How To Map Your Own Bike Lanes

A Philly Bike Action Production

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Introduction

Introduction

- So, you want to design your own bike lanes? You are in the right place. This a comprehensive guide to show you how to do just that. We believe that streets are best designed by communities that use them the most. While we value the skillsets of professional planners and engineers, we do not think that one needs to be a professional to share their vision of community spaces. This guide aims to democratize and decentralize this process specifically for the addition or improvement of bike lanes. Onward!

Introduction

- This guide is intended to demonstrate a method of creating maps showing public infrastructure, including existing and proposed conditions for the proposition of changes to public infrastructure. The method described uses **Geographic Information Systems (GIS)** software to create the maps. In order to maximize the potential user base and minimize barriers to entry, QGIS will be used as it is a **free** and **open source** GIS software suite. QGIS may be downloaded from the QGIS website, located here: https://qgis.org/en/site/.
- Similar maps could be created using other GIS software suites, such as ArcGIS or CAD software, but those approaches will not be treated explicitly by this guide.

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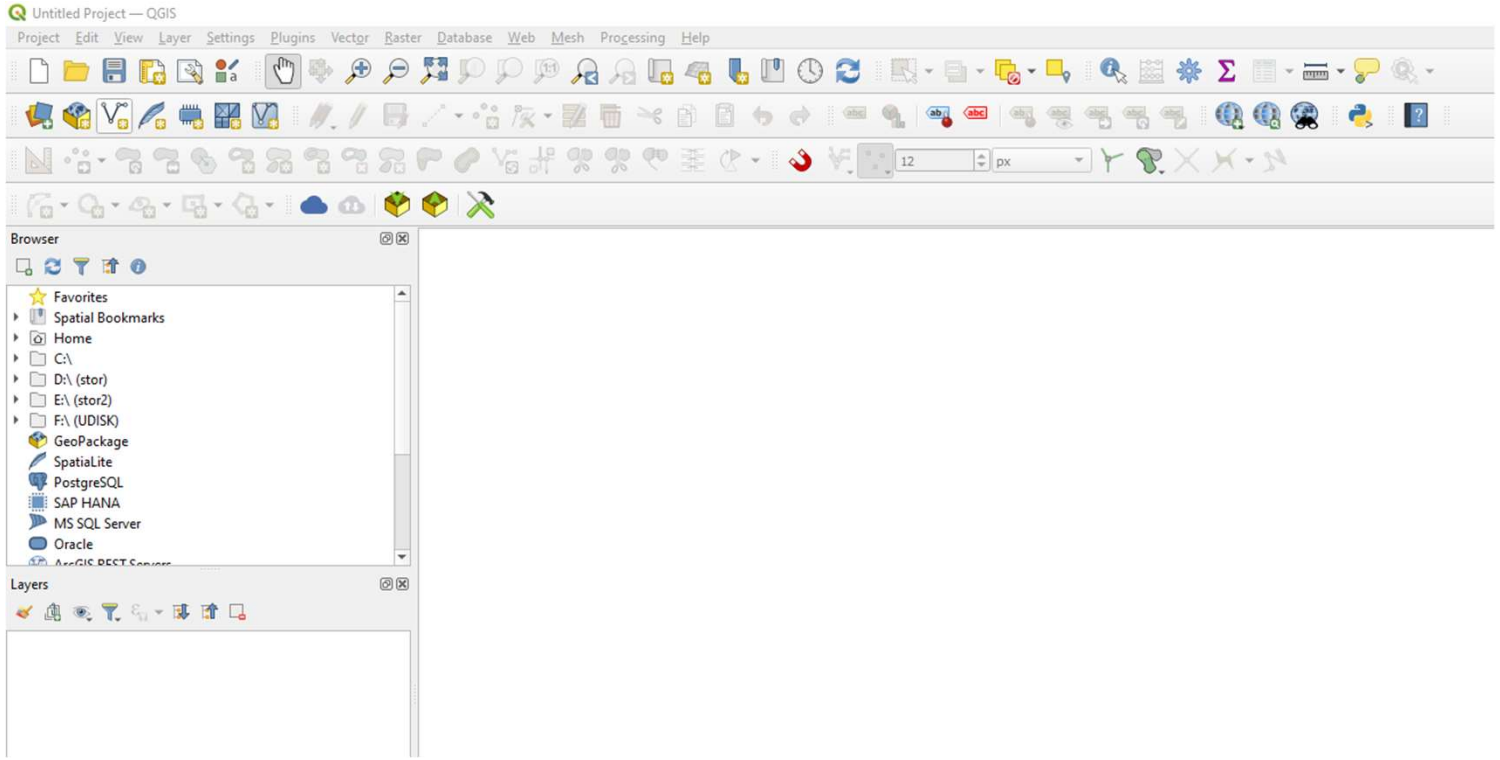
Setting Up A New QGIS Project

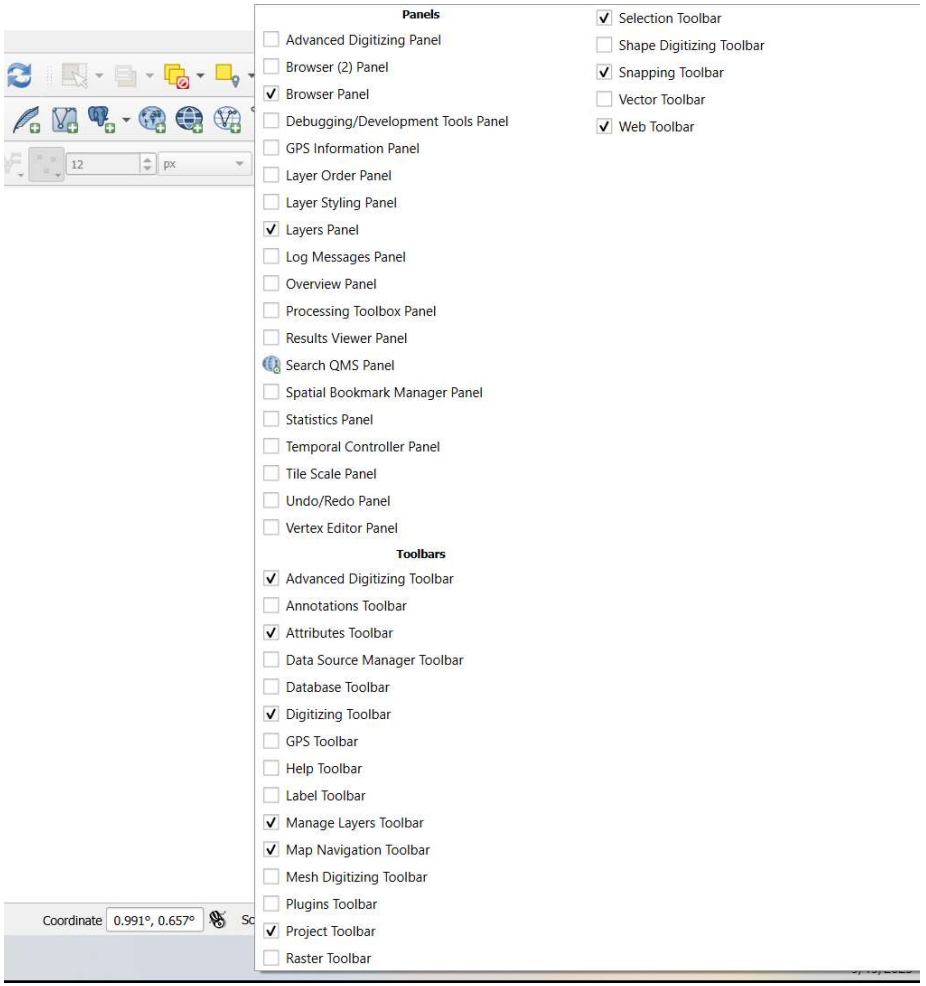
Setting Up A New QGIS Project

- After installing QGIS, launch the program and start a **new project**. You will be greeted with a blank screen like this:



Setting up Your Workspace

- In order to efficiently work through a project, you need all necessary tools quickly at your disposal
- **Right click** the **top toolbar** and add the panels and toolbars shown here

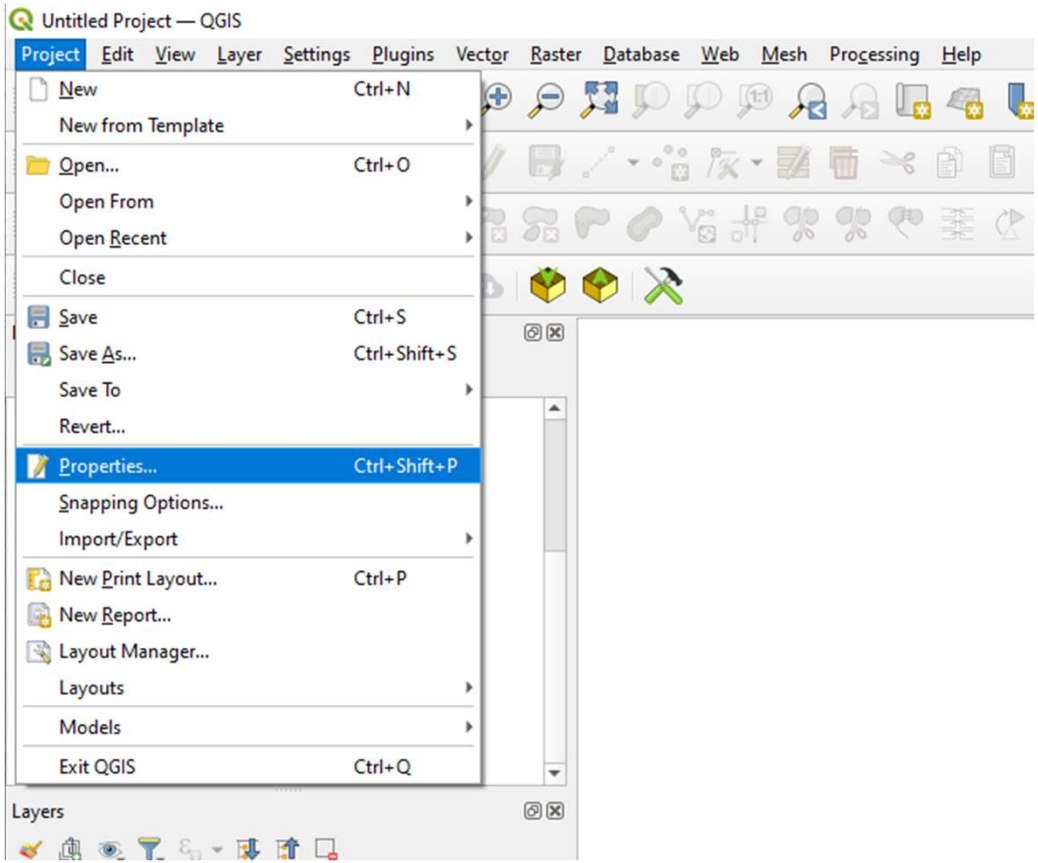


Selecting a Coordinate Reference System

- Before doing anything else, first select a **coordinate reference system (CRS)** for your project. There are many CRS that geographic data can use and QGIS is able to convert between them on the fly, but fewer conversions will be necessary if a coordinate system common to available data is chosen. This is especially useful for base maps and image layers, as base maps may become deformed by the conversions.
- For the southern latitudes in Pennsylvania, **NAD83 / PA South (ft), EPSG:2272**, is commonly used. This guide assumes that much of your data will use this coordinate system, but if you find that other coordinate systems are a better fit for your project, select that CRS instead. This can also be changed later.

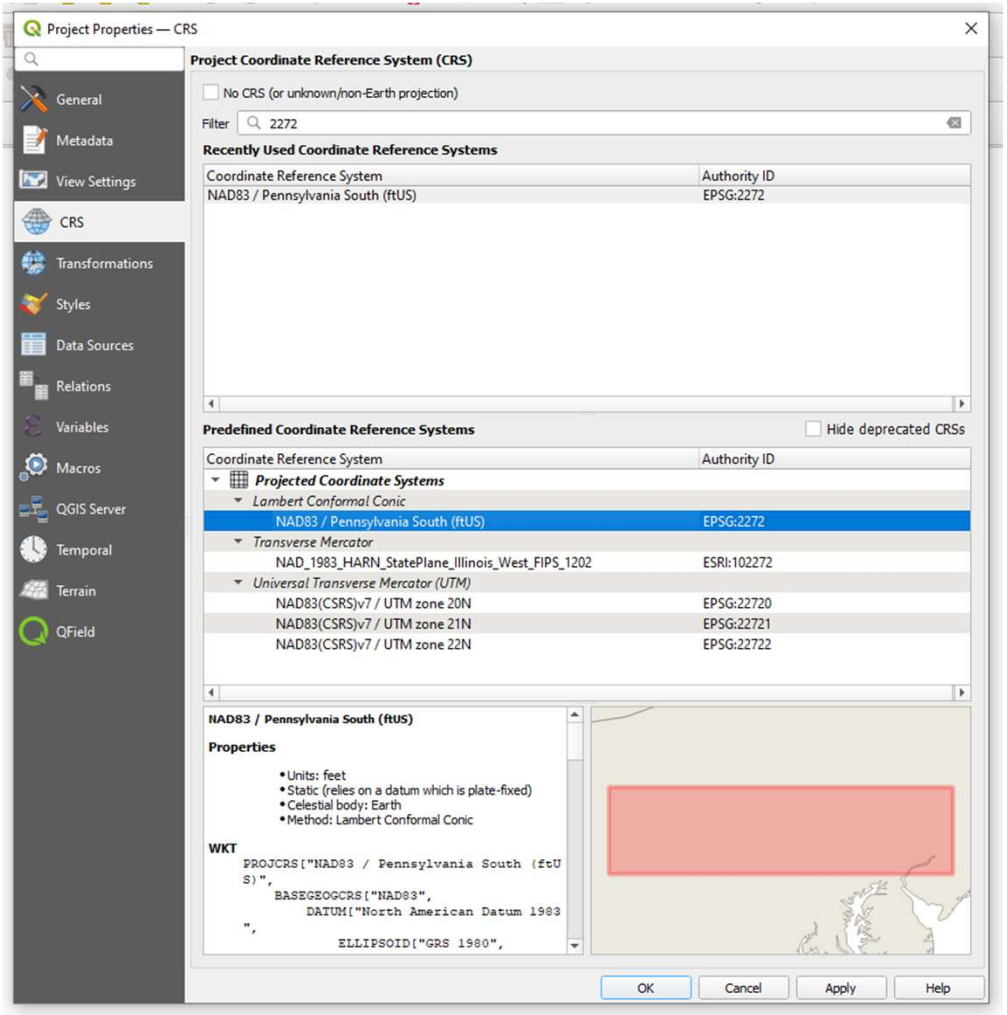
Selecting a Coordinate Reference System

- Select **Project / Properties** to raise the properties dialog:



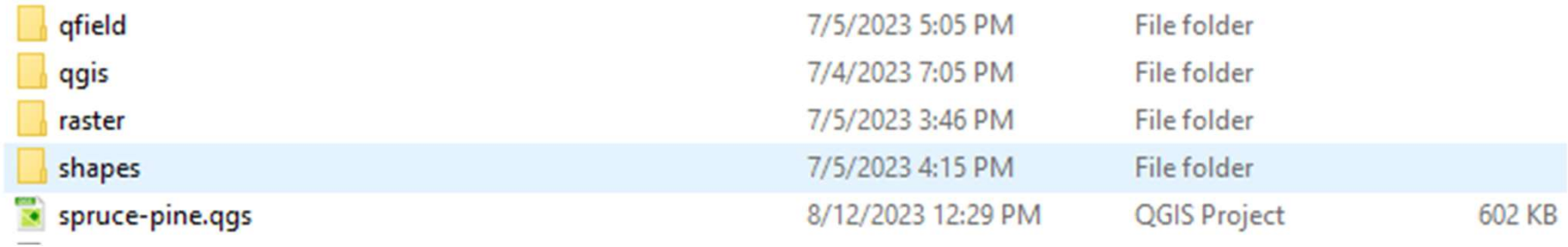
Selecting a Coordinate Reference System

- Next, click the **CRS tab** and enter **2272** into the **filter**. Select **Projected Coordinate Systems**, **Lambert Conformal Conic, NAD83 / Pennsylvania South (ftUS), EPSG:2272** from the list of Predefined Coordinate Reference Systems and click **Apply**.



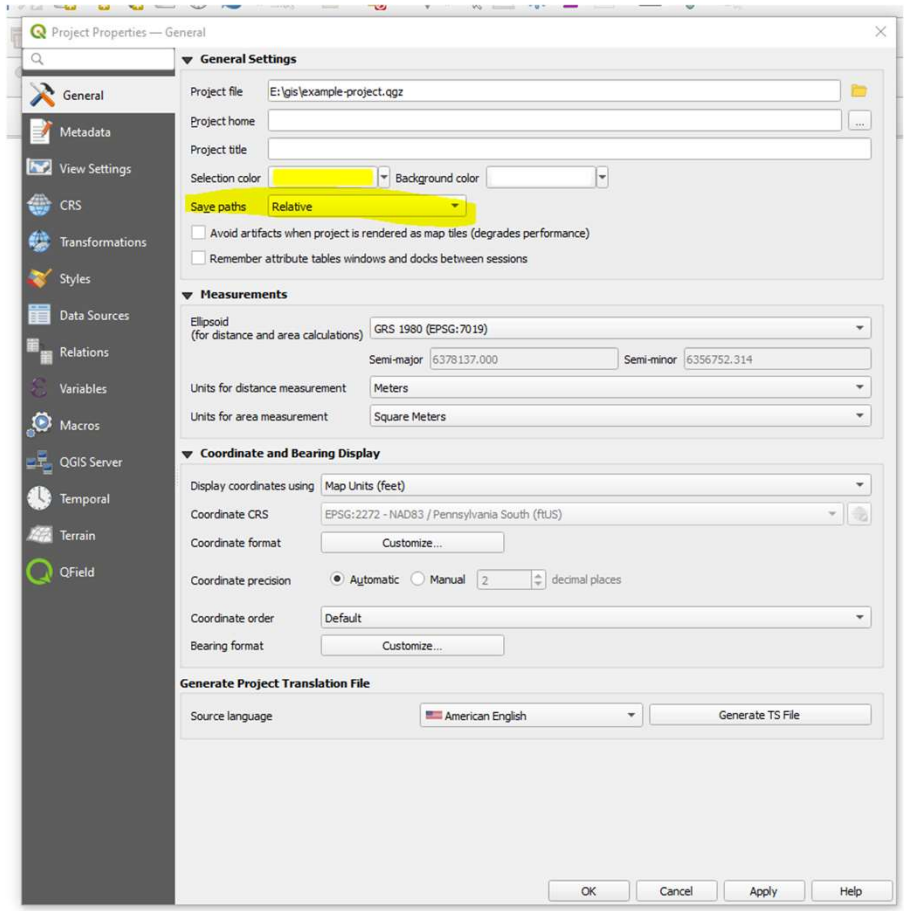
Establishing a Project Directory Structure

- GIS project files take a different approach to saving data than other programs you may be familiar with. When working on your project, you will only be establishing links to data sources (files, databases, web APIs, etc) and these data will not be included in the project directly. If your data is contained in local files on your computer, then it is a good idea to save your project file in a location near the GIS data and maintain that directory structure when transmitting the project file and data. For example, you could save your project files in a directory (for me, this is E:\gis) and then create subdirectories for data sources by data type.



Establishing a Project Directory Structure

- Next, make sure the project is configured to save data source paths as relative paths. This way, it won't matter if the files are moved from one location to another as long the established directory structure is maintained. Open **Project / Properties** and click the **General** tab. Ensure the **Save paths** setting is set to **Relative**.



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Adding Data To Your Project

Adding Data To Your Project

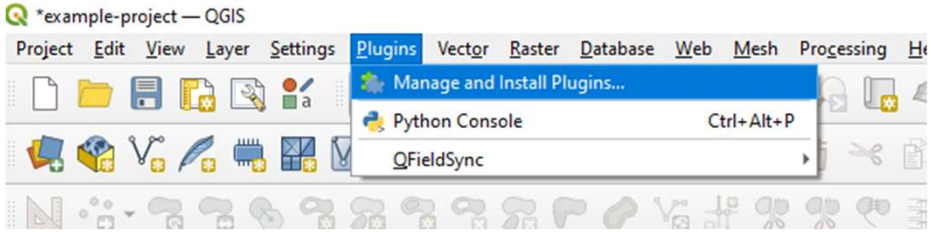
- After the preliminary set up, you will still only have a blank project. QGIS itself does not provide data, it only provides a system for organizing, presenting, analyzing and manipulating geographic data. You will need to provide your own GIS data for QGIS to work with. Thankfully, there is a world of freely available GIS data, especially where it concerns public infrastructure, which is the domain with which we are presently concerned. A few sources of GIS data worth mentioning:
  - 1. Pennsylvania Spatial Data Access (PASDA) - This is a huge repository of GIS data operated by Penn State University (PSU)
    - a. PASDA - https://www.pasda.psu.edu/
    - **b. PASDA Imagery Navigator - https://maps.psiee.psu.edu/ImageryNavigator/**
  - 2. Open Data Philly - https://opendataphilly.org/

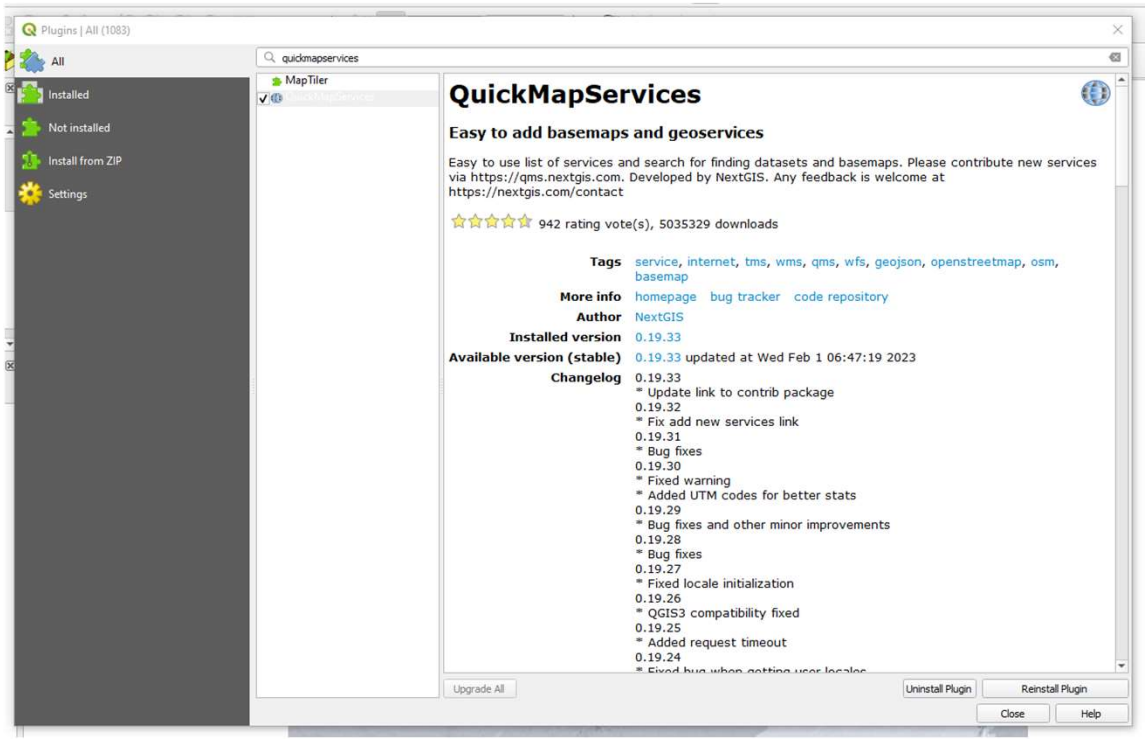
Adding A Basemap

- It is often useful to have a basemap to work with, even if that basemap will not be a part of the finished product. Basemaps can be street maps (like what you would see on the default view of google maps) or aerial/satellite photography. There are better sources for high quality basemaps, but the fastest way to get something on the screen so that you're no longer looking at a blank map is to add a publicly available basemap through a plugin like QuickMapServices.

Installing and Using QuickMapServices

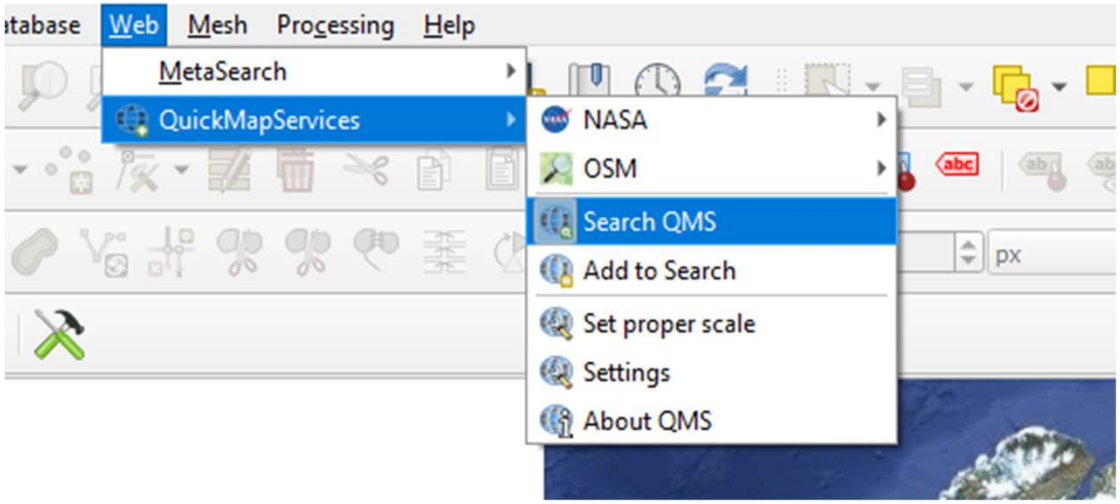
- Click **Plugins / Manage and Install Plugins** to raise the Plugin dialog. Then, enter **QuickMapServices** into the search bar and select **QuickMapServices** from the list. In the bottom right of the right pane, click **Install Plugin**.





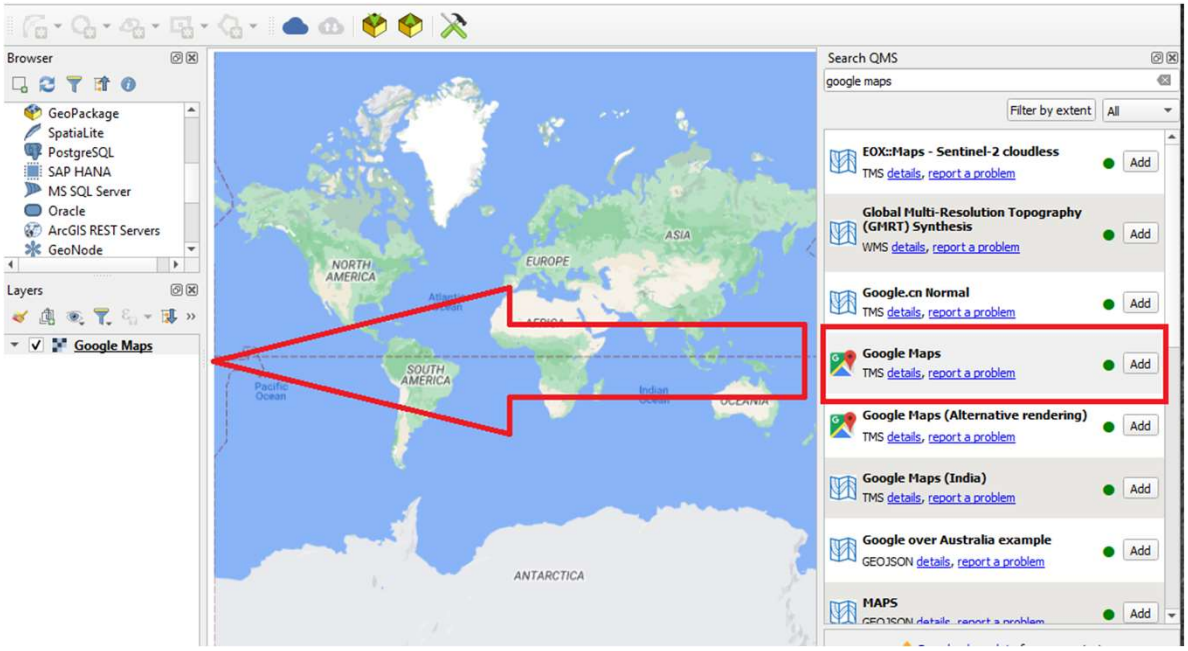
Installing and Using QuickMapServices

- After QuickMapServices is installed, you can use the plugin to add a wide array of base maps to the project. Click **Web / QuickMapServices / Search QMS**:



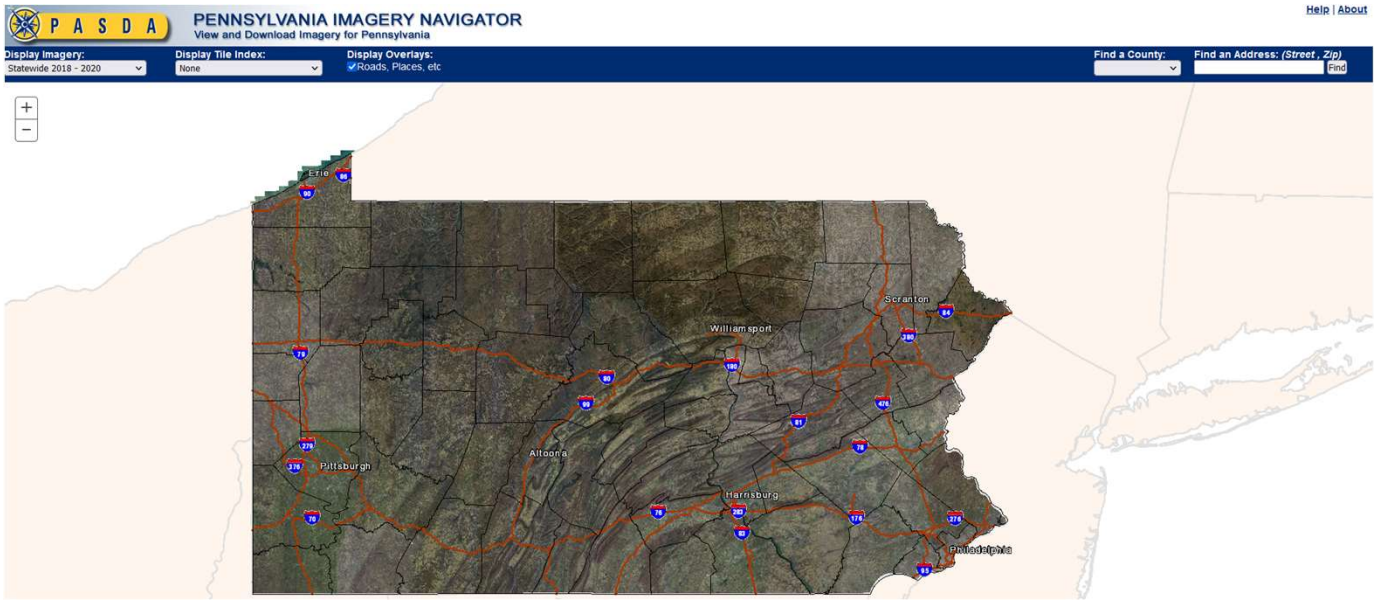
Installing and Using QuickMapServices

- This will open a pane on the right of the project where you can search for basemaps to add. Some useful, well known basemaps include various offerings from Google Maps and Bing Maps, but the plugin offers a very large variety to select from. To add a default Google Maps layer to the project, enter **Google Maps** into the **Search QMS** search bar and then click the **Add** button next to the **Google Maps** search result. A Google Maps entry will appear in the project layers and there the google maps layer will be visible in the main project pane. You can now scroll around and zoom in and out on the project map pane.



