C	1.1.1.0	35001C_1114	NP	AE		т	4988.00000000000000000	NAVD88	-9999.00000
2	35001C	1.1.1.0	35001C_1113	NP	AO		т	-9999.0000000000000000		2.00000000
3	35001C	1.1.1.0	35001C_1112	NP	АН		т	5134.0000000000000000	NAVD88	-9999.00000
4	35001C	1.1.1.0	35001C_1111	NP	AO		т	-9999.0000000000000000		1.00000000
5	35001C	1.1.1.0	35001C_1109	NP	AH		Т	4975.0000000000000000	NAVD88	-9999.00000 🗸
4										F .
7	Show All Features									8 🔳

Q Layer Properties - S_FL	.D_HAZ_AR   Symbolog	у					×
Q	🗧 Single symbol						-
🥡 Information	Fill Simple fi						
🗞 Source							
Symbology							
(abc Labels							
📬 Diagrams	<b>F</b>						
幹 3D View	Unit Millimeter					100.0 %	<ul> <li>▼</li> <li>↓</li> </ul>
Source Fields	Opacity Color					0 100.0 %	
🔡 Attributes Form							
• 📢 Joins							
Auxiliary Storage	Q Favorites					<	- 1
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≼ Rendering	gradient plasma	gray 3 fill	hashed black /	hashed black \	hashed black X	outline blue	
Variables			<b>* • • •</b> •		1222		
Metadata							
Copendencies	outline green	outline red	outline xpattern	pattern dot black	pattern zelda	simple blue fill	
E Legend							
QGIS Server							
M Digitizing	simple green fill	simple red fill					
					5	Save Symbol Advan	ced *
	Layer Rendering	I III					
	Style *			ОК	Cancel	Apply H	Help

# (9) Right-click on the layer again and select Symbology

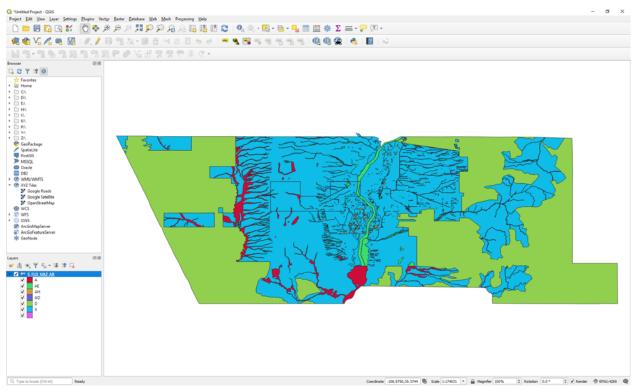
(10) Single symbol is the default display



(11) Change the type to Categorized and choose FLD\_ZONE for the column and then click on Classify

<b>Q</b> I	Layer Properties - S_FL	D_HAZ_AR	Symbology	/					×
Q		🚍 Catego	orized						•
i	Information	Column	abc FLD_ZC	DNE					3
્રે	Source	Symbol				Change			
	Symbology	Color ramp			R	andom colors			
~	symbology		▼ Value	Legend					
abc	Labels	✓ ✓	A AE	A AE					
<b>9</b>	Diagrams	✓	AH AO	AH AO					
<b>~</b>	3D View	V	D	D					
	Source Fields	V V	X all othe	Х					
8	Attributes Form								
•	Joins								
5	Auxiliary Storage								
٩	Actions								
9	Display								
*	Rendering								
8	Variables								
2	Metadata								
ł	Dependencies								
÷	Legend								
	QGIS Server	Classify	<b>+</b>	Delete All					Advanced *
<b>M</b>	Digitizing	▶ Layer	Rendering						
		Style	•			ОК	Cancel	Apply	Help

# (12) Click on Apply and then Click on OK



- (13) Now let us try the Graduated
- (14) Change the column to STATIC \_BFE

(15) Change Mode to Natural Breaks (Jenks) and then click on Classify

Q Layer Properties - S	_FLD_HAZ_AR   Symbology	×
۹	🚍 Graduated	-
🥡 Information	Column 1.2 STATIC_BFE	3
Source	Symbol	hange
Symbology	Legend format %1 - %2	Precision 0 🗘 🗖 Trim
(abc Labels	Method Color Color ramp	• •
🌱 Diagrams	Classes Histogram	
幹 3D View	Symbol         Values         Legend           V         -9999.00 - 9999.00 - 9999         -9999	
Source Fields	-9999.00 - 5035.00 -9999 - 5035 5035.00 - 5264.00 5035 - 5264	
🔡 Attributes Form	✓         5264.00 - 5636.00         5264 - 5636           ✓         5636.00 - 6171.00         5636 - 6171	
• 📢 Joins		
auxiliary Storage	Mode Natural Breaks (Jenks) *	Classes 5 🗘
octions	Classify 🖶 📼 Delete All	Advanced *
🧭 Display	✓ Link dass boundaries	
🞸 Rendering	Layer Rendering	
C Variables	T Style T	OK Cancel Apply Help

# (16) Delete the -9999 - 5143 class

(17) Rename the -9999 – -9999 to No Data; click Apply and then OK

Q Layer Properties - S	_FLD_HAZ_AR   Symbology ×
۹	Graduated
Information       Column       1.3 STATIC_SFE       ▼         Source       Symbol       Column       1.3 STATIC_SFE       ▼         Symbol       Labels       Column       1.3 STATIC_SFE       ▼         Diagrams       Column       Symbol       Precision 0       Tim         Method       Column       Column       Symbol       Precision 0       Tim         Source Fields       Symbol	
X Source	Symbol Change
Symbology	Legend format 1 %1 - %2
	Method Color
(abc Labels	Color ramp
Magrams	Classes Histogram
প 3D View	Symbol values Ecgend
Source Fields	5636.00 - 6171.00 5636 - 6171
Attributes Form	
Joins	
Auxiliary Storage	Mode Natural Breaks (Jenks)  Classes 5
Actions	
🧭 Display	
💉 Rendering	▶ Layer Rendering
~	Style      OK Cancel Apply Help
Q "Untitled Project - QGIS	
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■ 012           ● WASYMIS           ● WASYMIS           ● WASYMIS           ● Google Statilitie           ● Google Statilitie           ● Google Statilitie           ● WSS           ● WSS           ● WSS           ● Google Statilitie           ● WSS           ● WSS           ● WSS           ● Google Statilitie           ● WSS           ● WSS <td></td>	
■ 012           ● WASYMIS           ● WASYMIS           ● WASYMIS           ● Google Statilitie           ● Google Statilitie           ● Google Statilitie           ● WSS           ● WSS           ● WSS           ● Google Statilitie           ● WSS           ● WSS           ● WSS           ● Google Statilitie           ● WSS           ● WSS <td></td>	
■ OR:         ● WASYMATS           ● WASYMATS         ● WASYMATS           ●	

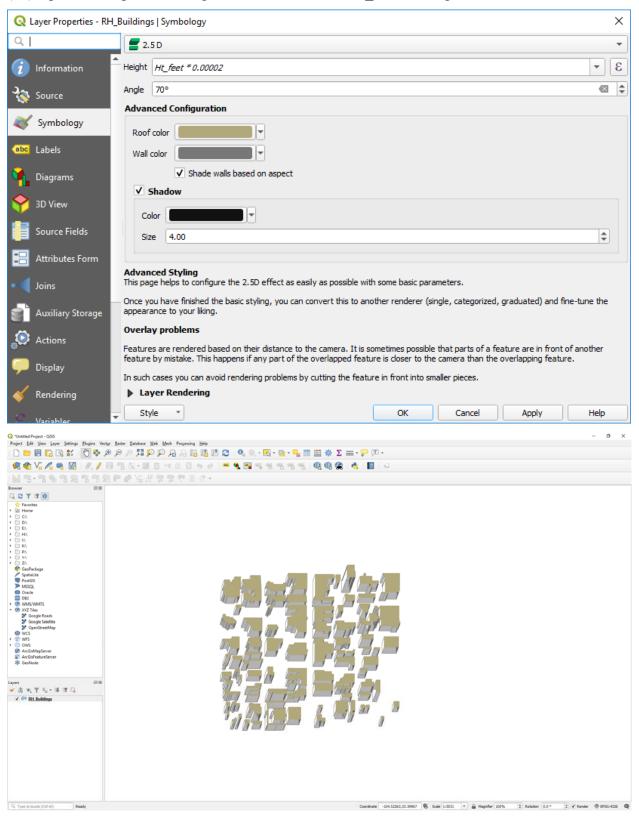
# (18) Now try the Rule-based symbology

<b>Q</b> I	Layer Properties - S_	FLC	0_HAZ_AR   Symbology					×
Q			🔚 Rule-based					•
্য ২ জু	Information Source Symbology	•	Label V No Data S636 - 6171 V S264 - 5636 V S035 - 5264	Rule "STATIC_BFE" > = -9999.00000 A "STATIC_BFE" > 5636.00000 AND "STATIC_BFE" > 5264.000000 AND "STATIC_BFE" > 5035.000000 AND	) "STATIC_BFE" <	<= 6171.000000 <= 5636.000000	Min. sca	le Max. s
abc	Labels							
<b>*</b>	Diagrams							
8	3D View							
	Source Fields							
-8	Attributes Form							
	Joins							
S,	Auxiliary Storage							
٩	Actions		<ul> <li>Φ = 2 Σ</li> </ul>					Symbol Levels
9	Display		Refine Selected Rules *					
*	Rendering		Layer Rendering					
e	Variables	Ŧ	Style *		ОК	Cancel	Apply	Help

