Geography 222

Laboratory 1

Introduction

Each day we are exposed to spatial data via news reports and media outlets. People readily link pictures to locations on maps or use GPS navigation to route around town. We wayfind our next meal by searching restaurants via google maps, or view weather reports displayed over satellite imagery. Our literacy for spatial data is ever increasing; however, the skills needed to read rather than create spatial data are vast. Creating, manipulating, and analyzing spatial data requires an understanding of geographic principles. Lab 1 is the start of gaining those skills.

In the following exercise you will learn about: spatial data models (Vector/Raster), data resolutions, and attribute data (the information linked to locations). By the end of the exercise you will know how to:

- View attribute data
- Change the spatial resolution of raster data
- Convert between raster and vector data types
- Design a map

Theory of Spatial Data Models

Vector Model - is a representation of the landscape using points, lines, and polygons. Vector geometry is best for mapping features with discrete boundaries such as:

- The location of towns, hospitals, police stations (points)
- Routing of rivers, roads, and pipelines (lines)
- Borders of country, neighbourhood, and land parcels (polygons)

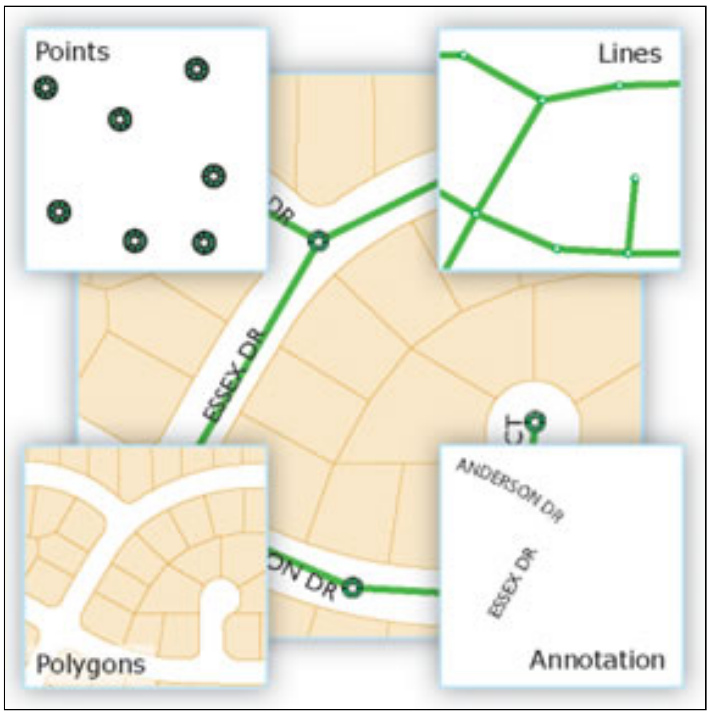


Image source: http://desktop.arcgis.com/en/arcmap/10.3/manage-data/geodatabases/feature-class-basics.htm

The fundamental building block of Vector features is a single point (x,y coordinate pair). Line features are constructed by connecting a series of points into chains (or arcs). When the lines between the points close, the feature becomes a polygon.

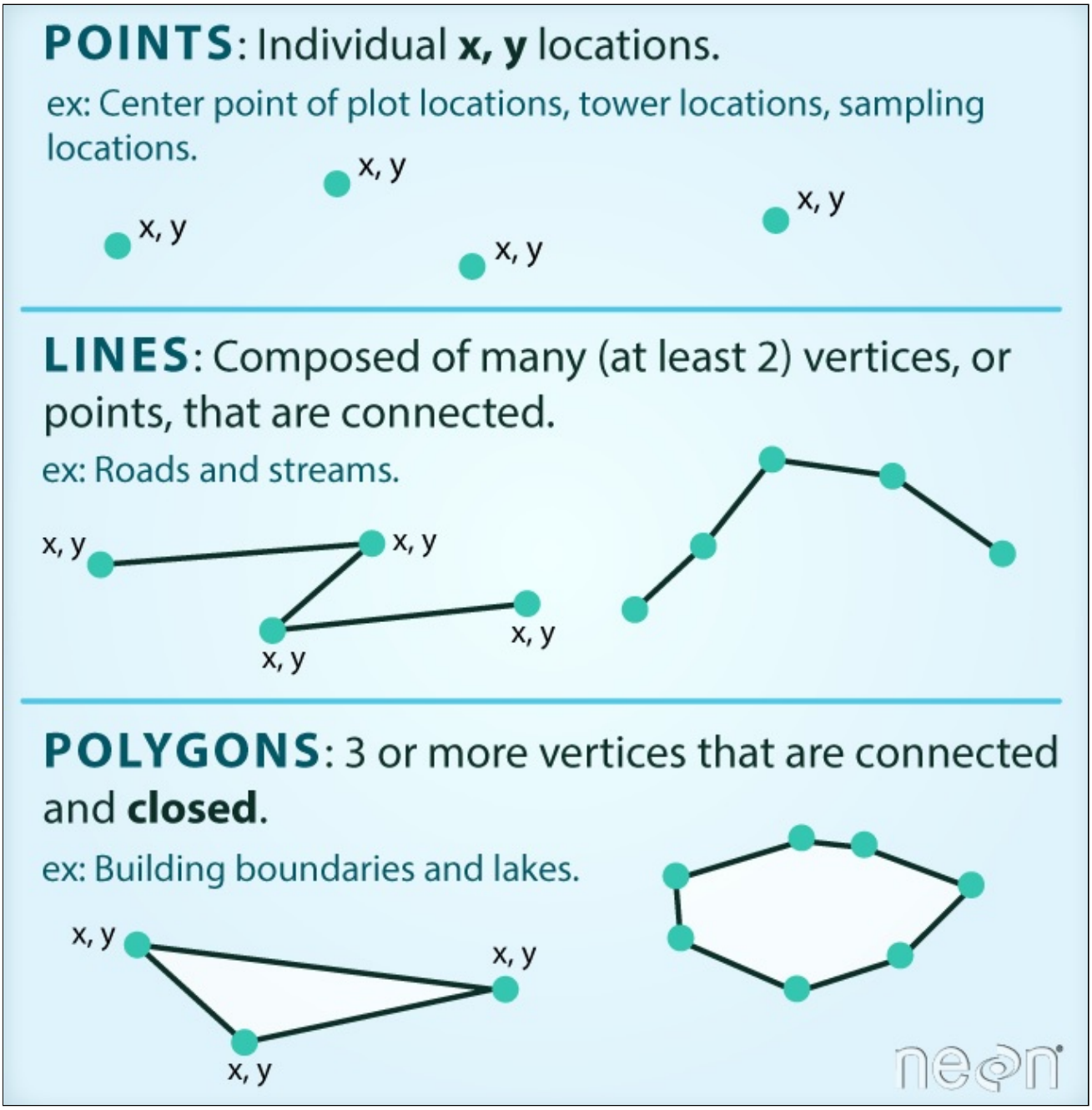


Image source: https://nceas.github.io/oss-lessons/spatial-data-gis-law/1-mon-spatial-data-intro.html

Vector data also have associated attributes. Attributes consist of text or numerical information, which describe the features at each location:

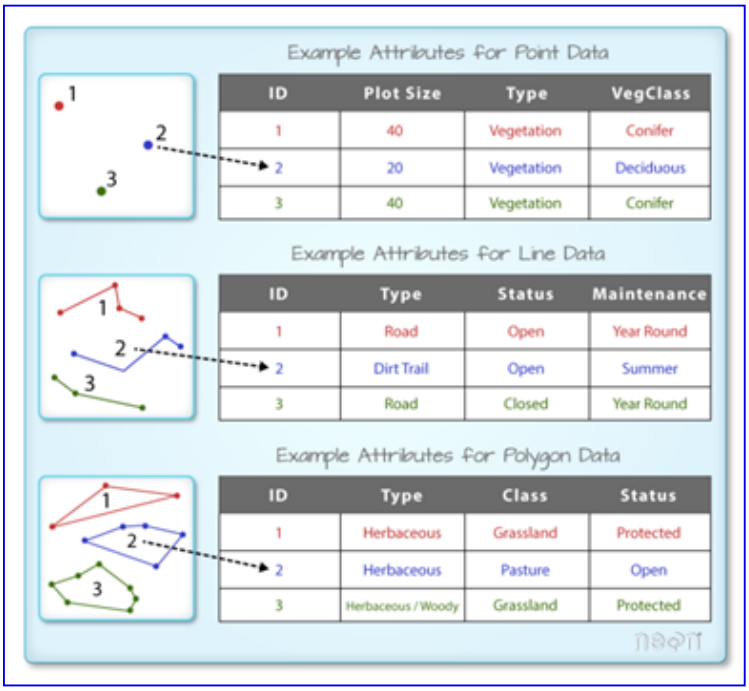


Image source: http://neondataskills.org/R/shapefile-attributes-in-R/

Raster Model - is a representation of the earth using a grid created by columns and rows. The columns and rows form what we call cells or pixels. Each pixel represents a geographical region, and the value in that pixel represents some characteristic or feature of that region (data). Attribute data associated with each cell can include:

- Discrete data: land use classes such as forest or water;
- Continuous data: percent population, elevation above sea level; or
- Spectral values: satellite imagery or aerial photography

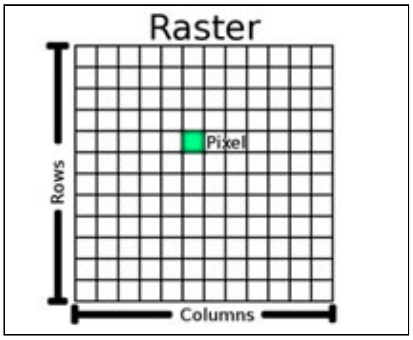


Image source: https://docs.qgis.org/2.14/en/docs/gentle_gis_introduction/raster_data.html

The shape and character of an object (e.g., lake) in a raster model is created by grouping pixels. Spatial entities are represented either by a single pixel or series of pixels, as shown in the right side of the figure below. The point is a single pixel, the river is a series of pixels, and the polygons are created by regions of pixels.

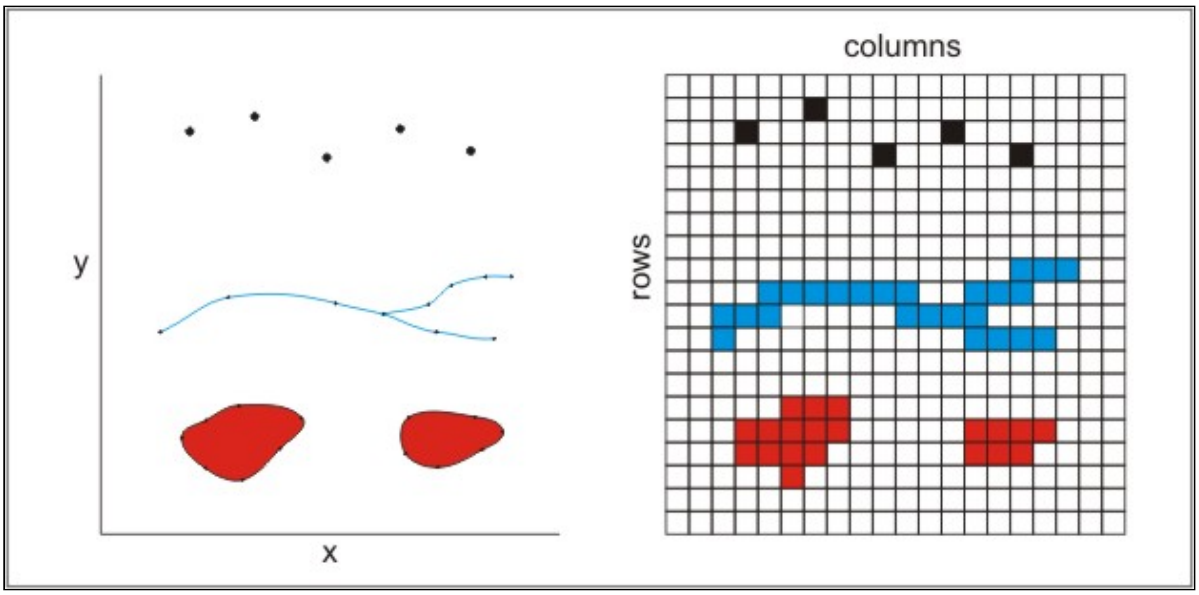


Image source: John Fowler, 2014

The spatial resolution of the raster datasets is defined by the size of the pixel. For example, each pixel in an image can represent 5m x 5m ($25m^2$), 25m by 25m ($625m^2$), or any other sized resolution that fits in the image extent (i.e., border).

Generally, raster resolution is stated as metres not metres squared. For example, a 20m resolution means the cell size is 20m x 20m ($400m^2$). Rarely is the spatial resolution ever written or discussed in the m^2 format.

The lower the resolution (larger the pixel size) the less detail you can see in the image. Think of the effects of pixel resolution when using your camera. If the resolution is too low your image will become pixelated and blurry. In contrast, if you have a high resolution, with a small pixel size, your image will be clear and crisp even at high zoom levels.