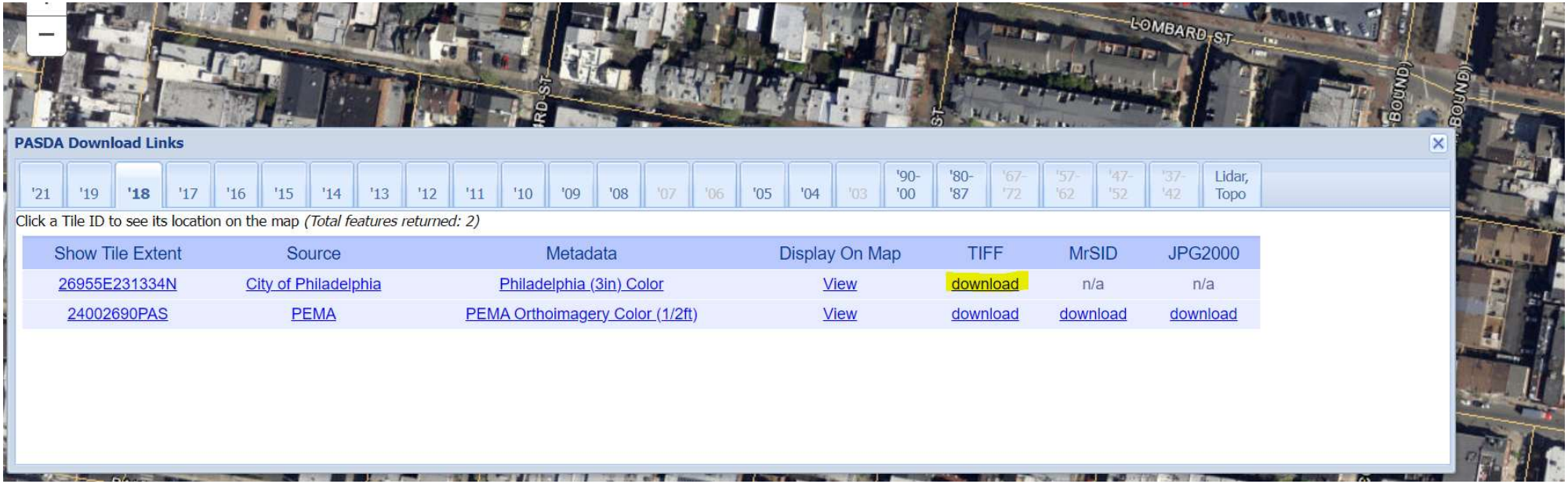
Finding and adding imagery from PASDA

- As mentioned above, PASDA is a good resource for imagery specific to Pennsylvania. Google Maps and Bing Maps are good sources for an overview, but at smaller scales, the imagery can leave something to be desired. PASDA has an Imagery Navigator, where you can navigate to the area of interest, click on the map and see what image datasets are available for that location (https://maps.psiee.psu.edu/ImageryNavigator/)



Finding and adding imagery from PASDA

- From the image navigator, zoom and scroll to the location of interest, then right click on the map. This will raise a dialog where you can find data sets organized into tabs by year. The map tiles (images) will have to be downloaded individually and in addition to age, they will vary by quality and size of extent of each tile. Feel free to click around looking for one that suits your needs, but I have personally found that the **2018 Philadelphia 3in Color** dataset is a good balance of being high quality and is recent enough for most purposes.

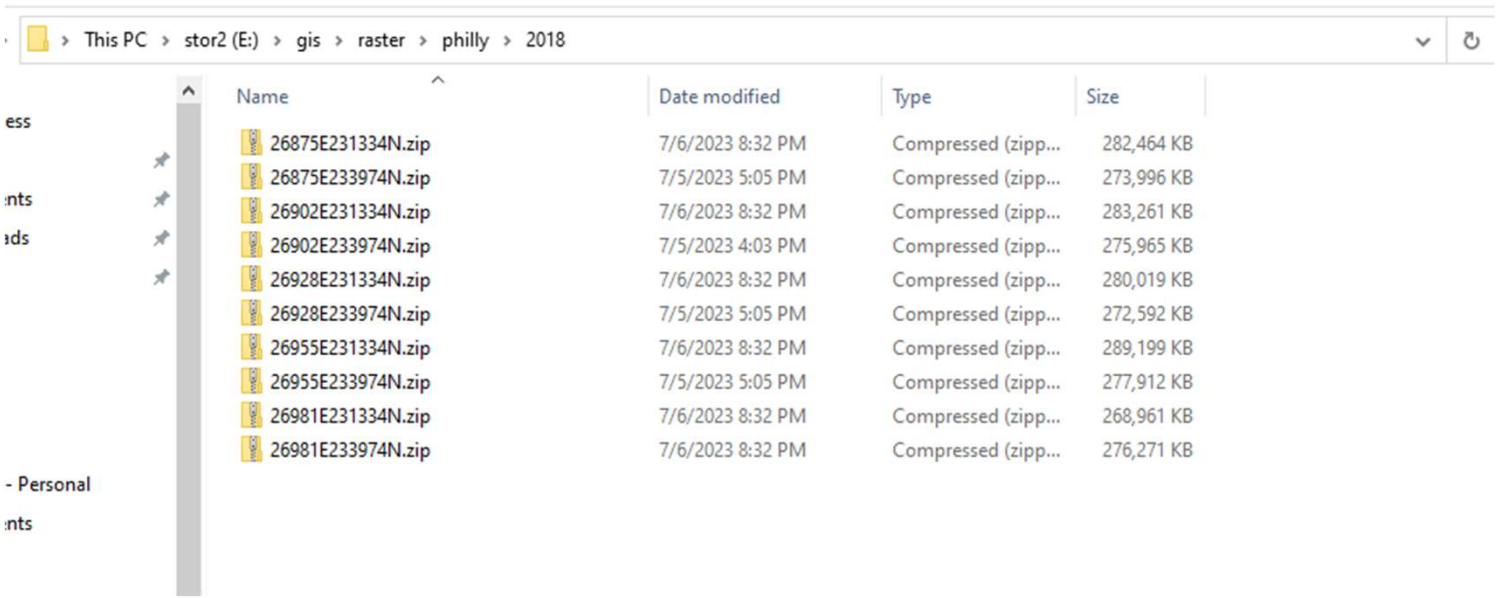


Finding and adding imagery from PASDA

- Each tile will have to be downloaded individually. Right clicking on the map will show only the tile containing the point clicked. You can show the extent of that tile by clicking on the **Show Tile Extent** link to see where you would need to click to download adjacent tiles. Alternatively, you may click on Advanced Download Options at the bottom of the main map and click List tiles in the current map extent. This will list all tiles in the current map extent, and you may then click through showing each tile extent and downloading only those of interest.

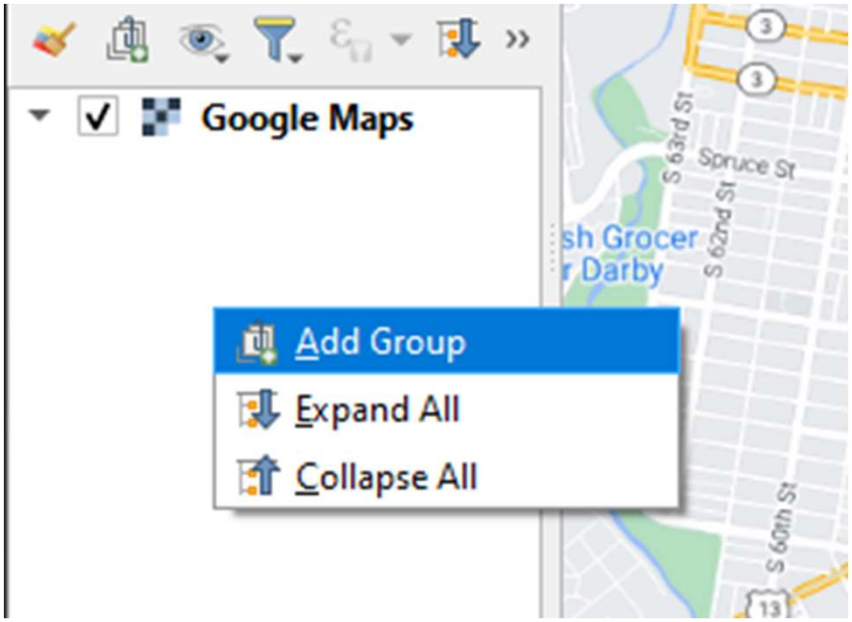
Finding and adding imagery from PASDA

- As mentioned above in the section regarding Project Directory Structure, before adding the imagery to the project, it should first be saved to a location in the established project directory structure, in my case, this is **E:\gis\raster\philly\2018**:



Finding and adding imagery from PASDA

- Next, you may want to create a layer group so that these individual images may be grouped together and toggled on and off all at once. In QGIS, in the layer window, right click and select **Add Group**. Name this group, **Imagery**.

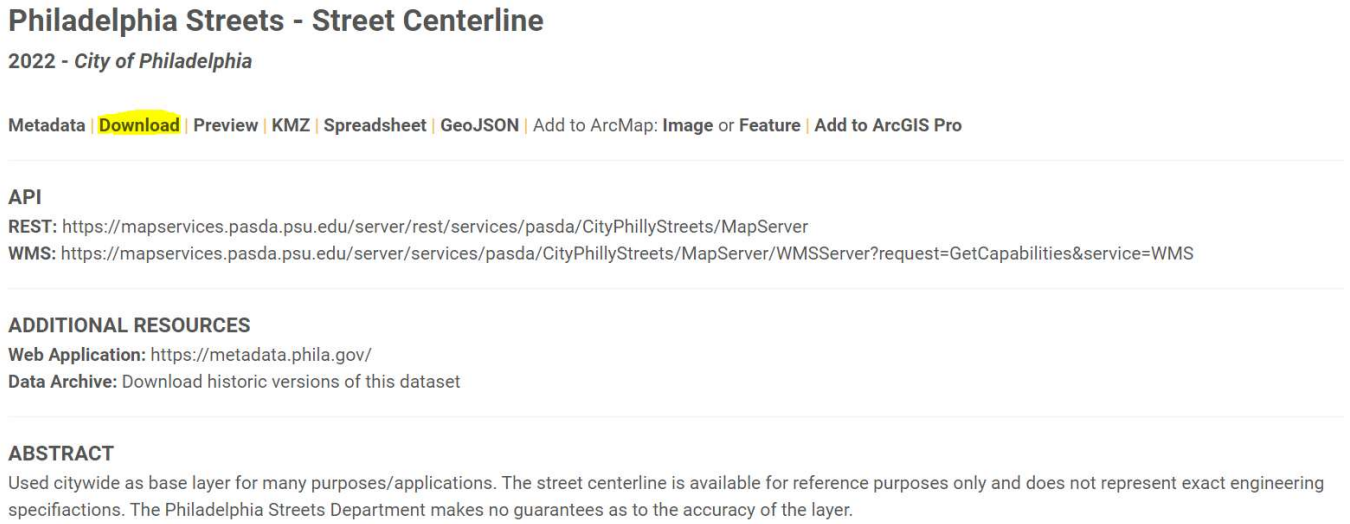


Finding and adding imagery from PASDA

- Next, you can **drag the files from a file manager** (like File Explorer on Windows) into the newly created group. If the CRS of the image data is different from CRS of the project, you may get a warning message regarding transformations. You can probably just click OK through these notifications; however, if many of your data layers require transformations, you may consider changing the base project CRS instead.

Adding Street Data

- Street centerlines are generally freely available. PASDA is a good resource for this data. You can just search for, "[political boundary] street centerlines" in PASDA and scroll through the results. One such dataset at the time of the writing of this guide is the City of Philadelphia 2022 Street Centerlines and may be found here: https://www.pasda.psu.edu/uci/DataSummary.aspx?dataset=7102



Philadelphia Streets - Street Centerline

2022 - *City of Philadelphia*

Metadata | Download | Preview | KMZ | Spreadsheet | GeoJSON | Add to ArcMap: Image or Feature | Add to ArcGIS Pro

API

REST: https://mapservices.pasda.psu.edu/server/rest/services/pasda/CityPhillyStreets/MapServer
WMS: https://mapservices.pasda.psu.edu/server/services/pasda/CityPhillyStreets/MapServer/WMSServer?request=GetCapabilities&service=WMS

ADDITIONAL RESOURCES

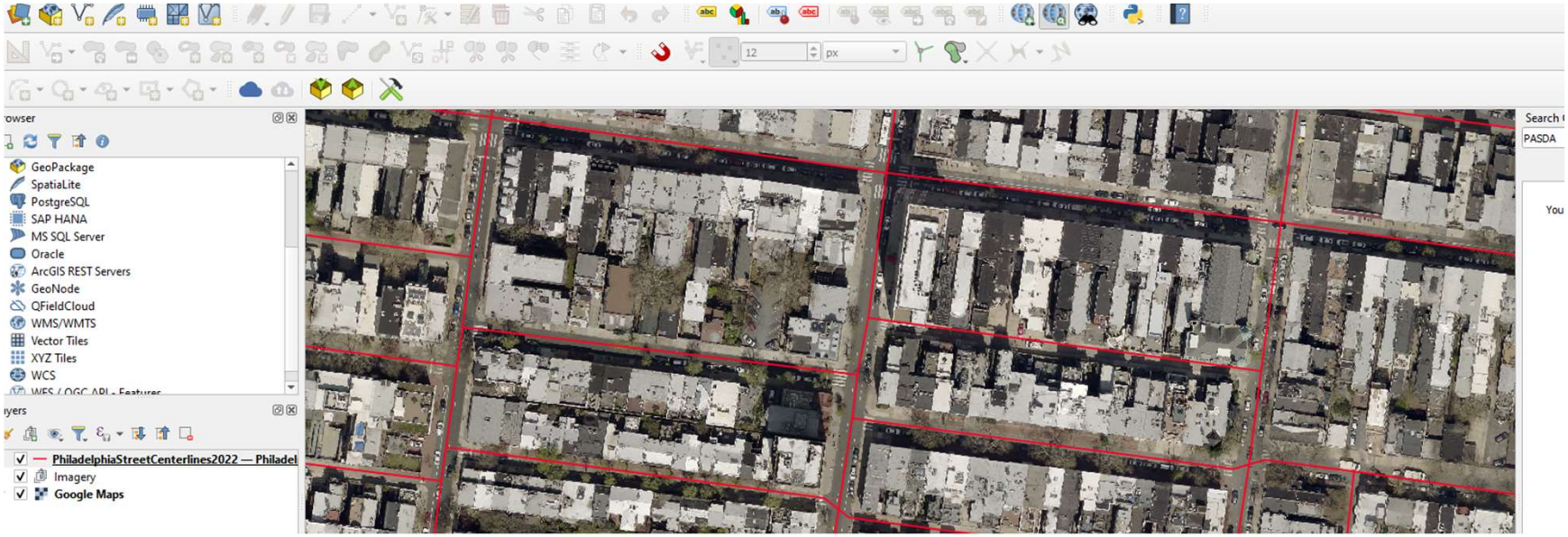
Web Application: https://metadata.phila.gov/
Data Archive: Download historic versions of this dataset

ABSTRACT

Used citywide as base layer for many purposes/applications. The street centerline is available for reference purposes only and does not represent exact engineering specifiactions. The Philadelphia Streets Department makes no guarantees as to the accuracy of the layer.

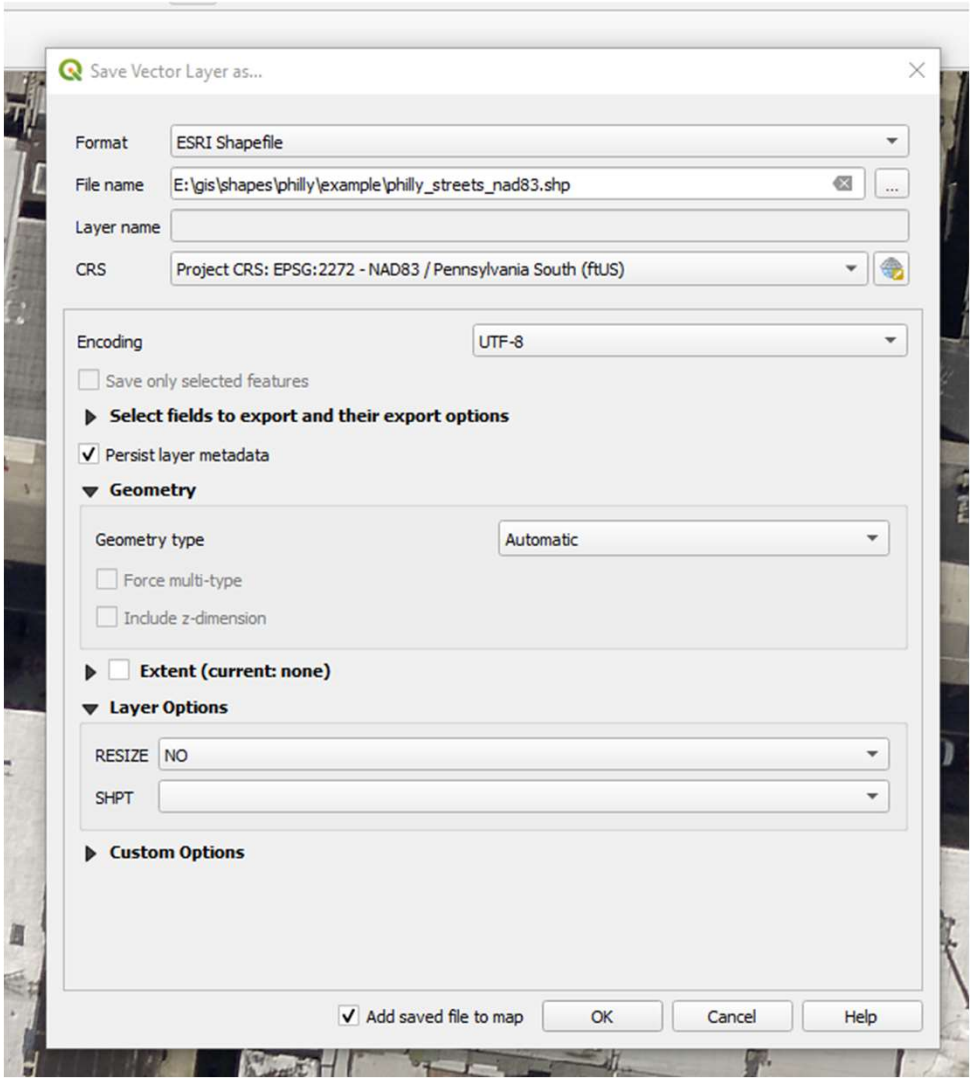
Adding Street Data

- Download the street centerline dataset and save it in the **shapes** folder of project directory structure, then add the data to the map by dragging and dropping into the layers window. Lines with default symbology will appear on the map:



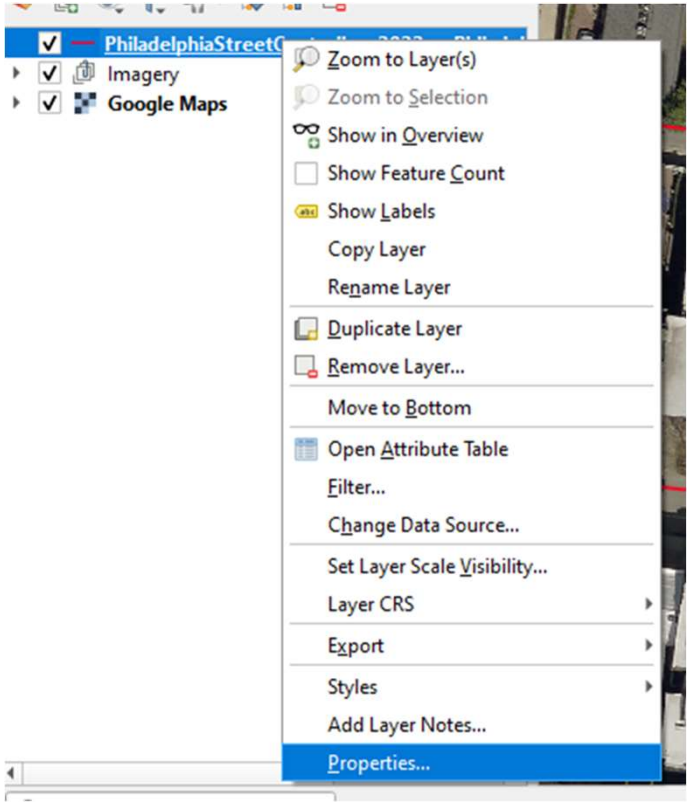
Adding Street Data

- Again, for the purposes of this guide, I am assuming the NAD83 PA South (ft) CRS. The above dataset uses another CRS. To use a common CRS and to allow for the use of feet as a map unit instead of degrees, it is a good idea to reexport this data layer using the project's CRS. Right click on the layer in the **Layers** window and click **Export**, **Save Features As**. Name the file **PhiladelphiaStreetCenterlines**. For **Format**, select **ESRI Shapefile**. For **CRS**, select **Project CRS**. Then click OK. The layer will be exported and a new layer will be added to the Layers window. We can remove the old street layer to reduce Layer clutter. Right click on the **Layer in the Layer window and click Remove Layer** for the old street layer, leaving only the new street layer we just exported with the project CRS.



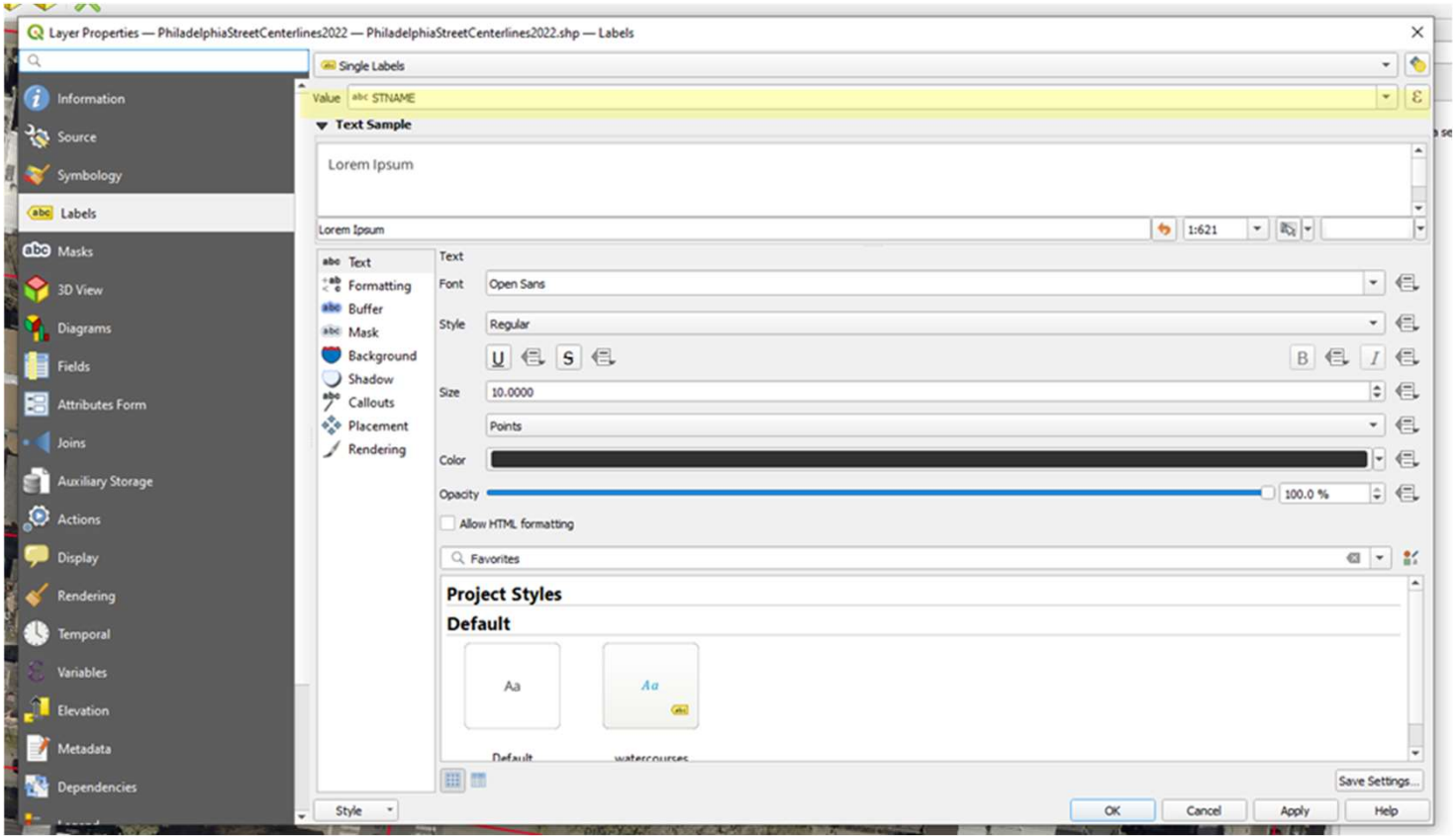
Adding Street Name Labels

- In addition to spatial information, GIS data carries tabular data. To see the table for a data layer, right click on the layer in the layer window and click, **Open Attribute Table**. For the street centerline table, we can see that the street name is included. This would be useful for creating street labels for our map.
- Right click on the data layer in the layers window and click on **Properties**.



Adding Street Name Labels

- Then, click on the **Labels** tab and set the labels to **Single Labels** and set the **Value** to the attribute column, **ST_NAME**:

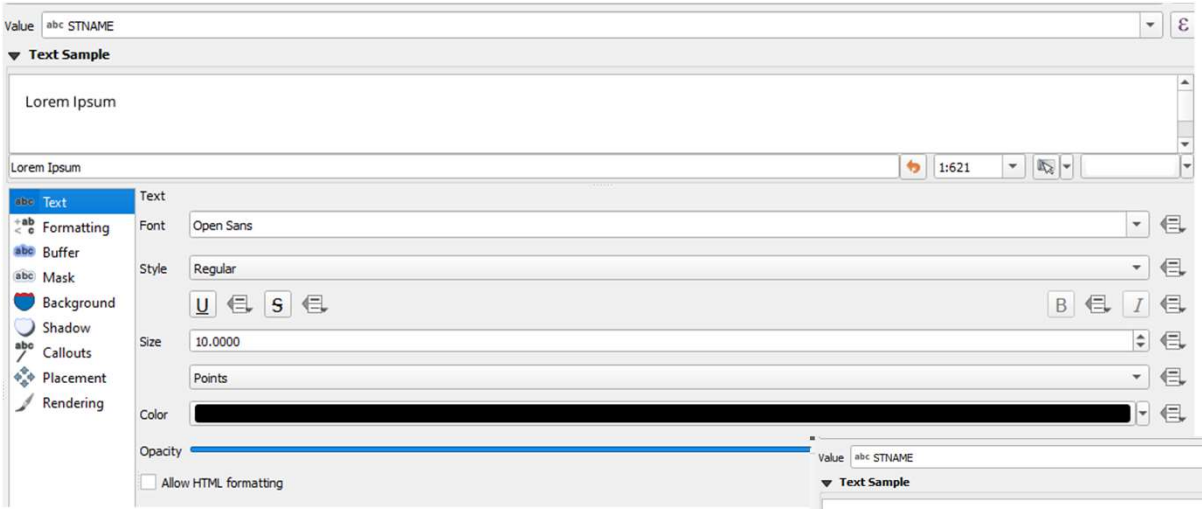


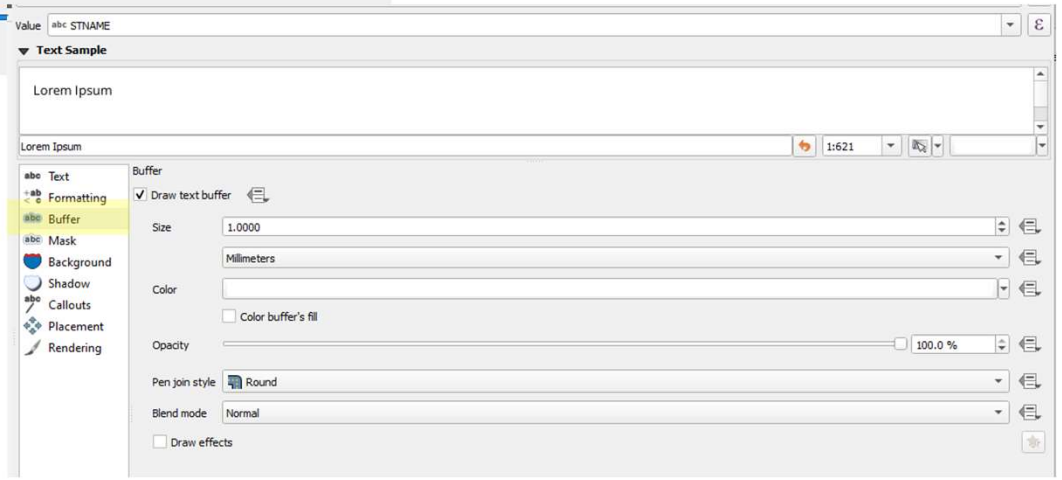
Adding Street Name Labels

- Click **Apply** and now the street centerlines should be labeled with the street name from the attribute data, but the default label style will likely be hard to read:

Adding Street Name Labels

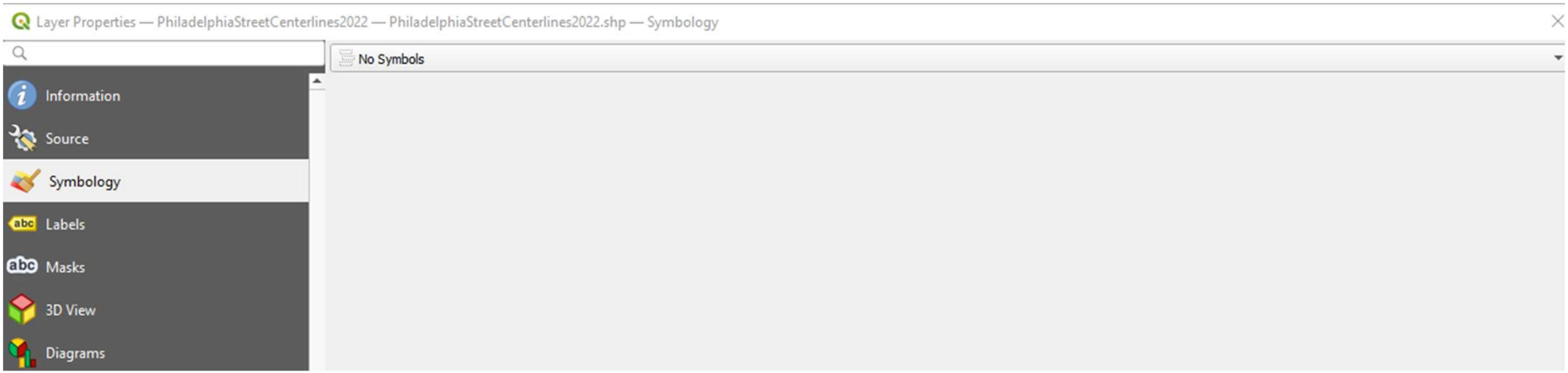
- To make the labels more legible, I like to add a buffer. Reopen the **StreetCenterlines** layer **properties** and click on the **labels** tab. From here, select **text** and set the text color to your preference and then click on **buffer** and set the buffer color to something that will contrast well with your text color and with the background. **Black text with a white background** tends to work well with aerial imagery:





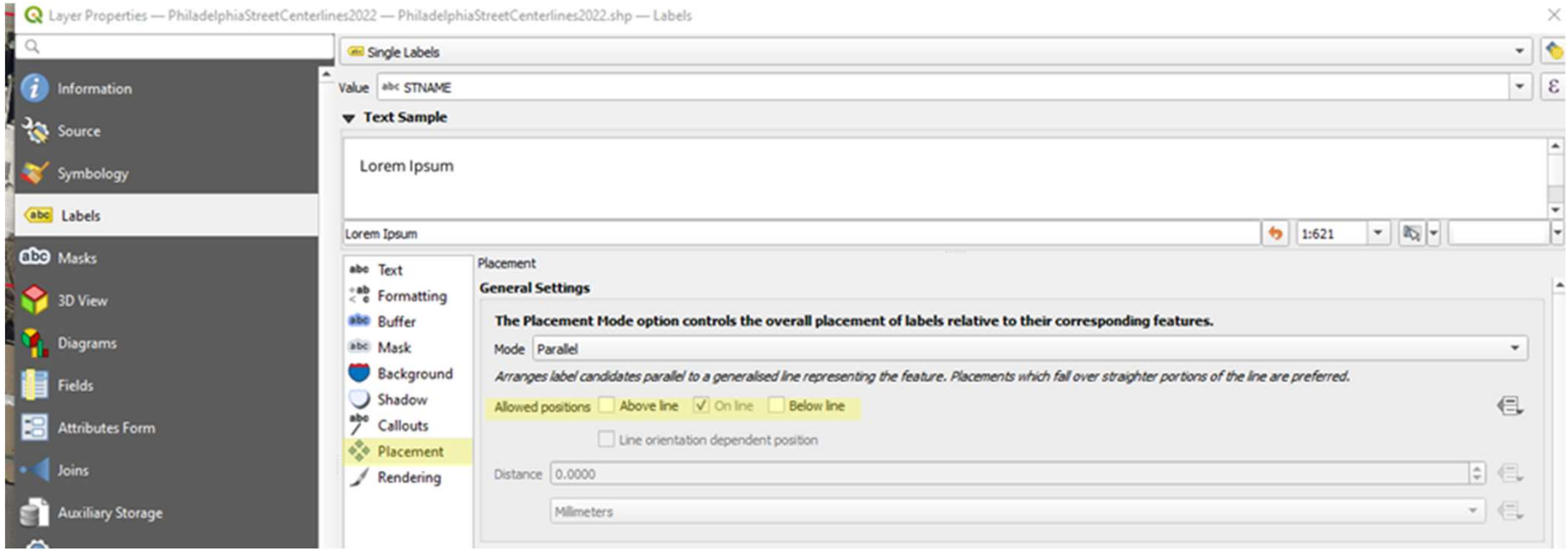
Adding Street Name Labels

- Next, because the purpose of this layer will be to label the streets and we will have aerial imagery to show the streets themselves, we don't really need symbols to show the street centerlines, so we can disable the line symbology. Click on the symbology tab and select **No Symbols**:



Adding Street Name Labels

- And finally, since we no longer need to worry about overlapping the symbols, it may make more sense to have our labels placed over the street centerline rather than above it. Click on the **Labels** tab, **Placement** and then select only the **On Line** allowed position:

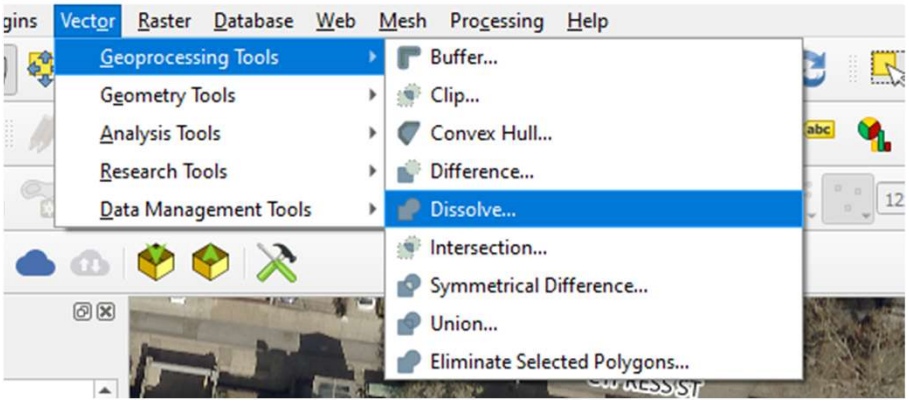


Adding Street Name Labels

- The street labels should now be more visible over the aerial imagery:

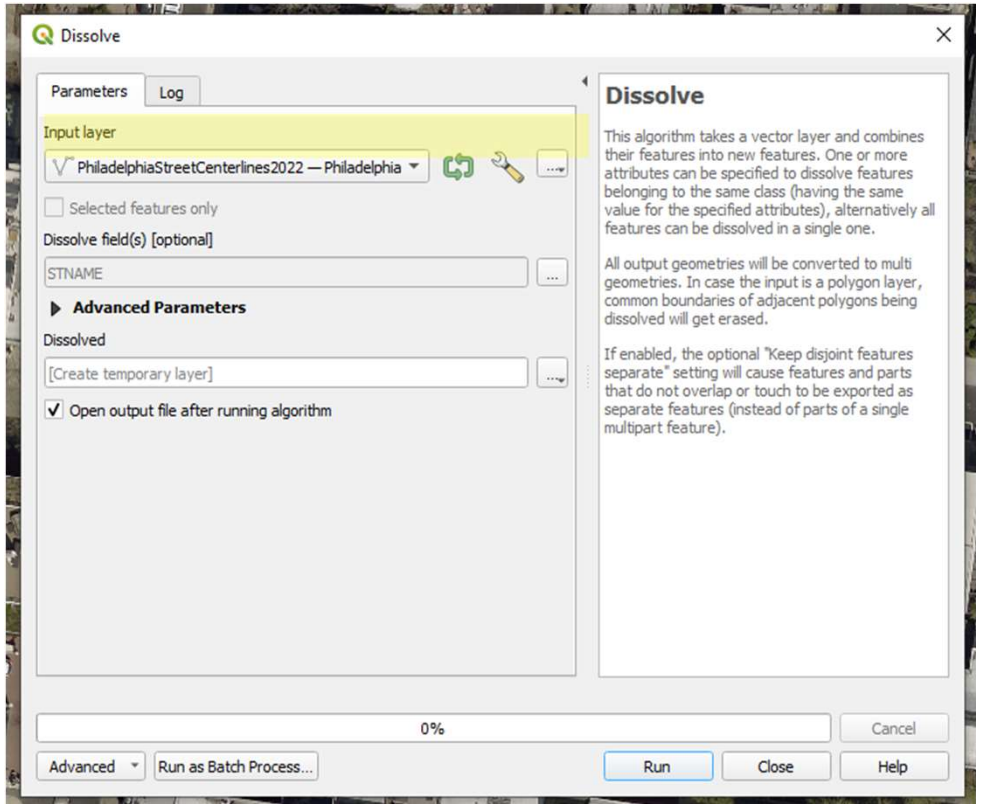
Adding Street Name Labels

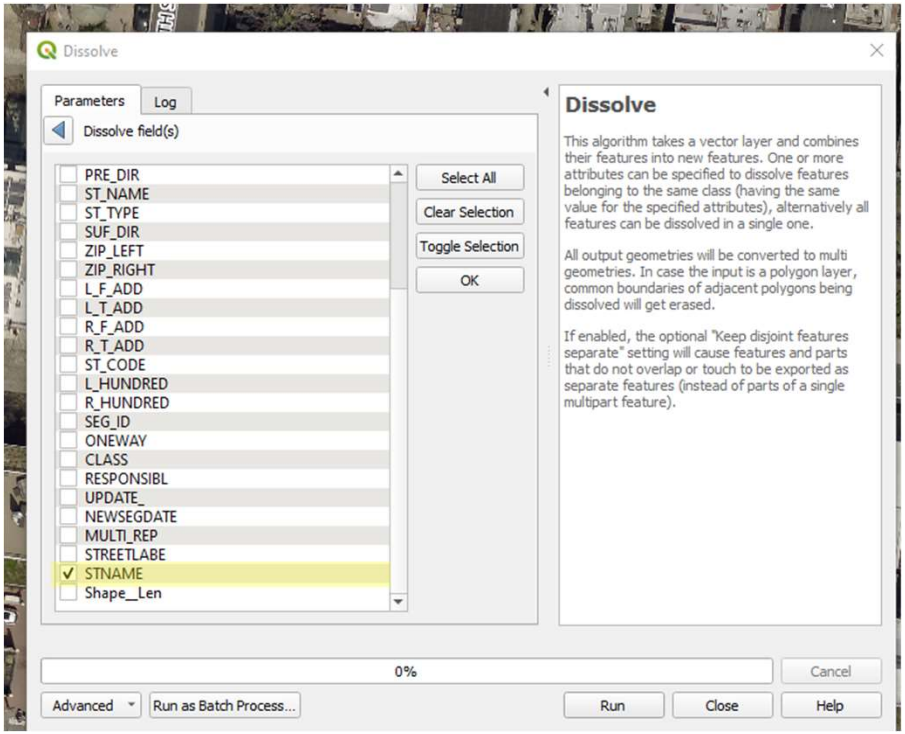
- You may notice a problem, though. Some labels appear many times. This is because the underlying data exists as many line features and each feature will be labeled. A quick and dirty way to solve this problem can be to use geoprocessing to dissolve the line features by street name to create a new data layer where no street names are repeated. Click **Vector, Geoprocessing Tools, Dissolve.**



Adding Street Name Labels

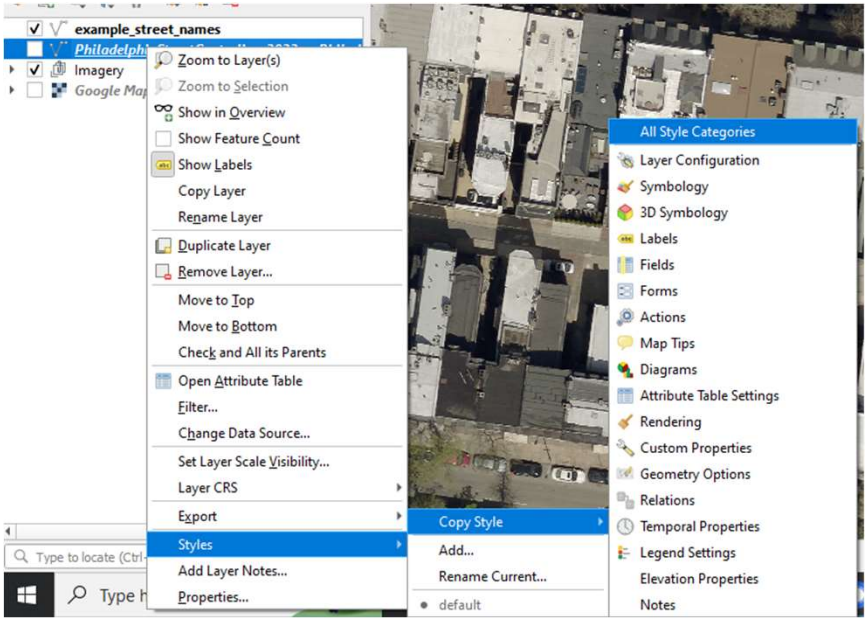
- Select the street centerline layer as the **input layer**, then click the … next to the **dissolve** field selection to raise the list of fields. Check the **STNAME** field and then click the **blue back arrow** in the upper left. From there, click on the … **next to the Dissolved** selection and select **Save to file**. Save a **shapefile (example_street_names)** in the project directory structure and click **run**.





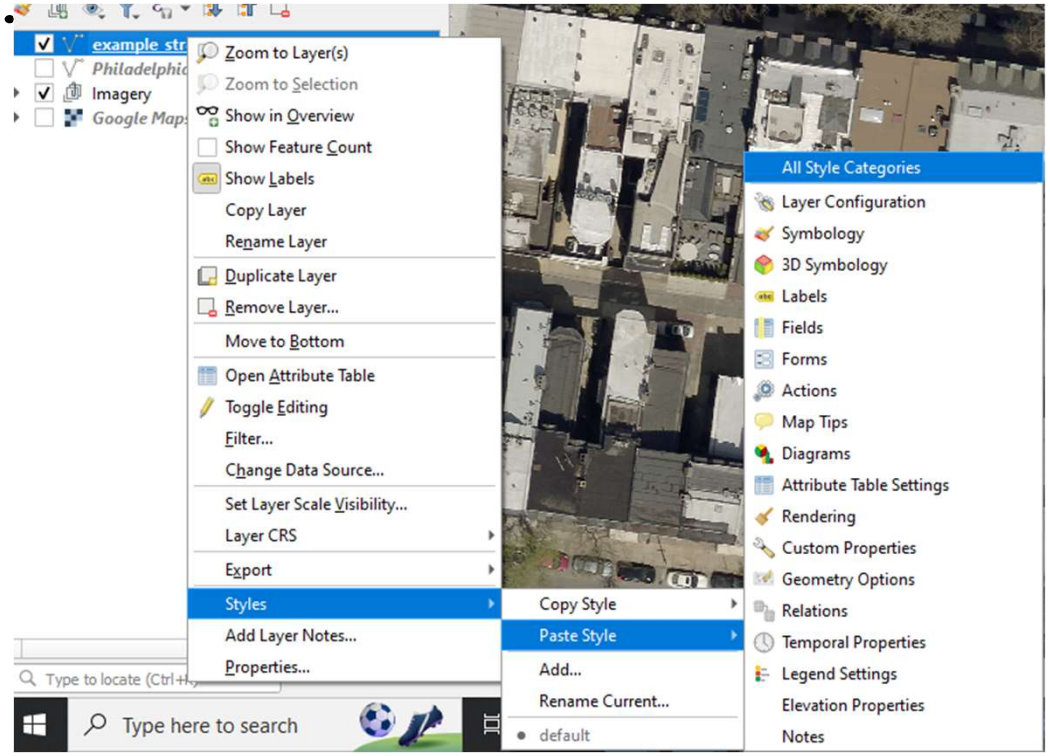
Adding Street Name Labels

- After running this, a new layer will be added to the Layers window where all line features with the same STNAME value will have been combined into a single feature, meaning labels will not be duplicated.
- We can copy the existing layer style (including symbology and labels) from the existing street centerline layer to the new dissolved layer. Right click on the **StreetCenterlines** layer in the Layers window and click **Styles, Copy Style, All Style Categories**.



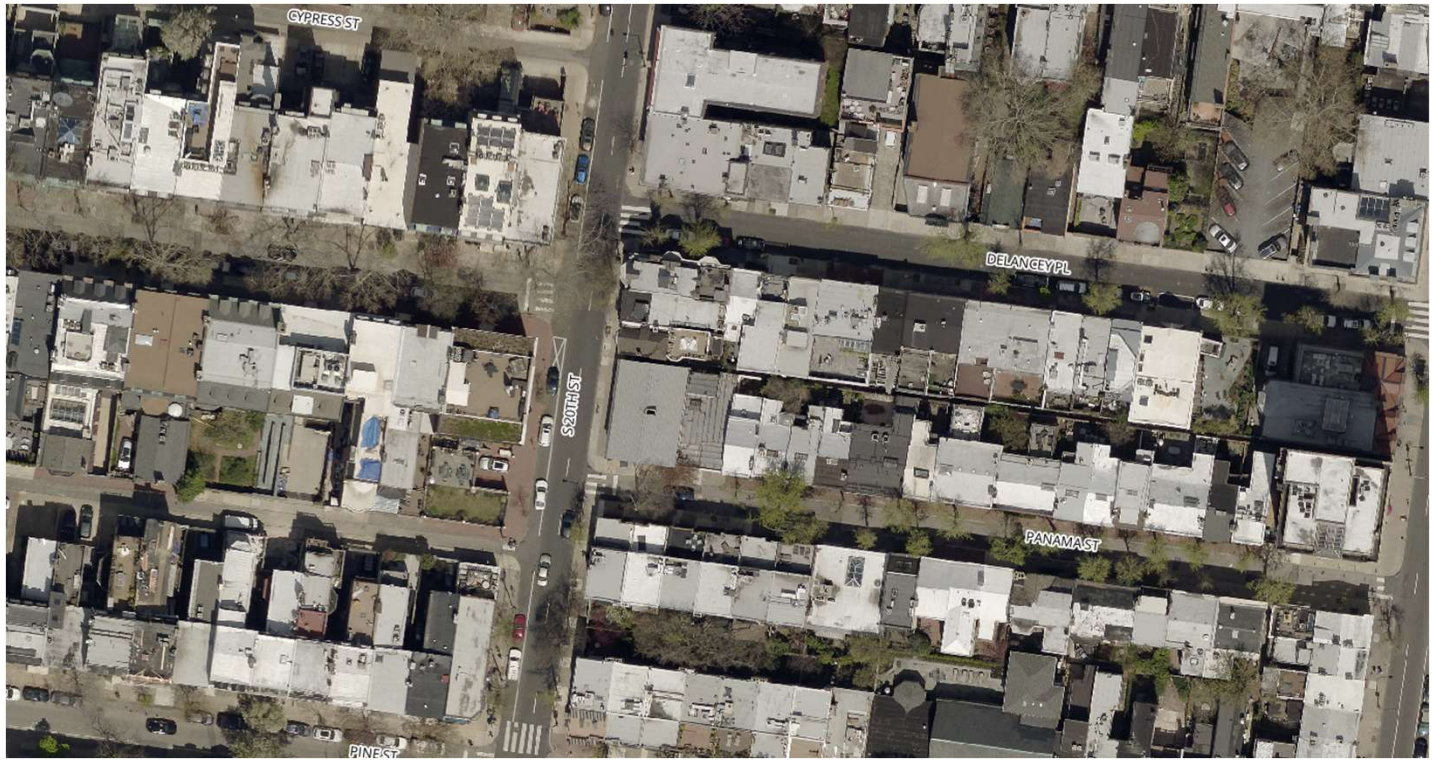
Adding Street Name Labels

- Then, **right click** on the new dissolved layer **(example_street_names)**, **styles, paste style, all style categories.**



Adding Street Name Labels

- Then, uncheck the original street centerline layer. Now, street labels should not be repeated multiple times:



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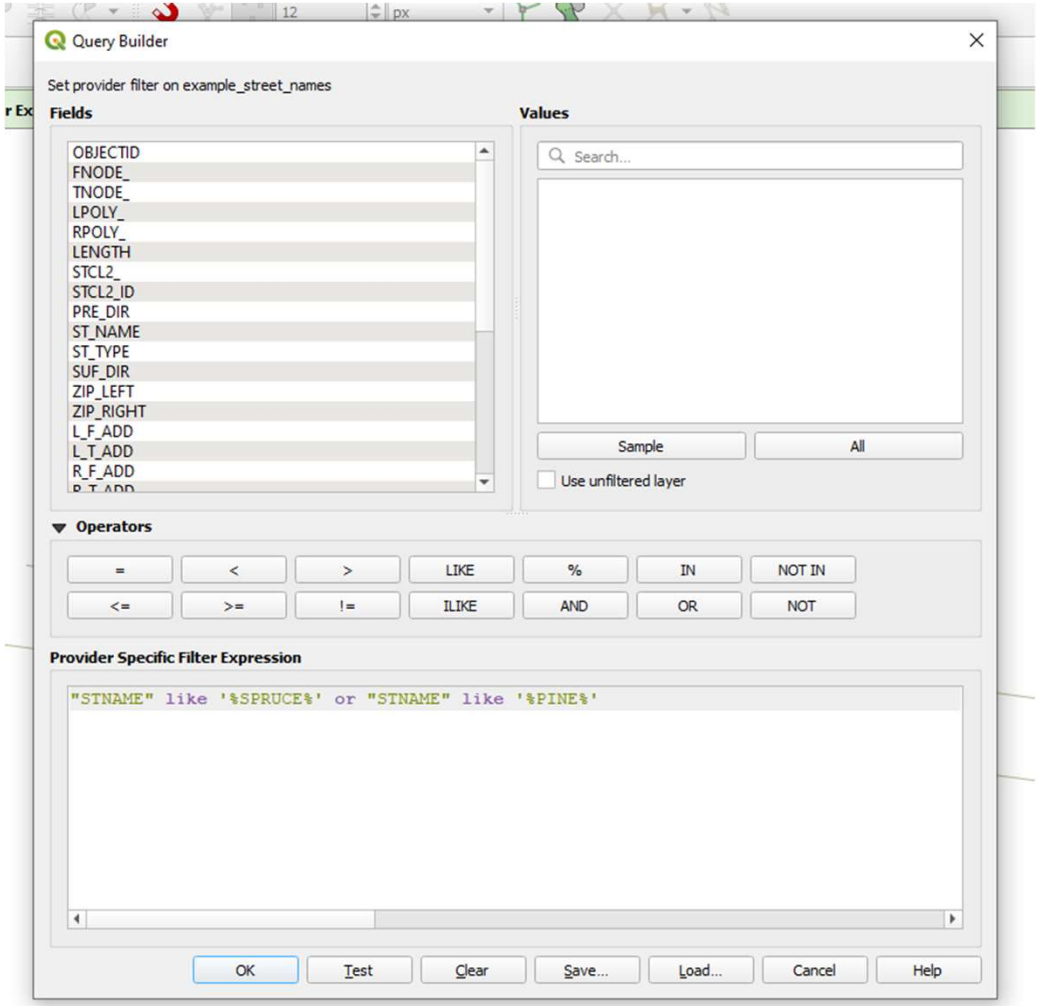
Generating New Features

Using the Street Centerlines to Generate Road Shoulder Polygons

- If we're interested in showing bicycle lanes on the map, but we don't already have data for those lanes, we'll have to create it ourselves. We could do that from scratch, but that would be a lot of work. Instead, we can use the street centerlines and some geoprocessing to generate a rough estimate.
- Many streets have a fairly uniform width, so long as the centerline is fairly accurate, we can generate lines parallel to the centerline, offset by a certain amount, then create a buffer of the lane width from those lines. The result won't be perfect, but it will be faster to edit the generated polygons than it would be to create them from scratch.

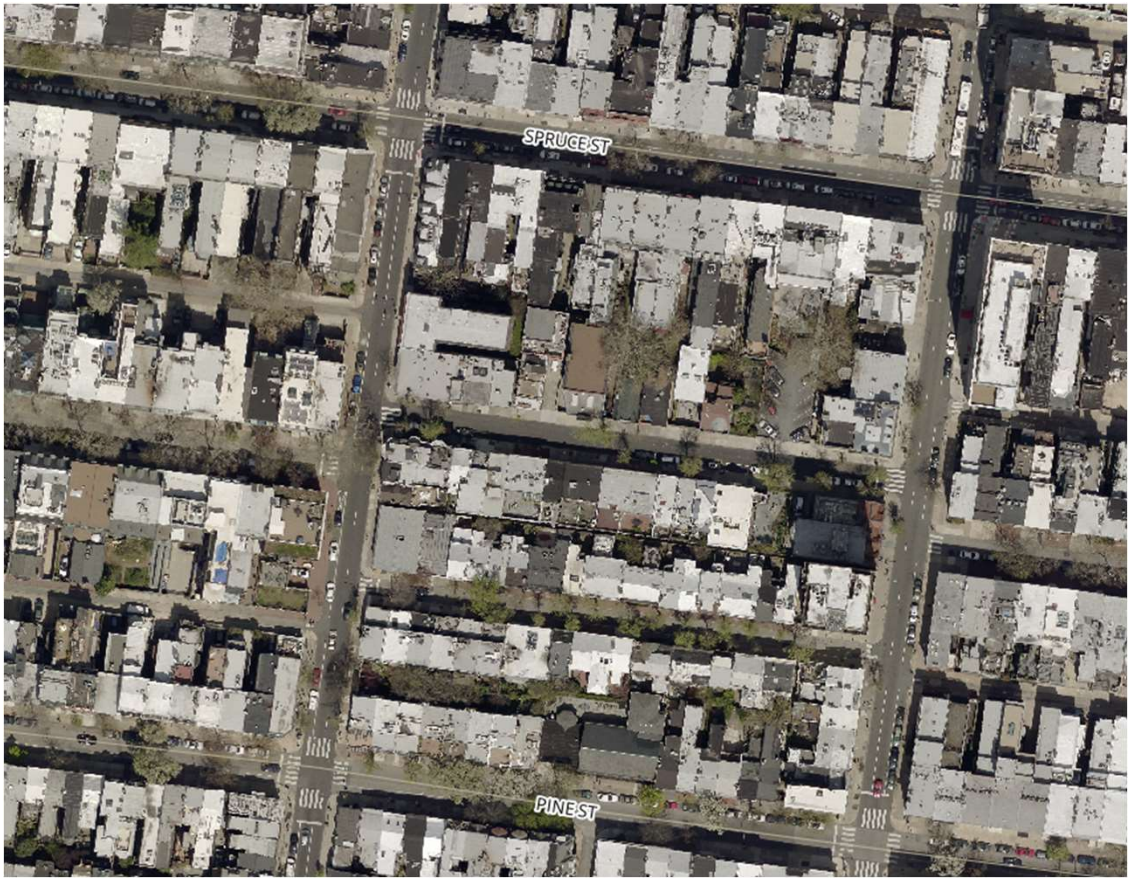
Filtering the Street Data by Name

- First, we should pare down the roads we're going to work on. Right now, we have all roads in Philadelphia. For any given project, we probably only care about a small subset of those roads. If we want to work on a specific road for its entire length, we could temporarily filter the road layer by street name.
- This can be done by right clicking on the street layer (**example_street_names)** in the **Layer** window and clicking, **Filter**. Then, you can write a SQL expression in the Filter Expression. If we wanted to filter the streets to only those containing, "SPRUCE" and "PINE", we could write: **"STNAME" like '%SPRUCE%' or "STNAME" like '%PINE%'**



Filtering the Street Data by Name

- Click **OK**. Now, only roads containing SPRUCE or PINE should be displayed:

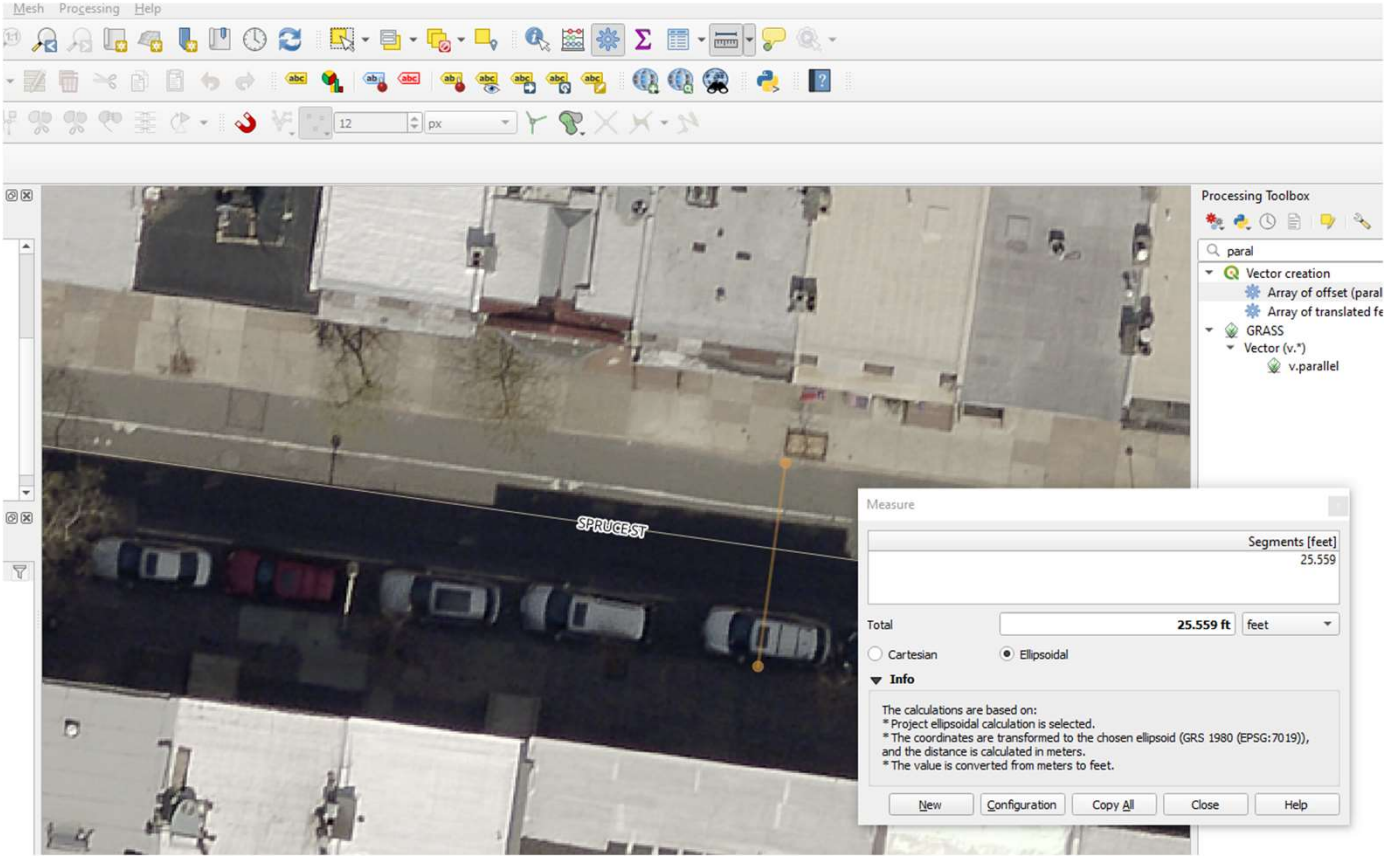


Generating parallel lines and buffers from the filtered street layer

- Next, we want to create lines parallel to the streets of interest. We'll have to do some calculations first. For the road of interest, **measure the road width**. Then, determine the **desired width of the bicycle lane** (or other polygon being generated). The offset from the road centerline should then be **(road width - desired polygon width) / 2.**

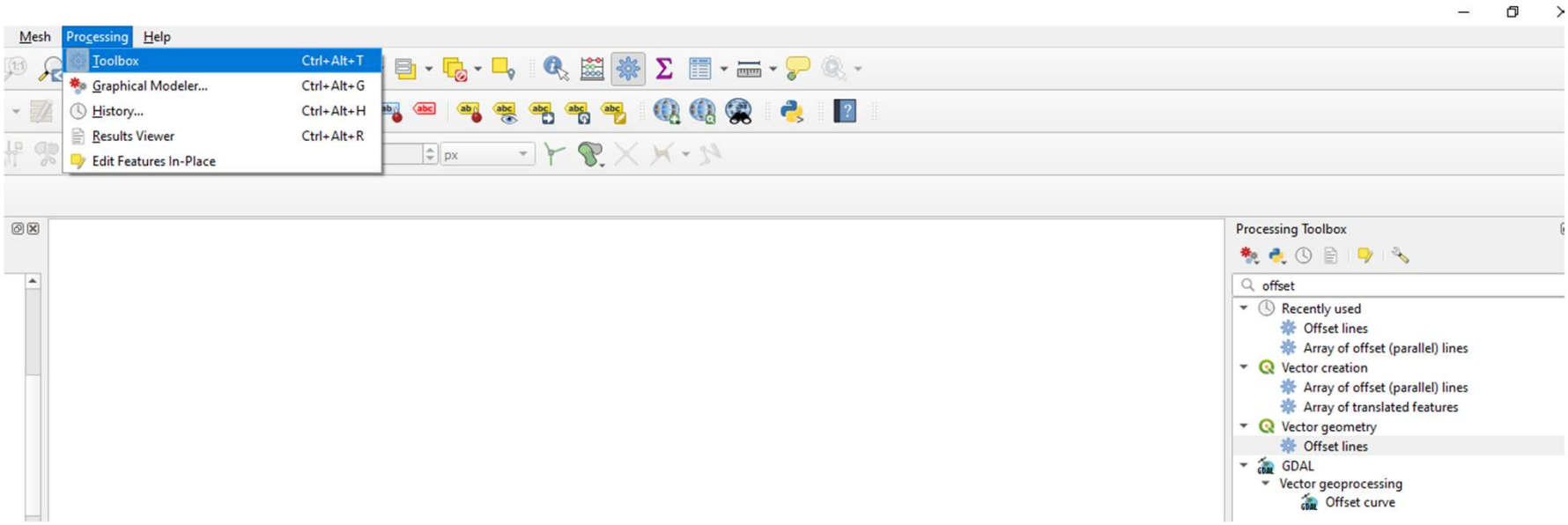
Generating parallel lines and buffers from the filtered street layer

- We can use the measurement tool in QGIS to take some of these measurements. Click the dropdown next to the measurement tool (**ruler icon**) and select **measure line** to raise the measure line tool. Then click on **one side of the street** and then the **opposite side of the street**, doing your best to draw a straight line across the street that intersects with the curb at right angles. **Switch the unit to feet if it's not already in feet** and then record the result. For spruce street, it appears that it's roughly 26 feet from curb to curb:
- Repeat the measurement steps with the shoulder area. In the pictured section of Spruce, we have parked cars and a painted bike lane to use as a guide. This appears to be roughly 7 ft across. That gives us an offset of (26 - 7) / 2, or 9.5 ft.



Generating parallel lines and buffers from the filtered street layer

- Next, open the processing toolbox (**Processing / Toolbox**) and begin entering "**offset lines**" into the search bar:

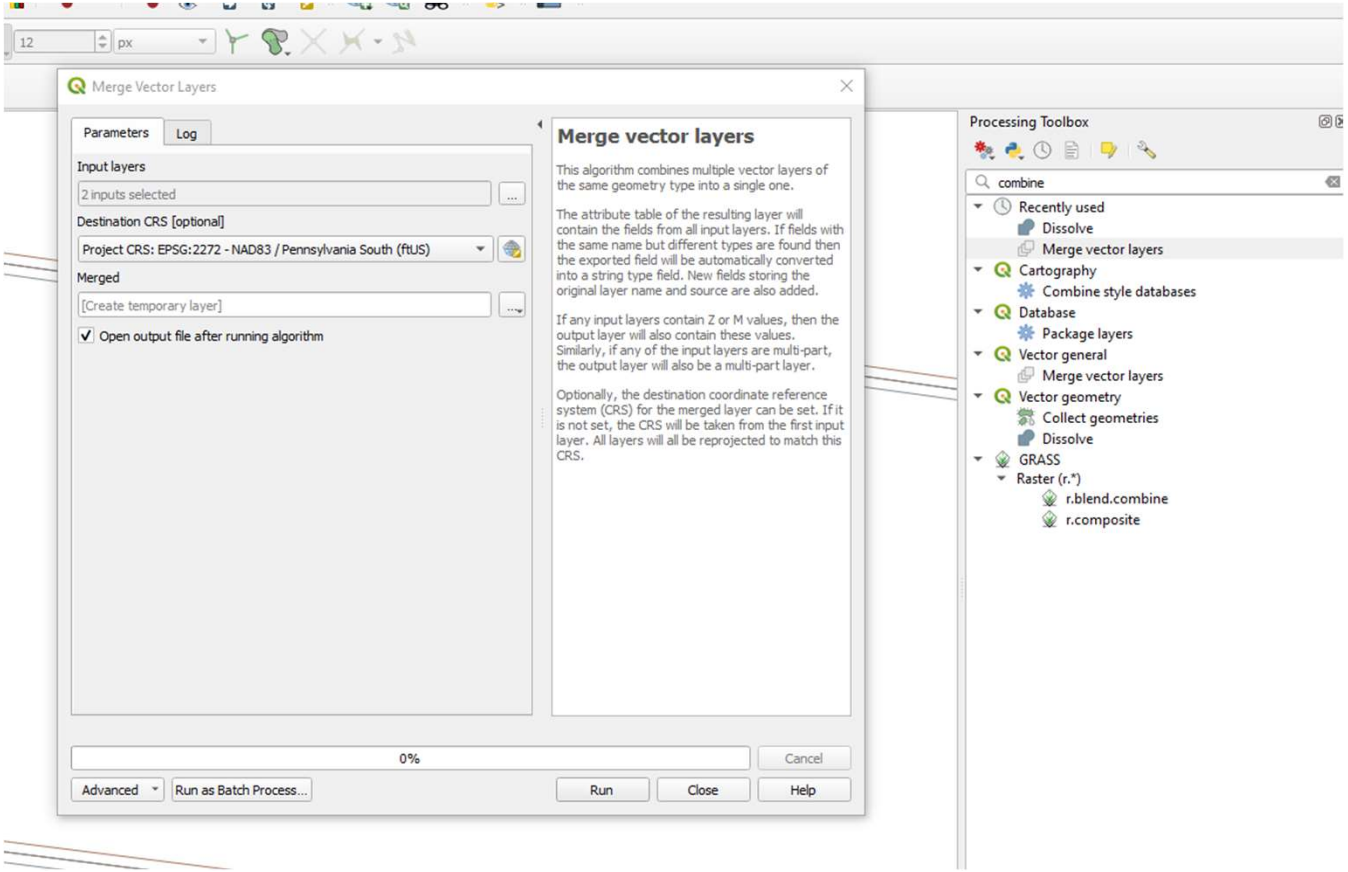


Generating parallel lines and buffers from the filtered street layer

- From the results, select Offset lines. Make sure the **example_street_names** is selected as the input layer. Set the distance to the **calculated offset** (9.5 ft for our example values) and the **segments to 1**. Click run. This will create a temporary layer named Offset. Rename it something descriptive (**positive_offset)** in order to keep track of these intermediate products until we're done with them.
- Repeat the Offset line generation for the negative offset. Open the **Offset lines** tool again and enter all the same values, **except flip the offset to a negative value** with the same magnitude. BE SURE THAT **"example_street_names"** is selected as the input layer. Otherwise your line will not be properly placed.