# (19) Now try the Inverted polygons symbology

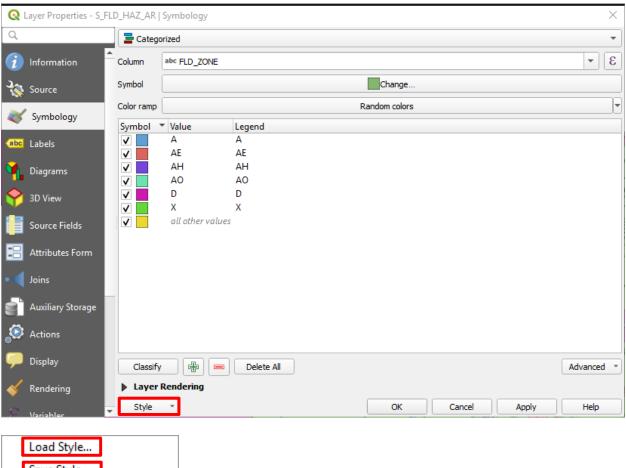
<b>Q</b> I	ayer Properties - S_	D_HAZ_AR   Symbology ×
9		Inverted polygons
i	Information	Sub renderer Single symbol
ે્	Source	Merge polygons before rendering (slow)
*	Symbology	Fill     Simple fill
abc	Labels	
۹.	Diagrams	
Ŷ	3D View	
	Source Fields	
8	Attributes Form	Unit Millimeter
•◀	Joins	Color
đ	Auxiliary Storage	
٢	Actions	
9	Display	Q. Favorites     Image: Constraint of the second seco
*	Rendering	Layer Rendering
0	V	Style  V  K  Cancel  Apply  Help

- (20) Now try the 2.5 D symbology
- (21) Add the RH\_Buildings layer
- (22) Open the Properties dialog and select 2.5 D; use Ht\_feet for height and times 0.00002



#### 2. Save and Load Styles

QGIS can save styles in two file formats: QGIS Layer Style File (.qml) and SLD File (.sld). The .qml style file is specific to QGIS, while the .sld style file is useable by other programs to style files. In general, you should plan on saving styles using the .qml file type as it does the best job of saving your styles; however, if portability is a priority, then the .sld file is the better option. To save a style, open the Layer Properties dialog, set the style you want to save, and then to go to Style >>> Save Style, and save the style as either a .qml or a .sld file. The save style file can later be loaded and applied to other data layers.

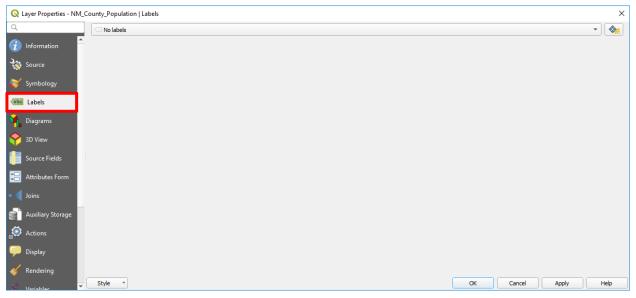


	Eoud Stylen
	Save Style
	Save as Default
	Restore Default
	Add
	Rename Current
$\checkmark$	default

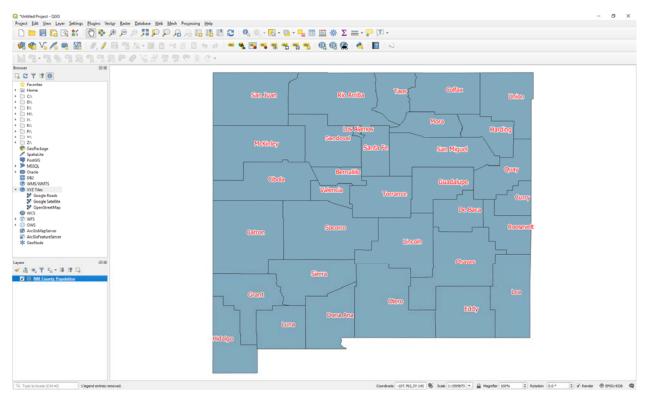
### 3. Labeling

(1) Start a new QGIS project, load the NM County Population layer

(2) Right-click on the added layer and then click on Labels



(3) Change No labels to Single labels, and then select Label with NAME10, Color Red, Size 14, Draw text buffer checked on



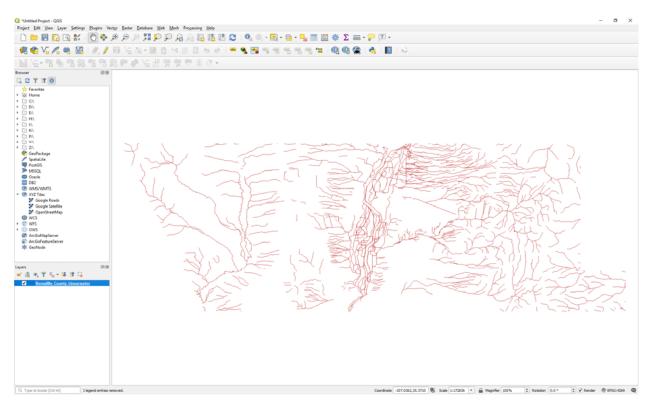
# (4) Explore the Background, Shadow, and Placement Options

ଭ	Layer Properties - NM_	County_Population   La	bels				×
Q		General Single labels				-	
i	Information	Label with abc NAME1	10			-	3
ગ્ર્	Source	▼ Text Sample					
~	Symbology	Lorem Ipsu	ım				<b>^</b>
ab	Labels						•
	Diagrams	Lorem Ipsum	-	<b>5</b> 1:1590832 <b>•</b>			•
		<sup>abc</sup> Text <sup>+ab</sup> Formatting	Background				
Y	3D View	<sup>+ab</sup> <sub>c</sub> Formatting abc Buffer	Draw background	e.			
	Source Fields	💭 Background	Shape	Rectangle		-	
-8	Attributes Form	Shadow	Size type	Buffer		•	
	Joins	Placement Rendering	Size X	0.0000		•	
			Size Y	0.0000		¢ (	-
				Milimeter		-	
ુ	Actions		Rotation	Sync with label	,	-	
9	Display			0.00*		¢ (	
*	Rendering			0.0000			
S.	Variables		Offset X,Y				
				Milimeter		•	
2			Radius X,Y	0.0000 🔃			
	Dependencies			Milimeter		•] (6	4
-	Legend		Opacity		00.0 %	¢) (E	1
	QGIS Server		Blend mode	Normal		•	1
127	Digitizing		Fill color				1
	Digitizing		Stroke color				
			Stroke width	0.000		<ul> <li>(c)</li> </ul>	
				Milmeter	-	- -	1
			Pen join style	Bevel		- €	
			Draw effects				
		Style *		OK Cancel	Apply	Help	

## 1. Re-project Layers

(1) Start a new QGIS project

(2) Insert the Bernalillo County Linearwater layer

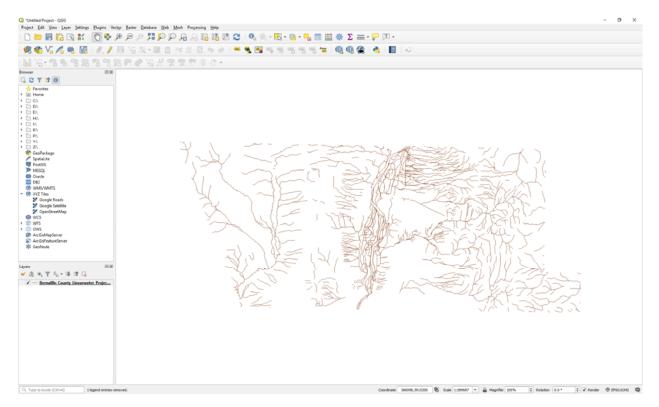


(3) Go to Vector >>> Data Management Tools >>> Reproject Layer

Q Reproject Layer	>	×
Parameters       Log         Input layer       ✓° Bernalillo_County_Linearwater [EPSG:4269]       ▼         Selected features only       Target CRS         EPSG:4326 - WGS 84       ▼         @       Reprojected         [Create temporary layer]          ✓       Open output file after running algorithm	Reproject layer This algorithm reprojects a vector layer. It creates a new layer with the same features as the input one, but with geometries reprojected to a new CRS. Attributes are not modified by this algorithm.	
0%	Cancel	)
Run as Batch Process	Run Close Help	]