Vector and Raster Advantages and Disadvantages

When comparing Vector and Rater data models, the vector model is usually more aesthetically pleasing for map making. It provides a realistic representation of landscape entities. Vector data uses less computer space than raster data and it can be programmed to represent spatial relationships between map features (topology). However, the data structure of a vector model can be complex and many of the analytical processes (integration of more than one map layer) can be accomplished more efficiently in raster format.

The raster data model offers many advantages (ESRI ArcGIS Resource Center, 2012):

- Simple data structure;
- Format for advanced spatial and statistical analysis;
- Represents continuous surfaces;
- Can perform surface analysis;

- Uniformly store points, lines, polygons, and surfaces;
- Can perform fast overlays with complex datasets

But there are some limitations when working with raster data:

- Spatial inaccuracies due to the limits imposed by the raster dataset cell dimensions (i.e., spatial resolution);
- Raster datasets are potentially very large, which increases the amount of disk space used and decreases processing speeds;
- A loss of precision that accompanies restructuring data to a regularly spaced raster-cell boundary (also known as pixilation causing ill-defined boundaries of spatial entities)

Exercise

Introduction

The objective of the lab is to understand attribute data, spatial data properties, and basic map making using open source GIS software. Data will provide information on recreation facilities and assets across Victoria.

Downloading QGIS

Only complete this section if you would like to download QGIS on your home computer.

1. Click on the **Download website** and choose the QGIS Standalone Installer Version 3.16 (64bit)

3. Save the software and press **Run** to install

4. Double click the **Setup** app → press **Run** → **Next** → **Next** → **Next** → **Finished**

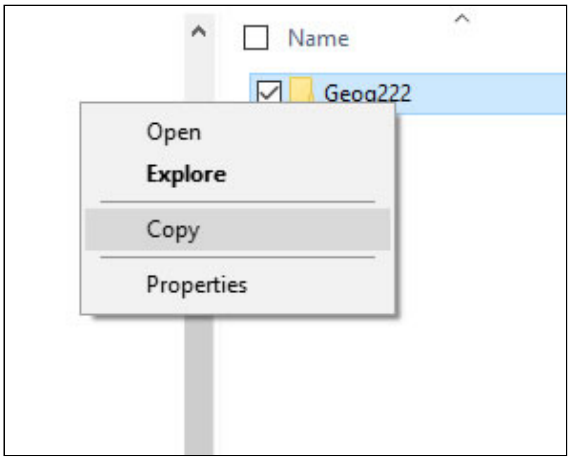
Folder structure for the course

In the following steps you will save the folder structure you will use for the remainder of the course. This folder structure is provided to assist you with saving your files in an organized manner.

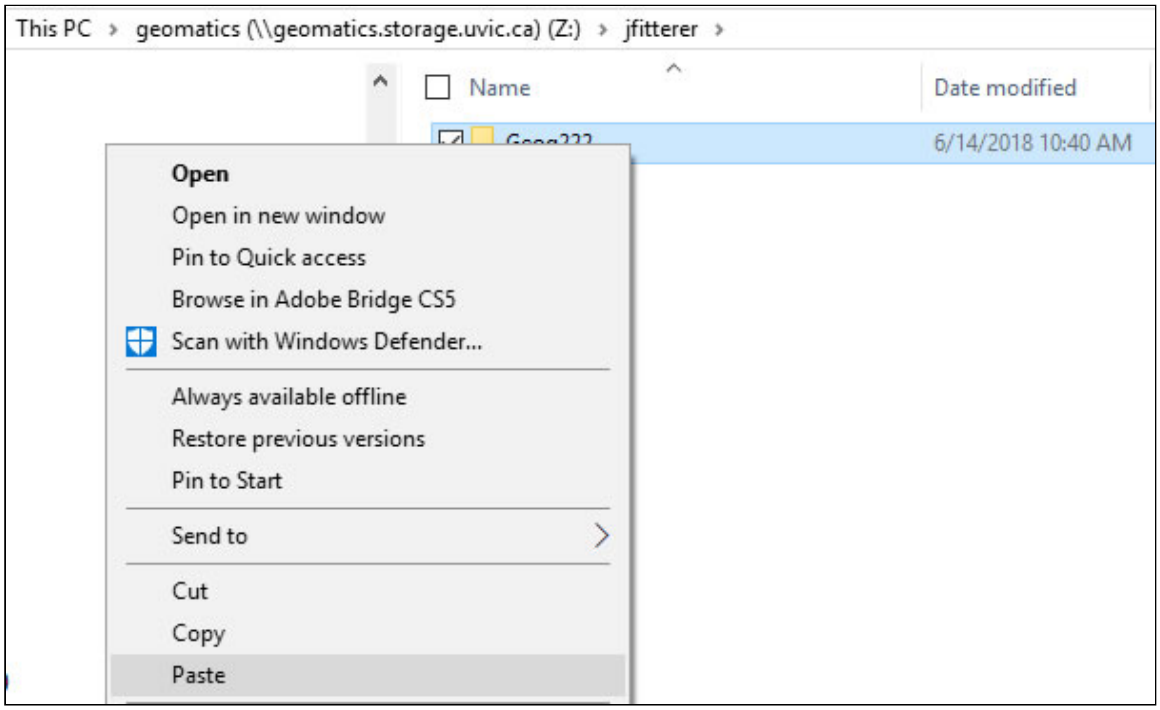
1.) Click to download the Geog222 folder structure

2.) Select **Open** with → Windows file explorer

3.) Right click to copy the folder structure



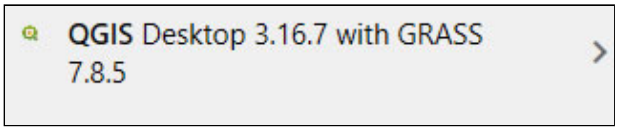
4.) Right click in your home directory → and choose to paste the folders



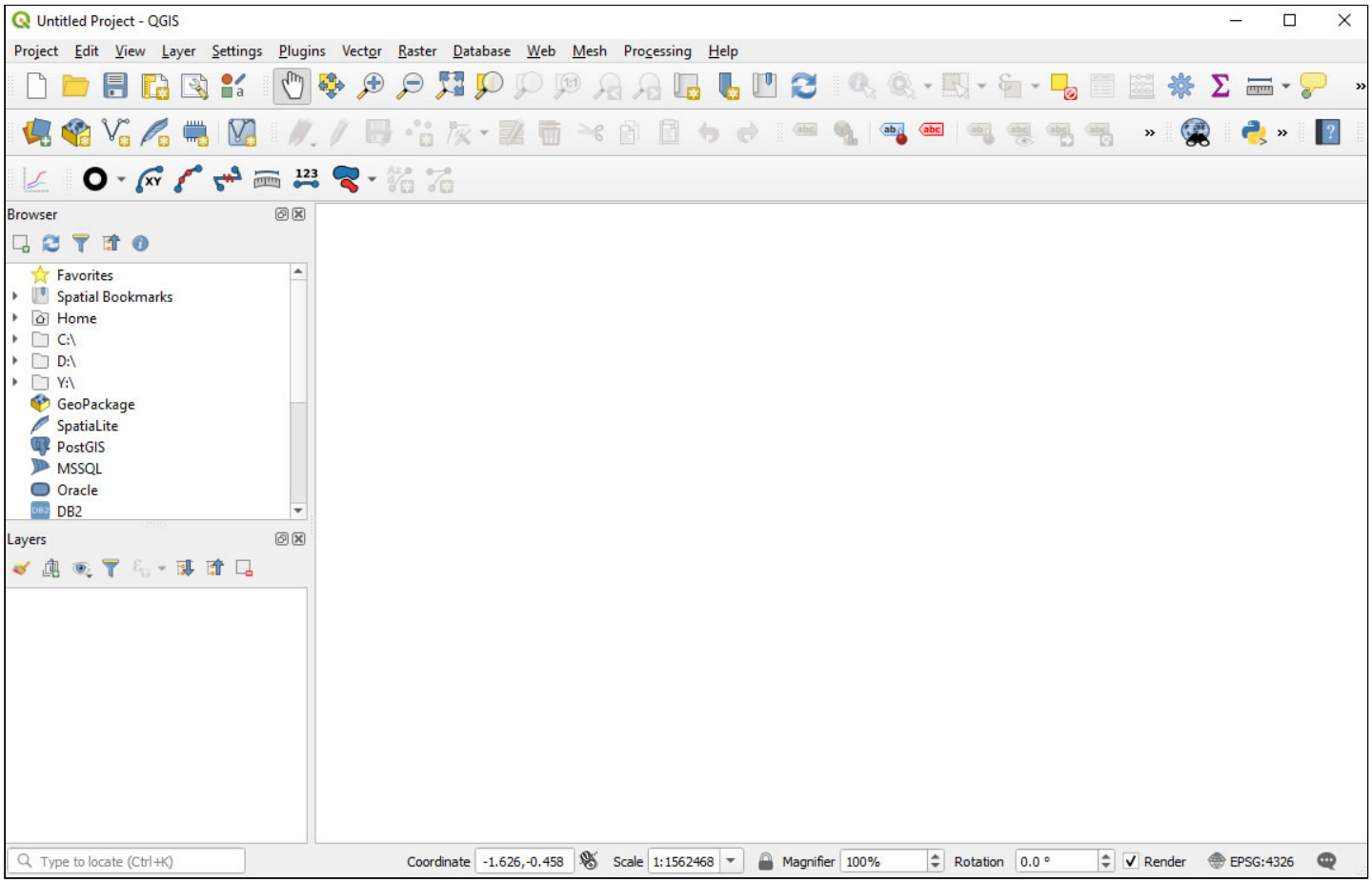
Geographical Information Systems

As part of the course objectives, you will learn how to use a GIS software program to manipulate and analyze spatial data. QGIS is an open source software package with a suite of geospatial processing tools that can be used to view, edit, create, analyze, and publish geospatial data.

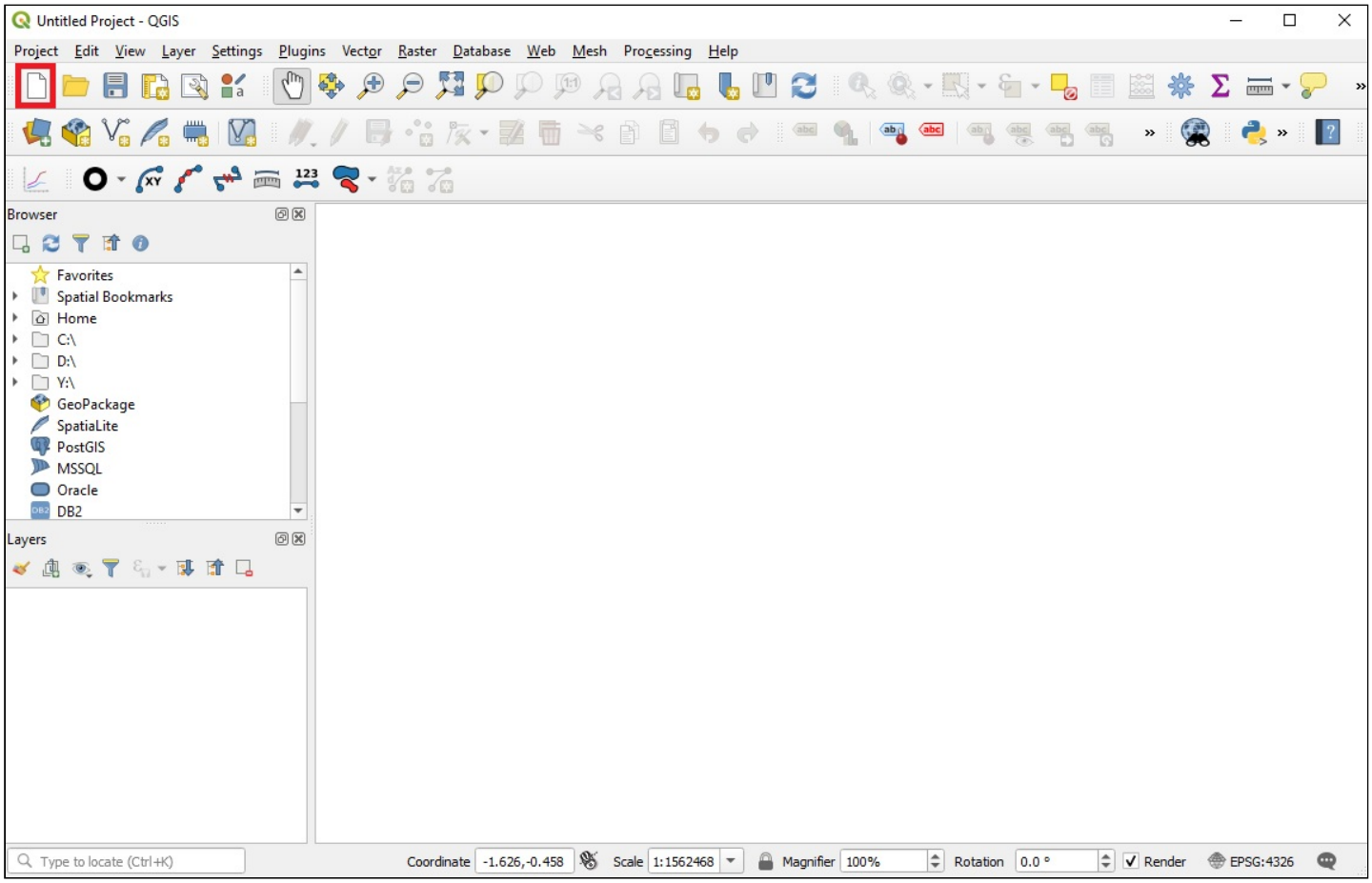
1. Open QGIS desktop on your computer. **Ensure to select the "with GRASS version".**