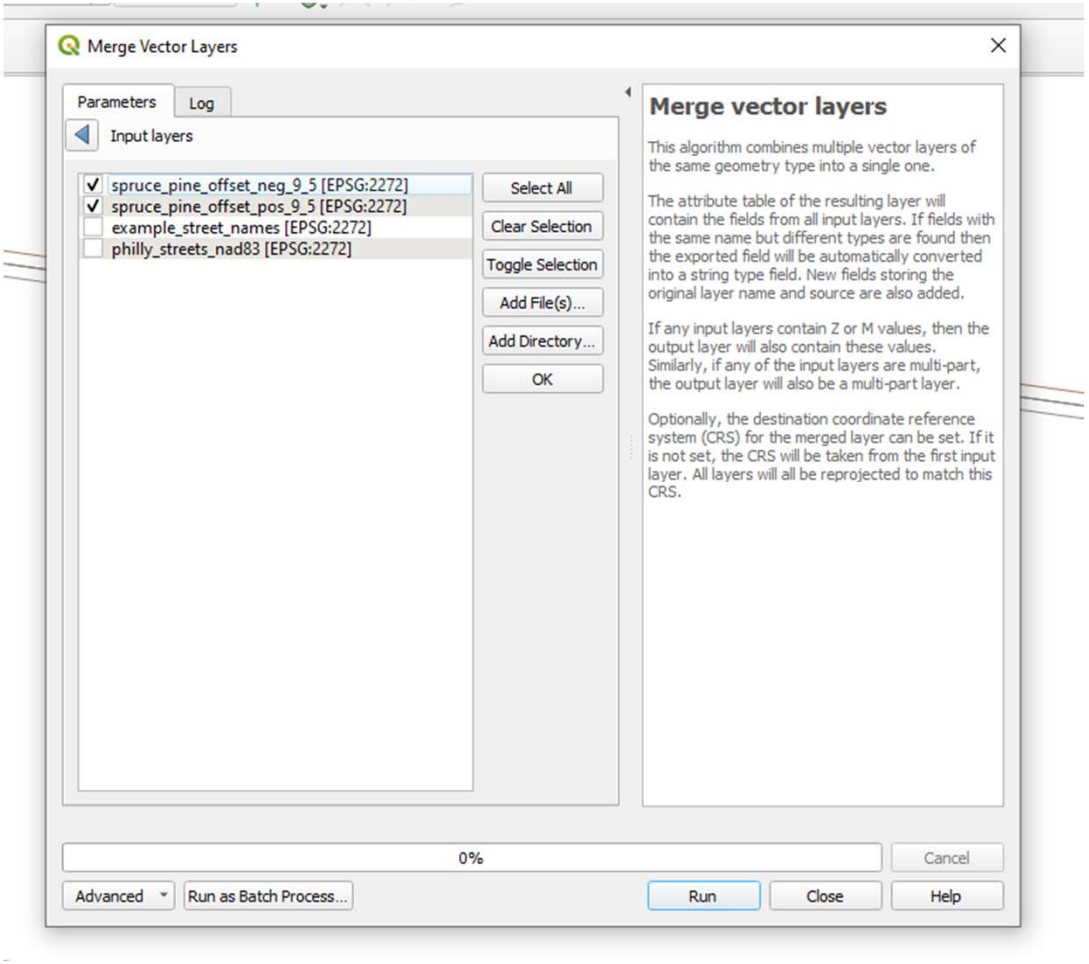
Generating parallel lines and buffers from the filtered street layer

- The result should now be two temporary layers, each offset from the street centerlines by the same amount on either side. Next, we can merge these separate layers into a single layer using the **Merge vector** layers tool. Enter, "**Merge vector layers**" into the processing toolbox search bar and select the **Merge vector** layers tool.



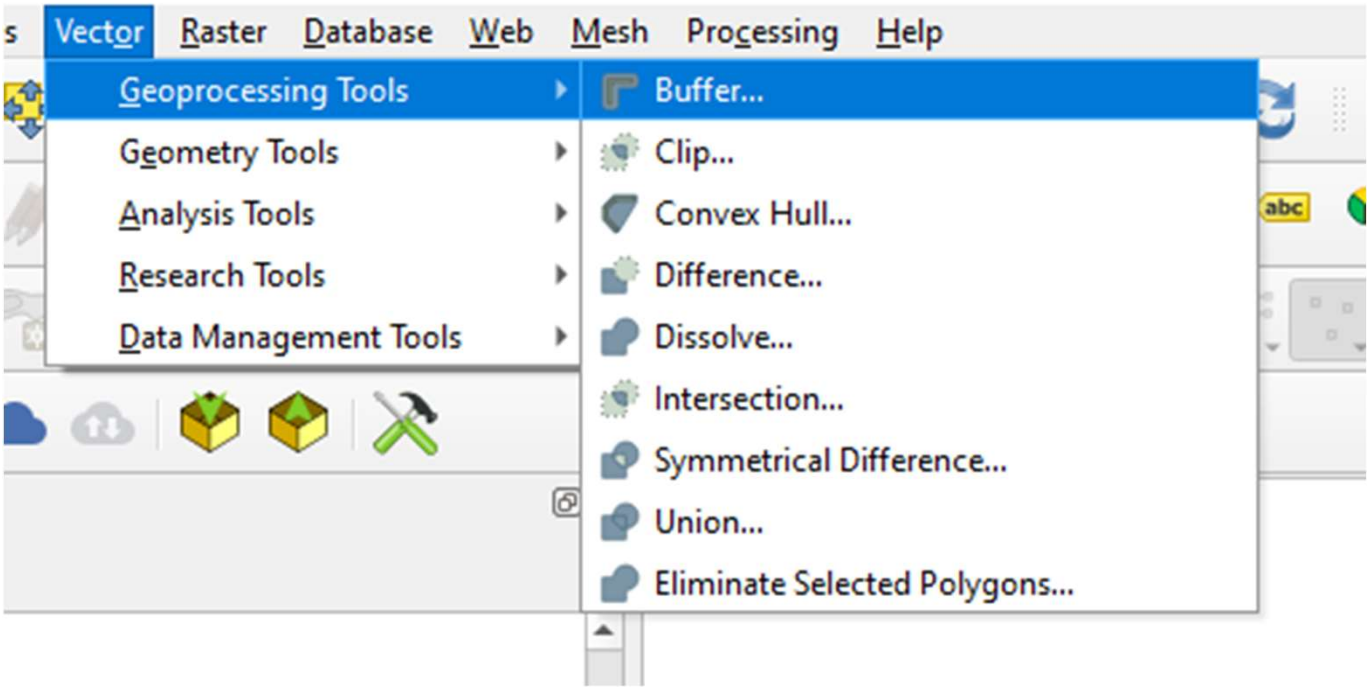
Generating parallel lines and buffers from the filtered street layer

- Click the … **next to Input layers** and select the layers to merge (the two temporary layers we just created).
- Then click **run**. A new temporary layer will be added to the layers window named, **Merged**.



Generating parallel lines and buffers from the filtered street layer

- Next, we can generate a buffer from these merged lines. Click **Vector**, **Geoprocessing Tools**, **Buffer** to raise the buffer tool dialog.



Generating parallel lines and buffers from the filtered street layer

- Select the **Merged** layer we just generated as the input and a **distance of bicycle lane width / 2**. For the example values we've been using, that would be 3.5 ft. **Set segments to 1** and end cap style to **flat**. Click **run**.

Generating parallel lines and buffers from the filtered street layer

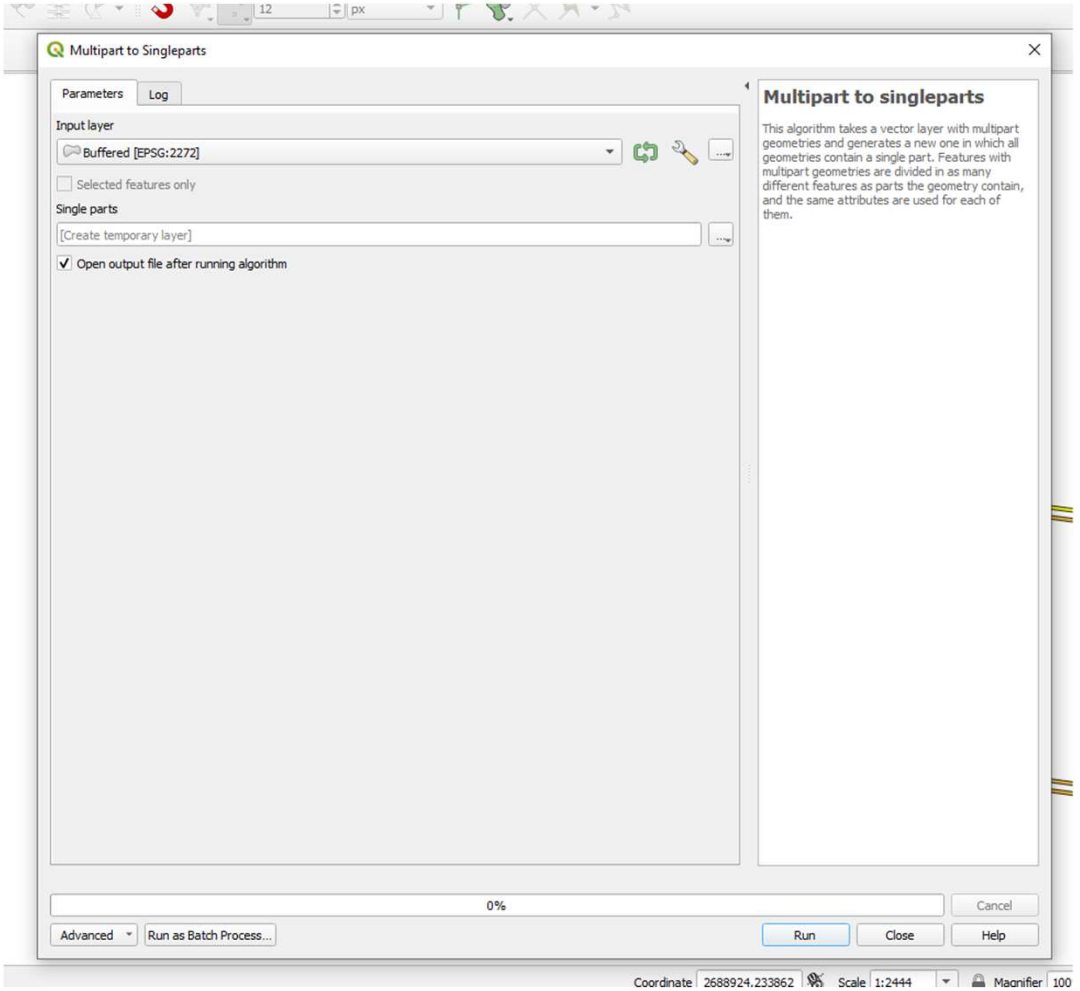
- A temporary layer will now be added to the map with polygons that should be an approximation of the road shoulder areas we want to classify:

Cleaning Up the Buffers

- If we zoom out a bit on our map, we can see that our filter may have captured some streets in error and we may have also captured stretches of street we don't really care about for the purposes of the project. Now is a good time to clean up this layer.

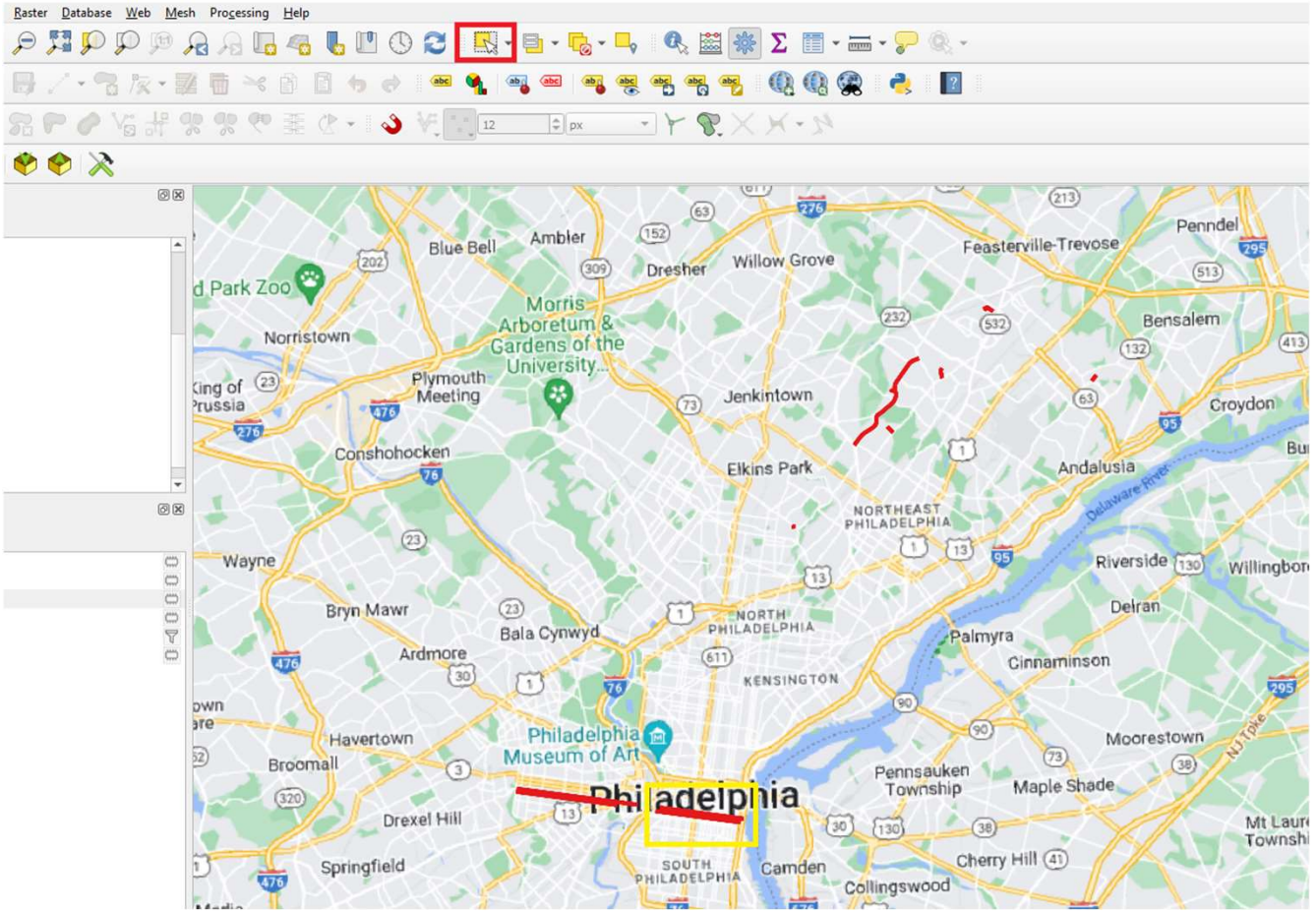
Cleaning Up the Buffers

- The method described above to generate the buffers may have resulted in noncontiguous geometries, so first click **Vector**, **Geometry Tools**, **Multipart to Singleparts**. Select the **buffered** layer as the input and click run.



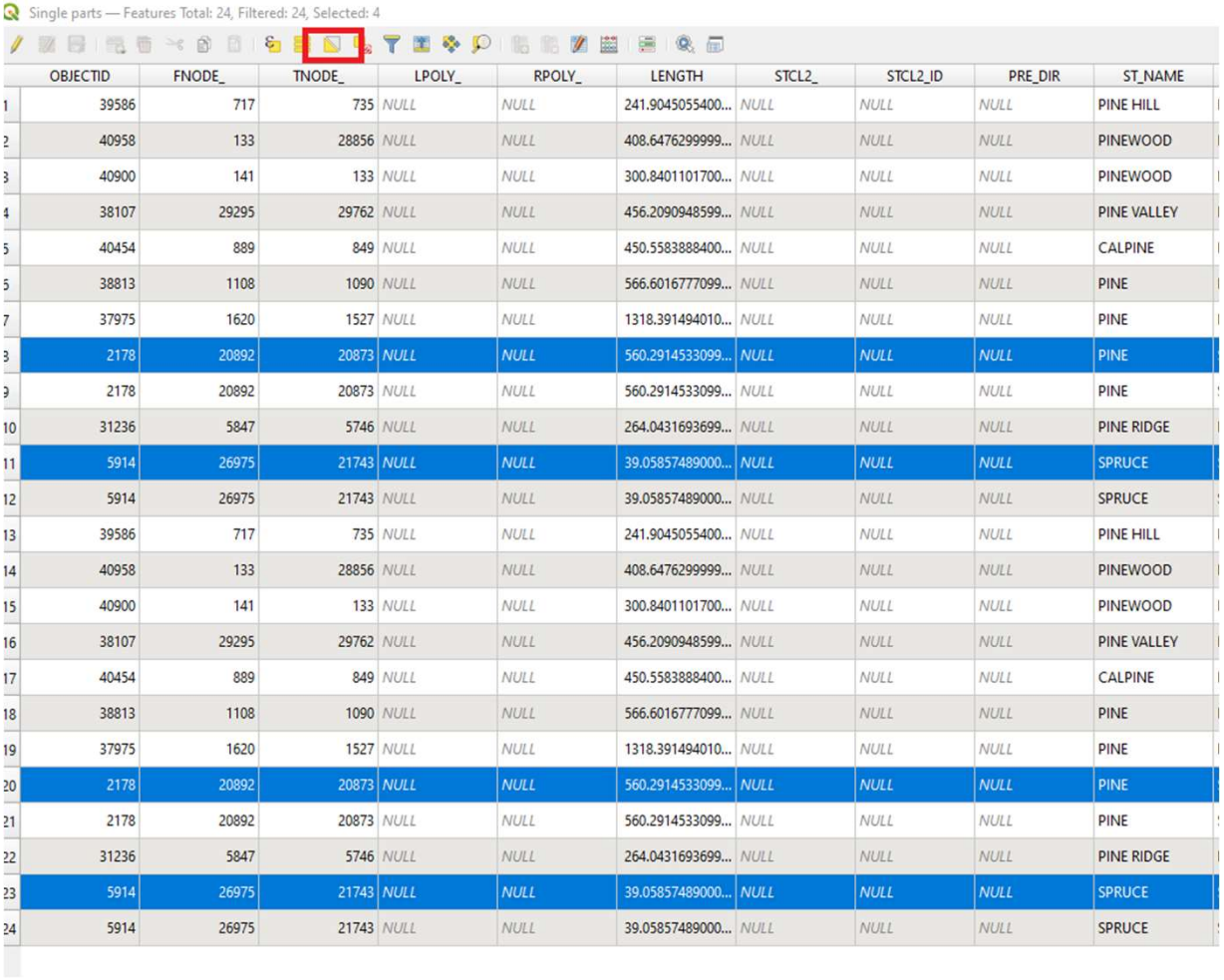
Cleaning Up the Buffers

- Next, we want to delete those features we don't care about. We can either select features to delete, either all together or individually and delete them, or if it's easier to select the features we do want to include, we can instead select the features to keep, then invert the selection. In this case, our project only involves the stretches of Spruce and Pine in center city, so we can just select the features in that area. **Click the selection tool, then select the desired features.**



Cleaning Up the Buffers

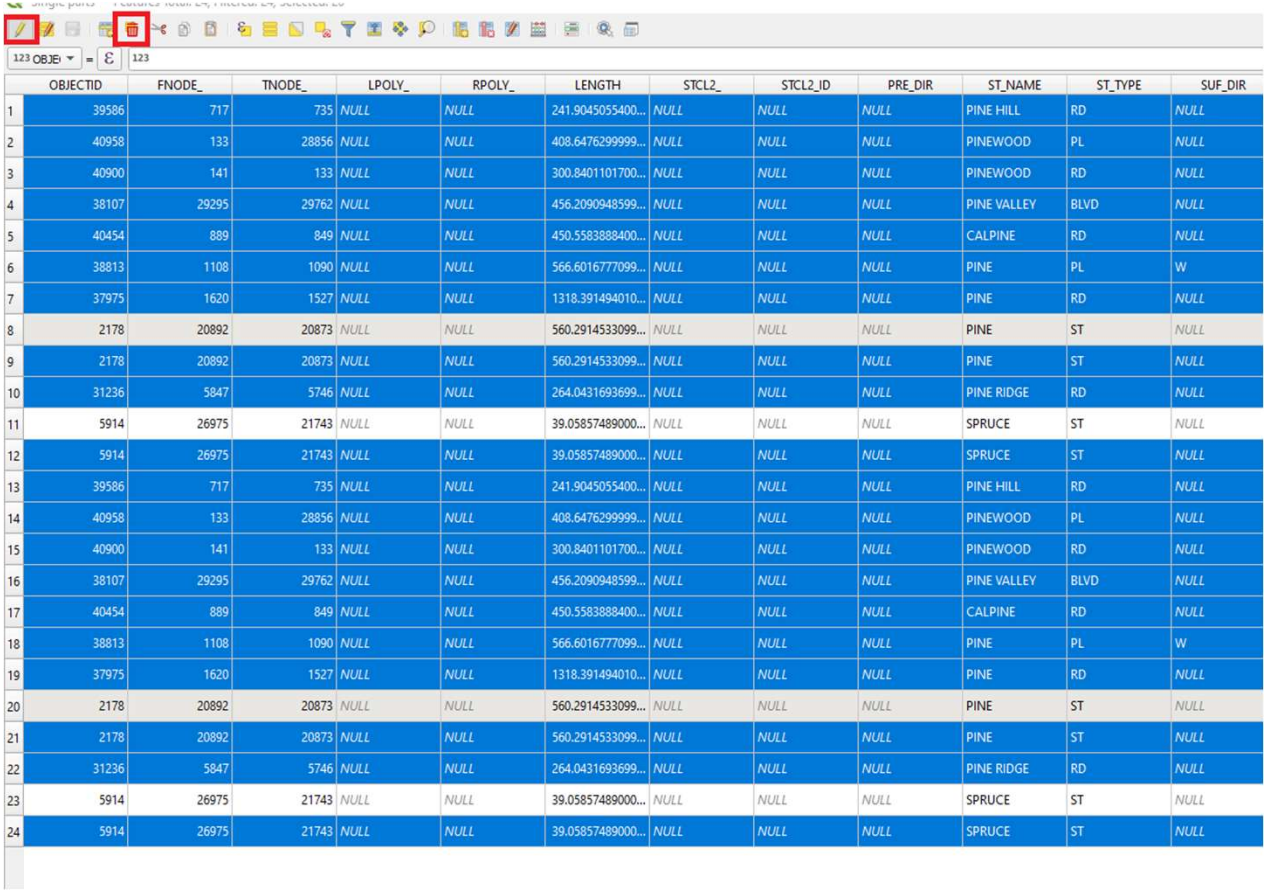
- Next, open the attribute table for the layer and click the invert selection button:



	OBJECTID	FNODE_	TNODE_	LPOLY_	RPOLY_	LENGTH	STCL2_	STCL2_ID	PRE_DIR	ST_NAME
1	39586	717	735	NULL	NULL	241.9045055400...	NULL	NULL	NULL	PINE HILL
2	40958	133	28856	NULL	NULL	408.6476299999...	NULL	NULL	NULL	PINEWOOD
3	40900	141	133	NULL	NULL	300.8401101700...	NULL	NULL	NULL	PINEWOOD
4	38107	29295	29762	NULL	NULL	456.2090948599...	NULL	NULL	NULL	PINE VALLEY
5	40454	889	849	NULL	NULL	450.5583888400...	NULL	NULL	NULL	CALPINE
6	38813	1108	1090	NULL	NULL	566.6016777099...	NULL	NULL	NULL	PINE
7	37975	1620	1527	NULL	NULL	1318.391494010...	NULL	NULL	NULL	PINE
8	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE
9	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE
10	31236	5847	5746	NULL	NULL	264.0431693699...	NULL	NULL	NULL	PINE RIDGE
11	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE
12	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE
13	39586	717	735	NULL	NULL	241.9045055400...	NULL	NULL	NULL	PINE HILL
14	40958	133	28856	NULL	NULL	408.6476299999...	NULL	NULL	NULL	PINEWOOD
15	40900	141	133	NULL	NULL	300.8401101700...	NULL	NULL	NULL	PINEWOOD
16	38107	29295	29762	NULL	NULL	456.2090948599...	NULL	NULL	NULL	PINE VALLEY
17	40454	889	849	NULL	NULL	450.5583888400...	NULL	NULL	NULL	CALPINE
18	38813	1108	1090	NULL	NULL	566.6016777099...	NULL	NULL	NULL	PINE
19	37975	1620	1527	NULL	NULL	1318.391494010...	NULL	NULL	NULL	PINE
20	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE
21	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE
22	31236	5847	5746	NULL	NULL	264.0431693699...	NULL	NULL	NULL	PINE RIDGE
23	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE
24	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE

Cleaning Up the Buffers

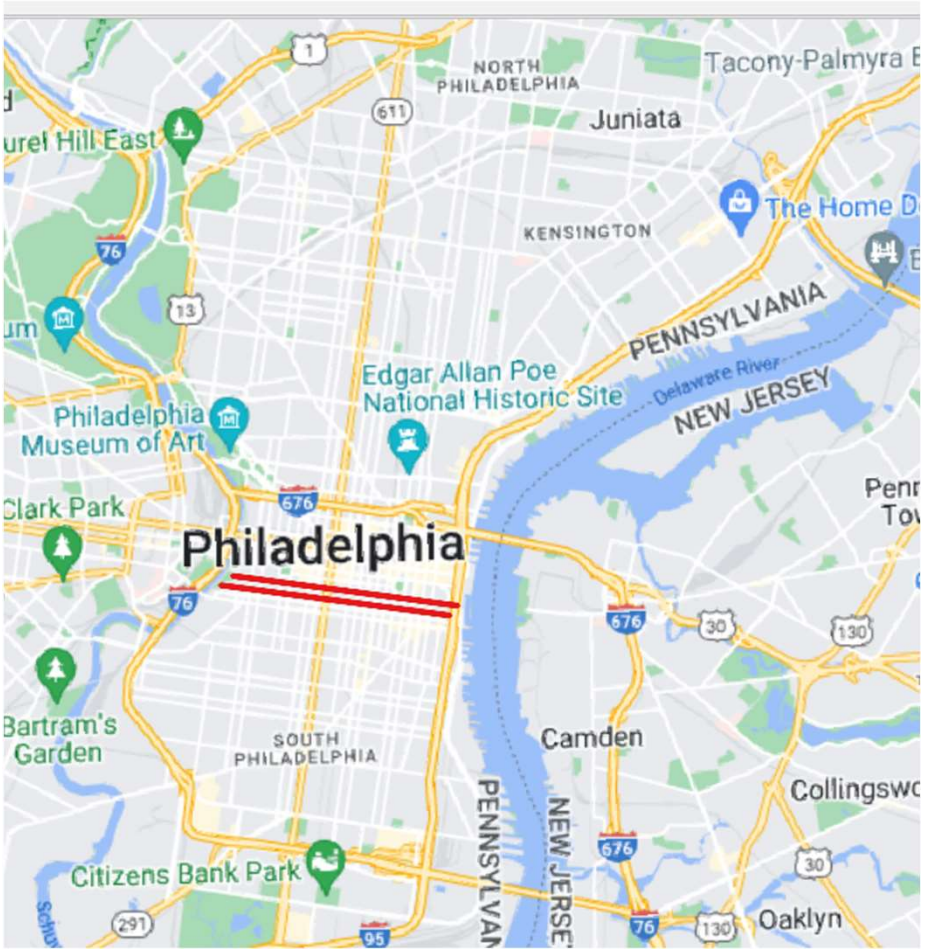
- Next, begin an edit session by clicking the pencil icon and then click on the delete selected features button.