Reproject Layer	>
Parameters       Log         Input layer	<ul> <li>Reproject layer</li> <li>This algorithm reprojects a vector layer. It creates a new layer with the same features as the input one, but with geometries reprojected to a new CRS.</li> <li>Attributes are not modified by this algorithm.</li> </ul>
0%	Cancel
Run as Batch Process	Run Close Help

- (5) Click Run
- (6) Start a new QGIS project
- (7) Add the newly created re-projected layer

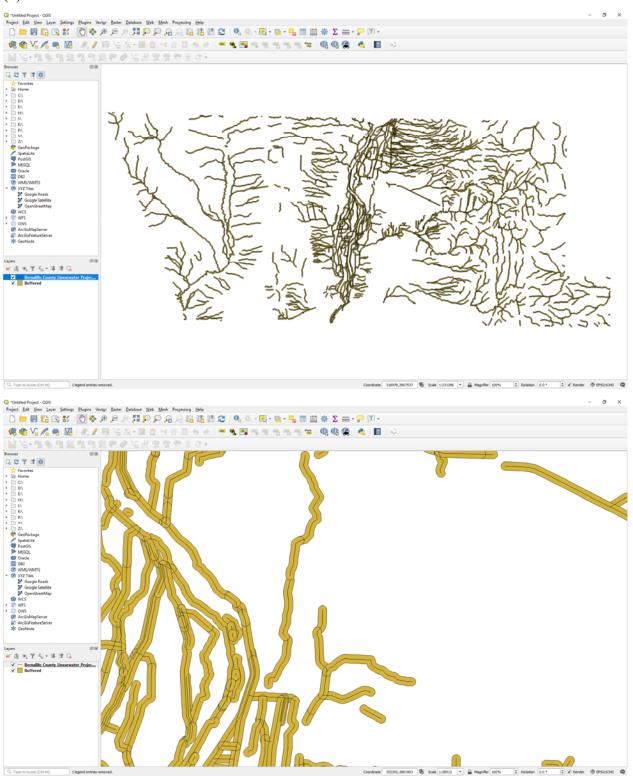


2. Buffer

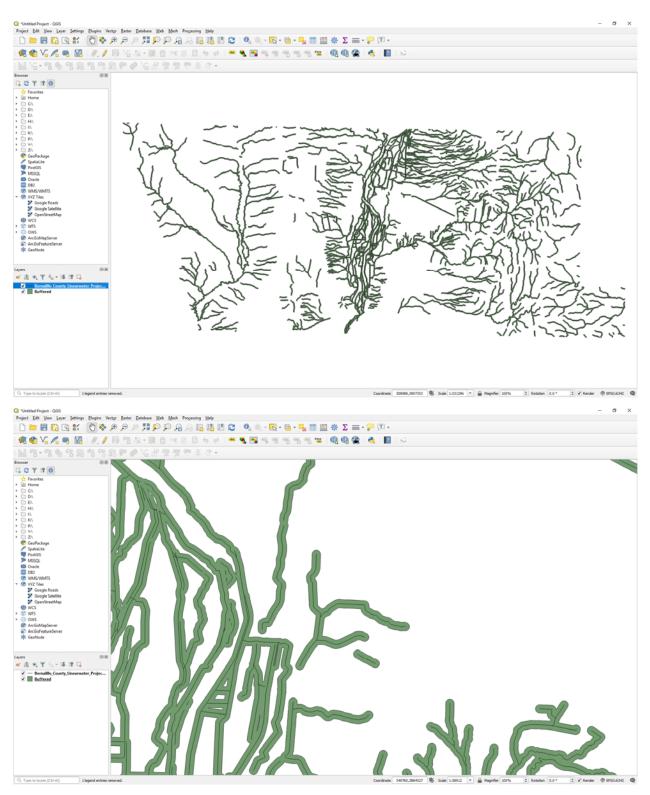
- (1) Start a new QGIS project
- (2) Insert the Bernalillo County Linearwater Projected layer
- (3) Go to Vector >>> Geoprocessing Tools >>> Buffer
- (4) Input the parameters as below

Q Buffer	X
Parameters       Log         Input layer          Parameters         Imput layer          Parameters         Selected features only          Distance         100.000000          meters         Segments          •          meters         Segments          •          meters         Segments          •          meters         Segments          •          •          •	Buffer           This algorithm computes a buffer area for all the features in an input layer, using a fixed or dynamic distance.           The segments parameter controls the number of line segments to use to approximate a quarter circle when creating rounded offsets.           The end cap style parameter controls how line endings are handled in the buffer.           The join style parameter specifies whether round, mitter or beveled joins should be used when offsetting corners in a line.           The mitter limit parameter is only applicable for mitter join styles, and controls the maximum distance from the offset curve to use when creating a mittered join.
0%	Cancel
Run as Batch Process	Run Close Help

(5) Click on Run



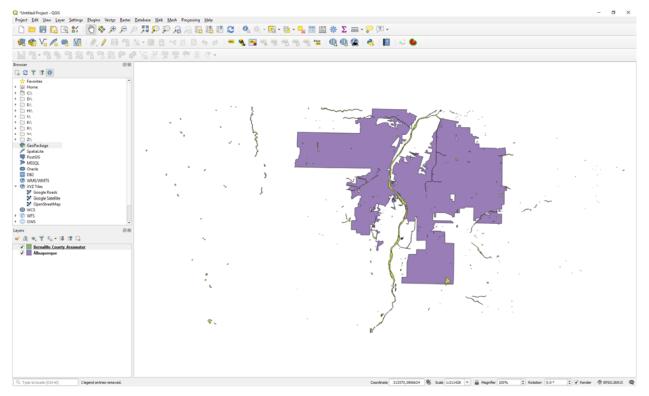
(7) Try Dissolve result option



Exercise: In Plugins, find the Multi-distance buffer plugin and install it. Explore the tool.

<u>3. Clip</u>

- (1) Start a new QGIS project
- (2) Insert the Bernalillo County Areawater layer
- (3) Insert the Albuquerque city boundary layer



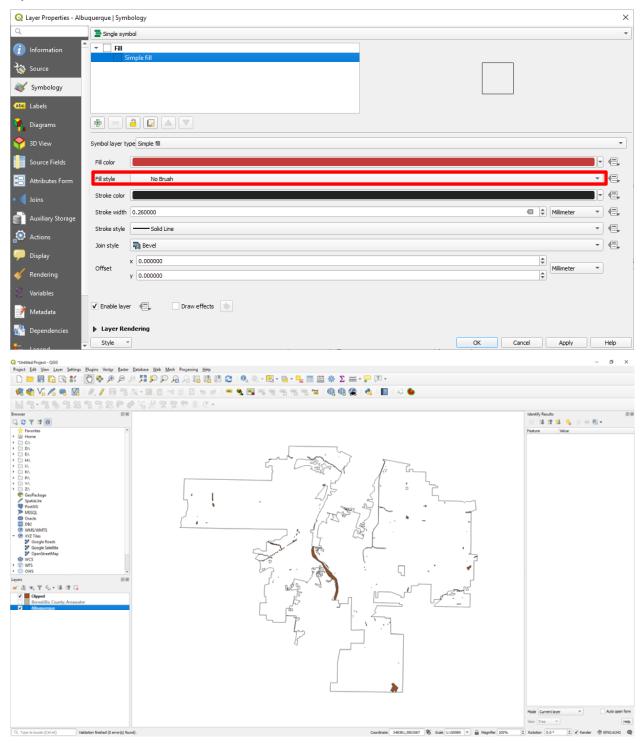
(4) Go to Vector >>> Geoprocessing Tools >>> Clip

Clip     Parameters     Log   Input layer   Bernalillo_County_Areawater [EPSG:6342]     Selected features only   Overlay layer   Albuquerque [EPSG:6342]     Selected features only     Cipped     C:/Users/szhang/Desktop/Study/Albuquerque_Areawater.shp     Open output file after running algorithm	Clip This algorithm clips a vector layer using the features of an additional polygon layer. Only th parts of the features in the Input layer that fal within the polygons of the Overlay layer will be added to the resulting layer. The attributes of the features are not modified although properties such as area or length of th features will be modified by the clipping operati If such properties are stored as attributes, tho attributes will have to be manually updated.	, he on.
0%	Cance	
Run as Batch Process	Run Close Help	

(5) Input the parameters as below

#### (6) Click Run

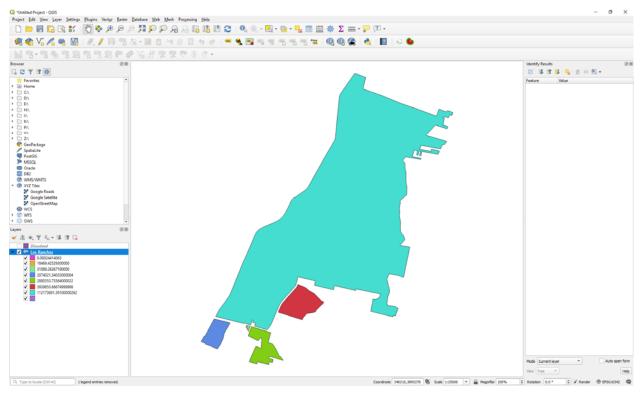
(7) Right-click on the Albuquerque boundary layer, and then select Symbology, change the Fill style to No Brush, and then click OK