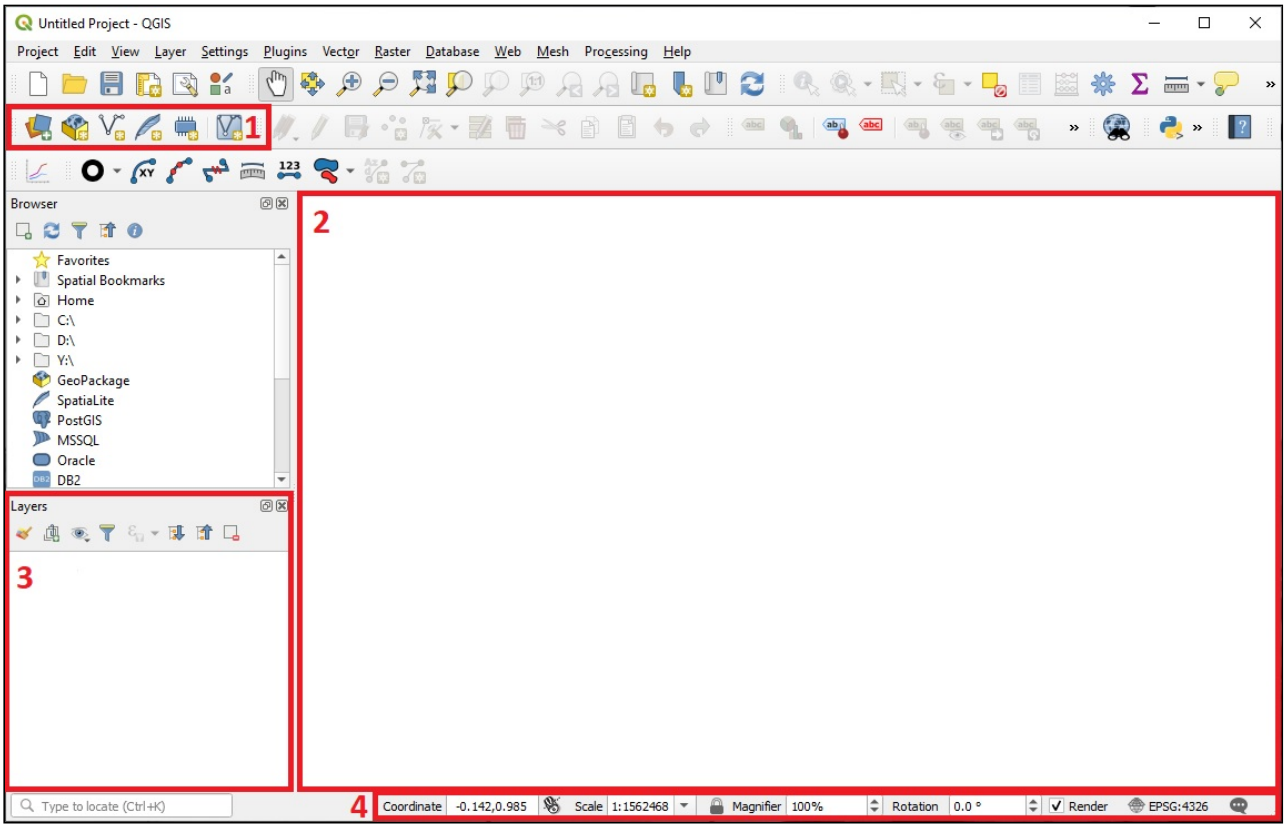
2. The QGIS window will open:



4. Click the **New Project** button to create new document.

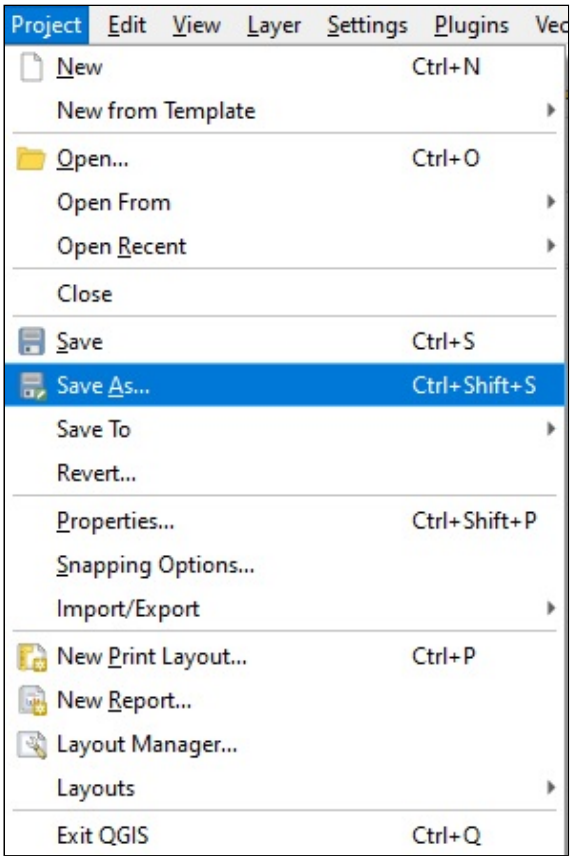


5. Windows:
    1. Add data menu
    2. The data view
    3. Layer table of contents
    4. Spatial reference information

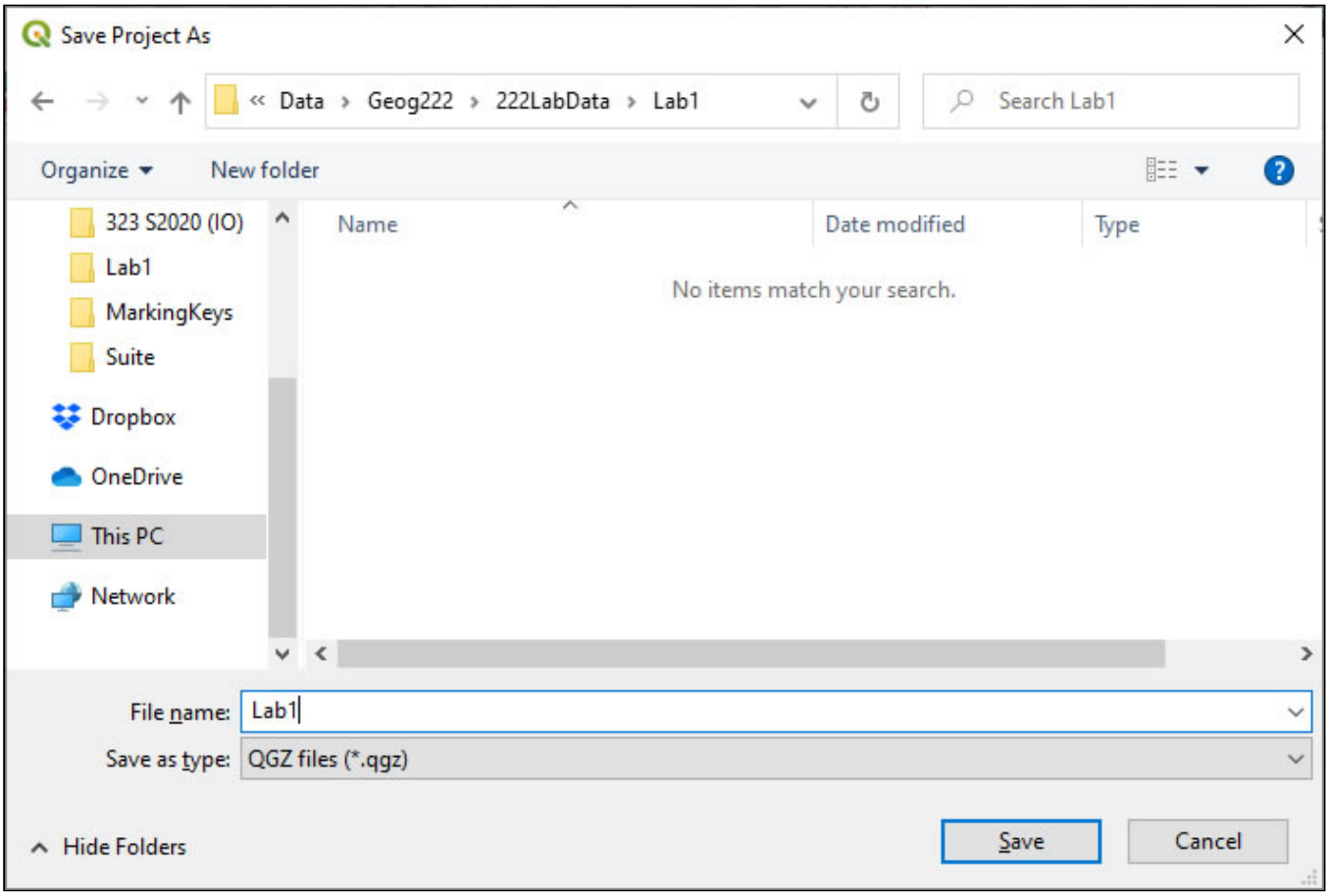


Now is a good time to save your project.

6. Navigate to the **Project** menu → select **Save As**



7. Save the project as **Lab1** in your **Lab1** Geog222 folder.



Downloading Open Data

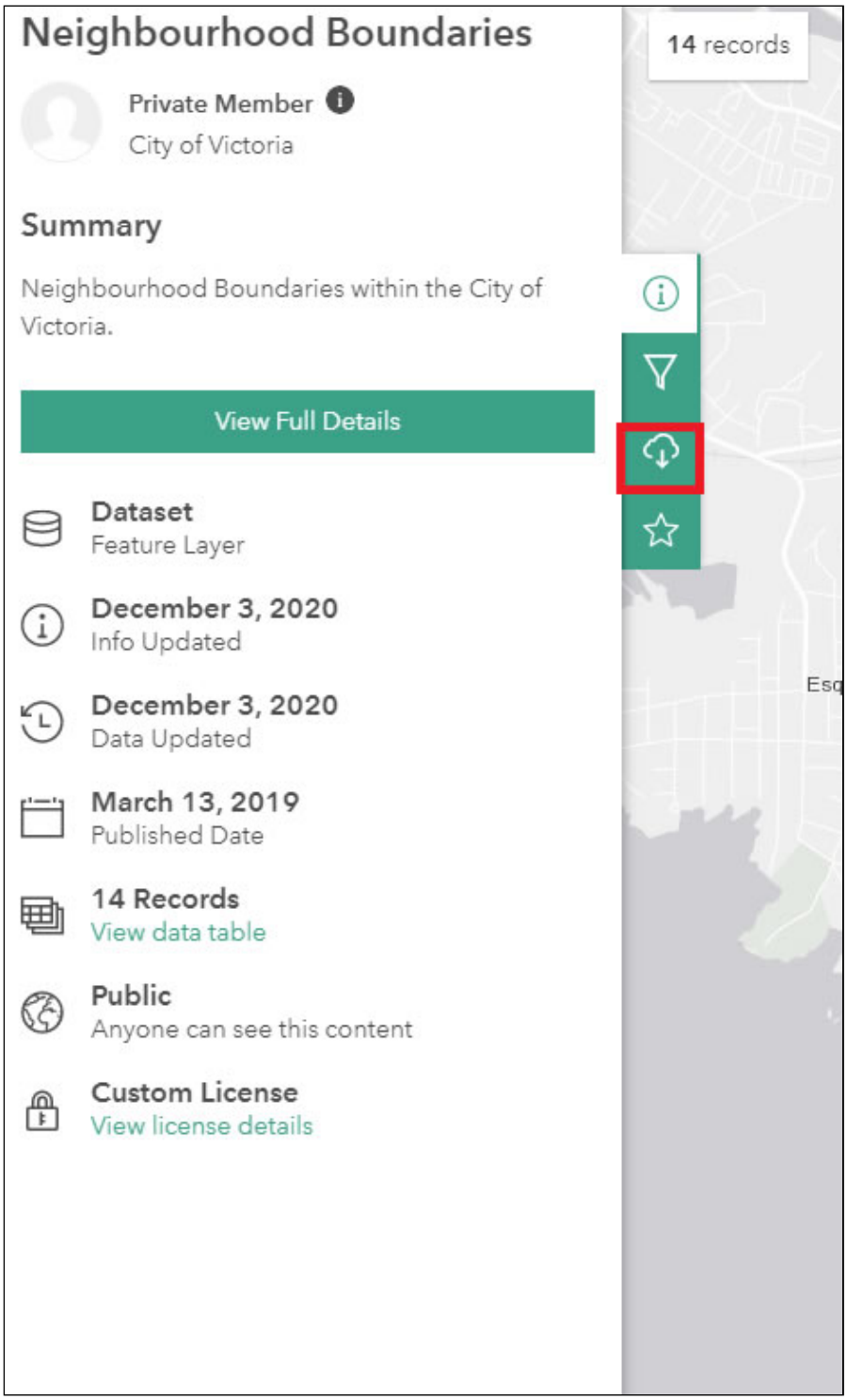
Since 2009 governments in the UK, US, and Canada have been committed to improving access to data via open data portals (Government of Canada, 2017). The open data movement is an initiative to provide data free of charge. The datasets may be re-used, and added to without permission. Canada officially came on board with open access data in March of 2011 when they launched the first version of data.gc.ca.