	OBJECTID	FNODE_	TNODE_	LPOLY_	RPOLY_	LENGTH	STCL2_	STCL2_ID	PRE_DIR	ST_NAME	ST_TYPE	SUF_DIR
1	39586	717	735	NULL	NULL	241.9045055400...	NULL	NULL	NULL	PINE HILL	RD	NULL
2	40958	133	28856	NULL	NULL	408.6476299999...	NULL	NULL	NULL	PINEWOOD	PL	NULL
3	40900	141	133	NULL	NULL	300.8401101700...	NULL	NULL	NULL	PINEWOOD	RD	NULL
4	38107	29295	29762	NULL	NULL	456.2090948599...	NULL	NULL	NULL	PINE VALLEY	BLVD	NULL
5	40454	889	849	NULL	NULL	450.5583888400...	NULL	NULL	NULL	CALPINE	RD	NULL
6	38813	1108	1090	NULL	NULL	566.6016777099...	NULL	NULL	NULL	PINE	PL	W
7	37975	1620	1527	NULL	NULL	1318.391494010...	NULL	NULL	NULL	PINE	RD	NULL
8	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE	ST	NULL
9	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE	ST	NULL
10	31236	5847	5746	NULL	NULL	264.0431693699...	NULL	NULL	NULL	PINE RIDGE	RD	NULL
11	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE	ST	NULL
12	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE	ST	NULL
13	39586	717	735	NULL	NULL	241.9045055400...	NULL	NULL	NULL	PINE HILL	RD	NULL
14	40958	133	28856	NULL	NULL	408.6476299999...	NULL	NULL	NULL	PINEWOOD	PL	NULL
15	40900	141	133	NULL	NULL	300.8401101700...	NULL	NULL	NULL	PINEWOOD	RD	NULL
16	38107	29295	29762	NULL	NULL	456.2090948599...	NULL	NULL	NULL	PINE VALLEY	BLVD	NULL
17	40454	889	849	NULL	NULL	450.5583888400...	NULL	NULL	NULL	CALPINE	RD	NULL
18	38813	1108	1090	NULL	NULL	566.6016777099...	NULL	NULL	NULL	PINE	PL	W
19	37975	1620	1527	NULL	NULL	1318.391494010...	NULL	NULL	NULL	PINE	RD	NULL
20	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE	ST	NULL
21	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL	PINE	ST	NULL
22	31236	5847	5746	NULL	NULL	264.0431693699...	NULL	NULL	NULL	PINE RIDGE	RD	NULL
23	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE	ST	NULL
24	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL	SPRUCE	ST	NULL

Cleaning Up the Buffers

- A confirmation dialog will pop up. Confirm the deletion, then click the save button and end the edit session by clicking the pencil icon again. We should now only be left with the buffers generated in the area of interest:



Cleaning Up the Buffers

- This would be a good point to export the temporary layer to a file. Right click on the **Single Parts layer** from the **Layers** window and click **Export/ Save features as**. Select **ESRI Shapefile** as the format and **save** the shapefile (**road_shoulder_area)** to the project directory structure. We can now **remove all the temporary layers** that were created up to this point, as they were only intermediate products being used to achieve the now exported shapefile

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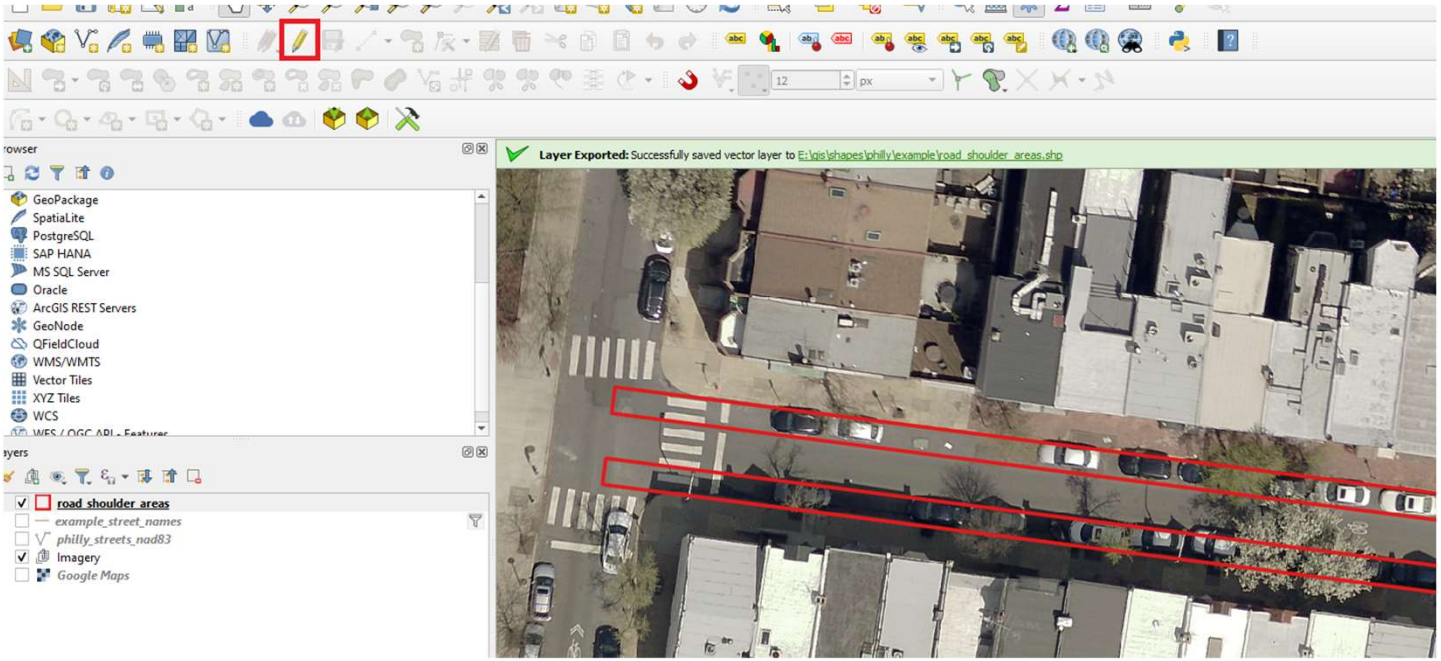
Editing Generated Features

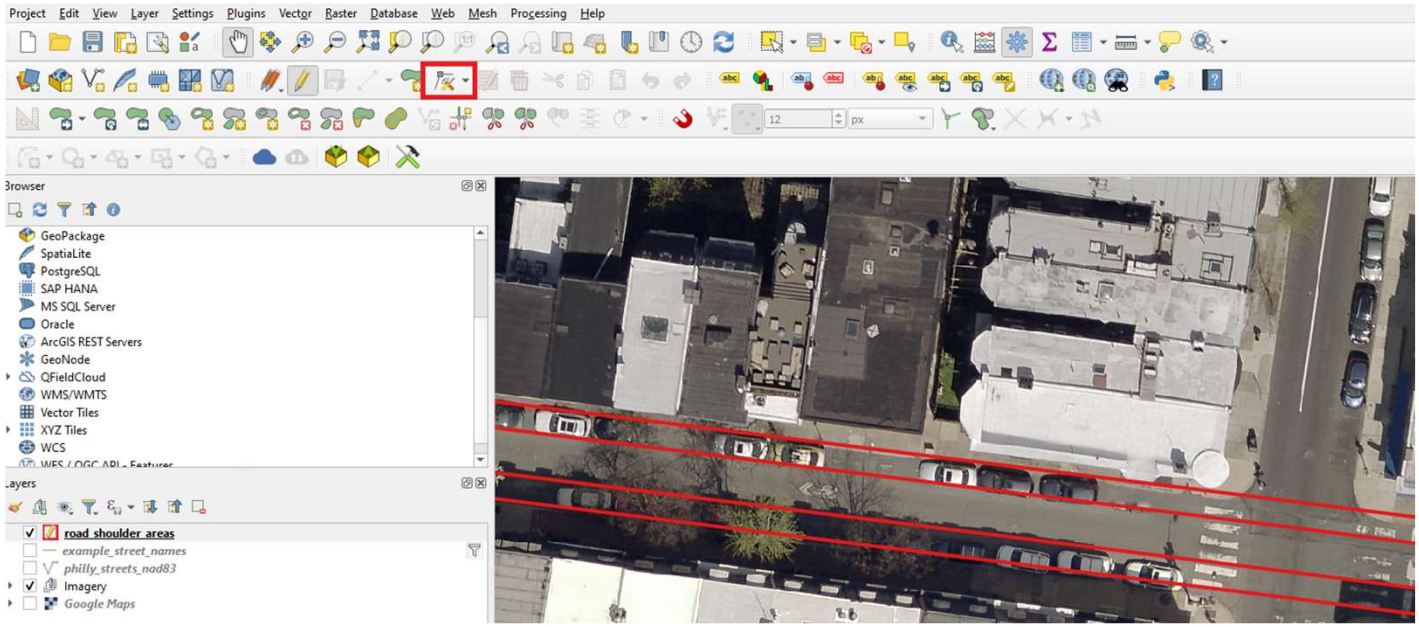
Adjusting the Road Shoulder Geometry

- Since the generation of the road shoulder area was based on a buffer of a line offset from a centerline, there's a lot of room for error. The shoulder may not be as properly aligned to the curb as we want. To correct this, we can edit the geometry of the generated road shoulder area polygons.
- Select the **road shoulder areas** polygon layer and click the **pencil icon** to enable edit mode.



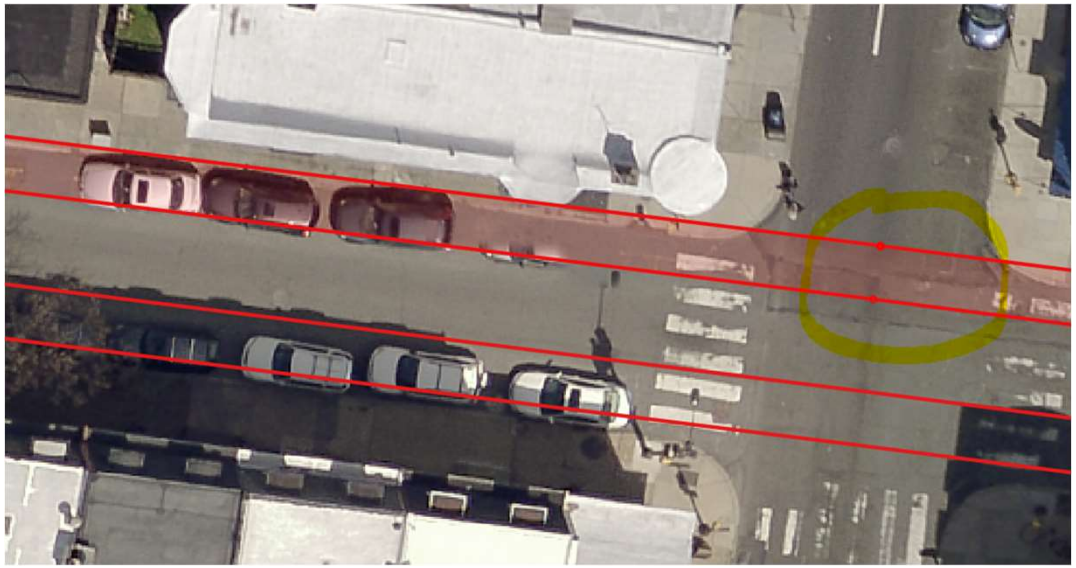
Adjusting the Road Shoulder Geometry

- Then, starting at one end of the street, pan along the length of the shoulder area polygon until you notice the shoulder area is misaligned with the road curb. Click the **vertex tool** from the toolbar and then hover over the polygon. The available vertices should appear as red dots. It's possible to add and remove vertices, but for the purpose of realigning the polygons, it is probably better to drag existing vertices in pairs. **Find a pair to drag** and then select them.



Adjusting the Road Shoulder Geometry

- With the pair of vertices selected, **left click on either vertex** and then **drag the pair to their new location**. *A* **faint highlight of the adjusted polygon should show as you're moving the pair**. You can use this highlight to align the polygon to the curb. When you're satisfied with the new alignment, left click again.

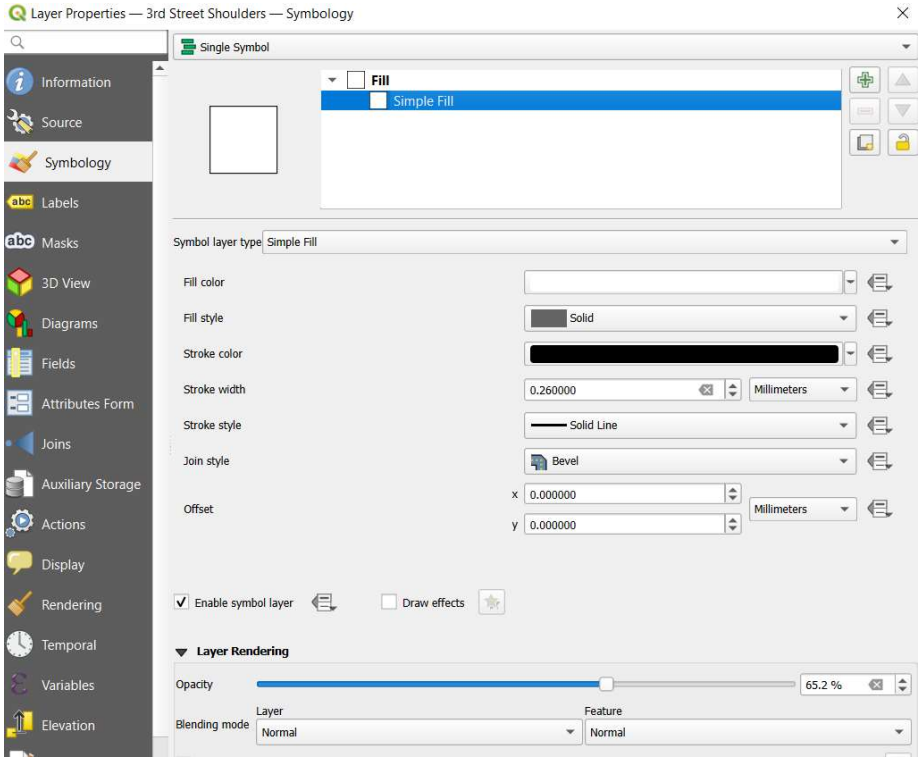


Cutting the Road Shoulder Polygons

- Ultimately, the goal will be to show different classifications for the road shoulder area, so the polygons will have to be cut into segments so that each segment can be given a classification (bike lane, permit parking, loading zone, etc.) This can be done using the **Split Features tool**. (split features is under the advanced digitizing toolbar) Select the road shoulder area layer and begin an edit session by clicking on the **pencil icon**. Then, at any breakpoint between areas that should have separate classifications, use the Split Features tool. Click on the Split Features tool icon, then click on the map to begin drawing a line. A faint outline of the line being drawn will appear as you move the mouse to select a second point. You can continue drawing line segments, but when the last line segment has been drawn for the cut, right click to end the cut. The polygon will then be cut into separate polygons by the line(s) drawn.

Preparing Template Atlas for Field Work

- Now that our polygons are cut appropriately, we need to change them to a shade appropriate for marking.
- Open **properties** on the street shoulder layer, **click symbology**, **simple fill**
- Choose a **white fill** and set the opacity to about **65%**. This best balances the need to make visible marks and the need to see underlying street features



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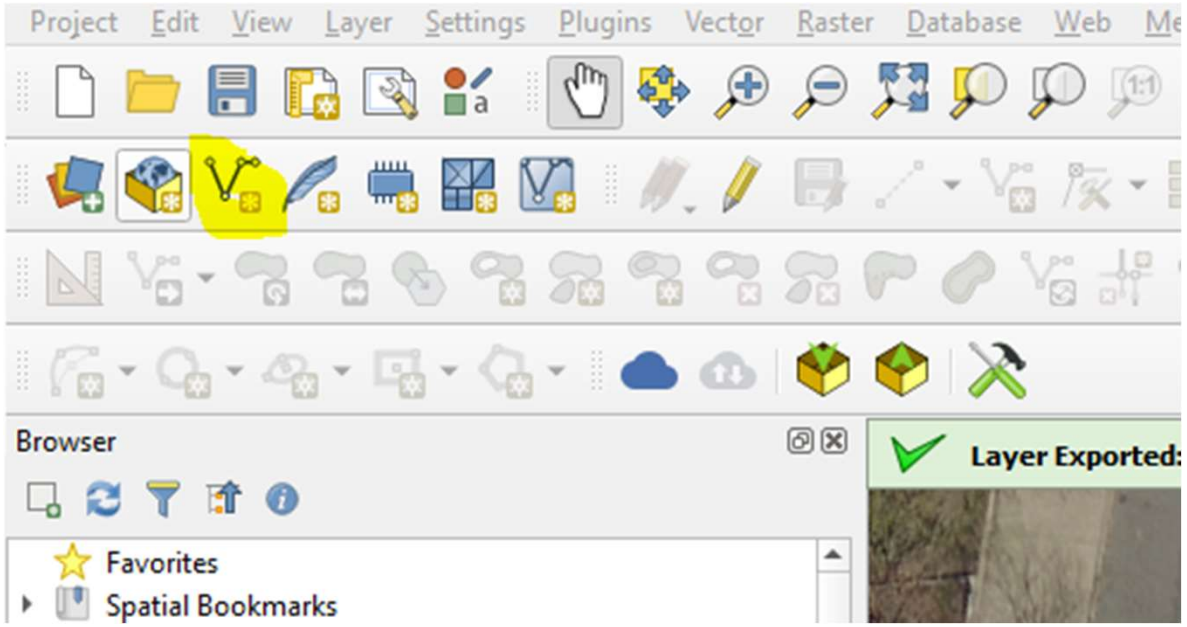
Creating Features for Atlas Generation

Creating Features for Atlas Generation

- Large projects, including long linear projects like bike lanes, cover too much area to fit on a single map page at a sensible scale. We can automate the generation of multiple pages by creating another layer which will contain data for each map page to be generated.
- Click on **create new shapefile** layer:

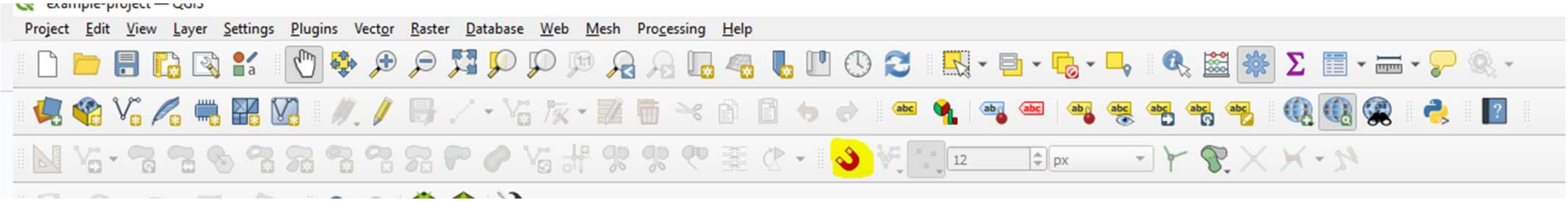


Creating Features for Atlas Generation

- Give the new shapefile layer a name (ATLAS). Set the geometry to **LineString**. Set the CRS to the **Project CRS** and then add several fields:
  - Order, Integer Type
  - StreetName, Text, Length 255
  - FromSt, Text, Length 255
  - ToSt, Text, Length 255
- Click **OK**
- Then, make sure the original street centerline layer is enabled in the **Layer window**. We're going to be creating new lines along the same alignment as the street centerlines. We're also going to leverage the angle of the line to automatically orient each map page, so it's important that the lines follow the street orientation and snapping to existing street centerlines is a good way to achieve that.

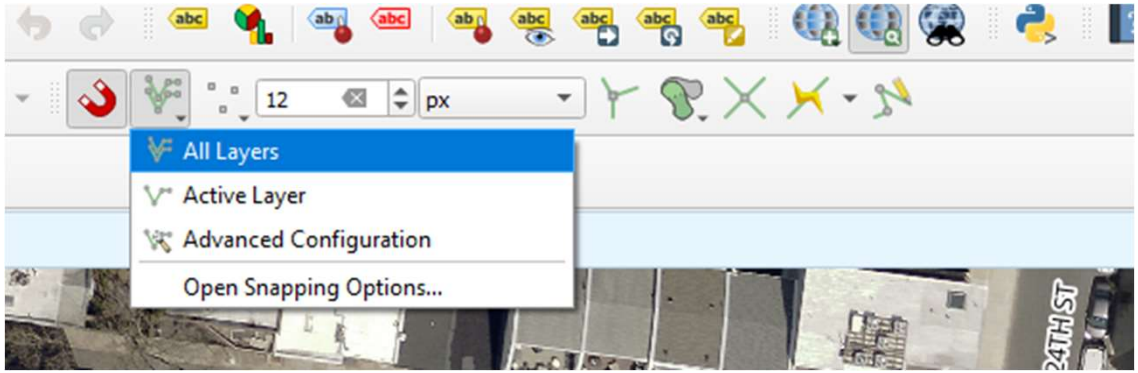
Creating Features for Atlas Generation

- Ensure snapping is enabled and snapping settings are set so that we can snap to the street centerlines. **Click the magnet** icon to enable snapping:

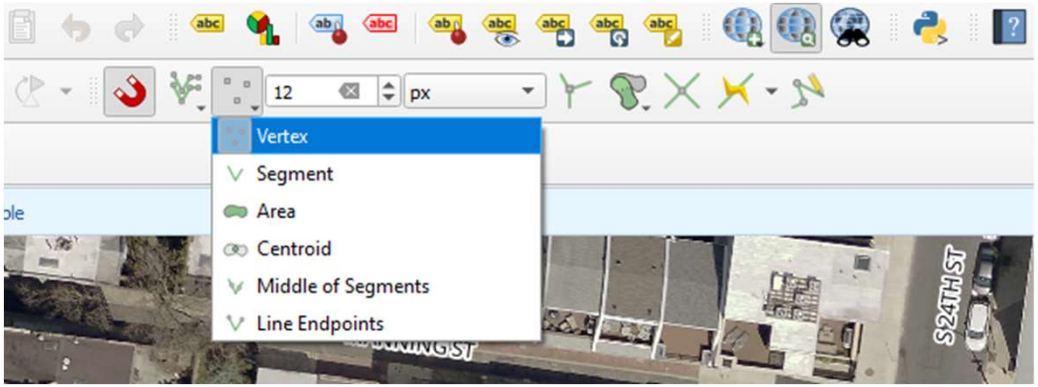


Creating Features for Atlas Generation

- Then enable snapping to all layers:



- And enable snapping to vertices

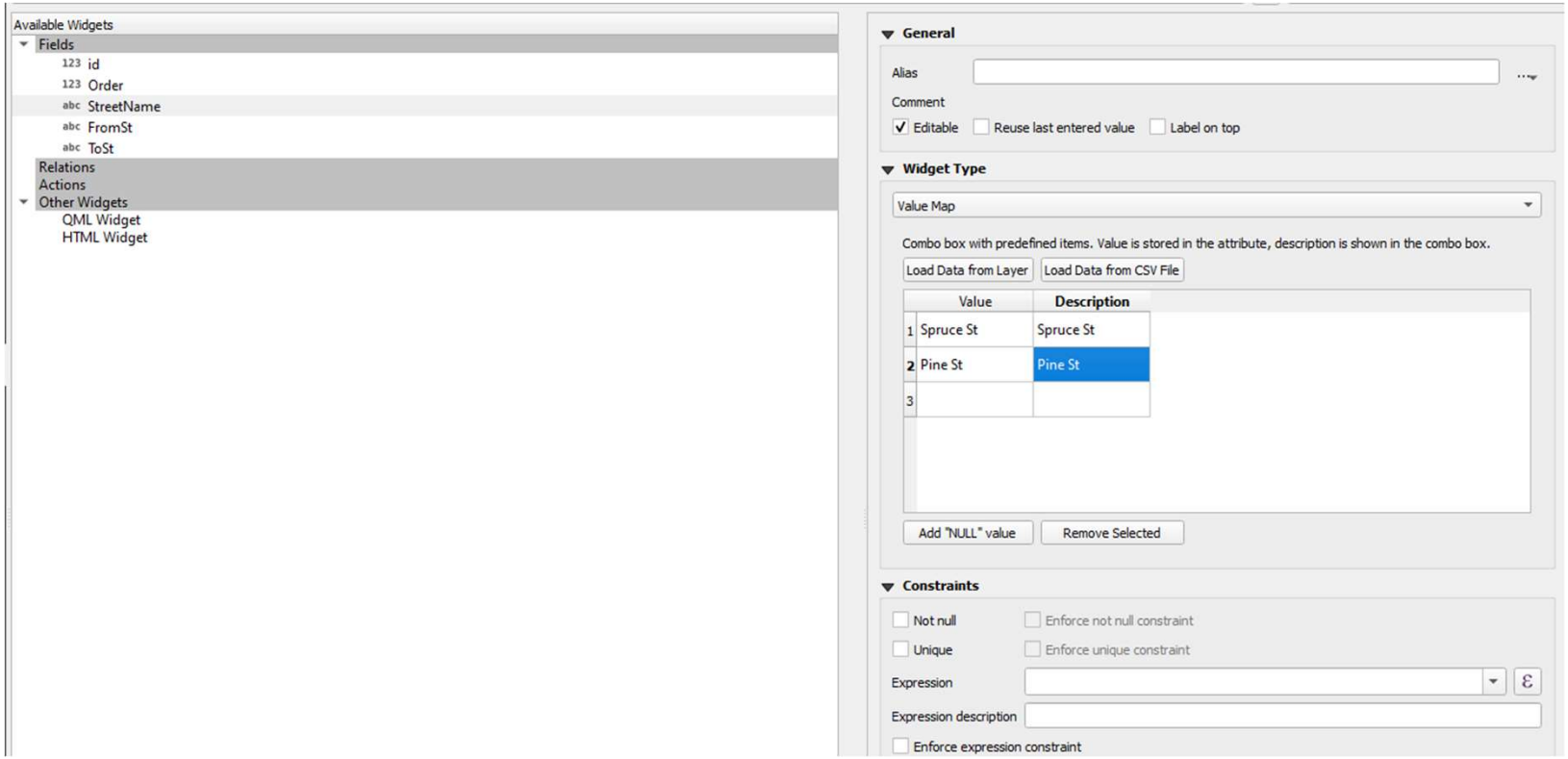


Creating Features for Atlas Generation

- We're going to be creating new lines and tracing the original street centerlines at their vertices. One block segments seems like a sensible scale for map pages and conveniently, the original street centerline layer has vertices at intersections that we can use to trace.

Creating Features for Atlas Generation

- One last bit of set up: since we have a street name field, but will be populating only a small set of streets that will be repeated often, we can add some value mapping that will make this entry easier. Right click on the **ATLAS layer** and open the **properties**. Open the **Attributes Form tab and click StreetName**. Change the **Widget Type to Value Map**. In this example, we're only dealing with **Spruce Street** and **Pine Street**, so add these values, duplicated in the **Value** and **Description** fields. **Apply** the changes and close the properties.

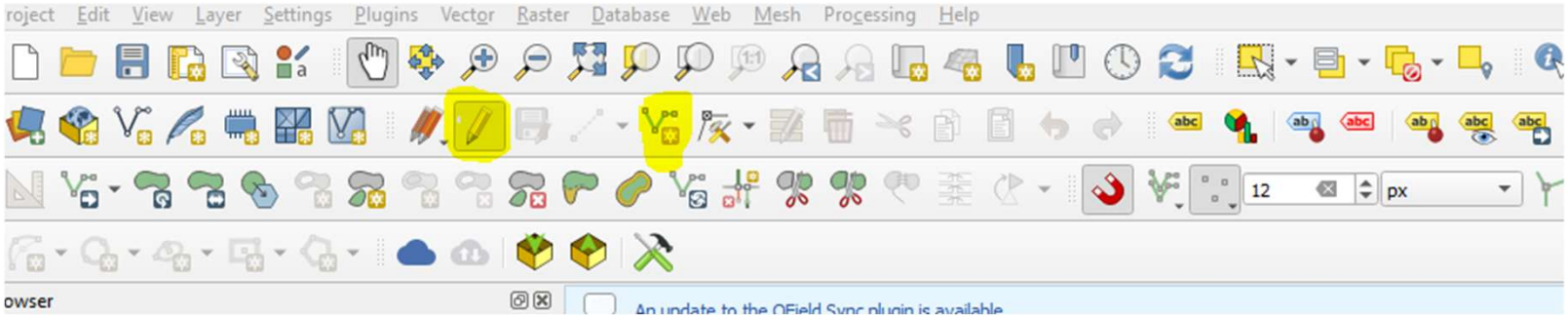


Creating Features for Atlas Generation

- Now, we're ready to begin creating the atlas data features. We're eventually going to be leveraging the line angle to orient pages, so it is imperative that we draw them going in a consistent direction (East to West or West to East) so that we can use the same calculation for all features later. Pick a direction and stick with it. For this example, I am going to draw the lines going West to East.

Creating Features for Atlas Generation

- Start an edit session on the **ATLAS** data layer and then click add line feature:



Creating Features for Atlas Generation

- Now hover the mouse near the west intersection of the first block we want to create. When you near the vertex at that intersection from the street centerline layer, it will be highlighted for you to snap to. Left click here:

Creating Features for Atlas Generation

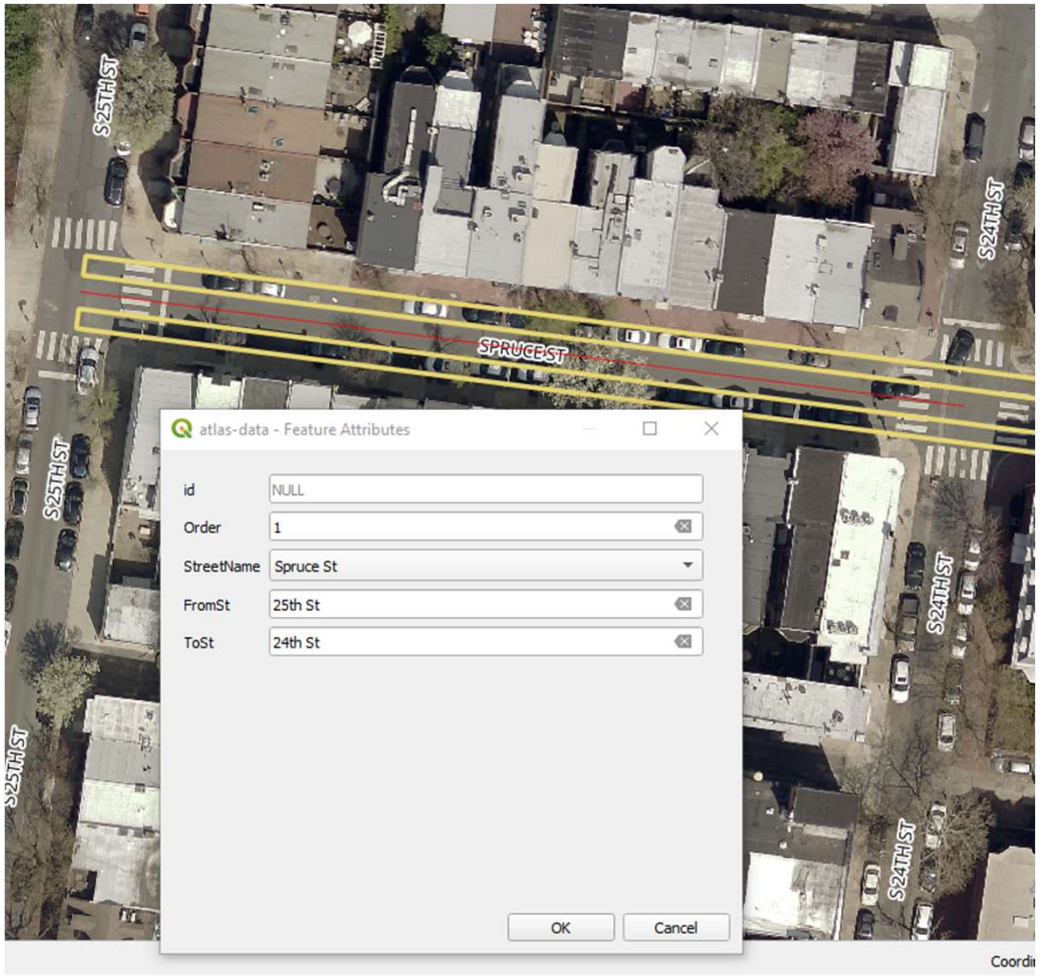
- Then repeat this for the vertex at the East intersection for this block:

Creating Features for Atlas Generation

- The line defined by these two points will be displayed. Because the geometry type for this layer can be a line string of many line segments, we need to right click to end the line string with only a single segment in the feature.

Creating Features for Atlas Generation

- Creating the feature will raise an attribute form. Enter an order number, select the street, and enter the cross streets and click **OK**.

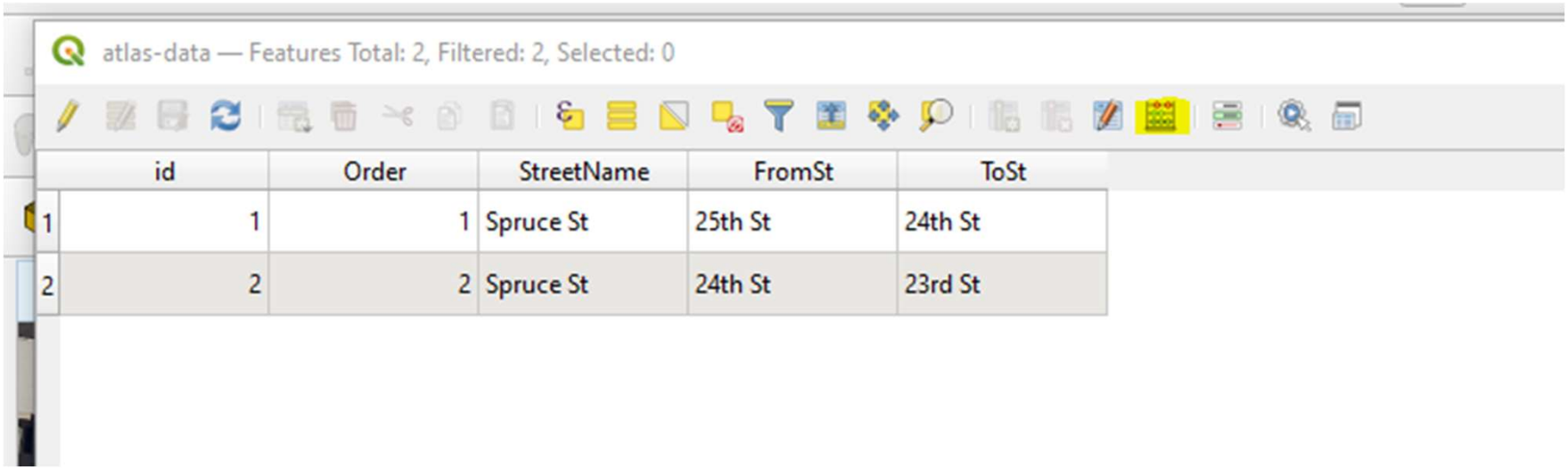


Creating Features for Atlas Generation

- **Repeat** this process for every block, creating one line string feature with one line segment each for every block to include in the map atlas. When you're done creating the line features, save your edits and end the edit session.

Creating Features for Atlas Generation

- Then, open the **ATLAS** attribute table and click on the field calculator icon.

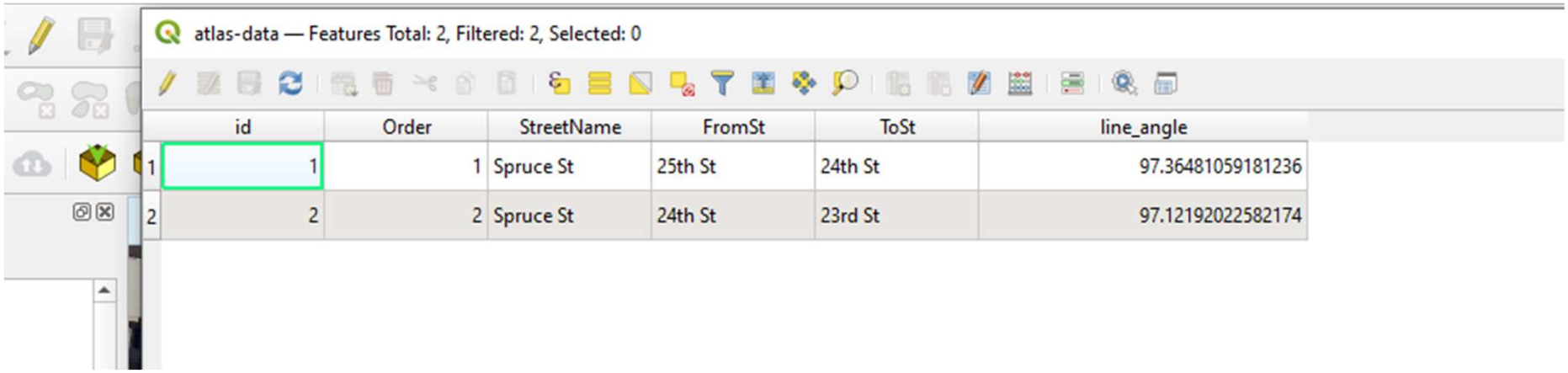


	id	Order	StreetName	FromSt	ToSt
1	1	1	Spruce St	25th St	24th St
2	2	2	Spruce St	24th St	23rd St

- In the field calculator dialog, select **create new field**, **create virtual field**, give the new **field a name (line_angle)** and select a **decimal data type**. In the expression field, enter, "angle_at_vertex(@geometry, 0)". This will take the angle at the first vertex for each feature, which we can later use to orient each map page.