### 4. Dissolve

### (1) Start a new QGIS project

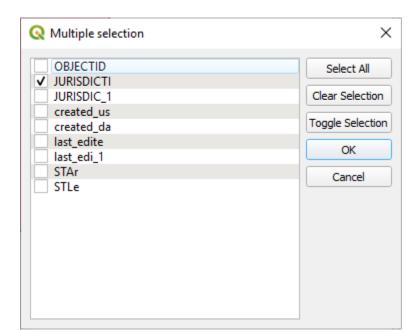
### (2) Insert the Los Ranchos layer



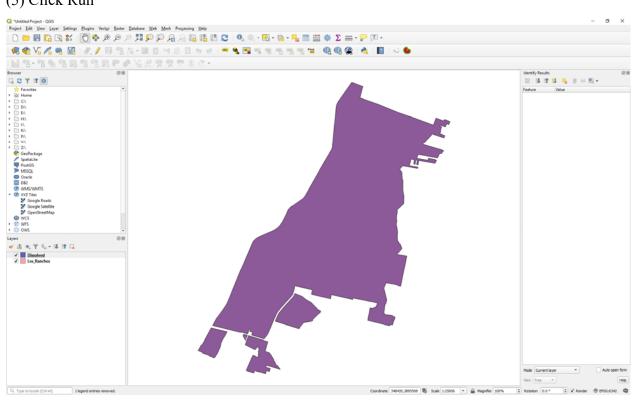
(3) Go to Vector >>> Geoprocessing Tools >>> Dissolve

#### (4) Input the parameters as below

Q Dissolve	×
Parameters       Log         Input layer       Input layer         Import Los_Ranchos [EPSG:6342]       Import and a start and start and a start and a start and a start an	Dissolve This algorithm takes a vector layer and combines their features into new features. One or more attributes can be specified to dissolve features belonging to the same class (having the same value for the specified attributes), alternatively all features can be dissolved in a single one. All output geometries will be converted to multi geometries. In case the input is a polygon layer, common boundaries of adjacent polygons being dissolved will get erased.
0%	Cancel Run Close Help

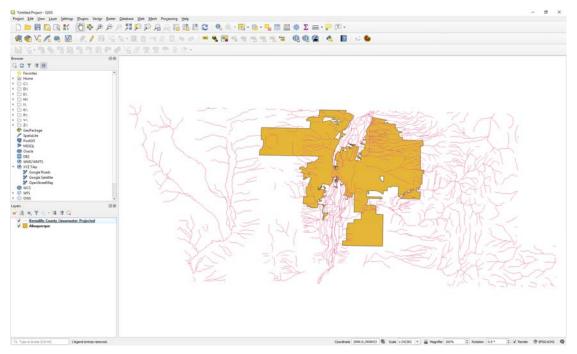


### (5) Click Run



# 5. Intersection

- (1) Start a new QGIS project
- (2) Insert the Bernalillo County Linearwater Projected layer
- (3) Insert the Albuquerque city boundary layer



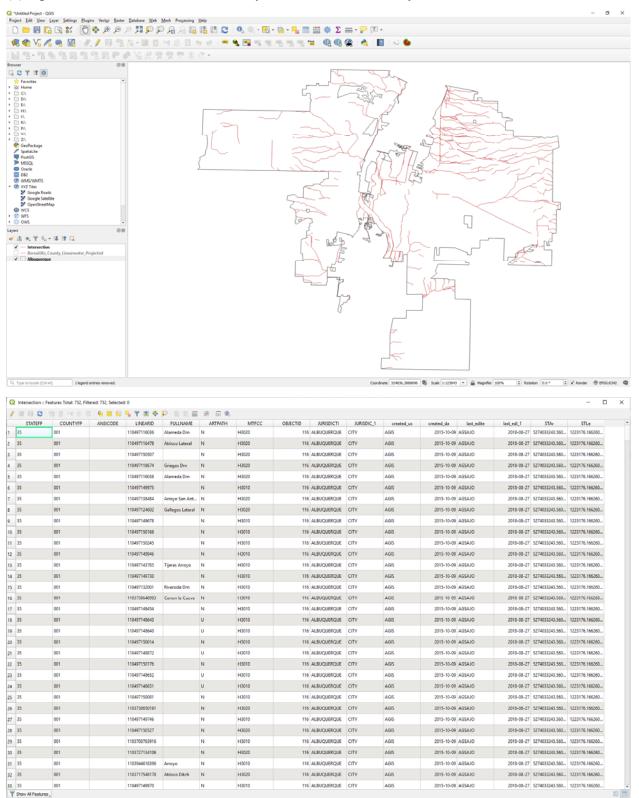
- (4) Go to Vector >>> Geoprocessing Tools >>> Intersection
- (5) Input the parameters as below

Q Intersection		×
Parameters     Log       Input layer     √* Bernalillo_County_Linearwater_Projected [EPSG:6342]     ▼       Selected features only     Overlay layer	Intersection This algorithm extracts the overlapping portions features in the Input and Overlay layers. Featur in the output Intersection layer are assigned the attributes of the overlapping features from both the Input and Overlay layers.	es
Albuquerque [EPSG:6342]     Selected features only Input fields to keep (leave empty to keep all fields) [optional]     O elements selected     Overlay fields to keep (leave empty to keep all fields) [optional]		
0 elements selected        Intersection		
sers/szhang/Desktop/Study/Albuquerque_Linearwater_Intersection.shp         Image: Comparison of the stress of the		
0%	Cancel	
Run as Batch Process	Run Close Help	

(6) Click Run

(7) It will take a while to complete the processing

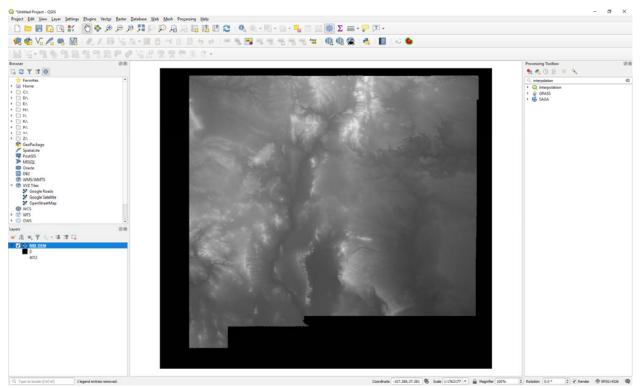
(8) Open the attribute table of the newly created intersection layer



## 1. Re-project Layers

(1) Start a new QGIS project

# (2) Insert the NM DEM layer



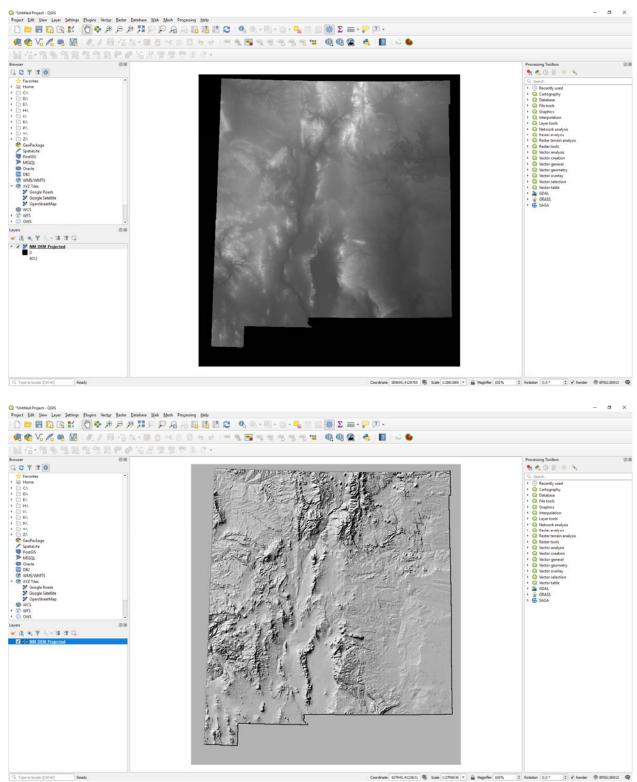
(3) Go to Raster >>> Projections >>> Assign Projection

(4) Input the parameters as below

Q Assign Projection	×
Parameters Log	
Input layer	-
M_DEM [EPSG:4326]	•
Desired CRS	
EPSG:6342 - NAD83(2011) / UTM zone 13N	- 🛞
GDAL/OGR console call	
python3 -m gdal_edit -a_srs EPSG:6342 C:\Users\szhang\Desktop\Intermediate_QGIS_Workshop\Part_E\NM_DEM.img	
0%	Cancel
Run as Batch Process     Run     Close	Help

(5) Click Run

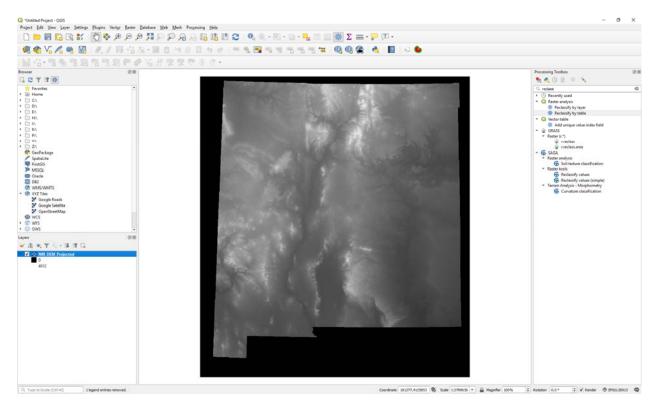
(6) The current Version 3.6.1 has problems with this tool. You cannot successfully re-project your raster layers. Therefore, I have provided a projected layer instead.