Today you will use the city of Victoria's Open Data Catalogue to download a spatial dataset to map the locations of outdoor exercise equipment, bike lanes, and recreations fields within each Victoria neighbourhood. You will learn to identify attributes associated with each layer and the projections used to map the information on screen.

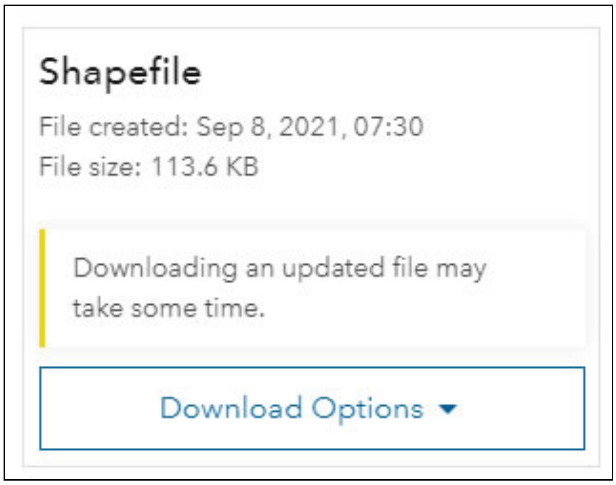
1. Open the Victoria Data Portal, and select GIS Mapping

2. Use the find tool to search neighbourhood boundaries

3. Click on the Neighbourhood Boundaries → Download

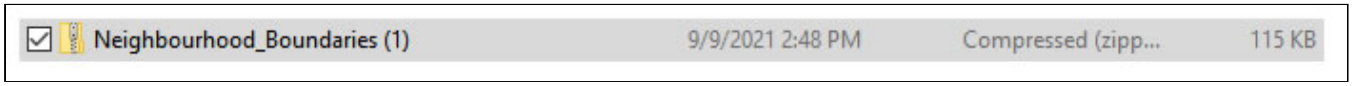


4. Choose the Shapefile option

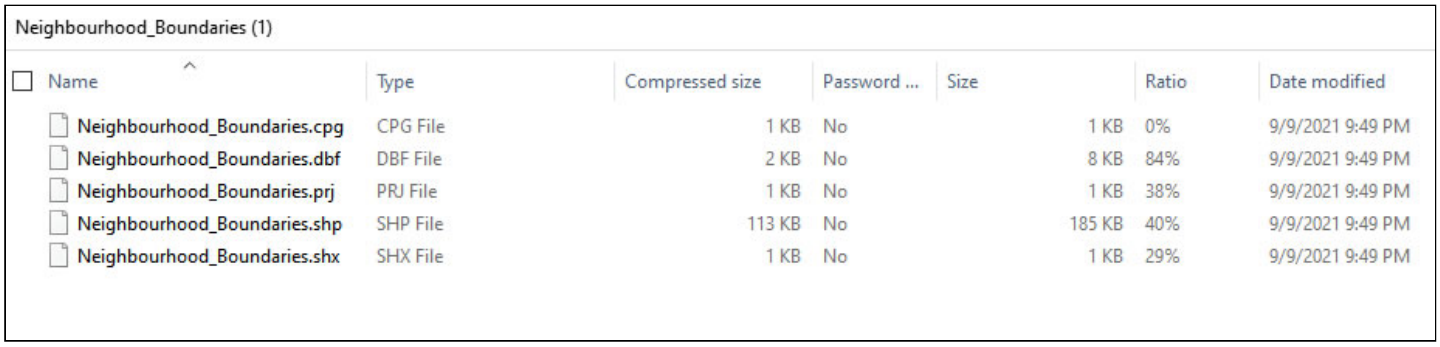


- Choose **"generate new download with the latest data"**

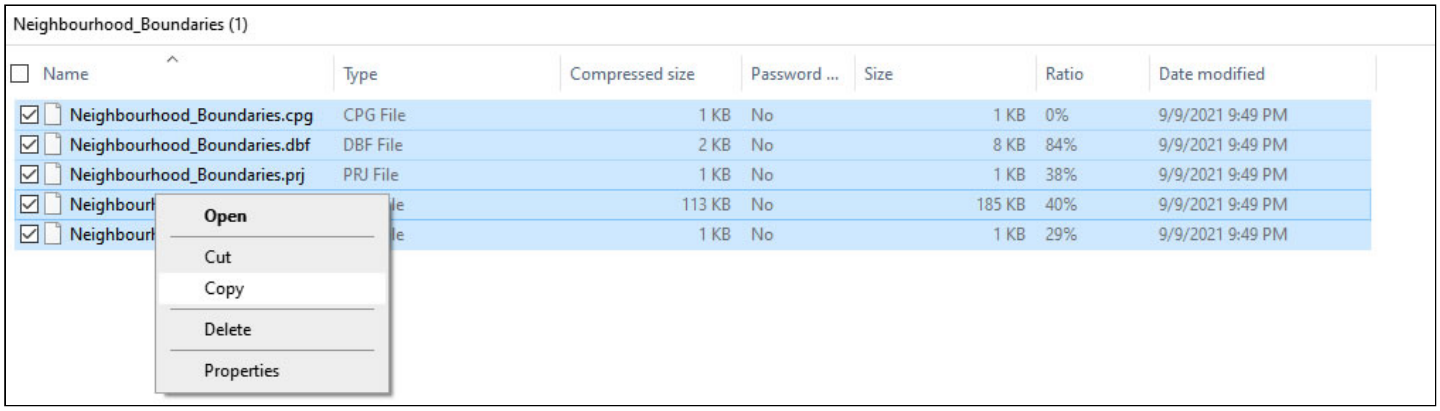
4. Open **Windows File Explorer**, the zipped folder will be available for extraction in your downloads folder:



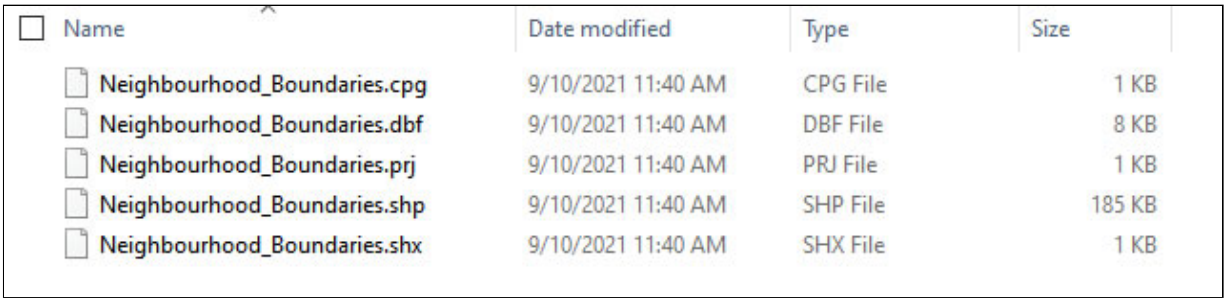
5. Double Click on the folder



6. Copy and paste the files → select → right click → copy



7. Paste the files in your **Lab1** folder (Ctrl + V)



Name	Date modified	Type	Size
Neighbourhood_Boundaries.cpg	9/10/2021 11:40 AM	CPG File	1 KB
Neighbourhood_Boundaries.dbf	9/10/2021 11:40 AM	DBF File	8 KB
Neighbourhood_Boundaries.prj	9/10/2021 11:40 AM	PRJ File	1 KB
Neighbourhood_Boundaries.shp	9/10/2021 11:40 AM	SHP File	185 KB
Neighbourhood_Boundaries.shx	9/10/2021 11:40 AM	SHX File	1 KB

If the neighbourhood boundaries do not download from the Victoria Open Data site open the file here.

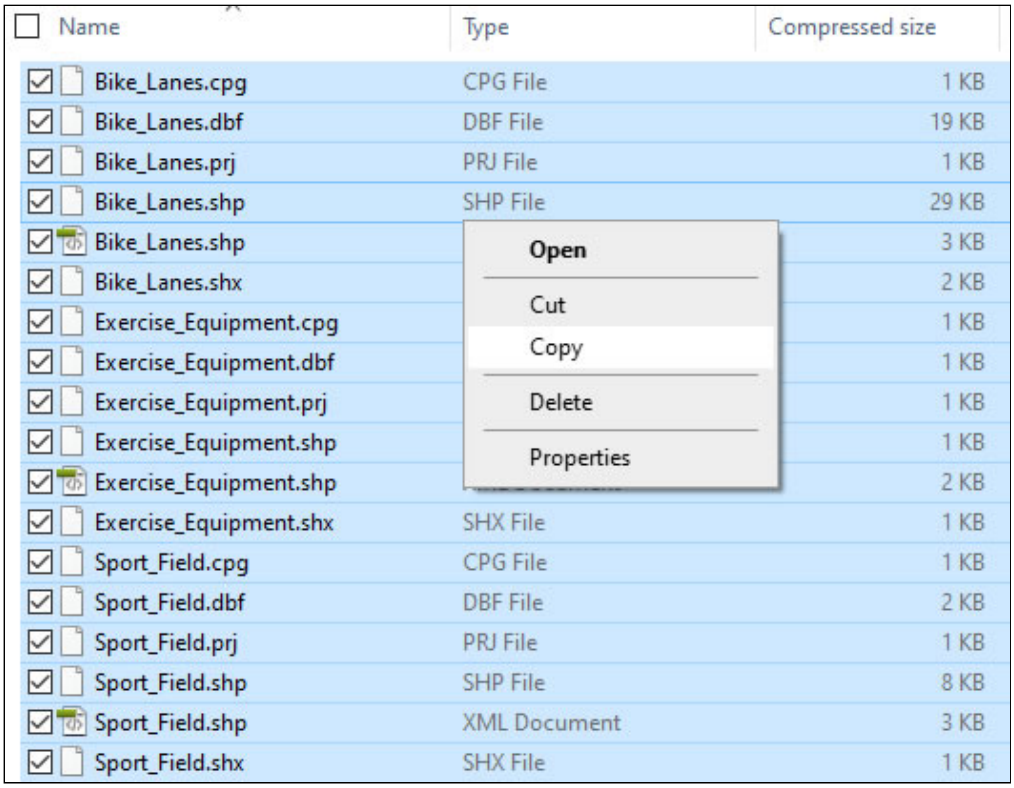
Shapefiles come with more than one extension. The mandatory types for a shapefile consist of:

- **.shp** - which houses the file geometry (verticies)
- **.dbf** - that contains the attribute information linked to the geometry
- .**shx** - file which indexes the header information, and fixed length of records (determined by the bit depth (e.g., 8bit verses 64bit))

The other common extension is the **.prj** file, which stores the projection information for the dataset.

7. Now you will download the **Sport Fields**, **Bike Lanes**, **Exercise Equipment** shapefiles to your **Lab1** folder. The files are found **here**.

8. Once you have downloaded the **Lab1MapData**, copy and paste all the files into your **Lab1** folder by holding the shift key → selecting the files → right click → choose **copy** → then navigate to your **Lab1** folder → right click → **paste**



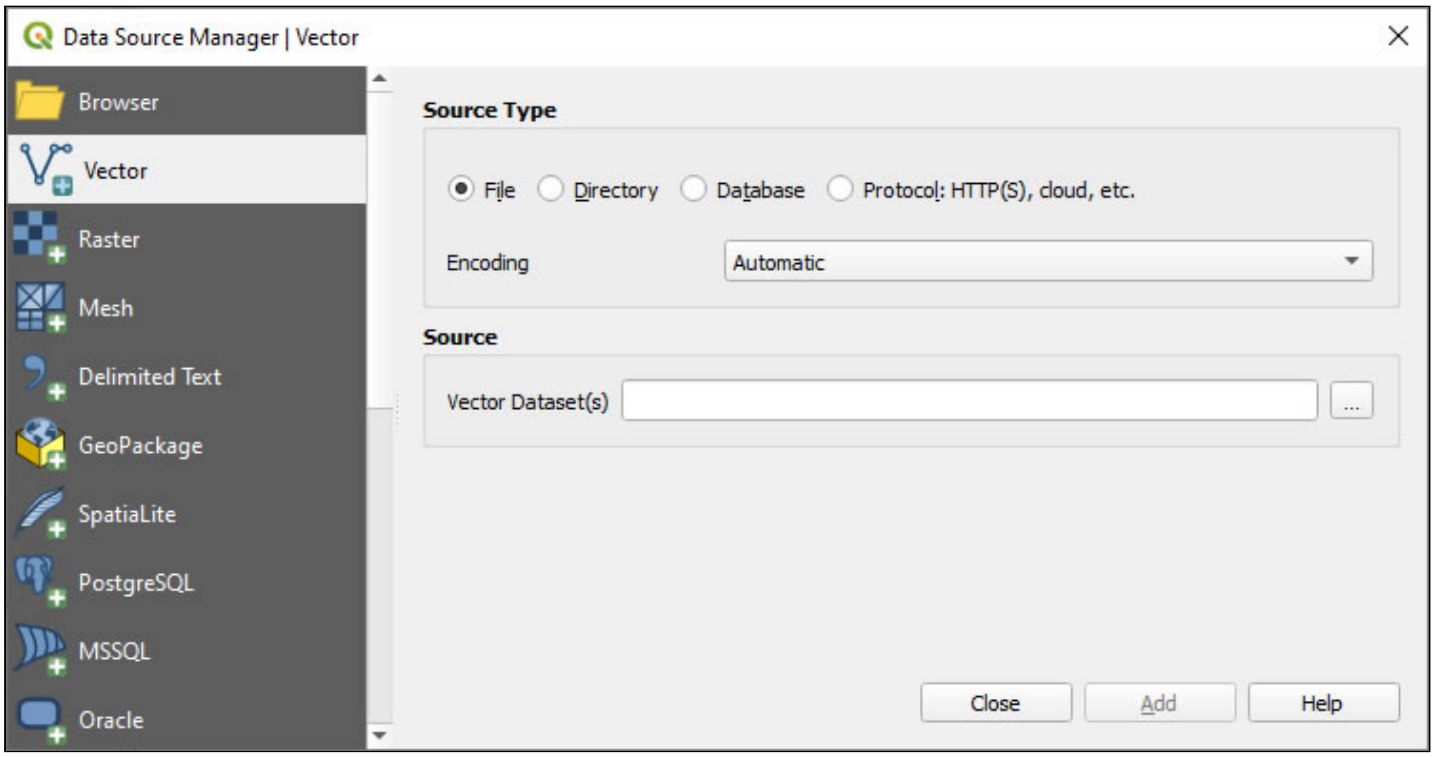
Adding data to your map

Now you are ready to load your datasets into QGIS.