Creating Features for Atlas Generation

- Click OK. The attribute table should now have a virtual field with the angle for each line:



	id	Order	StreetName	FromSt	ToSt	line_angle
1	1	1	Spruce St	25th St	24th St	97.36481059181236
2	2	2	Spruce St	24th St	23rd St	97.12192022582174

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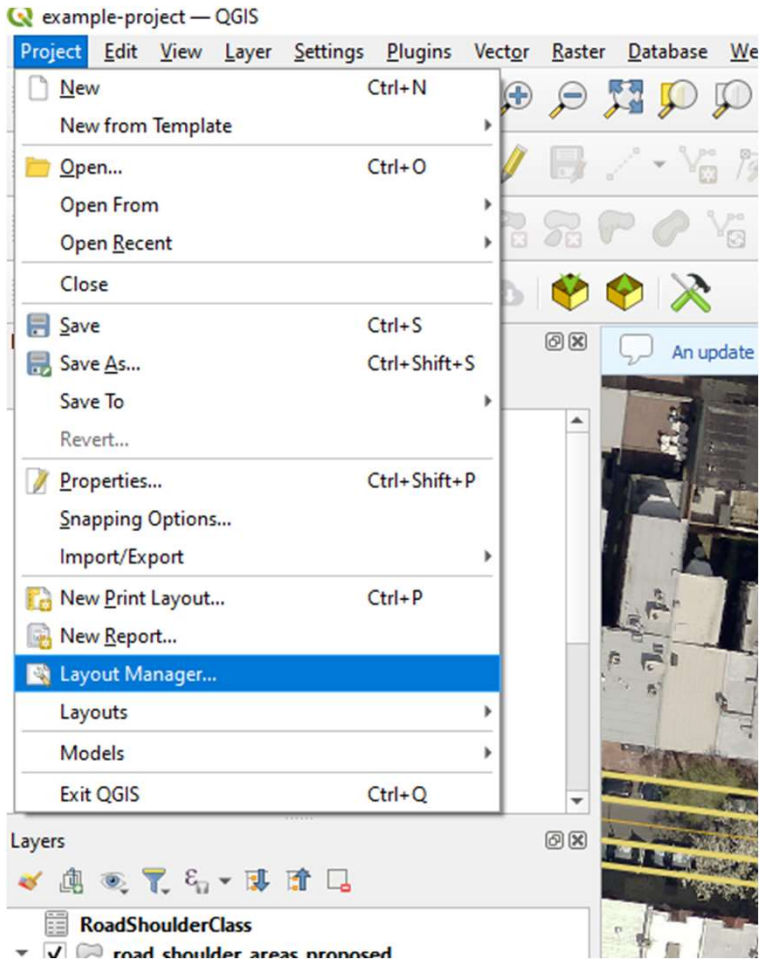
Generating an Atlas for Field Work

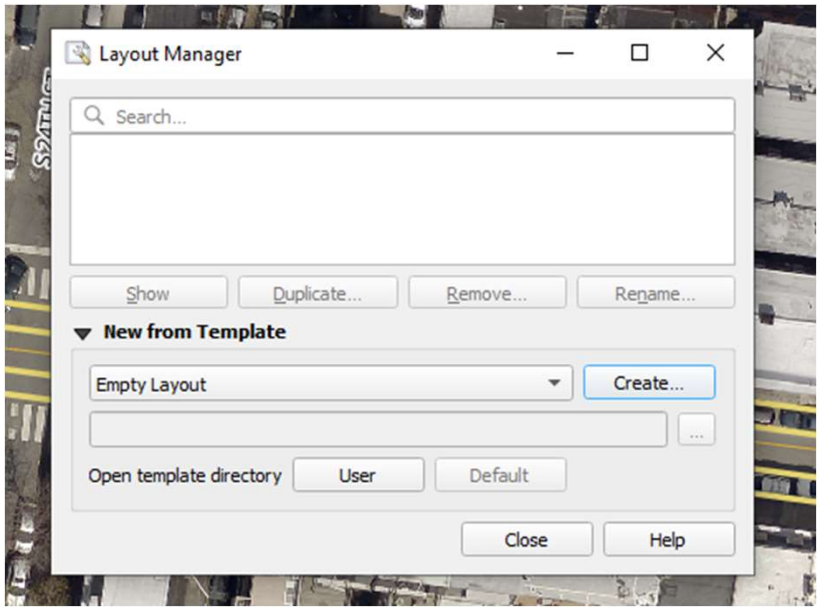
Creating a Layout

- Open the layout manager.



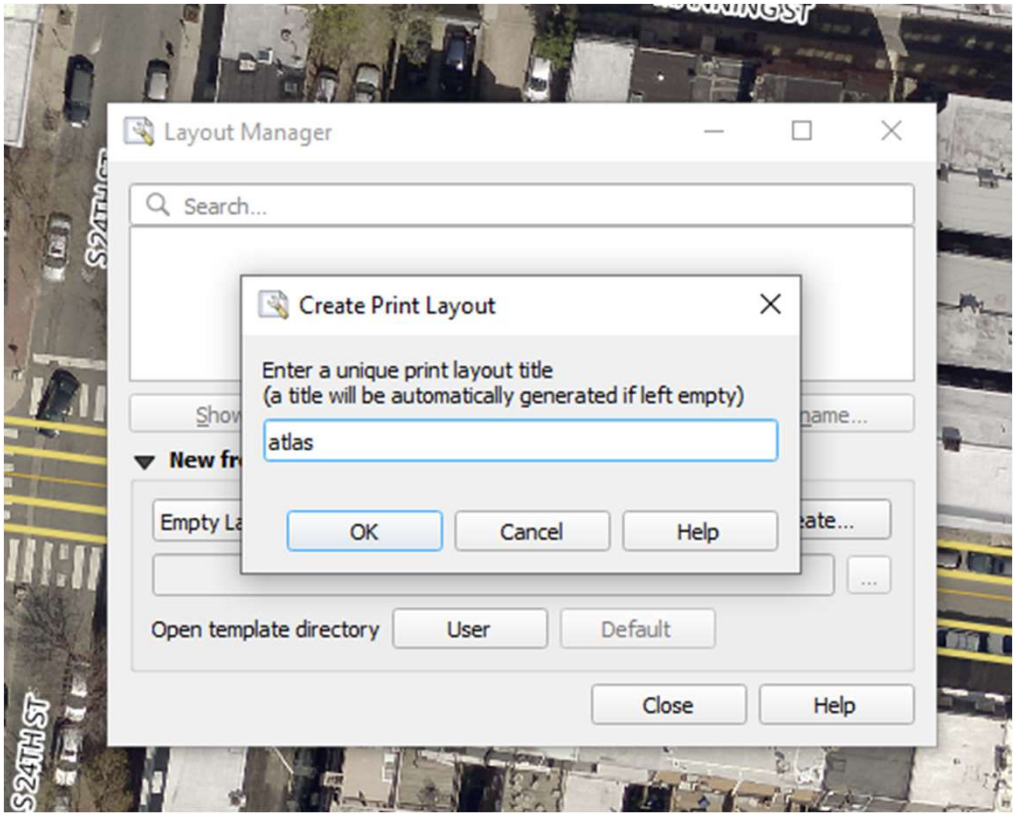
Creating a Layout

- Under new from template, click **Create**



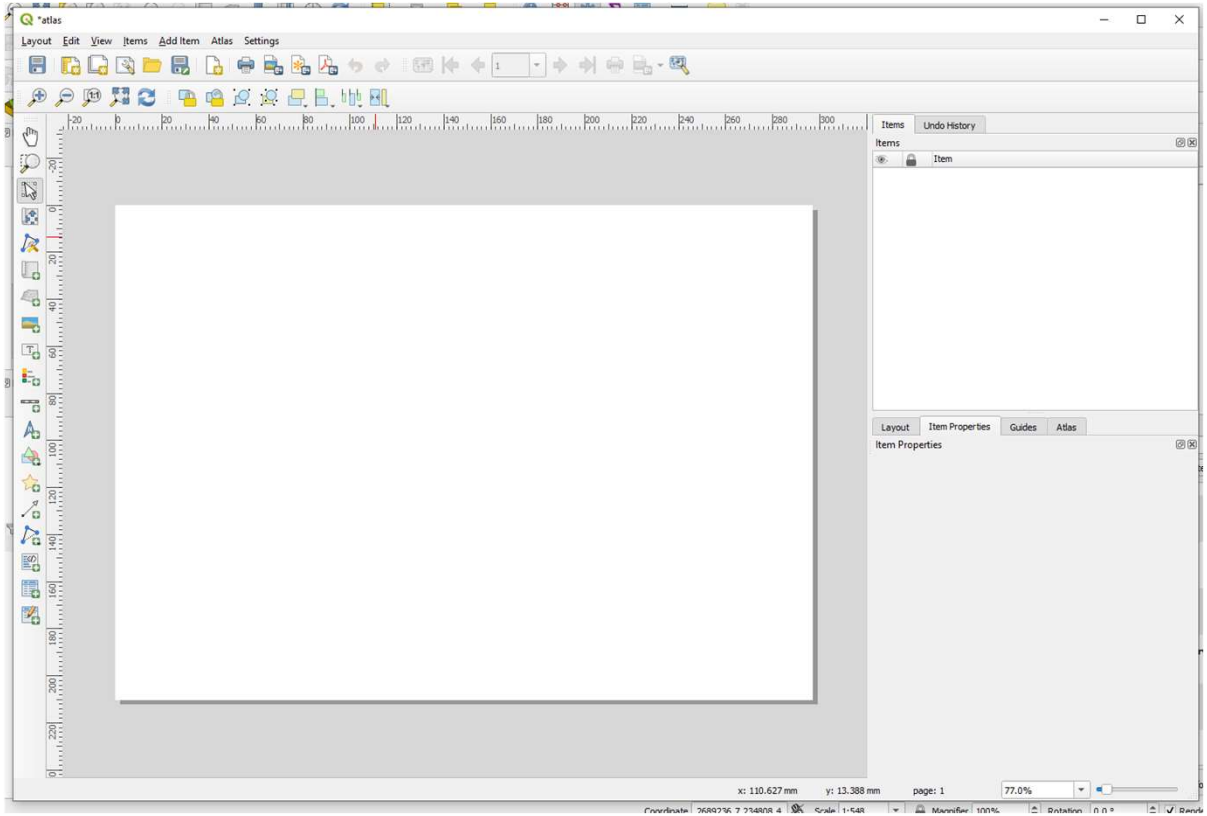
Creating a Layout

- Give the layout a title:



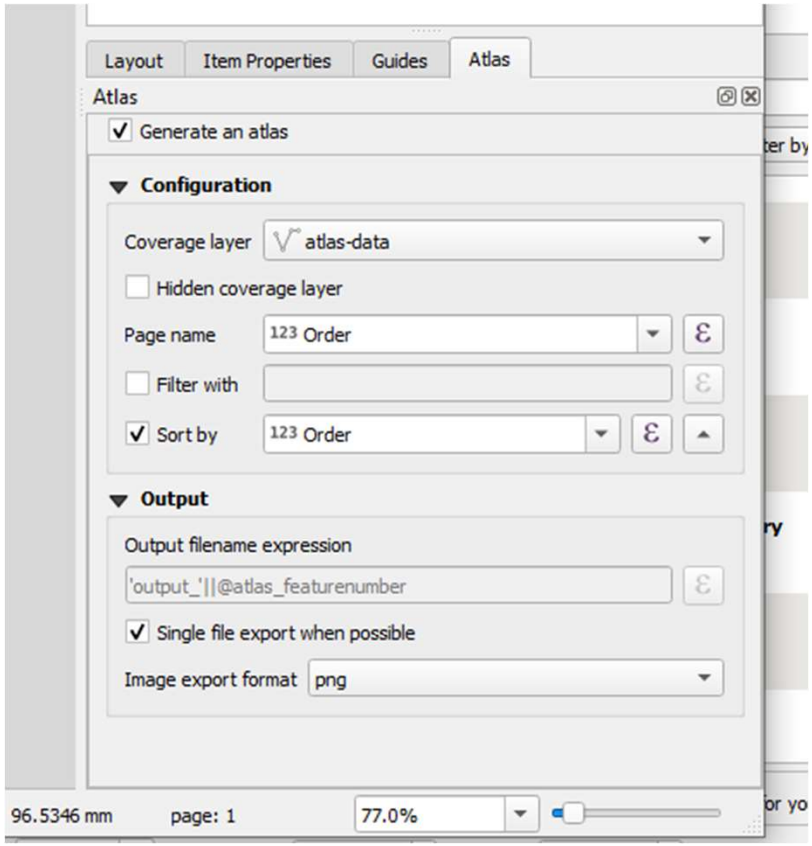
Creating a Layout

- This will open the layout window where you can start defining the map layout.



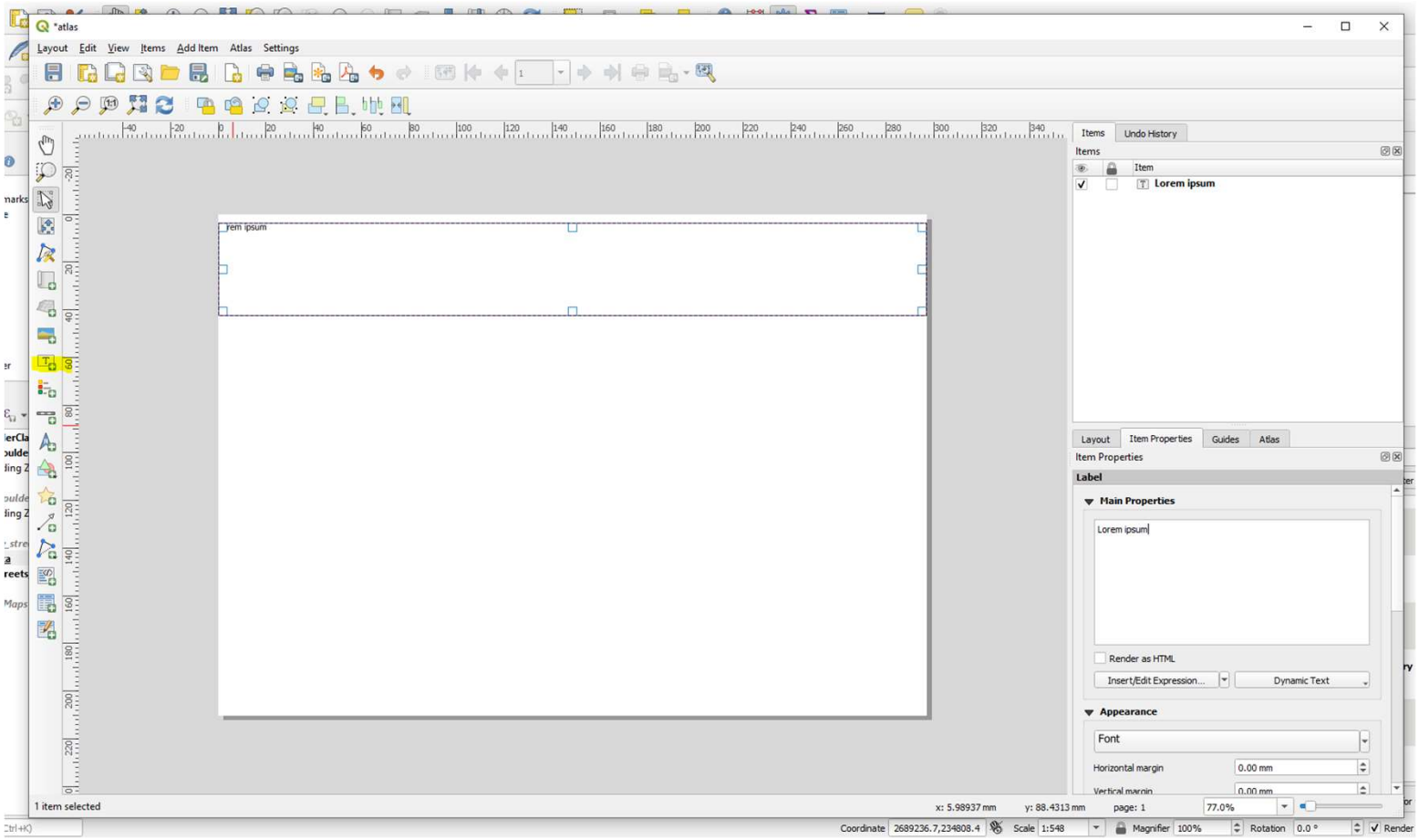
Generating an Atlas for Field Work

- In the lower right, click on the **Atlas tab**. (may need to click atlas and the atlas settings tab) Check **Generate an atlas**. Select the **ATLAS** layer as the **Coverage** layer. For the **page name**, select the **Order** field. Check **sort by**. In sort by, also select the **Order** field.



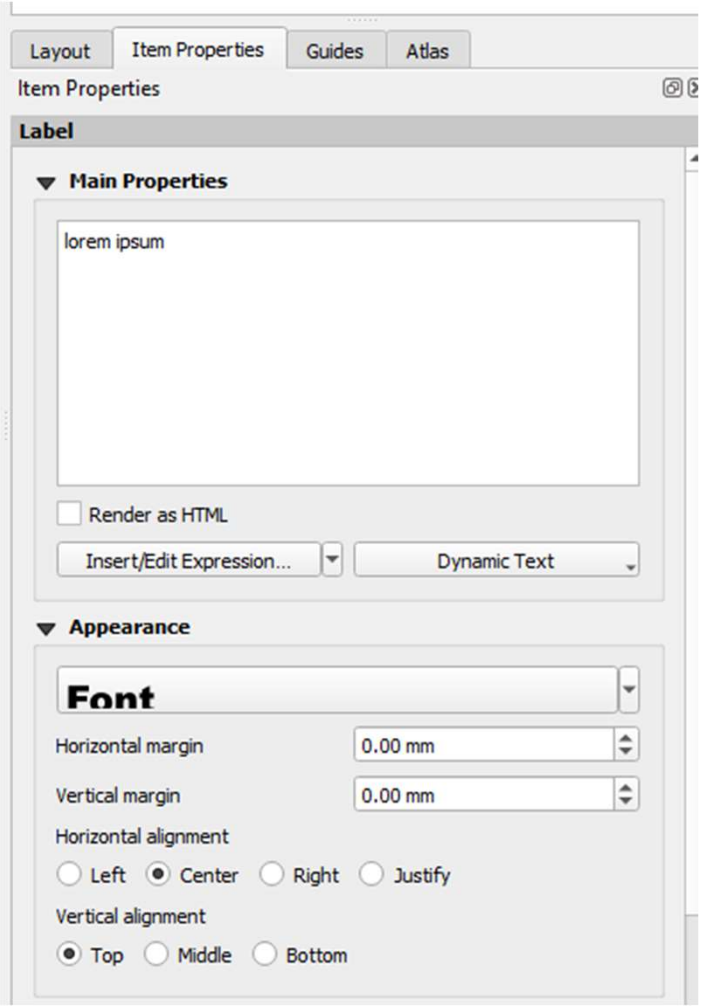
Generating an Atlas for Field Work

- Add a label for the map title (click button on left pane) :



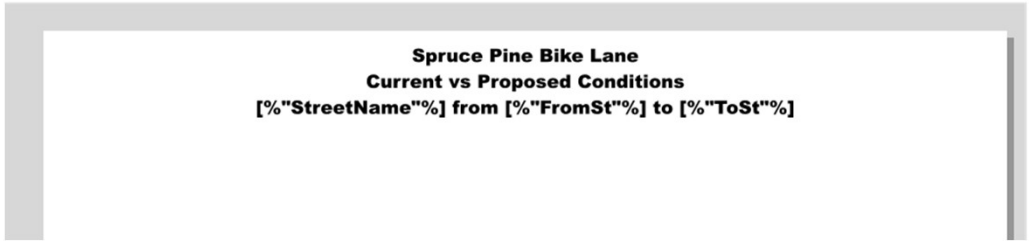
Generating an Atlas for Field Work

- In the Item Properties tab for the new label, change the label font (**Arial Black**).
- Use 18pt font



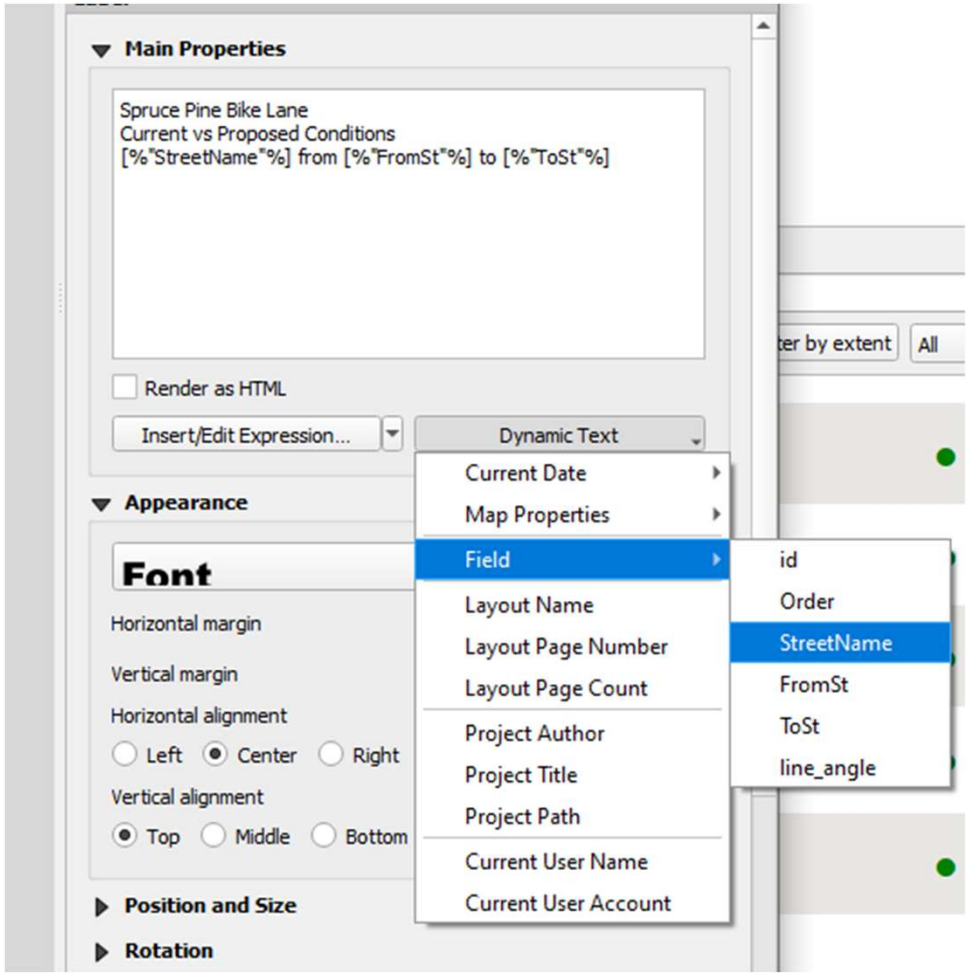
Generating an Atlas for Field Work

- Then, in the main properties section, change the text to an appropriate title. Each map page has access to the data stored in the atlas data feature, with each page getting a different row from that data table, so we'll populate some of the title data dynamically. Something like below:



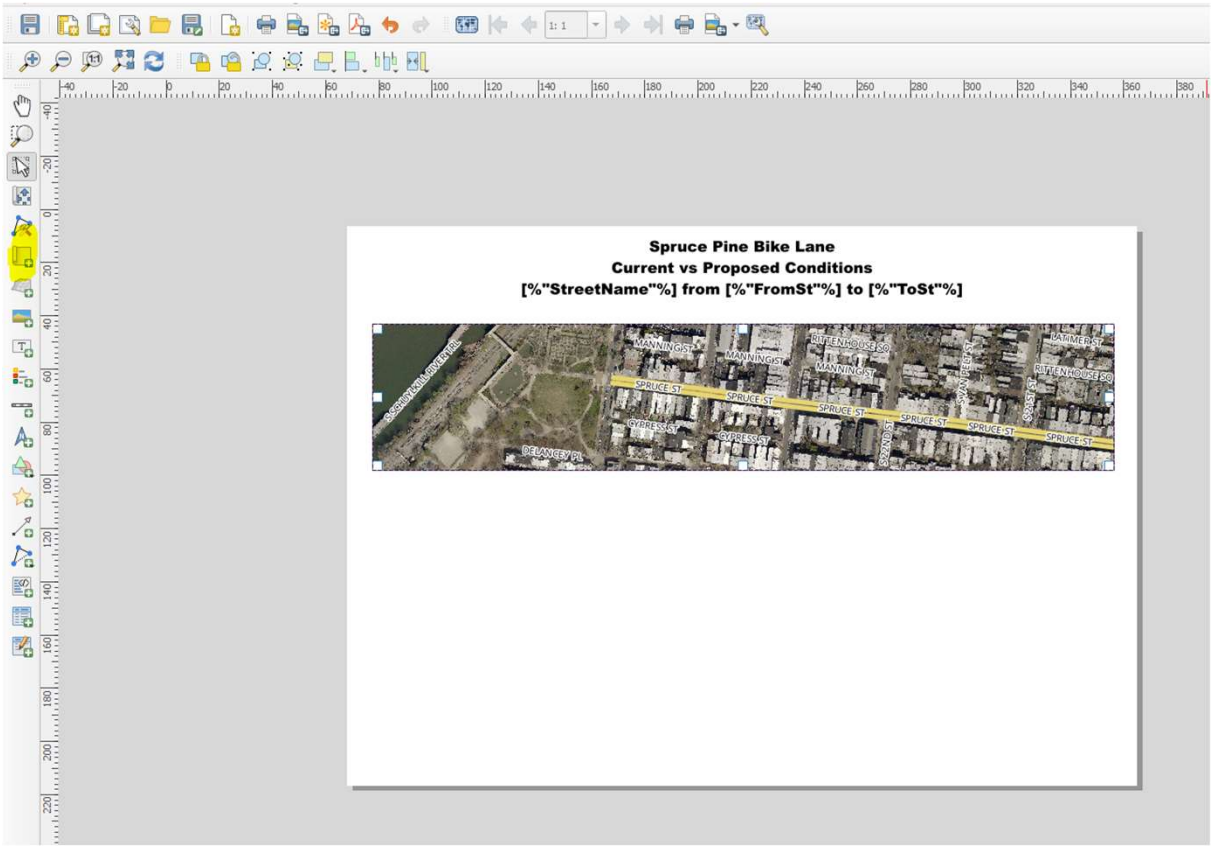
Generating an Atlas for Field Work

- The variables wrapped in square brackets can be easily added while typing out the static components of the label by clicking on the **Dynamic Text** dropdown, then selecting **Field** and the appropriate data field from the atlas data layer:



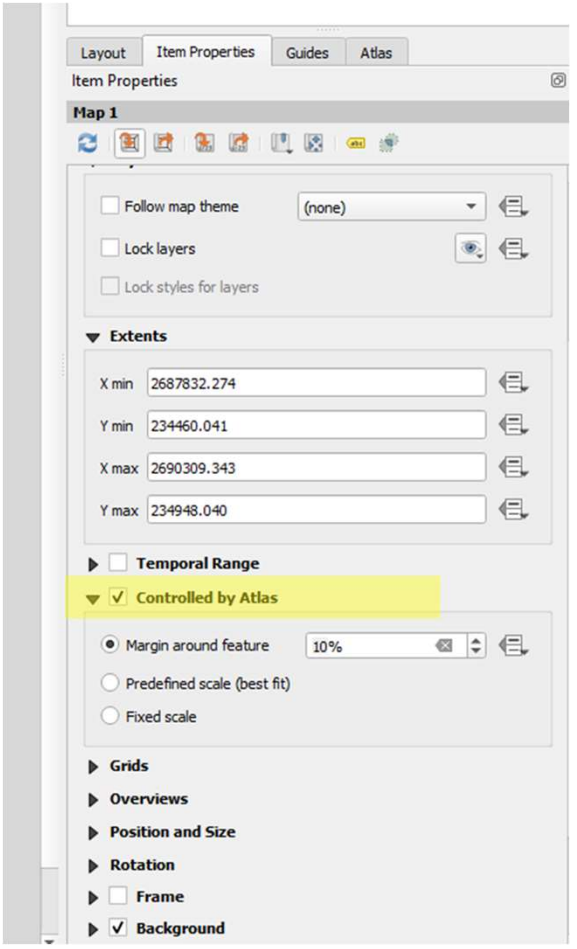
Generating an Atlas for Field Work

- Next, add a map view.



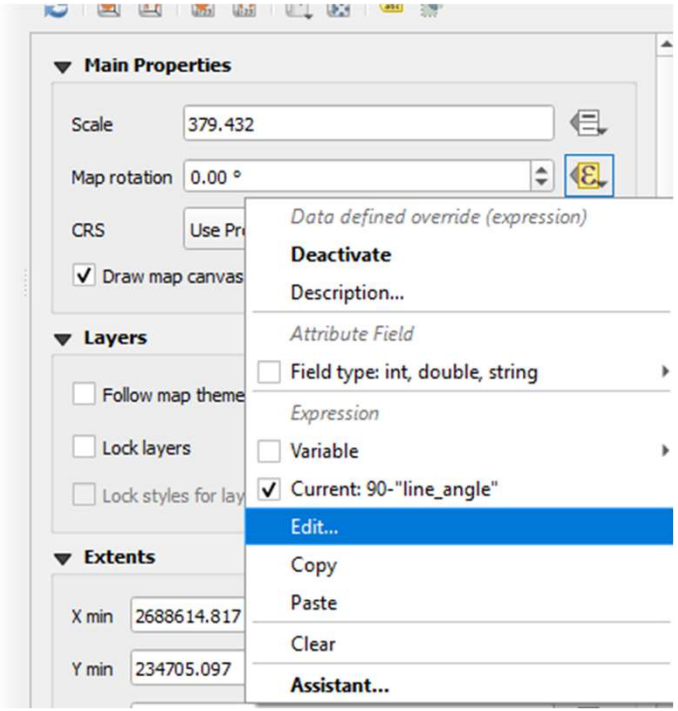
Generating an Atlas for Field Work

- Under item properties for the new map, check "Controlled by Atlas"



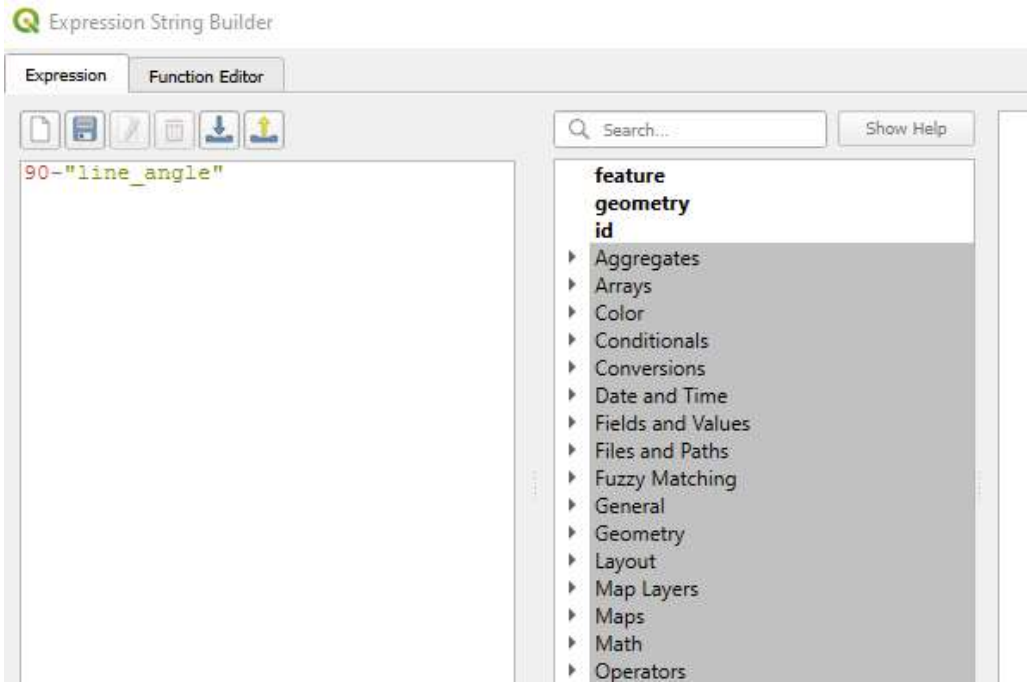
Generating an Atlas for Field Work

- Next, set the map rotation under main properties. Click the box to the right of **Map rotation** and click **Edit…** in the dropdown



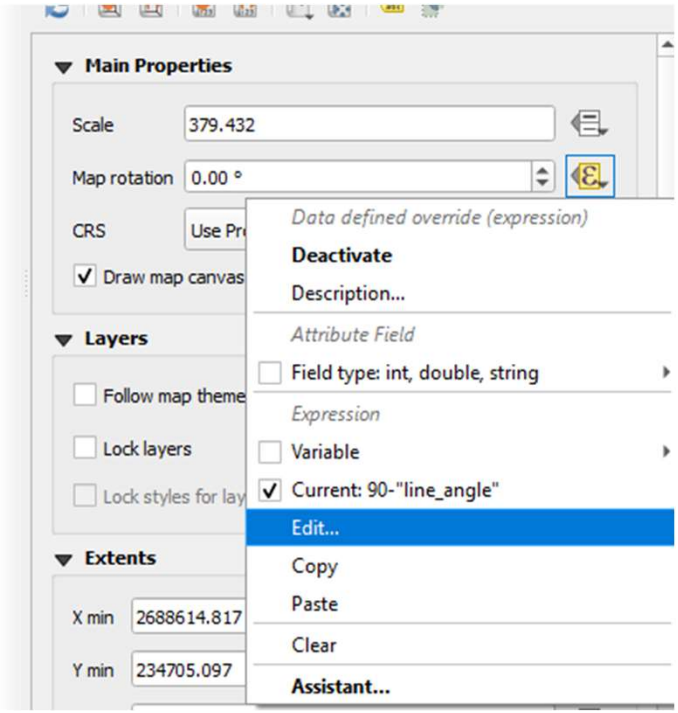
Generating an Atlas for Field Work

- Enter the expression **90-"line_angle"** into the expression box
- Click **OK**



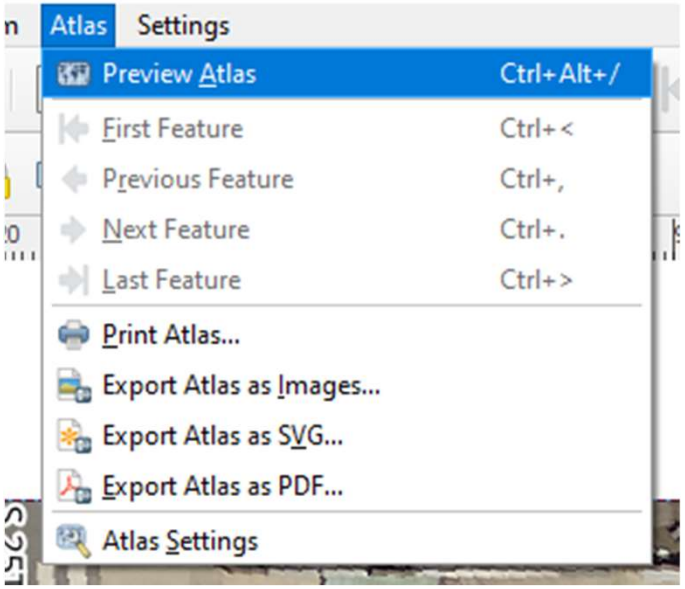
Generating an Atlas for Field Work

- Be sure the **Current: 90-"line_angle"** box is checked in the dropdown



Generating an Atlas for Field Work

- At this point, we can begin to see our data driven atlas if we would like. Click on Atlas, Preview Atlas:



Generating an Atlas for Field Work

- QGIS will generate the atlas pages. This may take a moment. When it's done, we should now have one page per atlas data feature. You can click through the generated atlas pages with the left and right arrows in the menu bar, or you can select any individual page with the dropdown.