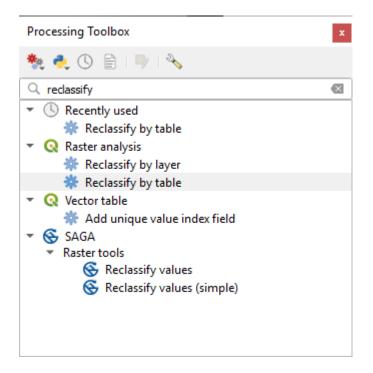
#### 2. Reclassify

(1) Start a new QGIS project

(2) Insert the NM DEM Projected layer



(3) In the Processing Toolbox, search reclassify



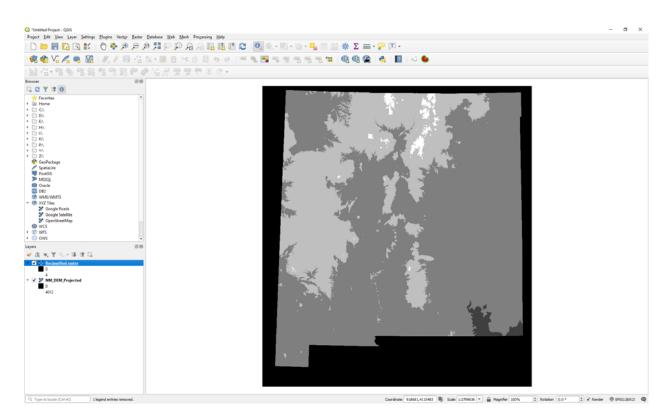
## (4) Select Reclassify by table

## (5) Input the parameters as below

Reclassify by Table			
Parameters Log		Reclassify by table	
Raster layer		This algorithm reclassifies a raster band by	
NM_DEM_Projected [EPSG:26913]		assigning new class values based on the range	s
Band number	,	specified in a fixed table.	
Band 1: Layer_1	-		
Reclassification table			
Fixed table (5x3)			
Advanced parameters			
Output no data value			
-9999.000000	\$		
Range boundaries			
min < value <= max	-		
Use no data when no range matches value			
Output data type			
Int16	•		
Reclassified raster			
C:/Users/szhang/Desktop/Study/Reclassified_NM_Elevation.tif			
✔ Open output file after running algorithm			
0%		Cance	21
Run as Batch Process		Run Close Help	

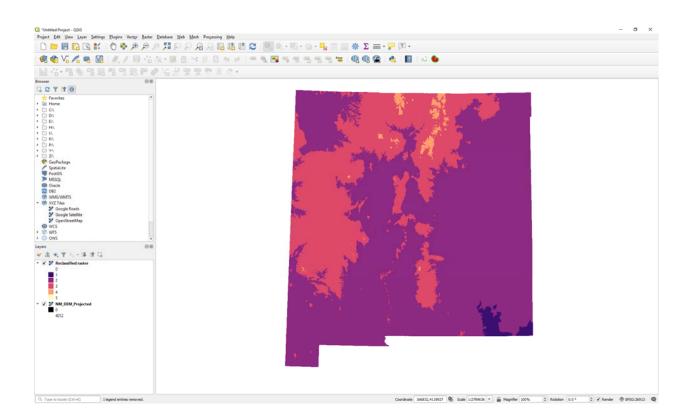
Min	mum Maximur	N Value	Add Row
1 0	1000	1	Remove Row(s
2 1000	2000	2	Remove All
3 2000	3000	3	ОК
4 3000	4000	4	Cancel
5 4000	4500	5	

(6) Click Run



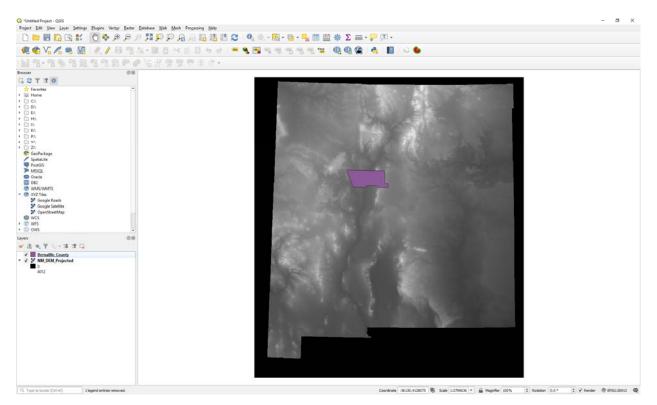
## (7) Right-click on the Reclassified raster layer and then select symbology

🔇 La	ayer Properties - Reclassi	fied raster   Sy	mbology							×
Q	_		dering							-
1	Information	Render type	Paletted/Unique	values 🔻						
<b>3</b>	Source	Band	Band 1 (Gray)						•	
*	Symbology	Color ramp								
1000	Transparency	Value	Color	Label					<b></b>	
		0		0						
	Histogram									
<b>«</b>	Rendering	1		1						
	Pyramids	2		2						
1	Metadata	3		3						
÷	Legend	4		4						
	QGIS Server	5		5					-	
			Classify		÷		Delete	e All		
_										
		Color Rer	ıdering							Ŧ
		Style *				ОК	Cancel	Apply	Help	



<u>3. Clip</u>

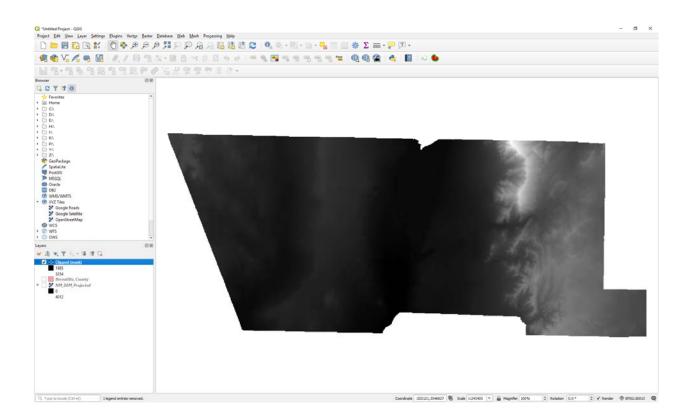
- (1) Start a new QGIS project
- (2) Insert the NM DEM Projected layer
- (3) Insert the Bernalillo County boundary layer



- (4) Go to Raster >>> Extraction >>> Clip Raster by Mask Layer
- (5) Input the parameters as below

Q Clip Raster by Mask Layer		>
Parameters Log		
Input layer		<b>^</b>
MM_DEM_Projected [EPSG:26913]		•
Mask layer		
Bernalillo_County [EPSG:26913]	-	🦻
Selected features only		
Source CRS [optional]		
		-
Target CRS [optional]		
		- 👻
Assign a specified nodata value to output bands [optional]		
-9999.000000		
Create an output alpha band		
✓ Match the extent of the clipped raster to the extent of the mask layer		
Keep resolution of input raster		
Set output file resolution		
X Resolution to output bands [optional]		
Not set		\$
Y Resolution to output bands [optional]		
Not set		\$
Advanced parameters		
Use multithreaded warping implementation		
Additional creation options [optional]		
Profile Default		
Name	Value	
문 Validate Help		
Output data type		
Use input layer data type		-
Clipped (mask)		
C:/Users/szhang/Desktop/Study/Bernalillo_County_DEM.tif		
00/		Canad
0%		Cancel
Run as Batch Process	Run Close	Help