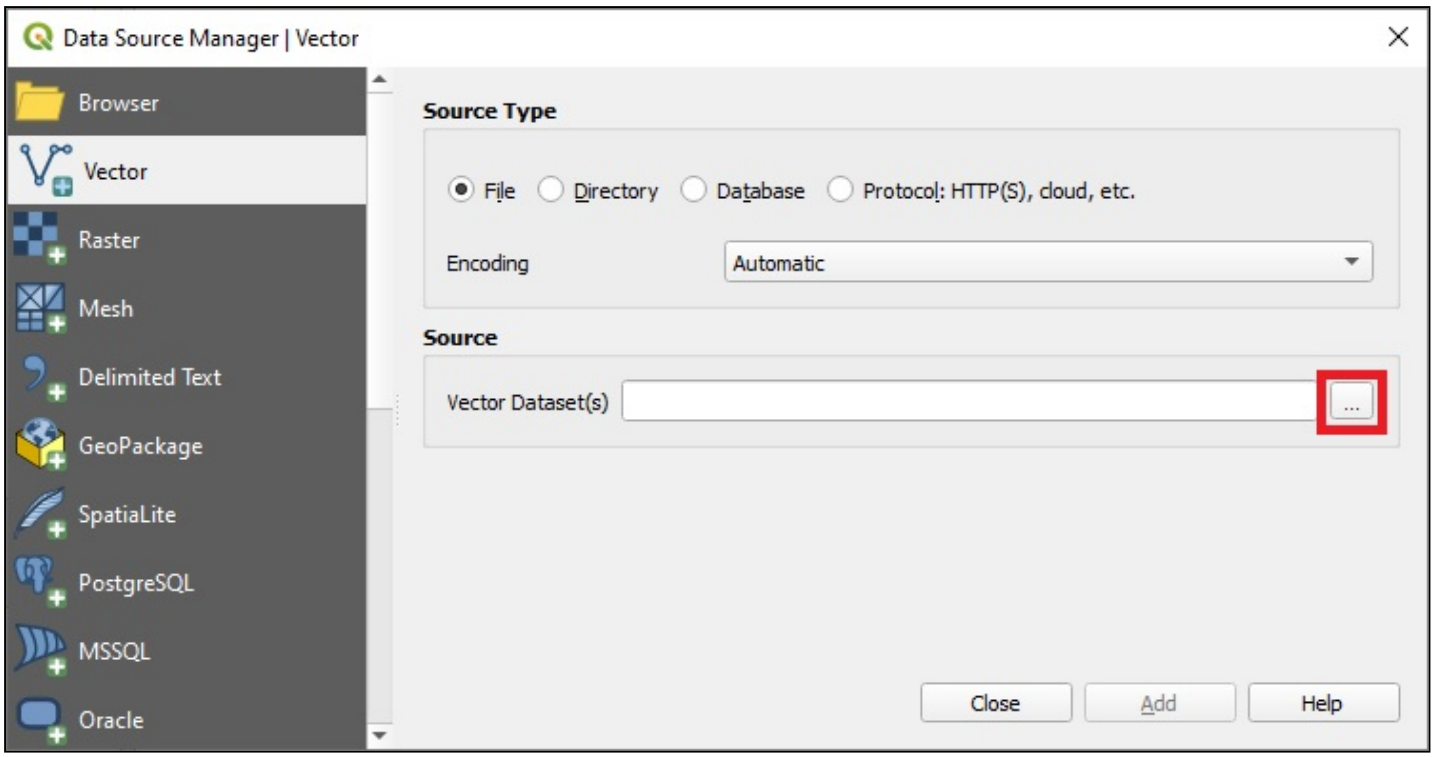
1. Navigate back to the QGIS software program.

2. Select the add data button

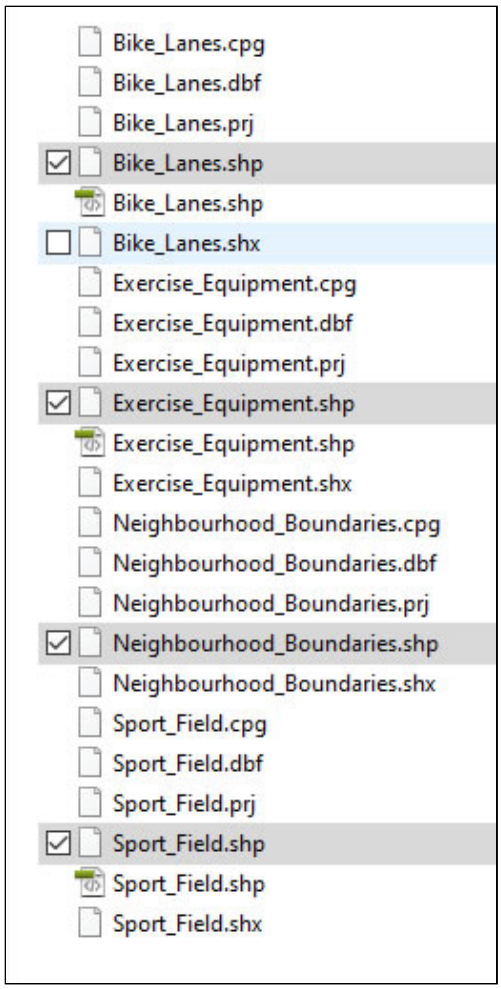
With the **Data Source Manager** open, sect the **Vector** tab:



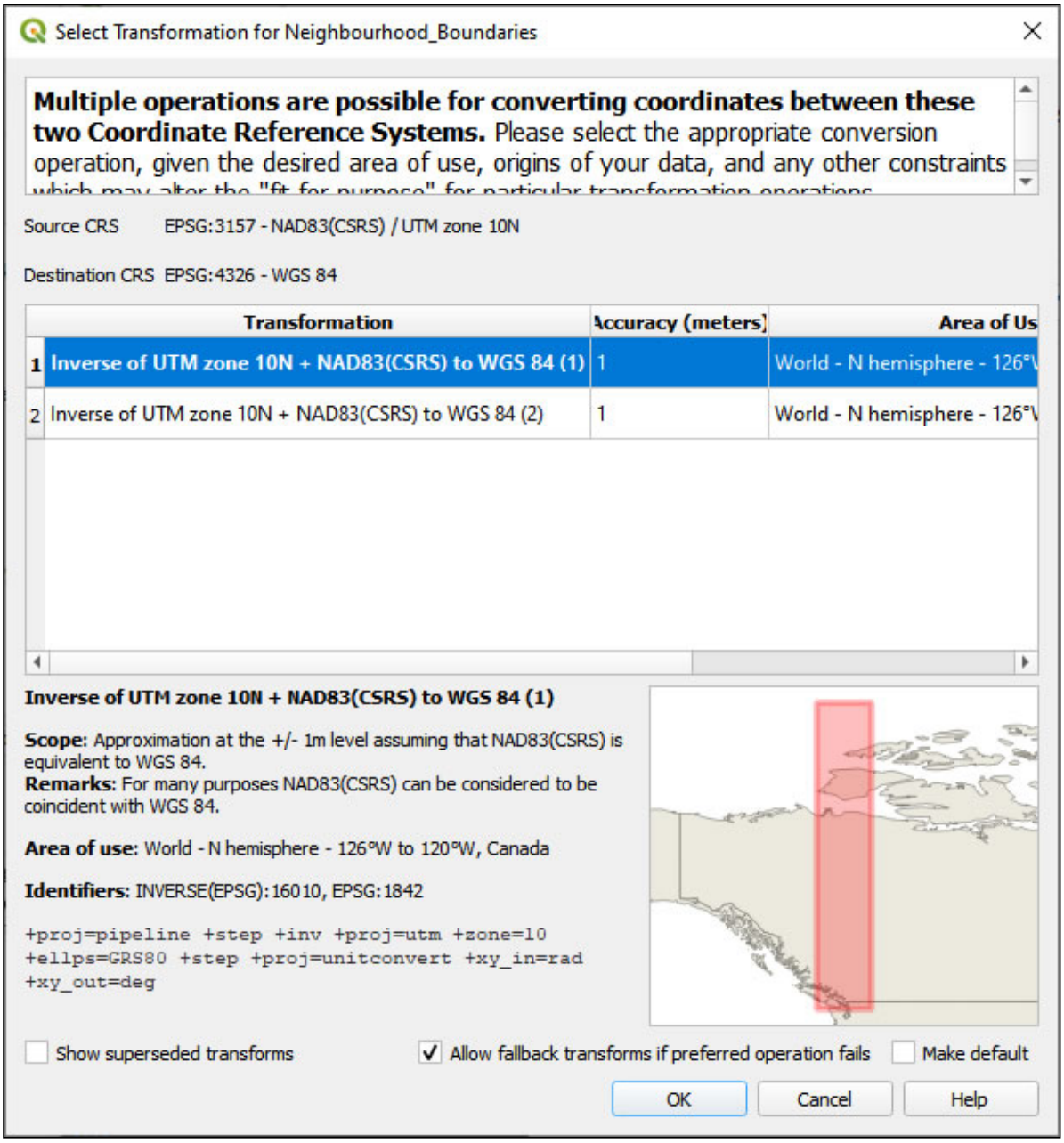
- Select to open a **Vector** data source:



- While holding **Ctrl** on your keyboard, select the **Bike_Lanes.shp**, **Exercise_Equiment.shp**, **Neighbourhood_Boundaries.shp** and **Sport_Field.shp** Vector files → and press OK

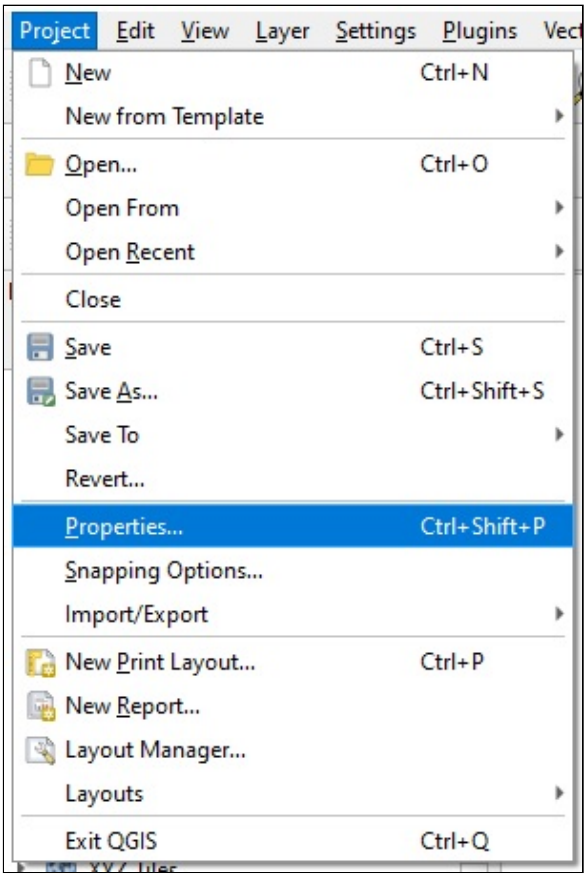


- Press **Open** → **Add**
- Press **Ok** to any transformation warnings → press **Close**