Generating an Atlas for Field Work

- Next, copy/paste the map pane to create a second map pane below the first and add some labels to distinguish them.

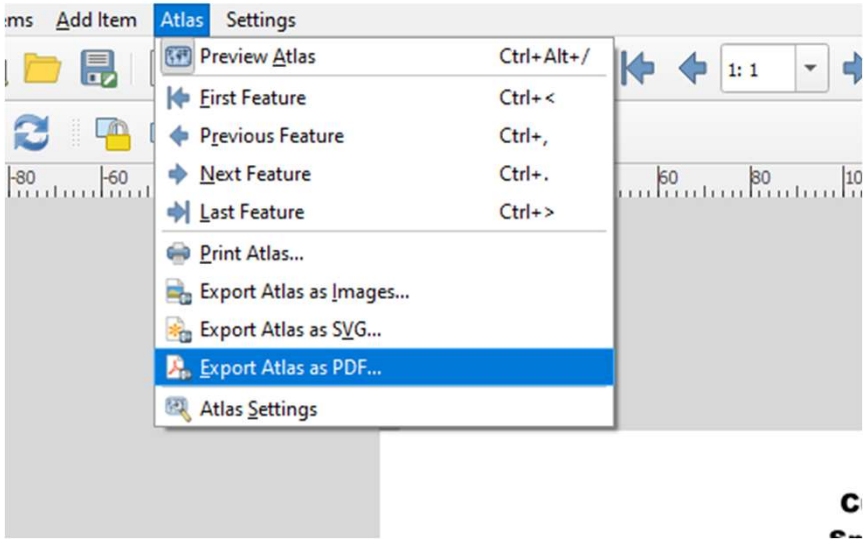
3RD Street Bike Lane
Current vs Proposed Conditions
3RD St from South to Lombard

Current Condition

Proposed Condition:

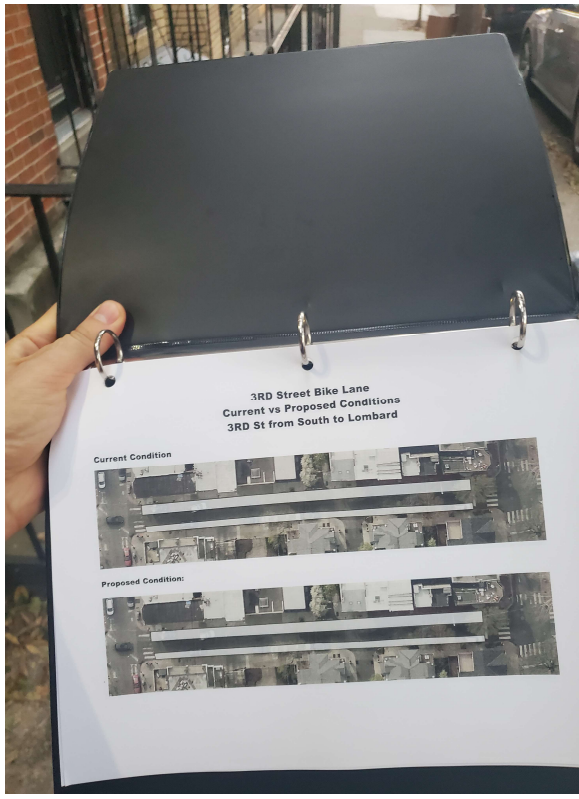
Generating an Atlas for Field Work

- Make sure to save your atlas layout when you have finished your changes. The layout is saved independently of the main project. Finally, when you are ready to export your field work atlas, you may do so under the Atlas menu item:



Generating an Atlas for Field Work

- You will be prompted for a file name and location as well as some rendering options. After entering this information, QGIS should export the atlas as a pdf to your selected location. Look at the pdf file and verify its what you want. Then print the file (grayscale or color is fine). Hole punch and secure in a binder.



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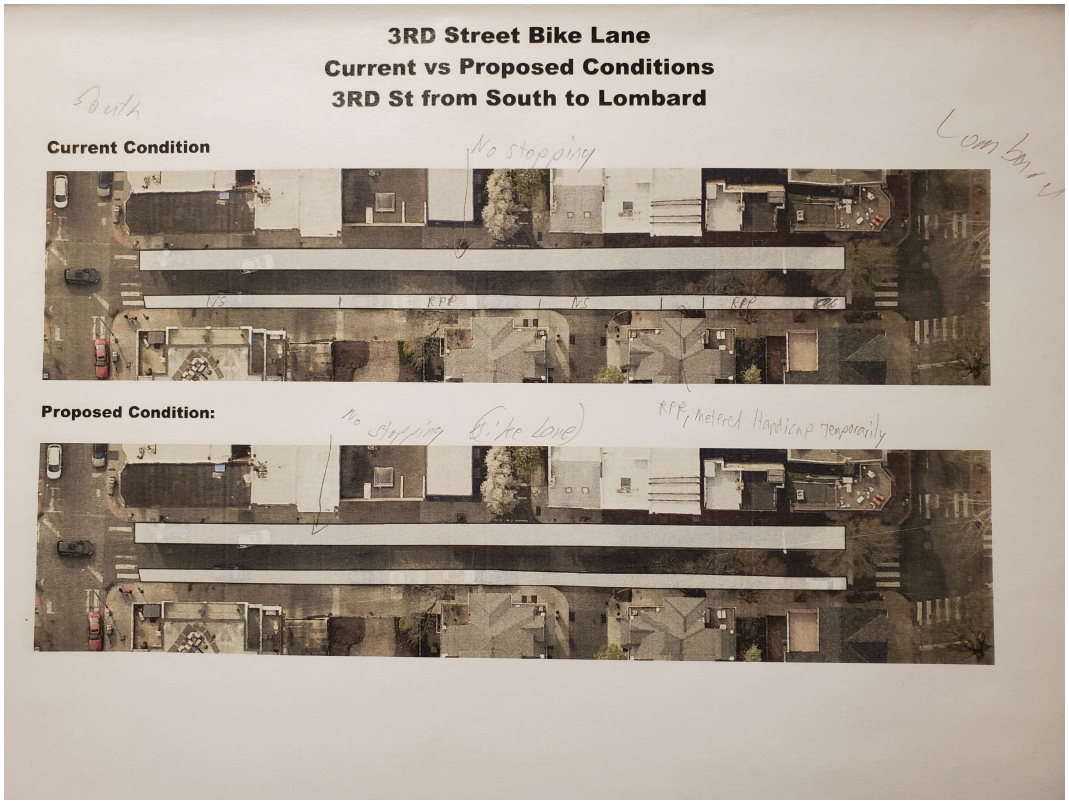
Field Work!

Field Work

- This is the fun part! With binder and pencil in hand, make your way to the street of interest.

Field Work

- Look at the signs and use the blank white space to mark what each area is used for. Use the edges of streets and buildings to help guide you.
- Zones you want to mark
  - No stopping
  - Bike lanes
  - Residential Parking
  - Metered parking
  - Bus zones
  - Handicap zones
  - Loading zones
  - And others!
- You may choose to write in your proposed changes while in the field or wait until after you have mapped everything in GIS



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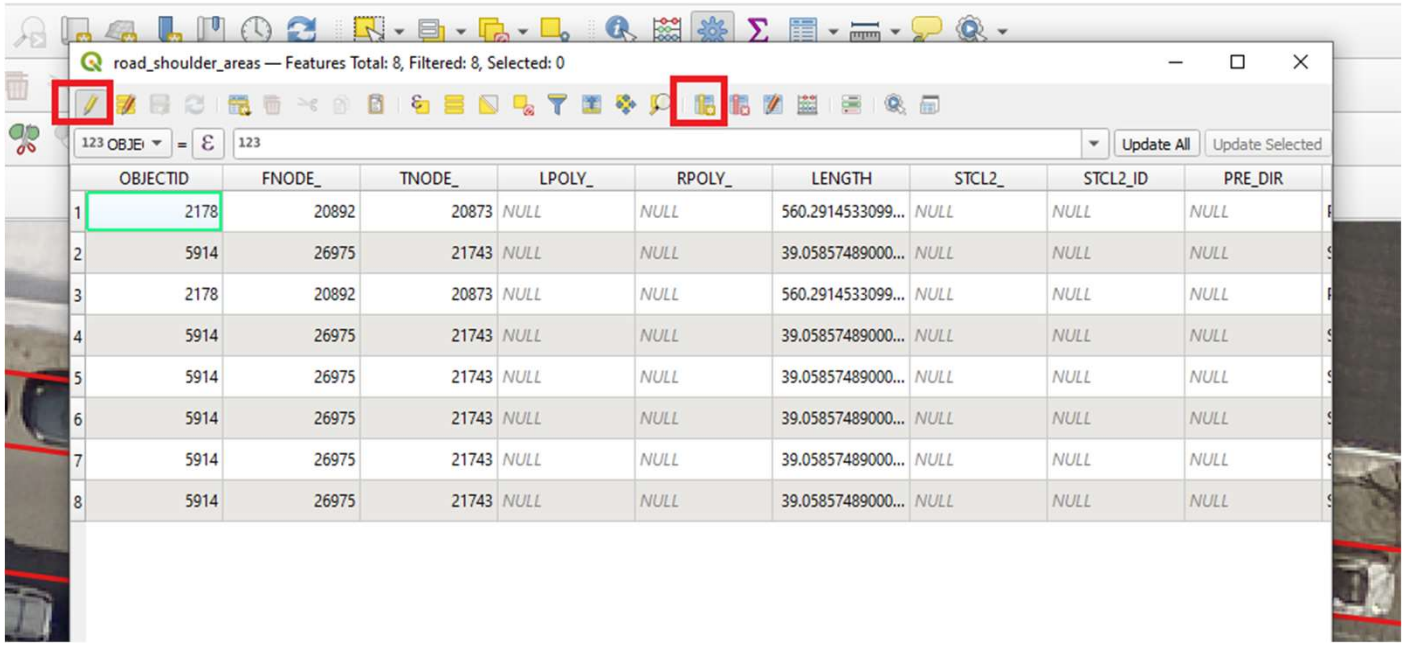
Adding Classifications to Road Shoulder Areas

Adding classifications to road shoulder areas

- To classify areas we marked during our field work, we will need to add a new data column to the attribute table and then populate that with data identifying the classification. To make this population easier, we can first modify the attribute form in the layer properties.

Adding classifications to road shoulder areas

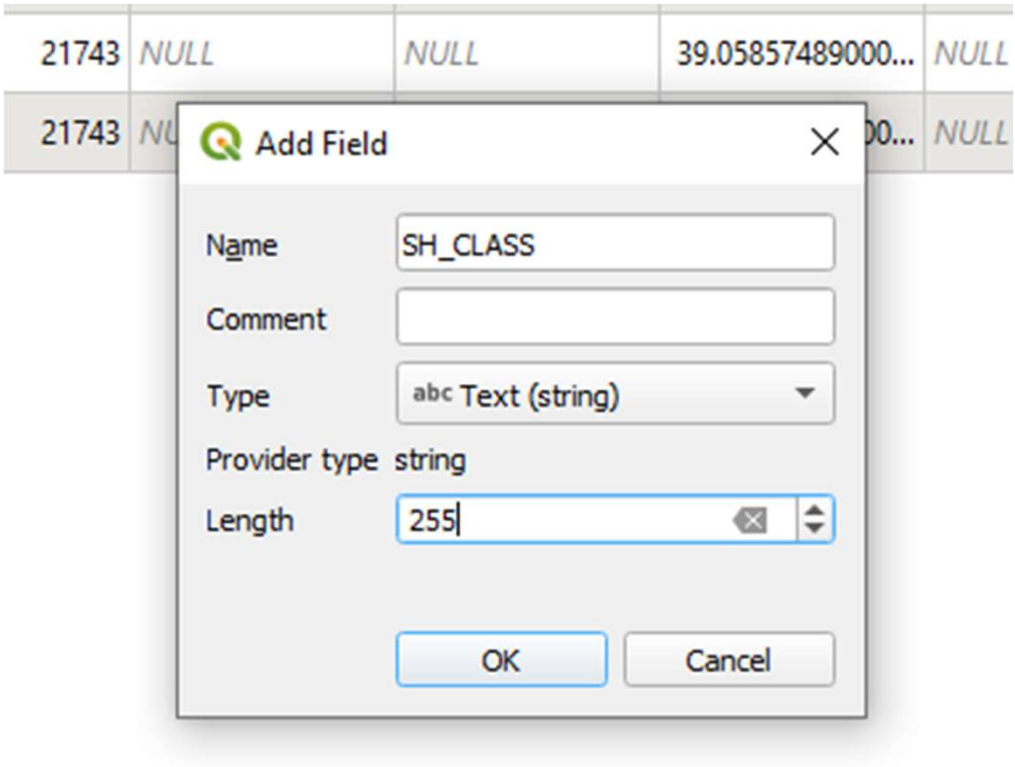
- First, open the **road_shoulder_area** polygon **layer attribute table**, begin an edit session and then **create a new attribute**.



	OBJECTID	FNODE_	TNODE_	LPOLY_	RPOLY_	LENGTH	STCL2_	STCL2_ID	PRE_DIR
1	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL
2	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL
3	2178	20892	20873	NULL	NULL	560.2914533099...	NULL	NULL	NULL
4	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL
5	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL
6	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL
7	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL
8	5914	26975	21743	NULL	NULL	39.05857489000...	NULL	NULL	NULL

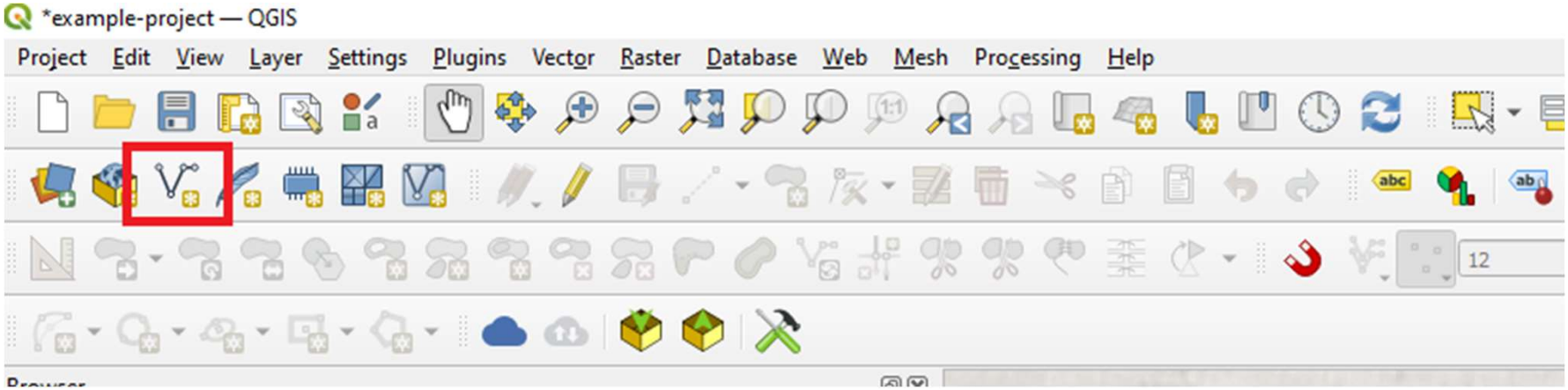
Adding classifications to road shoulder areas

- For our example, we will create a field named, **SH_CLASS** of type **Text** and a length of **255**. Click **OK**, save the edits and end the edit session.



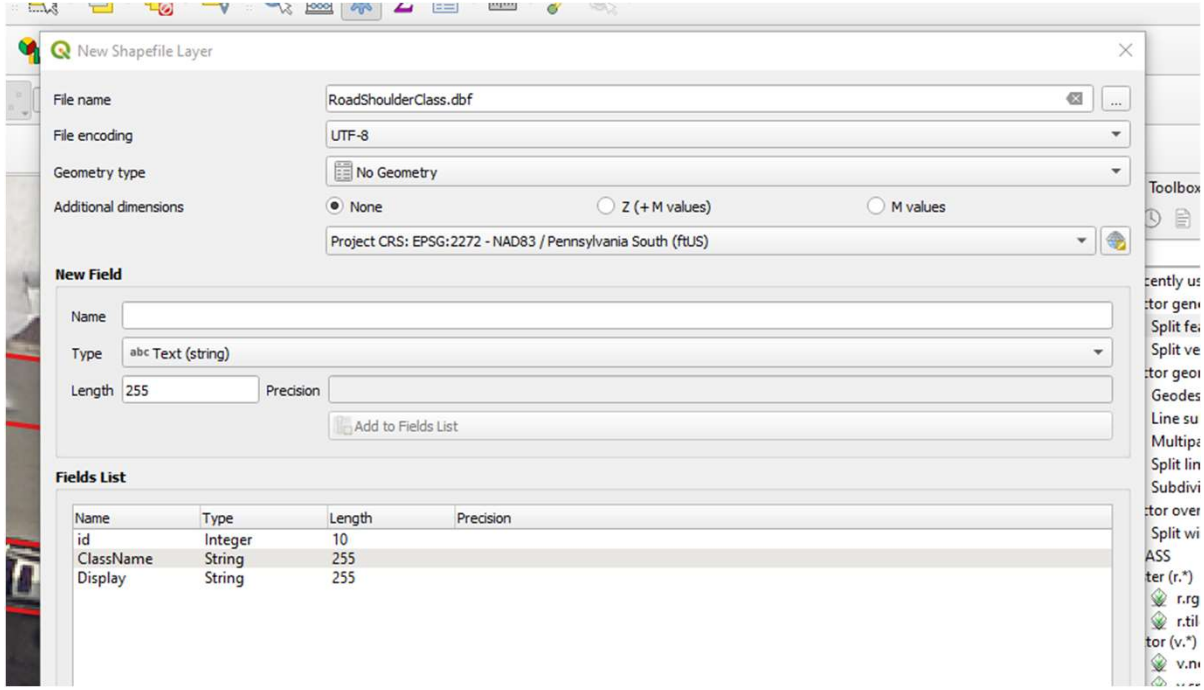
Adding classifications to road shoulder areas

- Next, we want to create a definition of the classifications we're using and map the populated values to display values. **Click on new shapefile layer**.



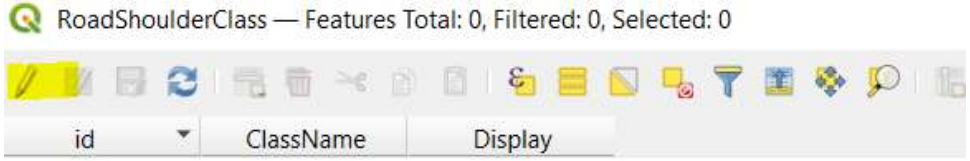
Adding classifications to road shoulder areas

- Next, give the file a name (**RoadShoulderClass**) and set the geometry to **No Geometry**. Then add two fields: **ClassName**, **Display**, both with a length of **255**. Click **OK**.

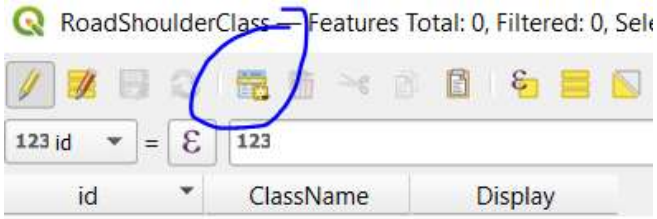


Adding classifications to road shoulder areas

- Next, **open the attribute table** for the newly created **RoadShoulderClass** layer and click **Edit**



- Click the **Add features** button. The ClassName field will be a coded value stored in the new data layer while the Display Value will be displayed to the user during entry.



Adding classifications to road shoulder areas

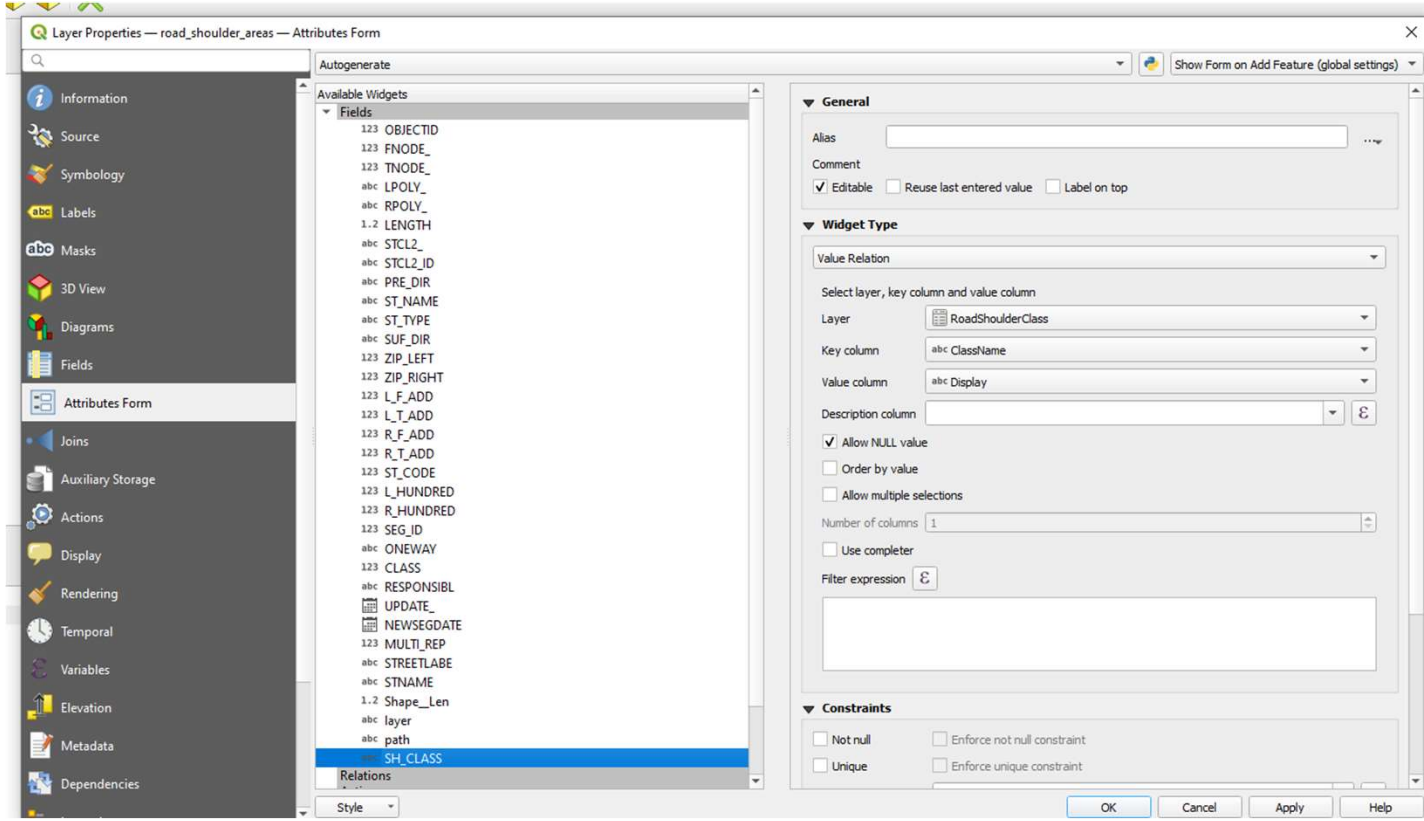
- Add the classifications for your project. The table here is a suggestion although your project may involve more or less. It is vital that the **ClassName** field is kept unique and that there are no duplicate values. When done, **save** the edits and end the edit session.

RoadShoulderClass — Features Total: 14, Filtered: 14, Selected: 0

	id	ClassName	Display
1	1	*NULL*	*NULL*
2	2	RPP	Residential Permit Parking
3	3	MP	Metered Parking
4	4	LZ	Loading Zone
5	5	NS	No Stopping
6	6	BLNP	Bike Lane (No Parking)
7	7	BLNS	Bike Lane (No Stopping)
8	8	MPM	Motorcycle Parking (Metered)
9	9	HP	Handicap Parking
10	10	HPM	Handicap Parking (Metered)
11	11	BS	Bus Stop
12	12	CP	Consul Parking
13	13	V	Valet
14	14	NP	No Parking

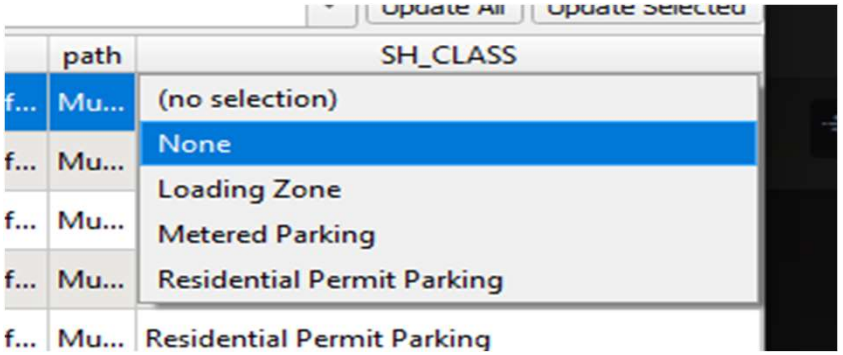
Adding classifications to road shoulder areas

- Next, open the **road_shoulder_area** layer **properties**, click on the **attributes form tab** and select the **SH_CLASS** field we just created. Change the **widget type to Value Relation**, set the **Layer to the classification layer** we just created, the **key column** to **ClassName** and the **Value column to Display**. Check **allow NULL** value. Click **Apply and OK**.



Adding classifications to road shoulder areas

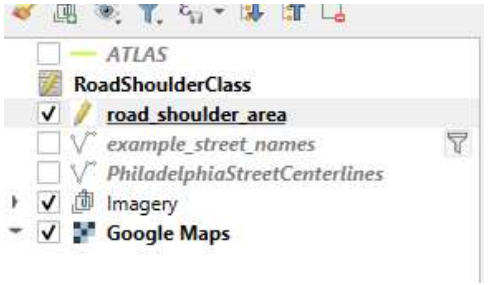
- Now, for every road shoulder polygon segment, we can select from user friendly values in a dropdown in the attribute table to update each to the correct classification:



- Classify all polygons so that the current conditions are accurately modeled for the purposes of the project.

Classifying Polygons

- To classify, first select the **road_shoulder_area** layer

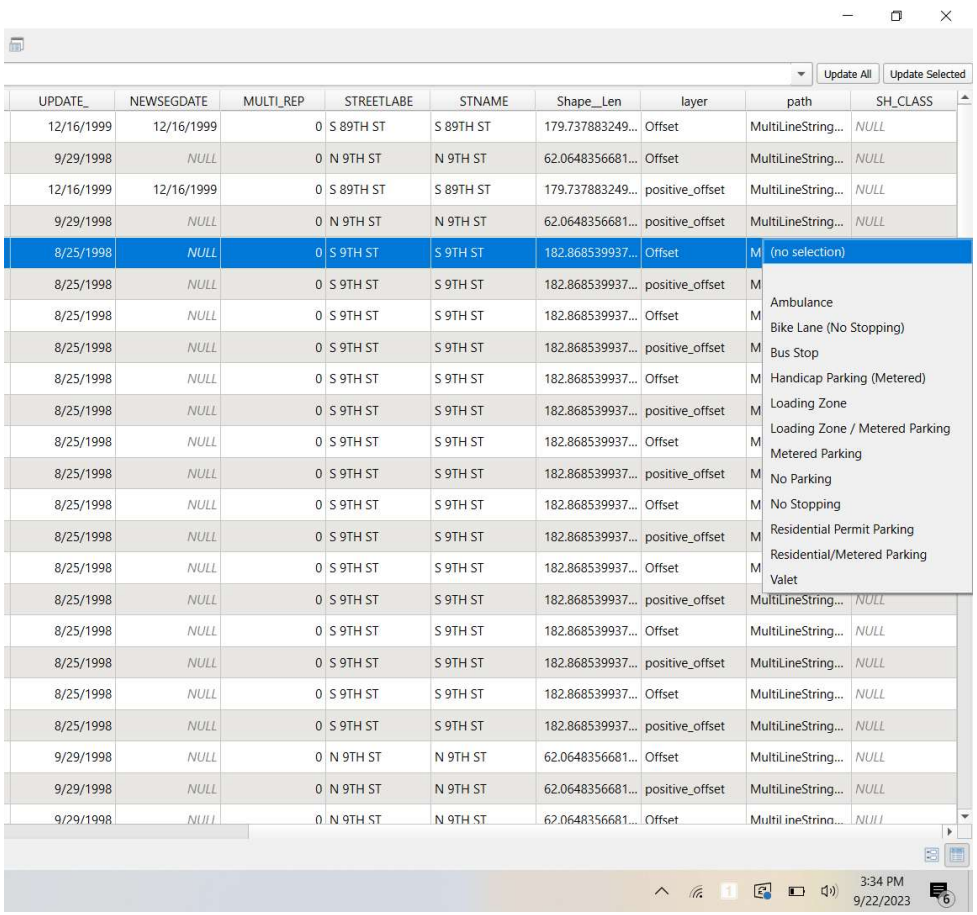


- Next, click the **edit** tool

- Use the **split feature** tool to cut the polygons to match your field work

Classifying Polygons

- Once the polygons are split appropriately, open the Attributes table of the **road_shoulder_area** layer
- With the attribute table open, use the select tool to select the polygon of interest. This will highlight the entry in the attribute table and allow you to classify it.
- Repeat until all polygons are classified
- It may be easier to finish the "**Setting Map Symbology**" portion of this guide before classifying so that you can see your progress as you classify



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Setting Map Symbology

Color Coding Standards

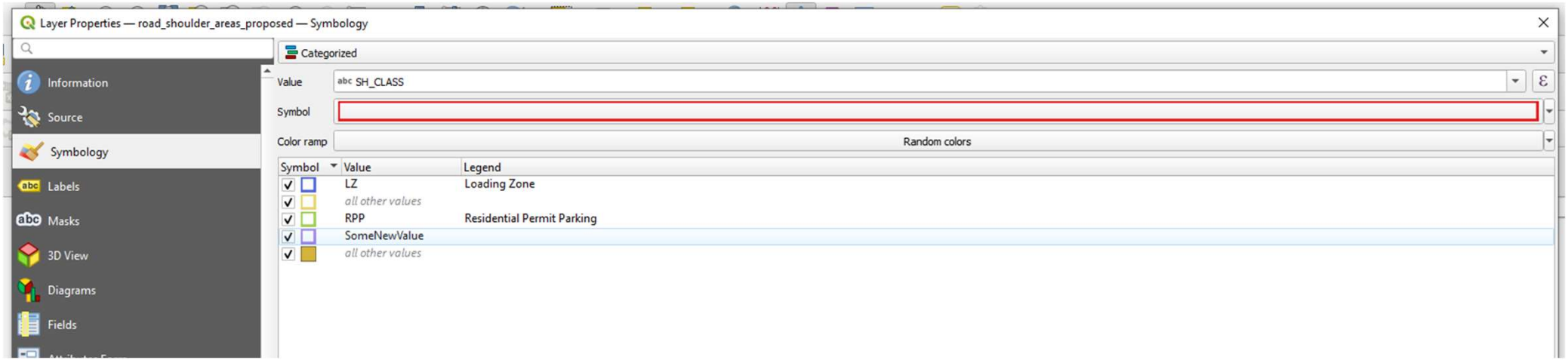
- Loading zone, Bike Lane (no parking): rgb (8 , 250, 7)
- No stopping, Bike Lane (no stopping): rgb (255, 1, 36)
- Residential Parking Permit, Motorcycle Parking (metered), Metered parking: rgb (247, 253, 2)
- Handicap Parking, Handicap Parking (metered): rgb (1, 233, 243)
- Bus stop: rgb (4, 0, 255)
- No parking: rgb (252, 164, 5)
- Valet: (125, 0, 143)

Setting Map Symbology

- Next, we want to be sure that our map symbology is set how we want it for the map output. Right click on the **road_shoulder_area** polygon layer. Click **properties**. Click the **symbology** tab. Set the **type to categorized**, the value to **SH_CLASS** and then click the **Classify** button. This will add a symbol for each unique value of **SH_CLASS**.