(6) Click Run



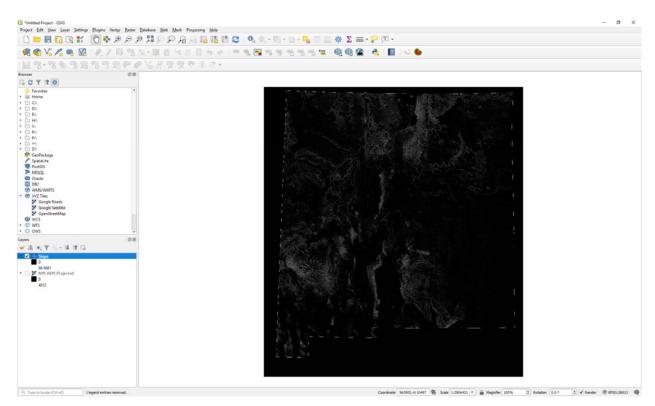
4. Slope

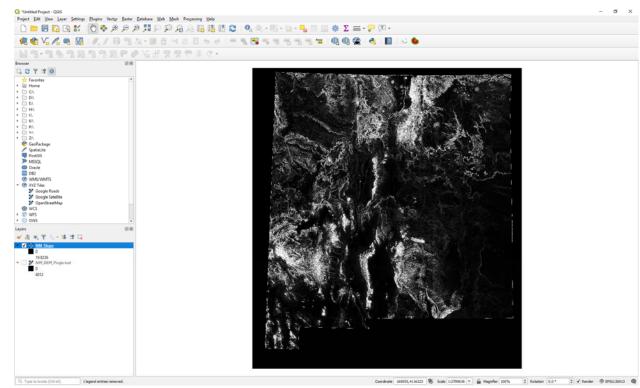
- (1) Start a new QGIS project
- (2) Insert the NM DEM Projected layer
- (3) Go to Raster >>> Analysis >>> Slope

#### (4) Input the parameters as below

🔇 Slope	×
Parameters Log	
Input layer	<b></b>
MM_DEM_Projected [EPSG:26913]	▼
Band number	
Band 1: Layer_1	
Ratio of vertical units to horizontal	
1.000000	\$
<ul> <li>Slope expressed as percent instead of degrees</li> <li>Compute edges</li> <li>Use Zevenbergen<u>T</u>horne formula instead of the Horn's one</li> <li>Advanced parameters</li> </ul>	
Additional creation options [optional] Profile Default	•
Name	Value
문 Validate Help	
Slope	
C:/Users/szhang/Desktop/Study/NM_Slope.tif	
<ul> <li>Open output file after running algorithm</li> <li>GDAL/OGR console call</li> </ul>	
gdaldem slope C:\Users\szhang\Desktop\Intermediate_QGIS_Workshop\Pa Study/NM_Slope.tif -of GTiff -b 1 -s 1.0	rt_E\NM_DEM_Projected.img C:/Users/szhang/Desktop/
0%	Cancel
Run as Batch Process	Run Close Help

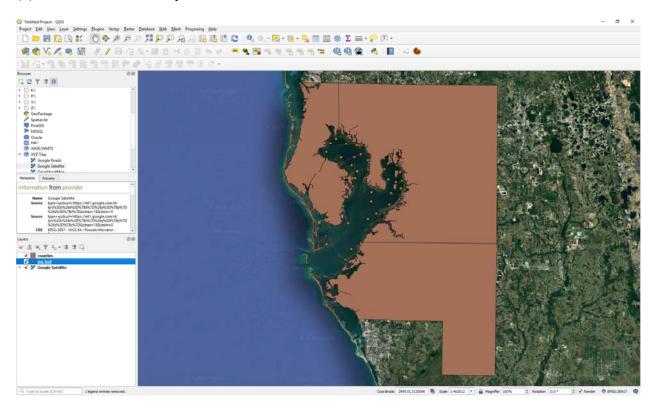
(5) Click Run



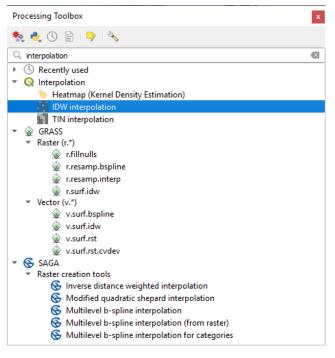


5. Interpolation

- (1) Start a new QGIS project
- (2) Insert the Water Quality layer
- (3) Insert the Counties layer



(4) In the Processing Toolbox, search Interpolation



#### (5) Select IDW Interpolation

#### (6) Input the parameters as below

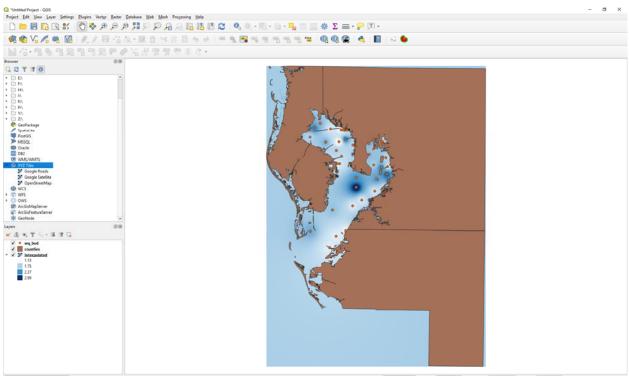
🔇 IDW Interp	polation						×
Parameters	Log						
Input layer(s)							
	,						
Vector layer	r	wq_bod ژ					 -
Interpolatio	on attribute	1.2 BOD_MG	L				•
Use Z-o	oordinate fo	or interpolation	I				
							æ
Vector laye	er A	ttribute	Туре				
wq_bo	od B	OD_MGL	Points				•
Distance coef	fficient P						
2.000000		1. vmax)					•
2.000000 Extent (xmin,	, xmax, ymir		963,3009889	9.08582772,311	7645.1742208	3 [EPSG:26917]	•
2.000000 Extent (xmin,	, xmax, ymir 97661084,3		963,3009889	9.08582772,311	7645. 1742208	3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289	, xmax, ymir 97661084,3 r size	96303.666378				3 [EPSG: 26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows	, xmax, ymir 97661084,3 r size 1079	96303.666378	Columns	787	\$	3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X	, xmax, ymir 97661084,3 r size 1079	96303.666378		787		3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X Interpolated	, xmax, ymir 97661084,3 r size 1079 100.00000	96303.666378 \$	Columns Pixel size Y	787	\$	3 [EPSG: 26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X Interpolated C:/Users/szh	, xmax, ymir 97661084,3 r size 1079 100.00000 hang/Deskto	96303.666378	Columns Pixel size Y Interpolation	787	\$	3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X Interpolated C:/Users/szh	, xmax, ymir 97661084,3 r size 1079 100.00000 hang/Deskto	96303.666378 \$	Columns Pixel size Y Interpolation	787	\$	3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X Interpolated C:/Users/szh	, xmax, ymir 97661084,3 r size 1079 100.00000 hang/Deskto	96303.666378	Columns Pixel size Y Interpolation	787	\$	3 [EPSG:26917]	
2.000000 Extent (xmin, 317702.6289 Output raster Rows Pixel size X Interpolated C:/Users/szh	, xmax, ymir 97661084,3 r size 1079 100.00000 hang/Deskto	96303.666378	Columns Pixel size Y Interpolation	787	\$	3 [EPSG: 26917]	

#### (7) Click Run

(8) Right Click on the created IDW interpolation layer, and then select Symbology and change the settings as below

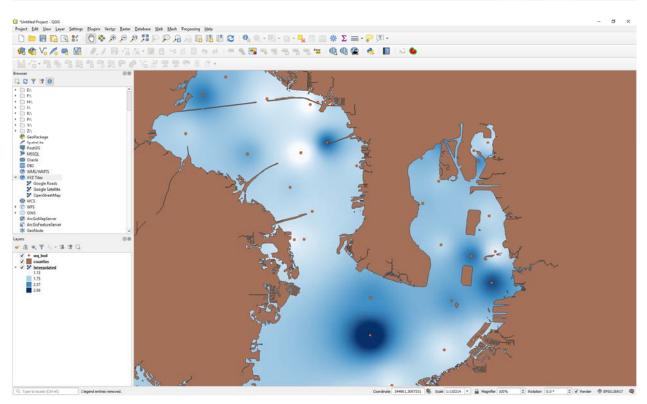
Q Layer Properties - Interpolated   Symbology					
Q	▼ Band Rendering	-			
information	Render type Singleband pseudocolor 💌				
🗞 Source	Band Band 1				
Symbology	Min 1.12872 Max 2.98559				
	Min / Max Value Settings				
Transparency	Interpolation Linear				
🗠 Histogram	Color ramp				
🞸 Rendering	Label unit suffix				
🖄 Pyramids	Value Color Label				
📝 Metadata	1.12872 1.13				
E Legend	1.747676666 1.75				
QGIS Server	2.366633333 2.37				
	2.98559 2.99				
	Mode Equal Interval 🔻 Classes 🚦 🗘				
	Clip out of range values				
	▼ Color Rendering				
	Blending mode Normal				
	Brightness O I Contrast O I	*			
	Style   OK Cancel Apply Help	· · ·			

(9) Click OK



cate (Ctrl+H) 1 legend entries removed.