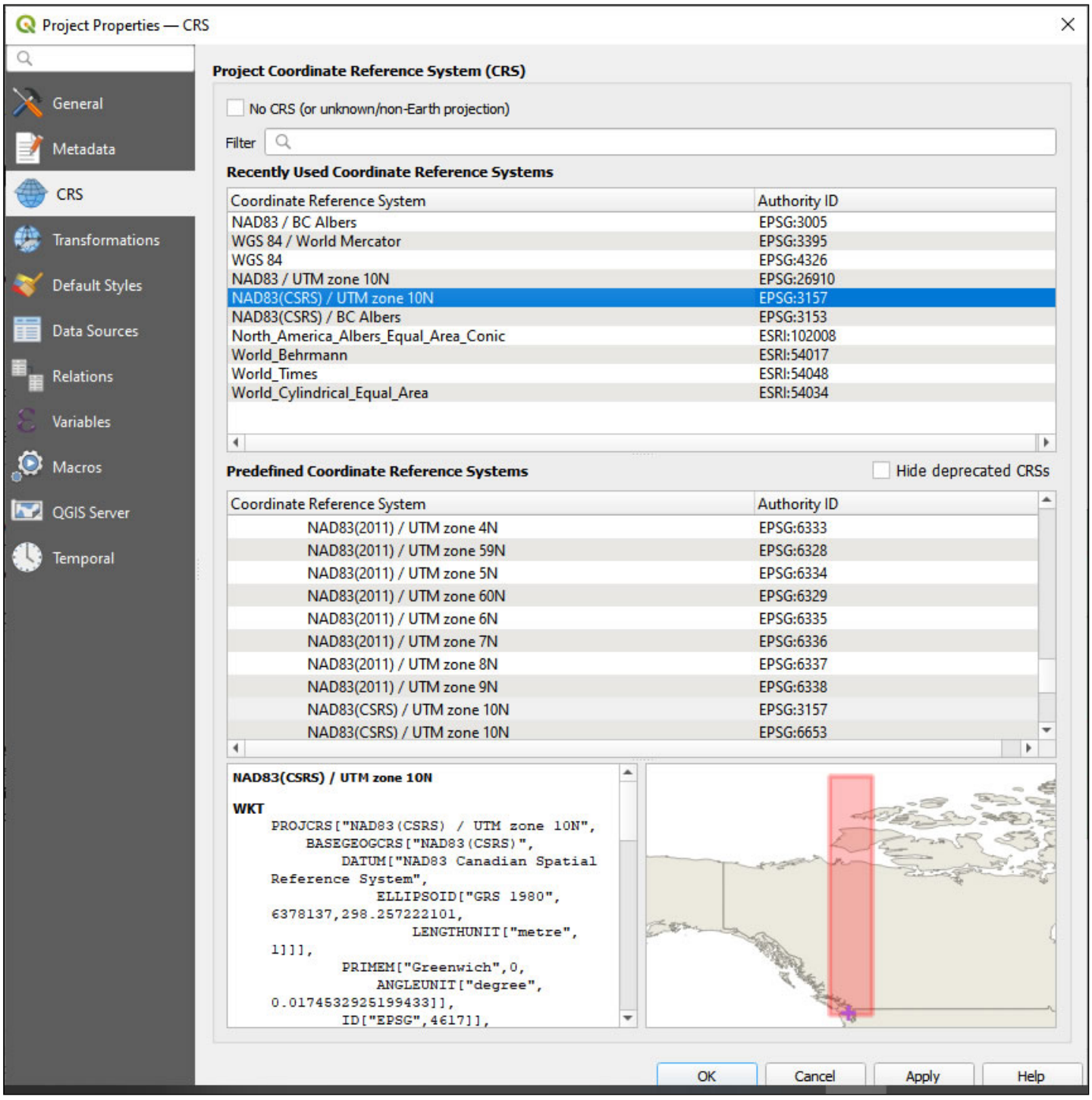


There are two places to view map projection information.

1. From the **Project** menu select **Properties**

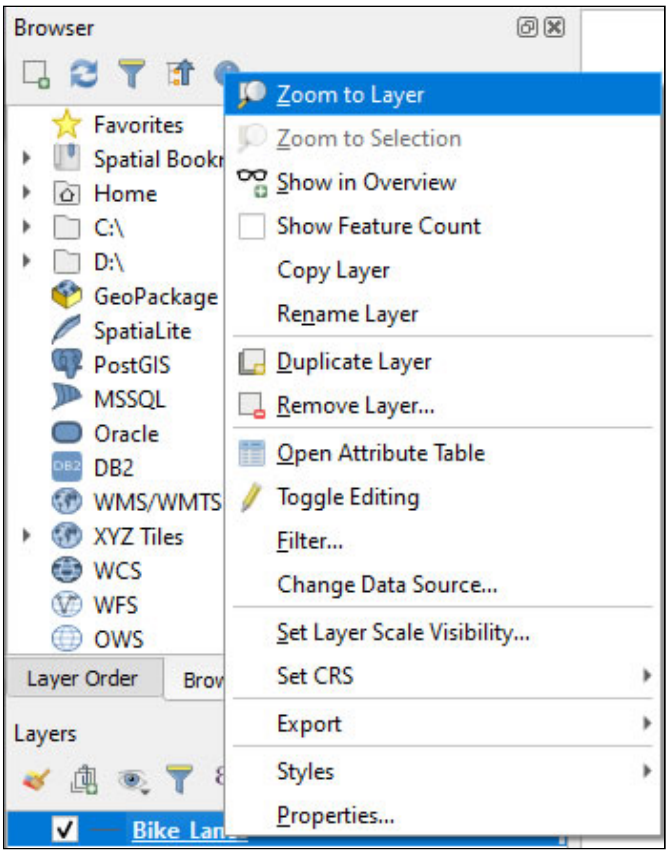


2. View the **Coordinate Reference System** then search for the **UTM zone 10N** and select **NAD83(CSRS)/UTM zone 10N EPSG:3157**



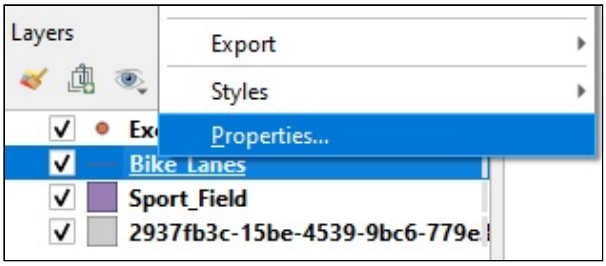
- Press Apply → OK → OK

3. If your data are not visble on screen, navigate to the **Layers** list select the **Bike Lanes** layer and choose **Zoom to layer**

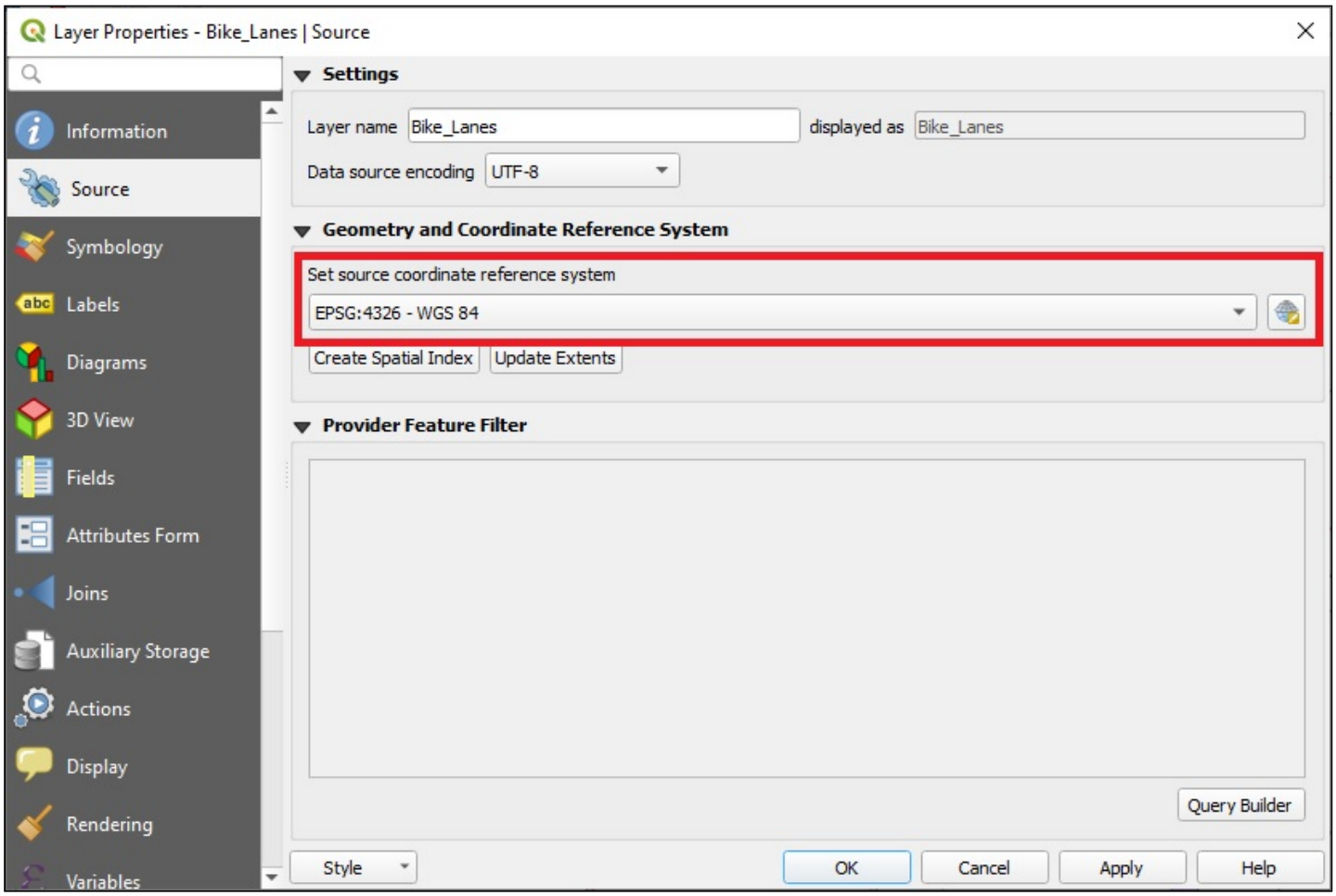


The data layers are visible on screen in a **NAD 83(CSRS)/UTM zone 10N** geographic projection.

3. Right click on the **Bike_Lanes** layer → select **Properties**

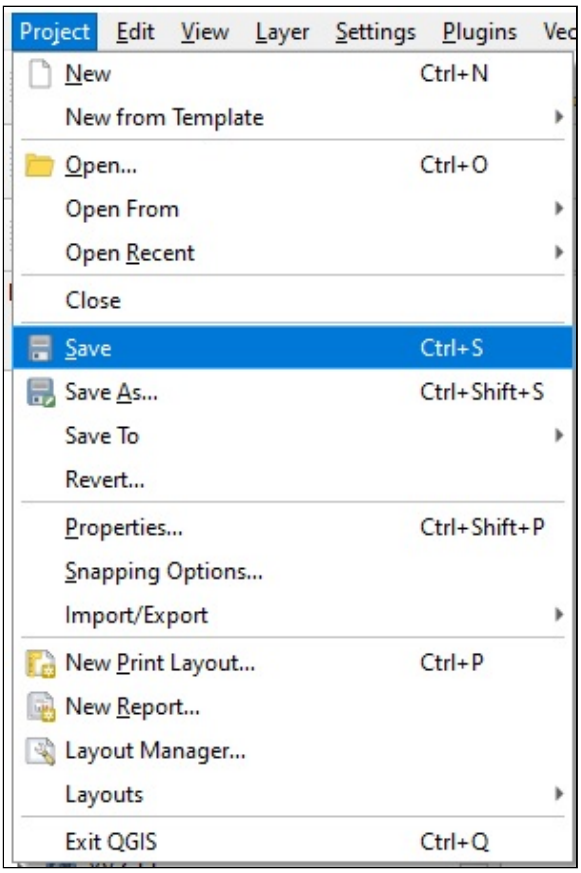


4. Open the **Source** tab



5. Note that the **Bike_Lanes** layer is projected in the **WGS 84** projection (more on projections next week), then select **Ok** to close the window.