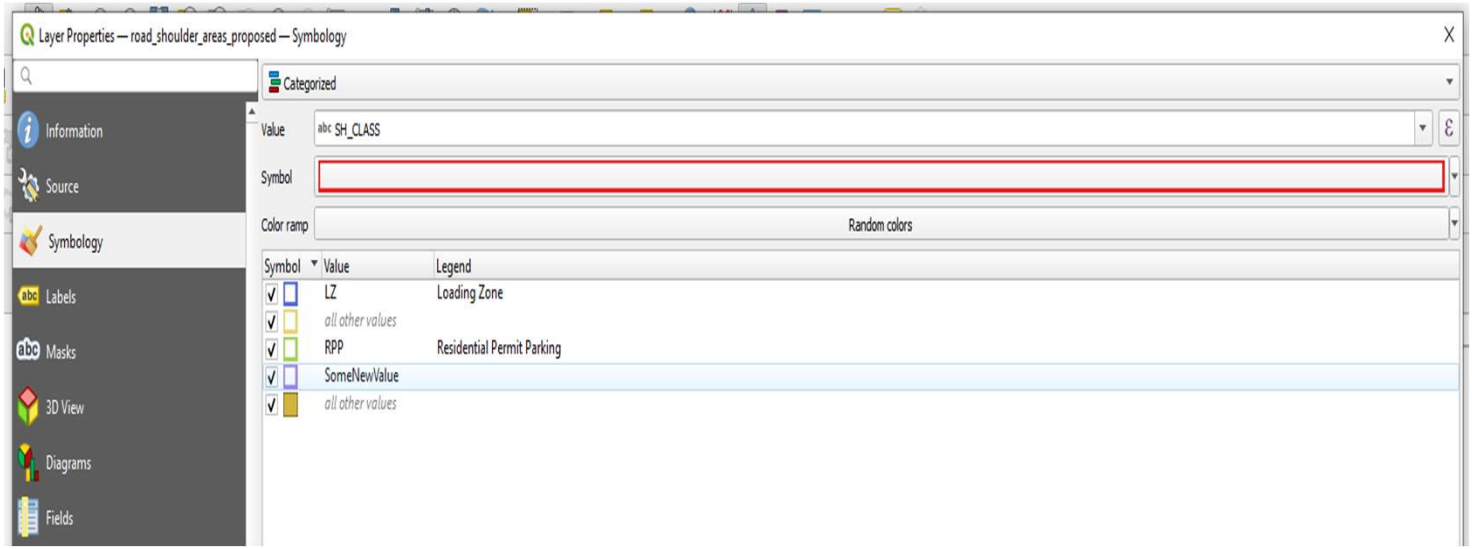
Setting Map Symbology

- If there are values of **SH_CLASS** that do not exist in the existing conditions layer but may exist in the proposed conditions layer, then these values may need to be added manually. We're going to copy the symbology from this layer to the proposed layer when we create it, so ideally, we only want to set the symbols once and then copy/paste them without having to manually recreate them, so add those now if necessary. Press the **plus button to add a new entry and then manually set the Value to the value of SH_CLASS** that the symbol will correspond to.



Setting Map Symbology

- Double click on each symbol and set its symbology. In the symbol selector, you can compose many different symbol components, such as outlines, fills, images, etc. Press the **Plus button** to add a new symbol component. Highlight a symbol component and click the minus icon to remove it.



Adding a Centroid Fill

- In many cases, you may wish to add markers within your symbology
- Do this by adding a centroid fill layer over the color layer
- Add an SVG or font marker and choose the appropriate color and size

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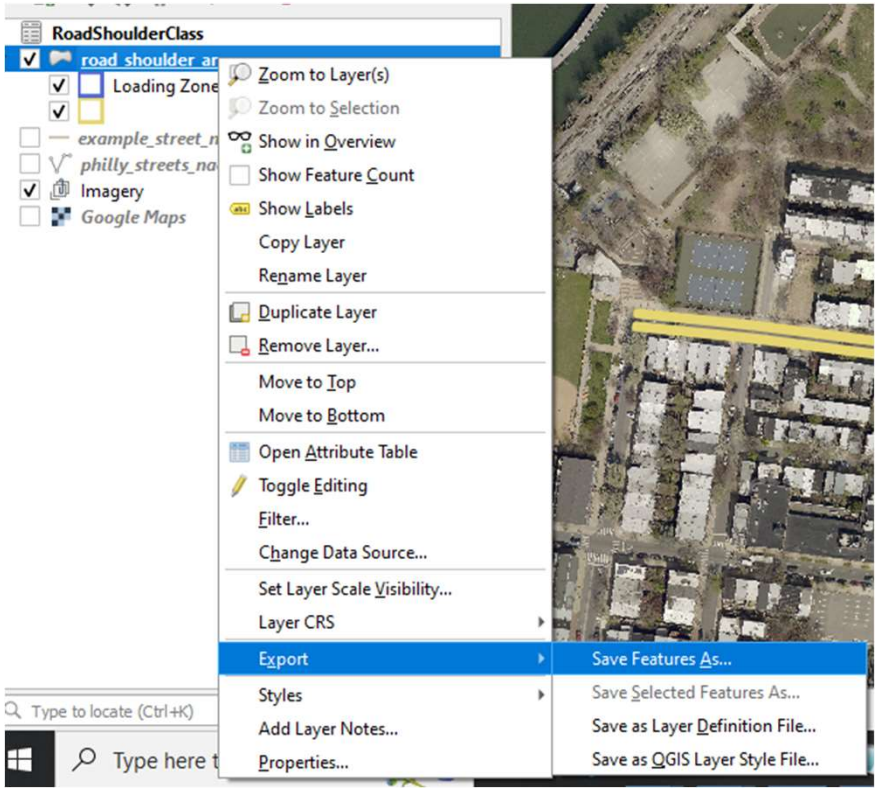
Layer Duplication for Proposed Conditions

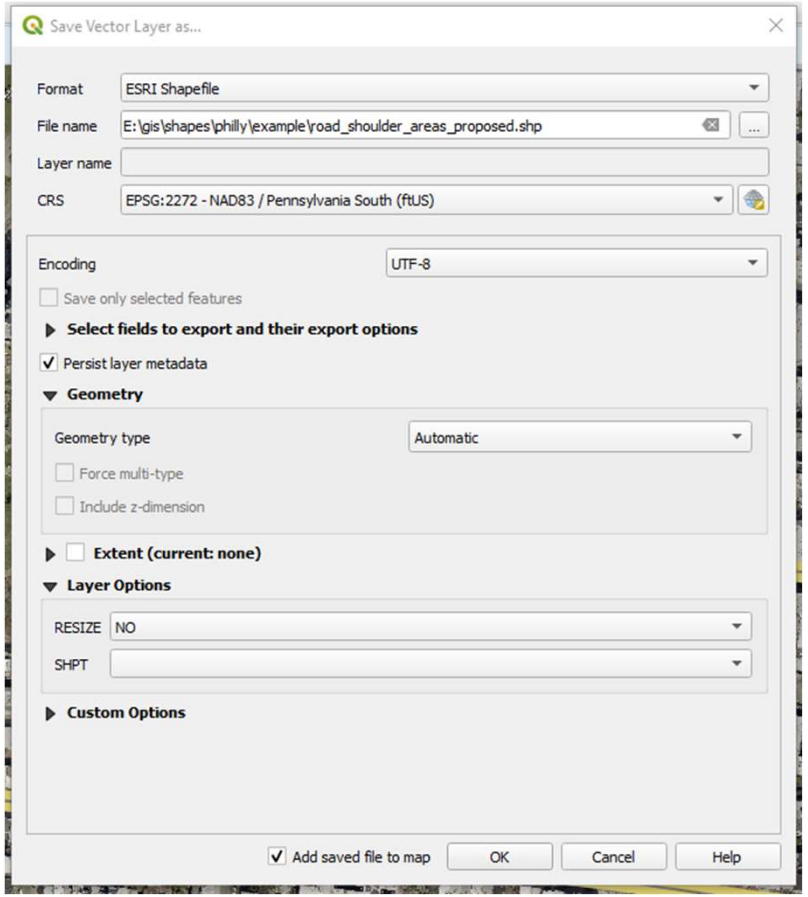
Layer Duplication for Proposed Conditions

- In addition to the existing conditions, we are also going to want to show proposed conditions. Now that the existing conditions have been modeled, we can use that layer as a starting point for the proposed conditions. Begin by duplicating the layer. **Right click on the road shoulder areas layer** and rename it as "**Current Conditions**". Then, in the Layers window and click **Export, Save Features As**.



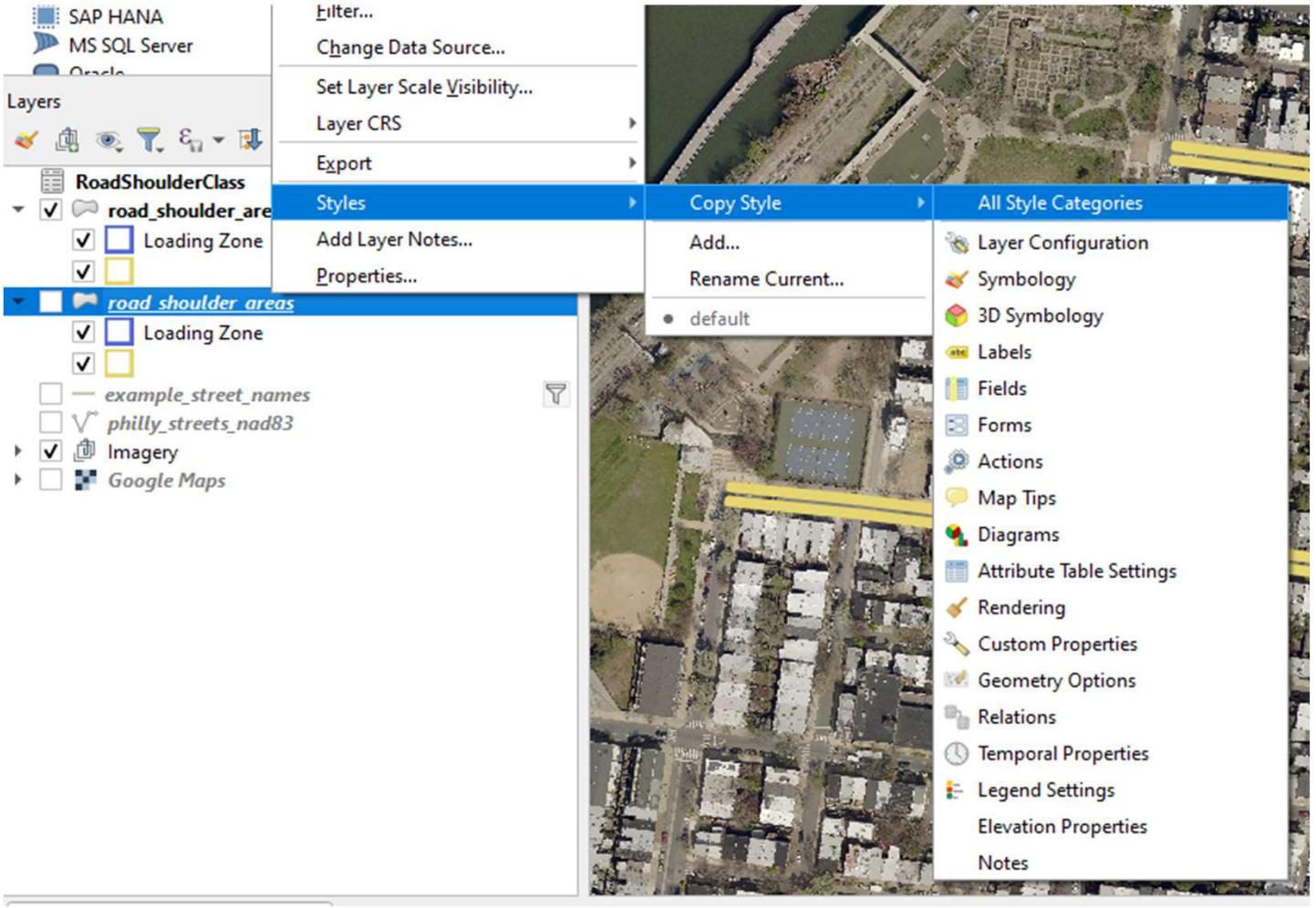
Layer Duplication for Proposed Conditions

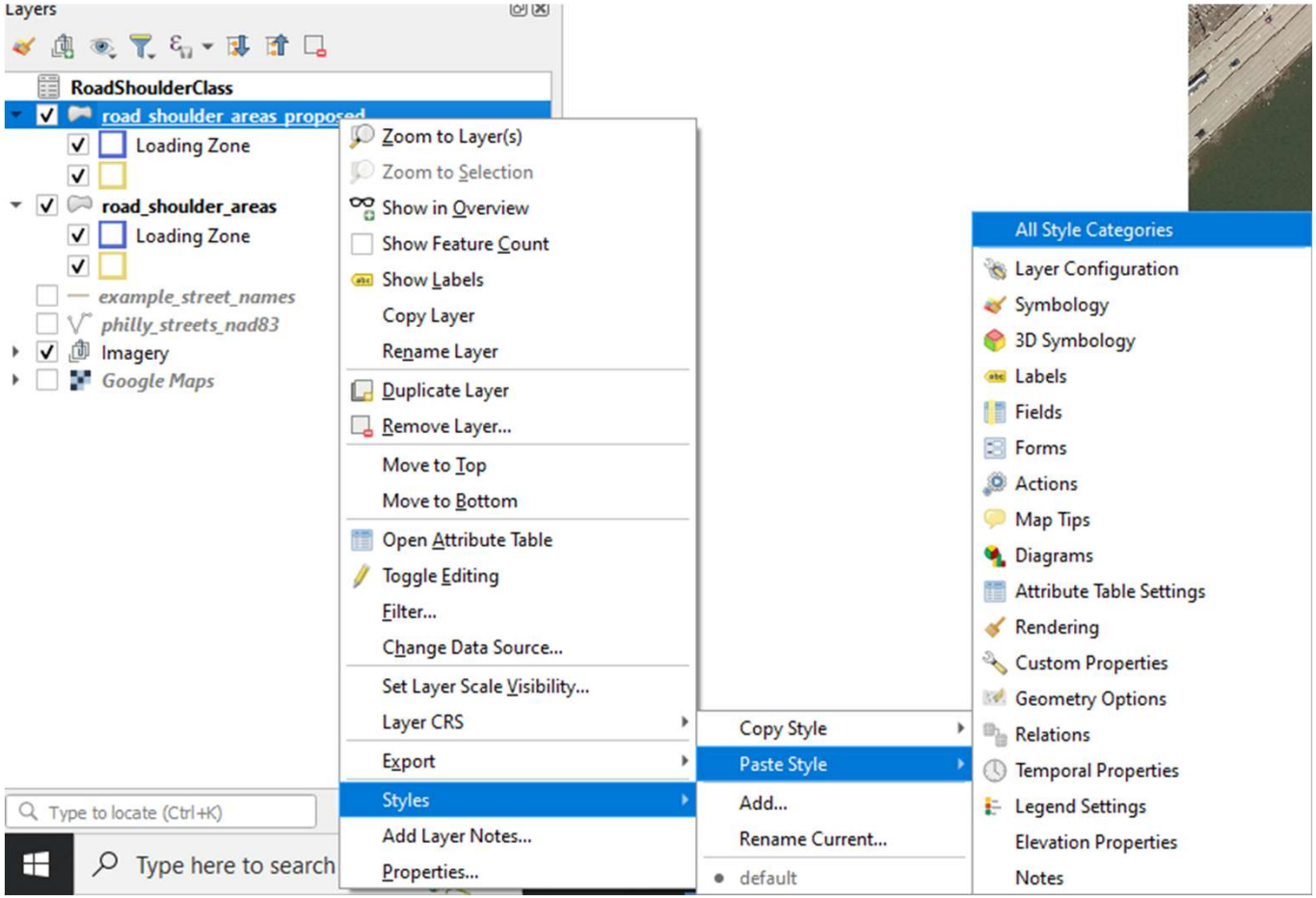
- In the **Save Vector Layer dialog, select ESRI Shapefile** and designate a path and filename in the project directory structure. Name it "**Proposed Conditions**".



Layer Duplication for Proposed Conditions

- Copy all symbology to the new layer (**Proposed conditions)** as well as the relationship to the classification table, so you can now go through the proposed conditions layer and reassign classifications as necessary.


SAP HANA
MS SQL Server
Layers
RoadShoulderClass
road_shoulder_are
Loading Zone
road_shoulder_areas
Loading Zone
example_street_names
philly_streets_nad83
Imagery
Google Maps
Filter...
Change Data Source...
Set Layer Scale Visibility...
Layer CRS
Export
Styles
Add Layer Notes...
Properties...
Copy Style
Add...
Rename Current...
default
All Style Categories
Layer Configuration
Symbology
3D Symbology
Labels
Fields
Forms
Actions
Map Tips
Diagrams
Attribute Table Settings
Rendering
Custom Properties
Geometry Options
Relations
Temporal Properties
Legend Settings
Elevation Properties
Notes


Layers
RoadShoulderClass
road_shoulder_areas_proposed
Loading Zone
road_shoulder_areas
Loading Zone
example_street_names
philly_streets_nad83
Imagery
Google Maps
Zoom to Layer(s)
Zoom to Selection
Show in Overview
Show Feature Count
Show Labels
Copy Layer
Rename Layer
Duplicate Layer
Remove Layer...
Move to Top
Move to Bottom
Open Attribute Table
Toggle Editing
Filter...
Change Data Source...
Set Layer Scale Visibility...
Layer CRS
Export
Styles
Add Layer Notes...
Properties...
Copy Style
Paste Style
Add...
Rename Current...
default
All Style Categories
Layer Configuration
Symbology
3D Symbology
Labels
Fields
Forms
Actions
Map Tips
Diagrams
Attribute Table Settings
Rendering
Custom Properties
Geometry Options
Relations
Temporal Properties
Legend Settings
Elevation Properties
Notes
Type to locate (Ctrl+K)
Type here to search

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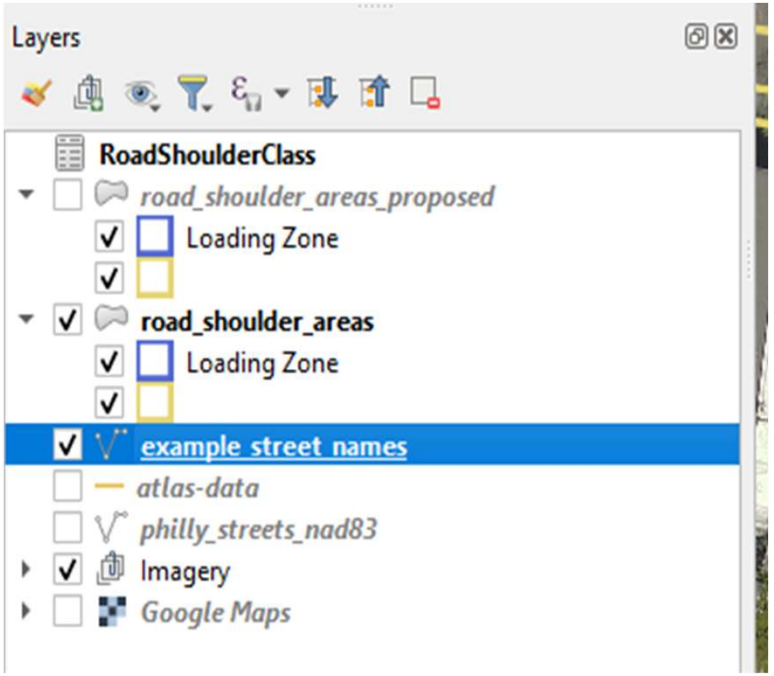
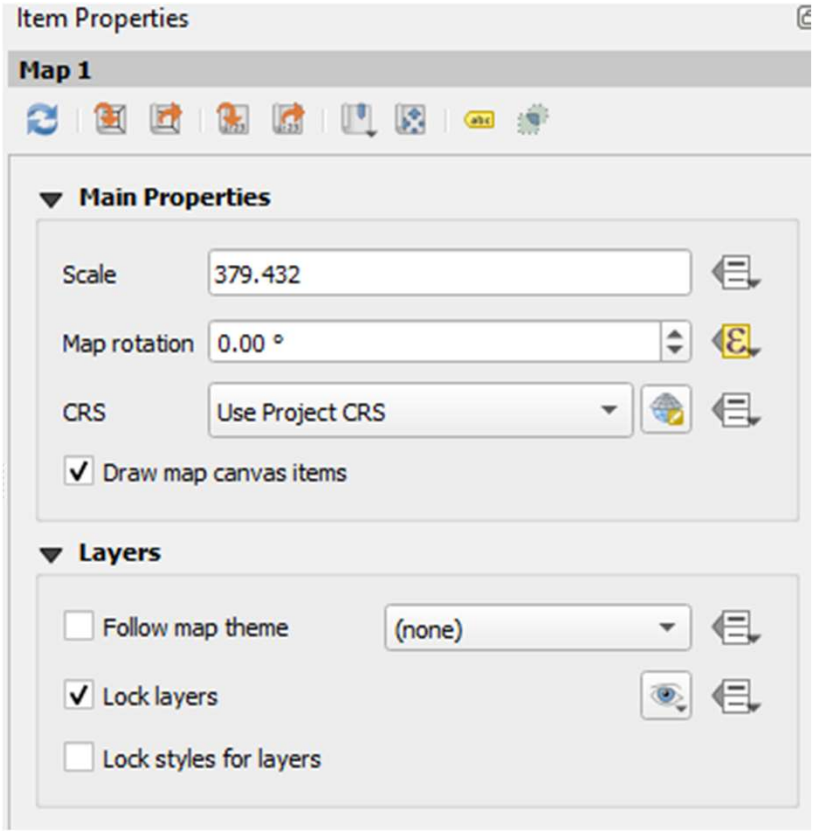
Locking Atlas Layers

- Right now, both map panes are synced to the layers in the main QGIS window, but they can be locked at any time. We're going to take advantage of that fact by first selecting only the existing conditions, locking the existing conditions map pane, then disabling the existing conditions layer and instead enabling the proposed conditions layer and locking the second pane.
- First, enable the **current conditions** layer and disable the **proposed conditions** layer:



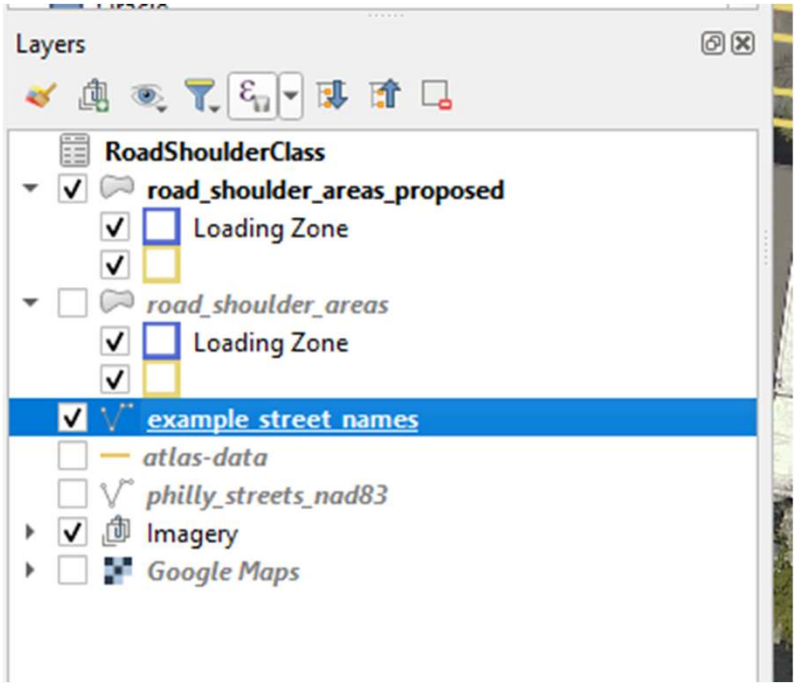
Locking Atlas Layers

- Then, go into the **layout** window and select the existing conditions map pane. Under layers, **click lock** layers.



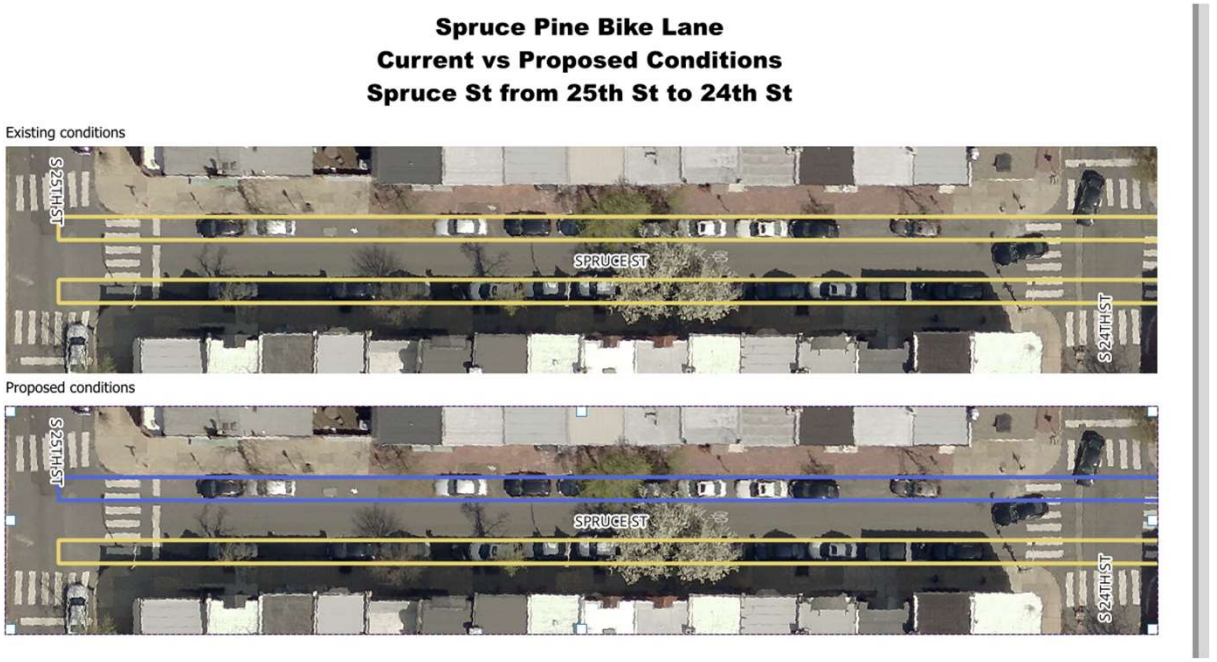
Locking Atlas Layers

- Then, go back to the main QGIS window and deselect the **current conditions** layer and select the **proposed conditions** layer.



Locking Atlas Layers

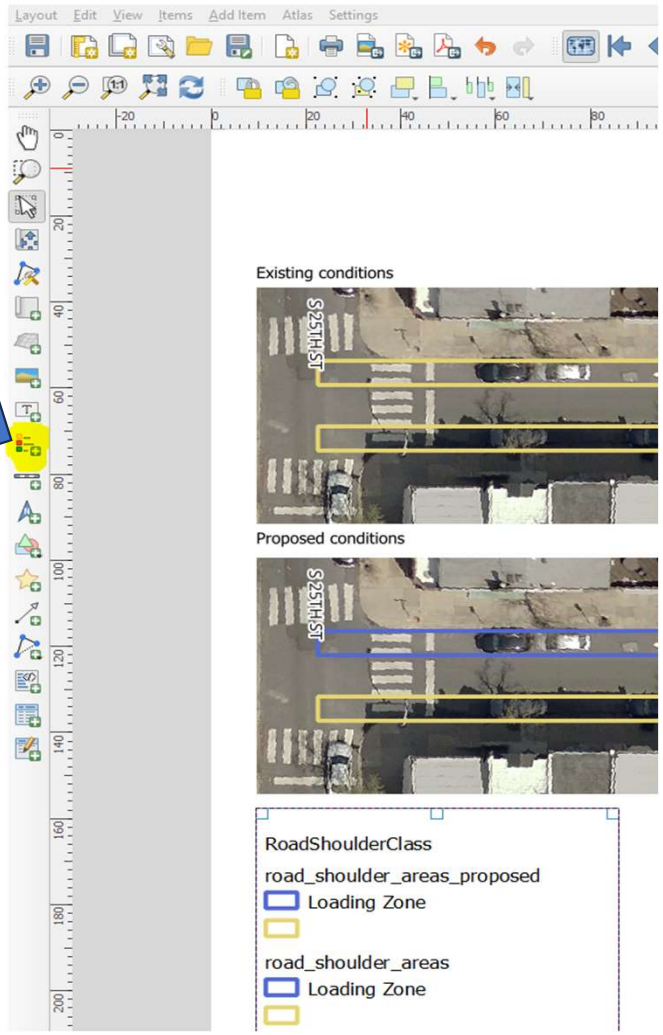
- Then, in the layout window, for the proposed conditions map pane, **check lock layers**. Now the top pane should display the existing conditions layer and the bottom pane should display the proposed conditions layer and any changes between existing and proposed within the same area boundaries should be clear.



Adding A Legend

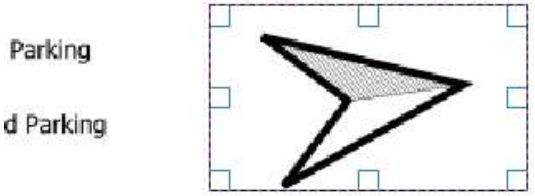
- Next, we'll add a legend. Click the button **here** to do so

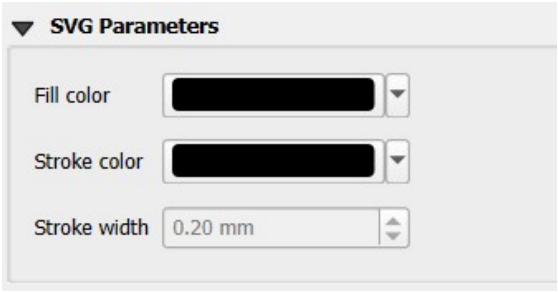
- Under item properties for the legend, **deselect** the layers we don't care to differentiate in the map. This will include all of our images/basemaps, the data layers, etc. Since our existing and proposed layers share symbology, we can leave only one copy, either the existing or the proposed.
- **Uncheck auto-update**, then click through the legend items, removing unwanted items by clicking the **minus** icon.

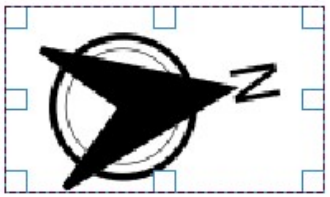


Adding a Compass

- A compass is helpful for orientation
- To add a compass, click the **compass tool**
- Drag a box over the area you want your compass
- Under **Item Properties**, change the fill color to black so the **North** orientation is visible







Adding final touches

- Very last!
- Add a PBA logo
- You can use the image in this presentation

Export File

- Export the file as a pdf
- Double check your labels in the field for correctness.
- You are all done. Reach out to Caleb if you would like your design added to the website