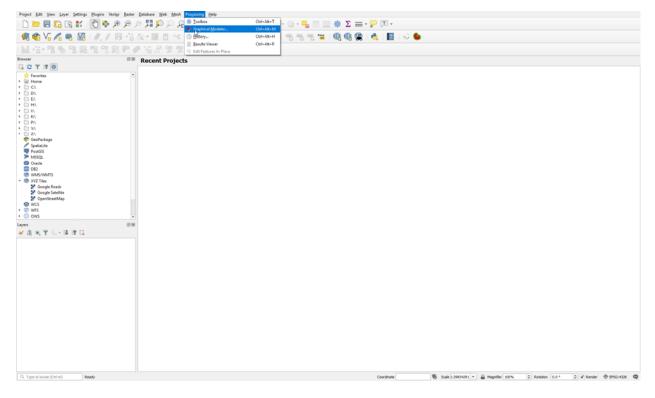
Coordnate 339699,3122956 🛞 Scale 1:440556 🔻 🔒 Magnifer 200% 🖏 Rotation 0.0\* 🗘 🖉 Render 🐡 BPSG:26917 🚳



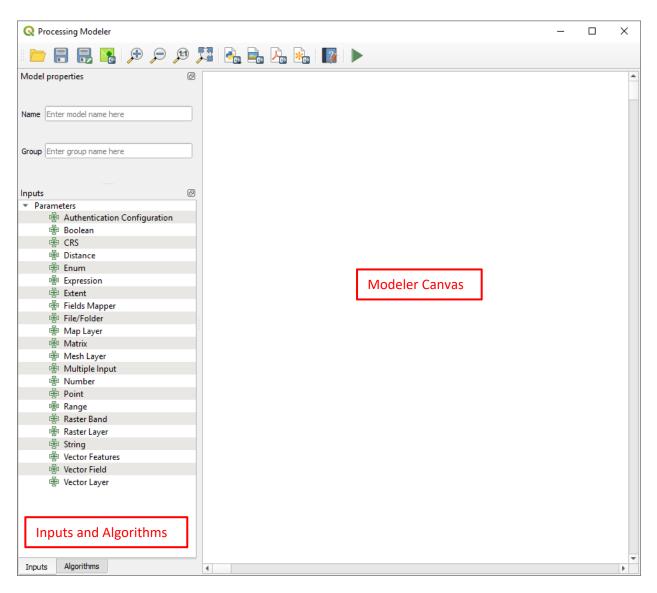
#### Part F. Working with the Graphical Modeler

A typical spatial analysis involves a series of GIS operations, with the output of one operation as the input for the next one, until the final result is generated. Using the Graphical Modeler, users can combine these individual steps into a single process. Thee interface of Graphical Modeler allows users to visually draw inputs, GIS algorithms, and output. A major benefits of this approach is that the completed analytical workflow can be modified and rerun.

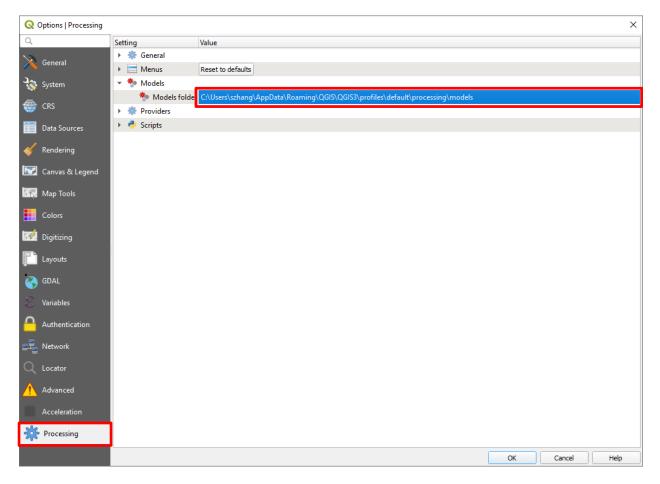
1. Click on Processing and then click on Graphical Modeler



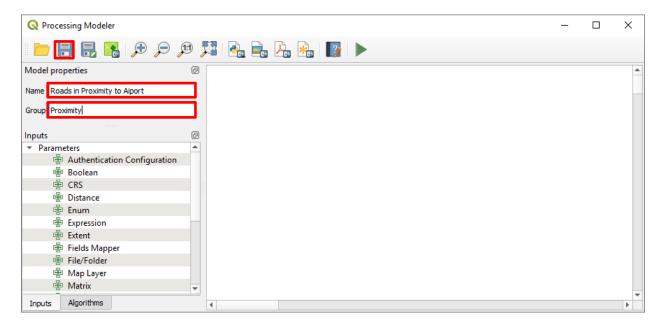
2. The Processing Modeler opens as a new window; on the left-hand side of the window, there are two tabs: **Inputs** and **Algorithms**; these are used to add both types of element to the modeler canvas that takes up the remainder of the window



3. Before creating a model, it is always a good practice to configure the modeler; models as saved as JSON files with a .model extension; when users save a model, QGIS will prompt the users to save the model file to the **Models** folder; users can set the location of the **Models** folder by navigating to Setting >>> Options >>> Processing



4. Create a new model; type in Roads in Proximity to Airport in "Enter model name here", and type in Proximity in "Enter group name here"; click on the save button 🔳 and the Save Model dialog will open



5. In the **Save Model** dialog, type in a name for your model file; the following figure shows the **Save Model** dialog; if models are saved to the **Models** folder, they will appear as model tools in the **Processing Toolbox** panel; the model will appear with the name that was entered into the graphical modeler as opposed to the name of the \*.model file. Models can be saved outside the **Models** folder, but they will not appear in the **Processing Box** panel

Q Save Model					×
$\leftarrow$ $\rightarrow$ $\checkmark$ $\bigstar$ AppData $\Rightarrow$ Roaming $\Rightarrow$ QGIS $\Rightarrow$ QGIS3 $\Rightarrow$ profiles $\Rightarrow$ default	> processing > mo	dels 🗸 Ö	Search models		٩
Organize 🔻 New folder					?
A Name	Date modified	Туре	Size		
Desktop	4/15/2019 5:09 PM	MODEL3 File	1 KB		
Downloads					
😫 Documents 🖈					
Network Strength Pictures 🖈					
🝊 OneDrive					
~					
File name: Select_Roads_in_Proximity_to_Airport.model3					~
Save as type: Processing models (*.model3 *.MODEL3)					$\sim$
∧ Hide Folders			<u>S</u> ave	Cancel	

Processing Toolbox x
🎭 🌏 🕒 📄 🔍 🗞
Q. Search
Recently used
Q Cartography
• Q Database
<ul> <li>Q File tools</li> </ul>
• Q Graphics
<ul> <li>Q Interpolation</li> </ul>
Q Layer tools
<ul> <li>Q Network analysis</li> </ul>
<ul> <li>Q Raster analysis</li> </ul>
<ul> <li>Q Raster terrain analysis</li> </ul>
• Q Raster tools
Vector analysis
Vector creation
Q Vector general
Q Vector geometry
Q Vector overlay
Q Vector selection
Q Vector table
GDAL
► 🔬 GRASS
Models
<ul> <li>Proximity</li> <li>Roads in Proximity to Airport</li> </ul>
SAGA
r 👿 JAUA

# 6. To open a saved model, in the **Processing modeler** dialog, click on the button to open the

Open Model dialog and then navigate to the location where you model has been saved

Q Processing Modeler			_		×
- E 昆 🕵 🗩 🗢 🎾 🍱 📤 🚔 🖓 🕨 🕨					
Model properties Ø					
Name Enter model name here					
Group Enter group name here					
Inputs Ø					
▼ Parameters					
🕀 Authentication Configuration					
🕀 Boolean					
은 CRS					
🕀 Distance					
🕀 Enum					
Expression					
윤 Extent					
문 Fields Mapper					
伊 File/Folder					
伊 Map Layer					
合 Matrix 👻					*
Inputs Algorithms					•
Q Open Model					×
$\leftarrow$ $\rightarrow$ $\checkmark$ $\Uparrow$ (AppData $\Rightarrow$ Roaming $\Rightarrow$ QGIS $\Rightarrow$ QGIS3 $\Rightarrow$ profiles $\Rightarrow$ default $\Rightarrow$ processing $\Rightarrow$ r	models v ひ	Search models			P
Organize 🔻 New folder					?
↑ Name Ô Date modified	Туре	Size			
Select Roads in Proximity to Airport model3 4/15/2019 5:09 PM	1 MODEL3 File	1 KB			
Desktop					
🕂 Downloads 🖈					
🚔 Documents 🖈					
Dictures 🚽 🗸					
File name: Select_Roads_in_Proximity_to_Airport.model3	~	Processing m	odels (*.	model3 <sup>s</sup>	•. ~
		<u>O</u> pen		Cancel	

7. To begin the creation of a model, users will need to define the inputs. The graphical modeler will accept the followings as input:

- o Boolean
- o Extent
- o File
- o Number
- Raster layer 0
- String 0
- Table 0
- Table field 0
- o Vector layer