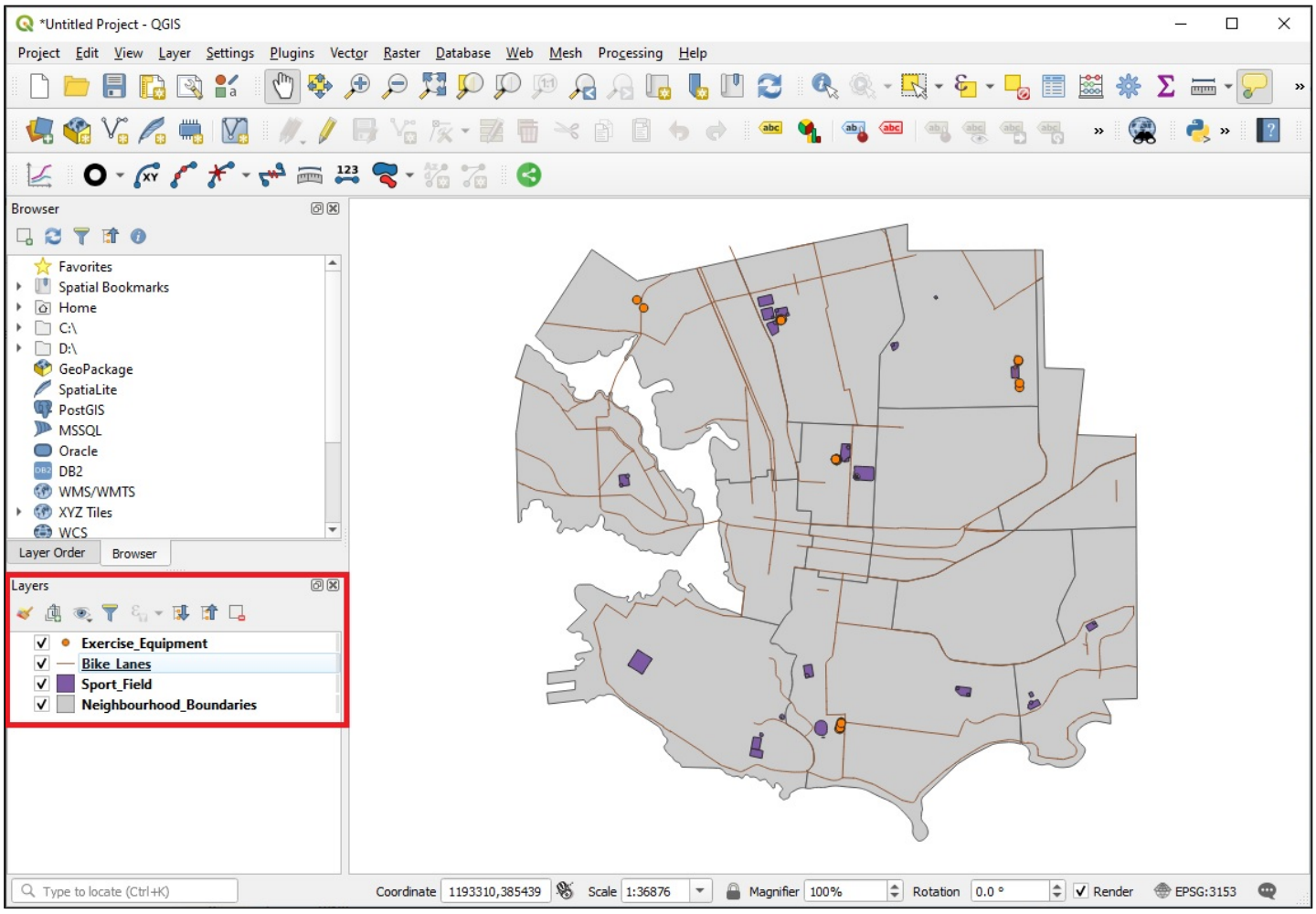
6. Now is a good time to **Save** your project



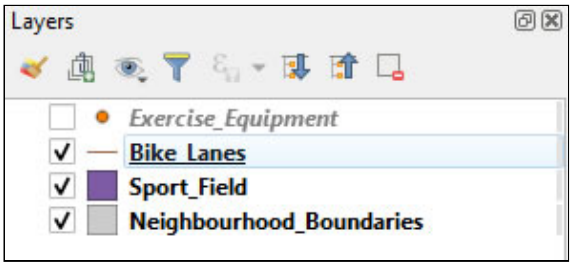
Layer Visibility

When files are added to QGIS all the layers are selected and viewable. This is denoted by the check mark selected next to the layers in the Contents pane.

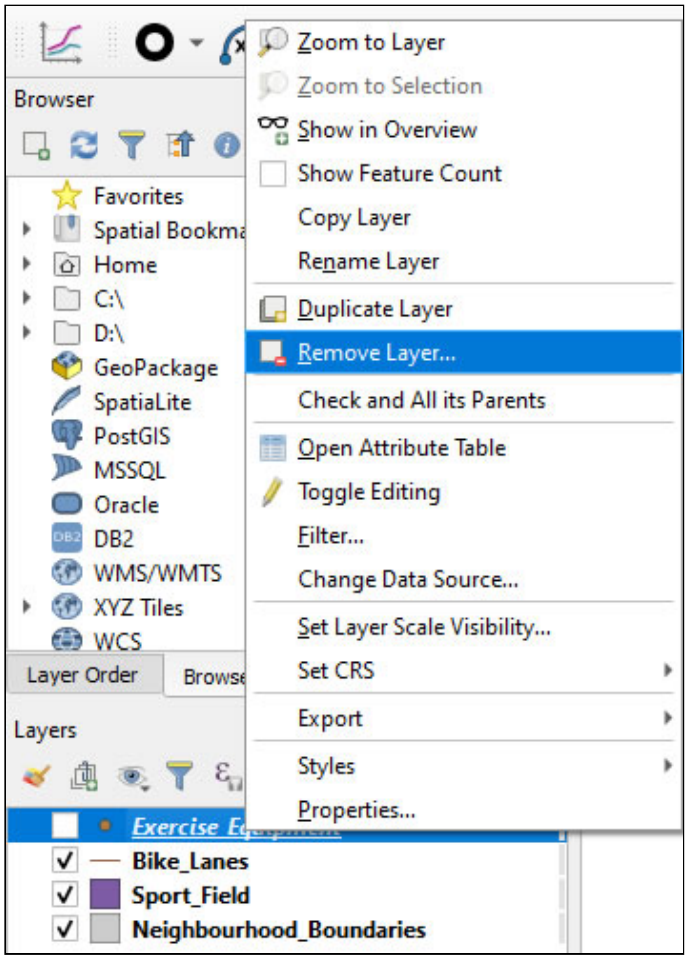
1. Reorder the **Layers** list by selecting the layers in the **Layers** list and moving them above the neighbourhood boundaries



2. To turn off a layer (make it invisible), uncheck the layer in the Contents pane:



3. To remove a layer, select the layer in the Contents pane and choose **Remove Layer...**

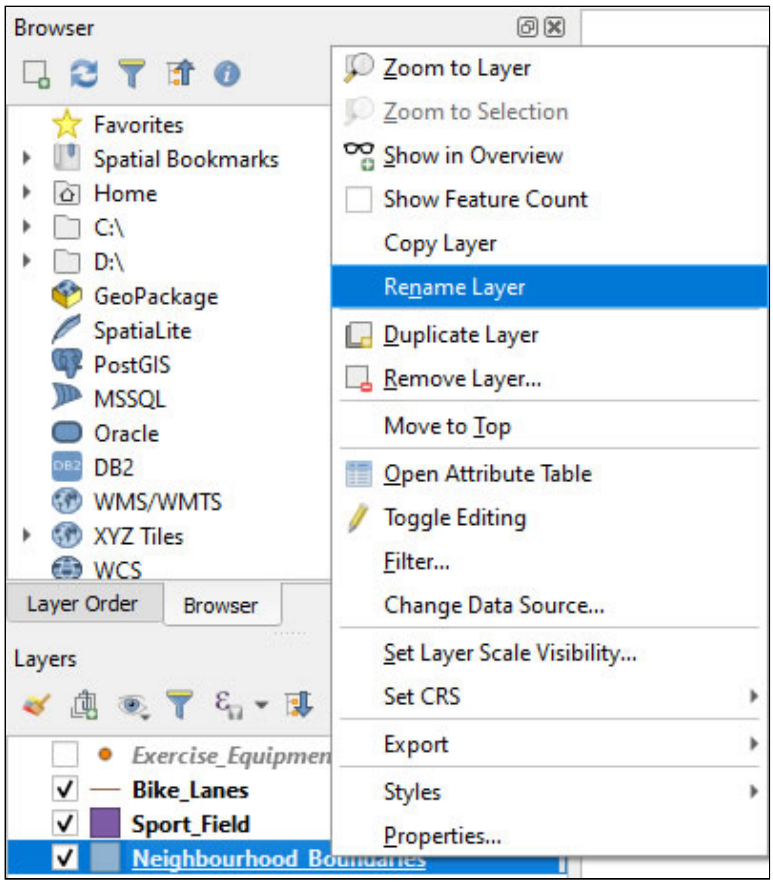


If you have removed any layers from your map window, use the **Add Data** button to retrieve them before proceeding to the next section.

Rename Layers

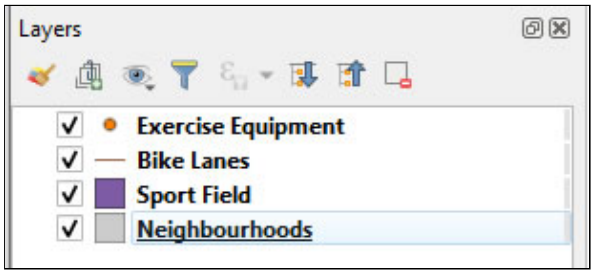
Right now the neighbourhoods layer has the default name from the Victoria Open Data Catalog. You will want to rename it.

1. Right click on the layer in the Layer's list and choose **"Rename Layer"**



2. Type: Neighbourhoods and press enter

3. Now remove the underscores from the other layer names



Zooming

1. To move your map extent:

 Use the pan button to move the map around the screen

 Zoom into the data on screen

 Zoom out of the data on screen

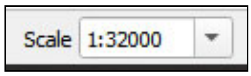
 Zoom to full extent

 Zoom to selection

2. Use the scroll button on your mouse to zoom in and out.

3. Choose the zoom in tool  to draw a box around the map to zoom into a particular extent

4. To change the map scale, type in a 1:32,000 value in the bottom left hand corner of your map screen and press enter or change the scale from the drop down menu



5. Now type in a 1:80,000 scale, and see how the map zooms out.

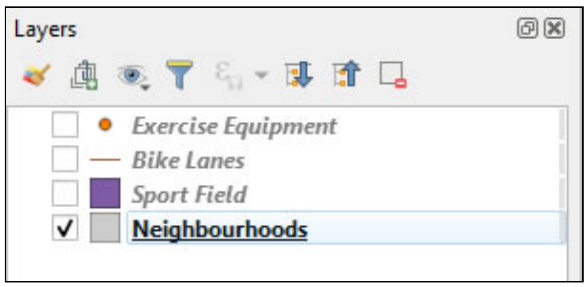
The change in zoom level is the fundamental concept of scale. As the representative fraction increases from 1:25,000 to 1:80,000 you zoom out on the spatial data and see fewer details on the map. This is why large scale maps, which represent smaller areas (1:5,000), are much more detailed than small scale maps (1:250,000) that represent larger areas.

Viewing attribute data for Vectors

Attributes are information (data) linked to the spatial locations on screen. You can access attribute data in more than one way.

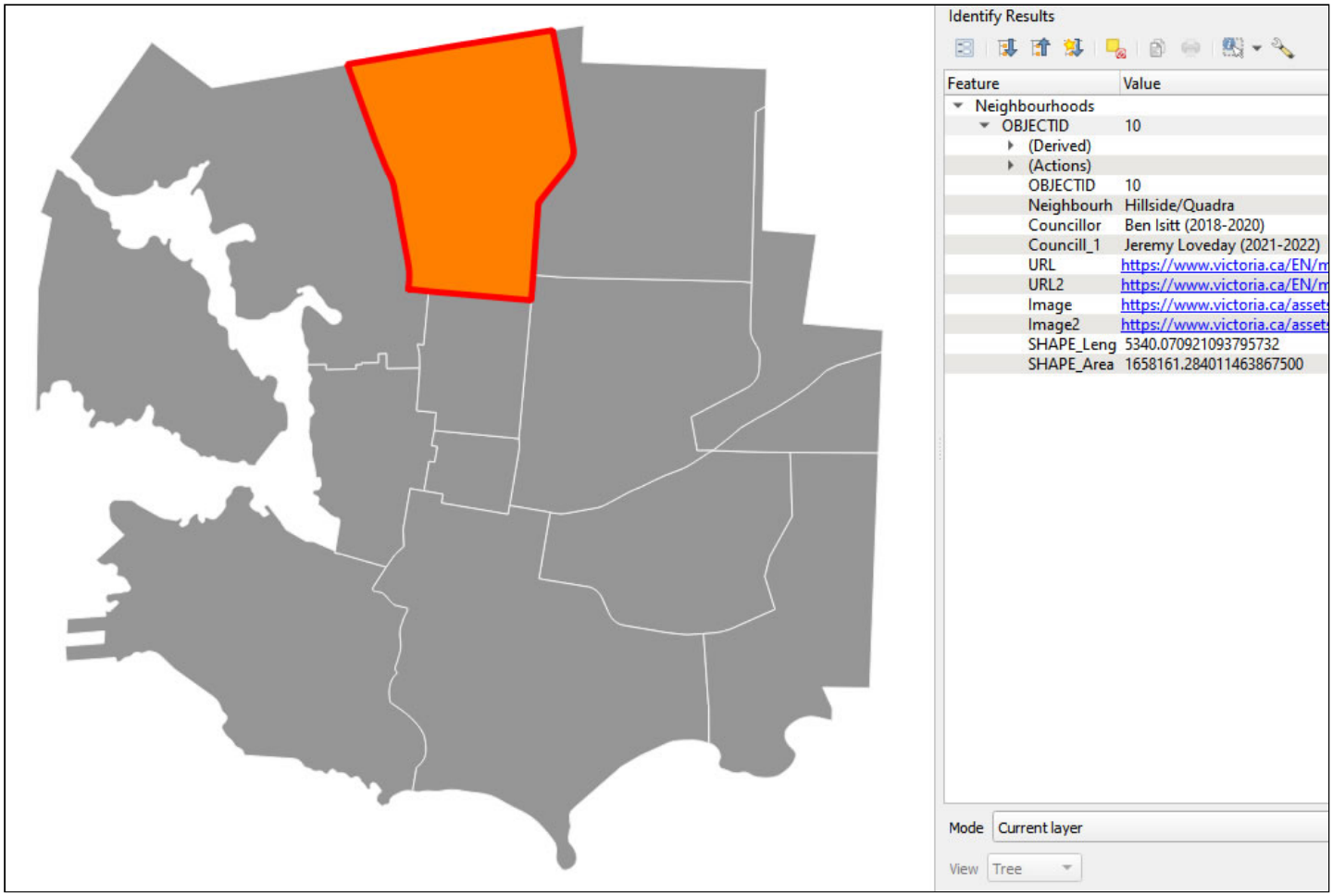
- You can use your cursor to and the identify tool  to click on a feature, and the attribute data will pop up.