8. To add an input, either double-click on the appropriate category from the Inputs tab or drag the input onto the modeler canvas; the Parameter definition dialog will open; give the parameter a name and fill in any other details, which change depending on the input that is selected; when an input parameter is defined and added to the model, it is essentially a conceptual parameter; it is not actually be connected to a data layer until you are ready to run the model

9. For this exercise, we will add a vector layer; we will specify the geometry of the vector data and select it as a required parameter:

<b>Q</b> Vector Layer Para	meter Definitio	n	×
Parameter name			
Airports			
Geometry type			
Point			-
✓ Mandatory	ОК	Cancel	

10. Once you click on OK, the input object will be added to the modeler canvas; all the objects in the modeler canvas can be selected with a mouse click and dragged to reposition; click on the three dots icon of an input will open the Parameter definition dialog to make changes; users can also double click on the objects to make changes

Airports

11. We will also add a number input, which allows us to expose the buffer distance value as an input that can be changed when the model is executed; it will be named "Buffer distance" and it will be given a Default value of 3000, since 3000 it the distance that we initially want to use Note: in the graphical modeler, distances are expressed in current project's coordinate system units

<b>Q</b> Number Parameter Definition	×
Parameter name	
Buffer distance	
Number type	
Integer -	•
Min value	
Max value	
Default value	_
3000	
✓ Mandatory	
OK Cancel	

\_

12. The following screenshot shows the model with a vector layer input and a number input

Q Processing Modeler		-	×
📁 🗐 🛃 🎦 🗩	🏂   🗞 💼 🕰   🌇   🕨		
Model properties @			*
Name Roads in Proximity to Airport			
Group Proximity			
Inputs 0			
▼ Parameters			
🕀 Authentication Configuration	🕆 Airports 🍀 Buffer distance 🏁		
🕆 Boolean			
中 CRS			
🕀 Distance			
문 Enum			
Expression			
🕀 Extent			
🕆 Fields Mapper			
🕆 File/Folder			
🕀 Map Layer			
🕀 Matrix			
🕆 Mesh Layer			
r Multiple Input			
🕀 Number			
			-
Inputs Algorithms	4		•

13. Algorithms are added to the graphical modeler in the same way as inputs; click on the "Algorithms" tab; in the Algorithms tab, there is a special category named Modeler tools, and there are three tools, including Calculator, Raster layer bounds, and Vector layer bounds; they are tools that can only be used in the graphical modeler

Q Processing Modeler	_	×
📁 🖶 🛃 🗩 🔎 🥦 🍱 📤 🚔 🎝 🖓 📗		
Model properties 🙆		
Name Roads in Proximity to Airport		
Group Proximity		
Algorithms Ø		
Q. Search	<b>N</b>	
Categraphy All Polts Burrer distance	×	
▶ Q Database		
Q File tools		
▶ Q Graphics		
Q Interpolation		
Q Layer tools		
▼ Q Modeler tools		
🌞 Load layer into project		
🎋 Rename layer		
🏶 String concatenation		
Q Network analysis		
Q Raster analysis		
Q Raster terrain analysis		
Inputs Algorithms 4		•

14. In the search bar, type in buffer and many tools show up; click on the "Buffer" tool in Vector geometry >>> Buffer

Q Processing Modeler	-	×
- 🗁 🗐 🛃 😥 🗩 🎾 🏂 🔩 💺 🏂 🖓 - 💽		
Model properties 🖉		
Name Roads in Proximity to Airport		
Group Proximity		
Algorithms		
🔍 bufferi 🚳		
Q Vector geometry		
P Buffer distance		
* Create wedge buffers		
🐝 Multi-ring buffer (constant dis		
🌞 Single sided buffer		
🏘 Tapered buffers		
P Variable distance buffer		
🏶 Variable width buffer (by M val		
✓ m GDAL		
Vector geoprocessing		
Buffer vectors -		•
Inputs Algorithms		

15. Drag the "Buffer" to the canvas and the Buffer dialog open; set up the parameters as below; the **Segments** indicate how many segments that your buffer circle will consist of (the more segments the smoother the circle; default value is 5); output will be Airport buffer;

🔇 Buffer			×
Description Buffer			
Input layer			
Airports			•
Distance			
123 10.000000			\$ €.
Segments			
123 20			
End cap style			
Round			-
Join style			
Round			-
Miter limit			
<b>123</b> 2.000000			\$
Dissolve result			
123 Yes			•
Buffered			
Airport buffer			
Parent algorithms			
0 elements selected			
	ОК	Cancel	Help

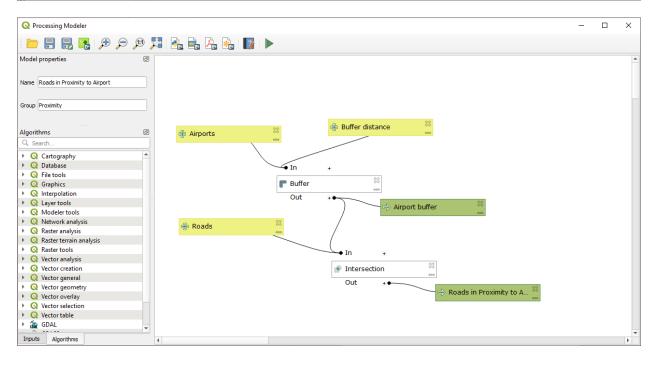
16. Next, click on the button next to Distance and then select Model Input of Buffer distance

🔇 Buffer			×
Description Buffer			
Input layer			
Airports			•
Distance			
Using model input Buffer distance			-
Segments			
123 20			
End cap style			
Round			-
Join style			
Round			-
Miter limit			
<b>123</b> 2.000000			\$
Dissolve result			
123 No			-
Buffered			
Airport buffer			
Parent algorithms			
0 elements selected			
	ОК	Cancel	Help

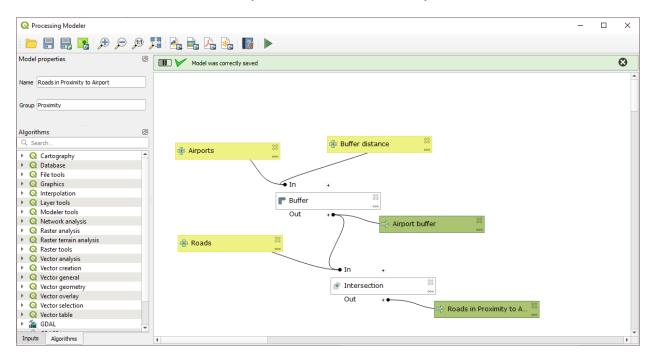
16. Next, add the Roads layer and the Clip tool to the model using the following parameters

Q Vector Layer Parameter Definition	×
Parameter name	
Roads	
Geometry type	
Line	-
Mandatory	

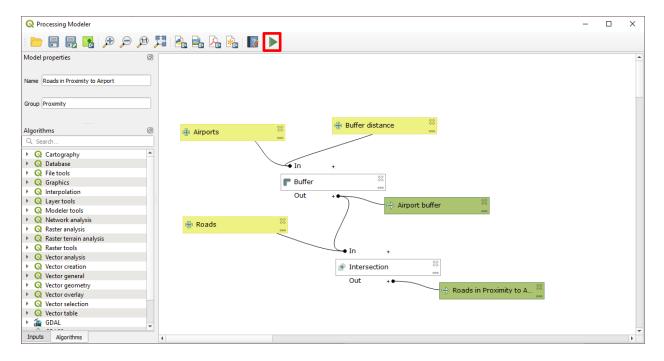
Q Intersection			×
Description Intersection			
Input layer			
Roads			•
Overlay layer			
'Buffered' from algorithm 'Buffer'			•
Input fields to keep (leave empty to keep all fields) [optional]			
[Not set]			•
Overlay fields to keep (leave empty to keep all fields) [optional]			
[Not set]			•
Intersection			
Roads in Proximity to Airport			
Parent algorithms			
0 elements selected			
	ОК	Cancel	Help

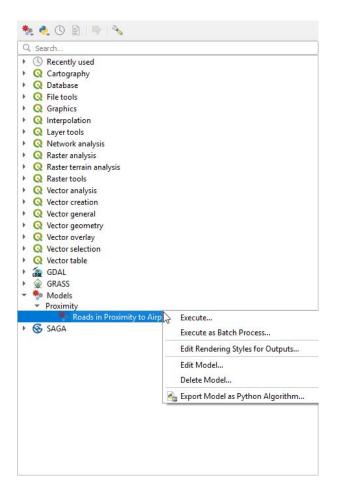


17. Click on the Save button to save your model and then close your model



18. The model can be run either from the **Processing modeler** window or from the **Processing Toolbox** panel; in the **Processing modeler** window, click on the **Run model** button ▷; to run from the **Processing Toolbox**, first save and close the model and then find the model by navigating to model and then right-click on it, and choose **Execute** from the context menu





19. The tool will open with a regular tool interface, fill in the parameters as below and then click on Run; the results will be placed in the folder that you selected