1. Turn off the **Bike Lanes**, **Exercise Equipment**, and **Sport Field** layers, and then select the **Neighbourhoods** file in the layer contents and choose the identify tool from the menu 



2. Click on the **Hillside** neighbourhood (or any neighbourhood polygon) on the map screen

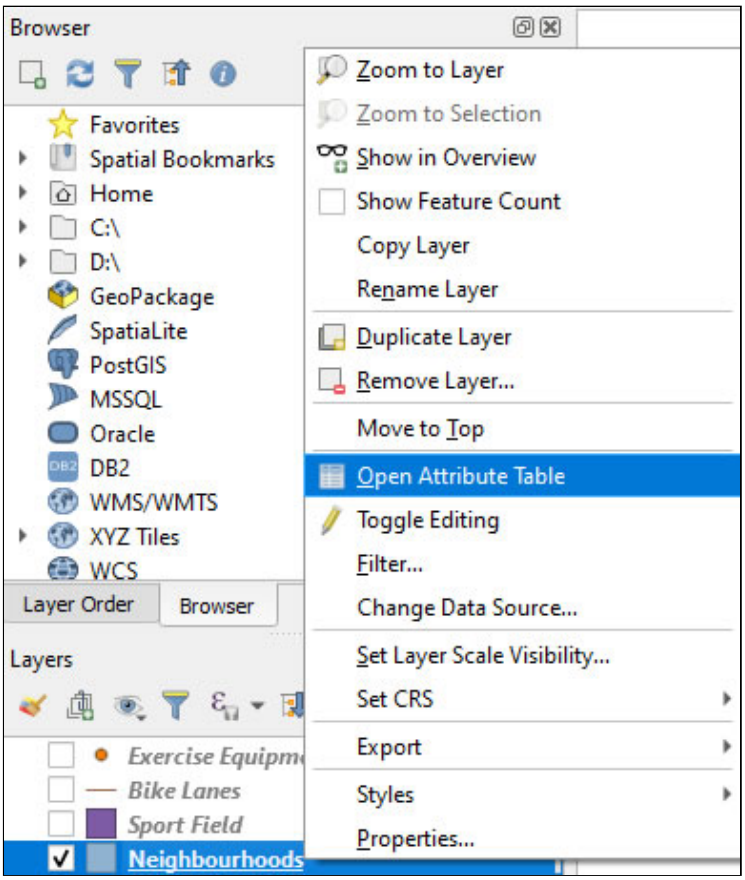
- The **Identify Results** show the neighourhood name, the object ID, and the geometry properties (length and area of the polygon)



3. Use the **x** to close the **Identify Results** window.

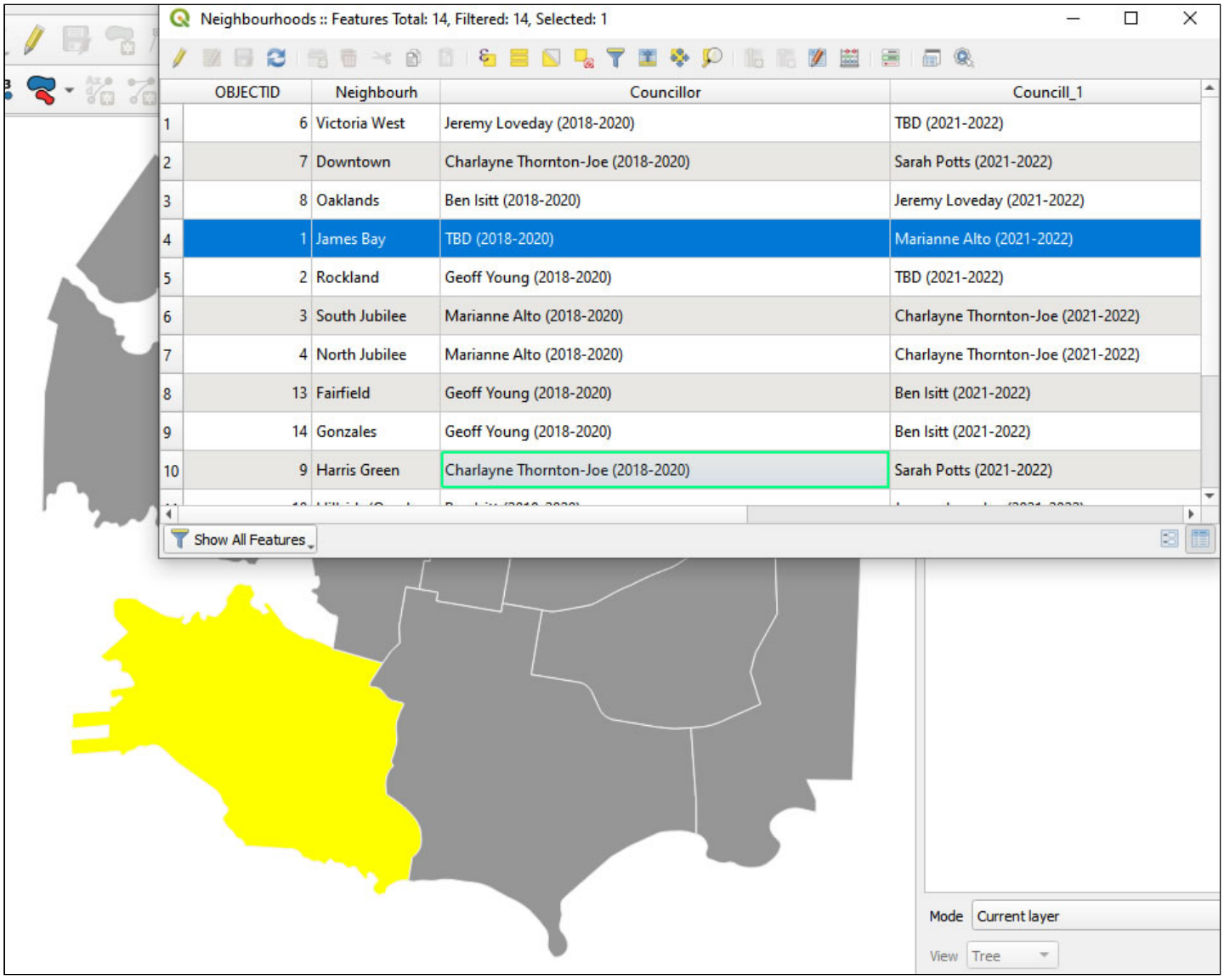
You can also access attribute data from the **Contents** pane.

4. In the **Contents** pane select the **Neighourhoods** layer → right click → and open the **Attribute Table**



Once the attribute table is open you can click on the rows to interactively show the regions on screen.

5. Click on the grey box next to the first row (James Bay) of the **Neighourhoods** attribute table → the select the **Zoom To** tool from the options on the top of the attribute table.



6. Close the attribute table by selecting the **x** on the top left hand side of the attribute table.

7. Using the menu, clear the selected features:

Vector layers can have an endless amount of attribute columns linked to each feature. In contrast, raster data can only represent one attribute at a time (e.g. temperature).

Measuring Tools

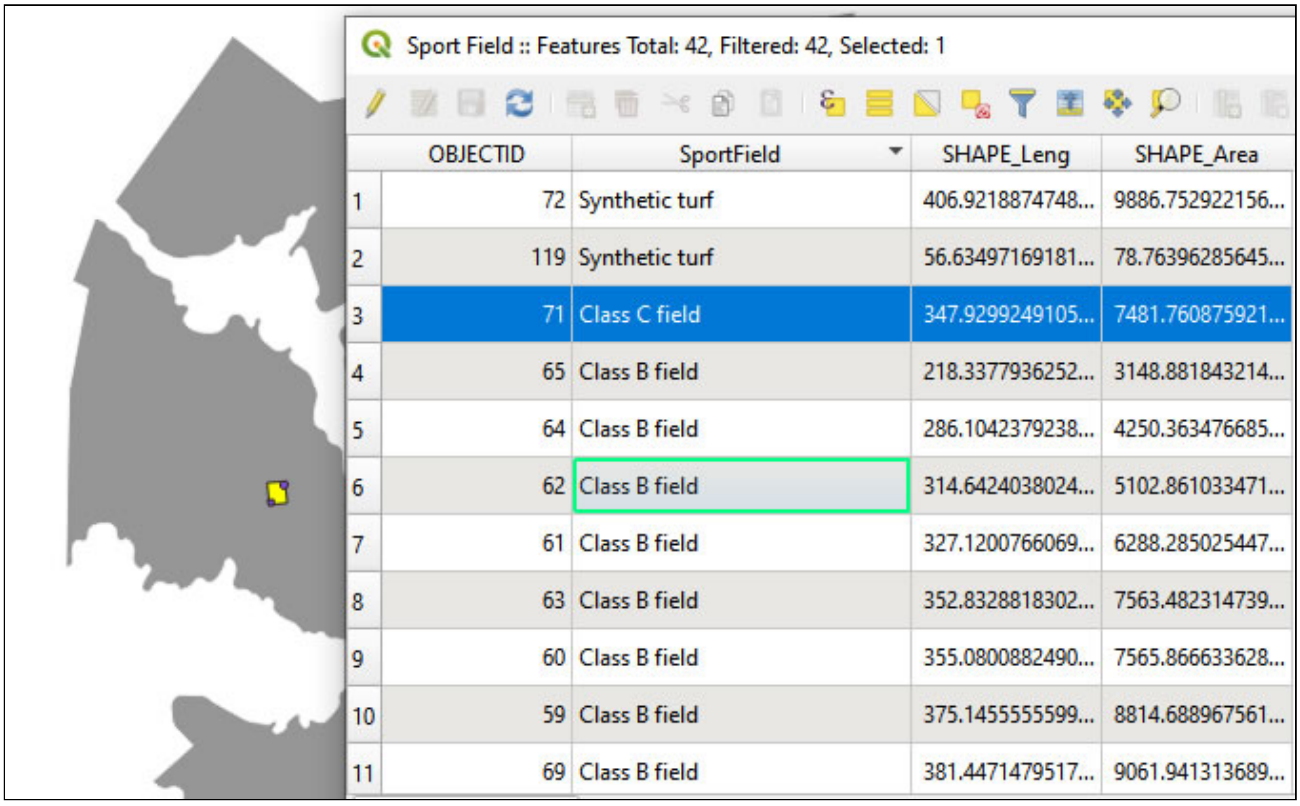
The measure tool provides important geographic information about the distance, perimeter, and area of Vector features.

In the next steps you will explore the properties of the **Class C field** sports field in Victoria.

1. Open the **Sport Field** attribute table by right clicking on the layer in the **Contents** pane, and selecting: **Attribute Table**

2. With the attribute table open, select the **Sport Field** attribute column → to sort the column.

3. Select the **Class C field** row (click on the grey box next to the row), and choose **Zoom to Selection**.



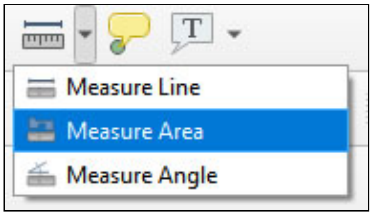
	OBJECTID	SportField	SHAPE_Leng	SHAPE_Area
1	72	Synthetic turf	406.9218874748...	9886.752922156...
2	119	Synthetic turf	56.63497169181...	78.76396285645...
3	71	Class C field	347.9299249105...	7481.760875921...
4	65	Class B field	218.3377936252...	3148.881843214...
5	64	Class B field	286.1042379238...	4250.363476685...
6	62	Class B field	314.6424038024...	5102.861033471...
7	61	Class B field	327.1200766069...	6288.285025447...
8	63	Class B field	352.8328818302...	7563.482314739...
9	60	Class B field	355.0800882490...	7565.866633628...
10	59	Class B field	375.1455555599...	8814.688967561...
11	69	Class B field	381.4471479517...	9061.941313689...

Now you are ready to explore the spatial properties of the **Class C field**.

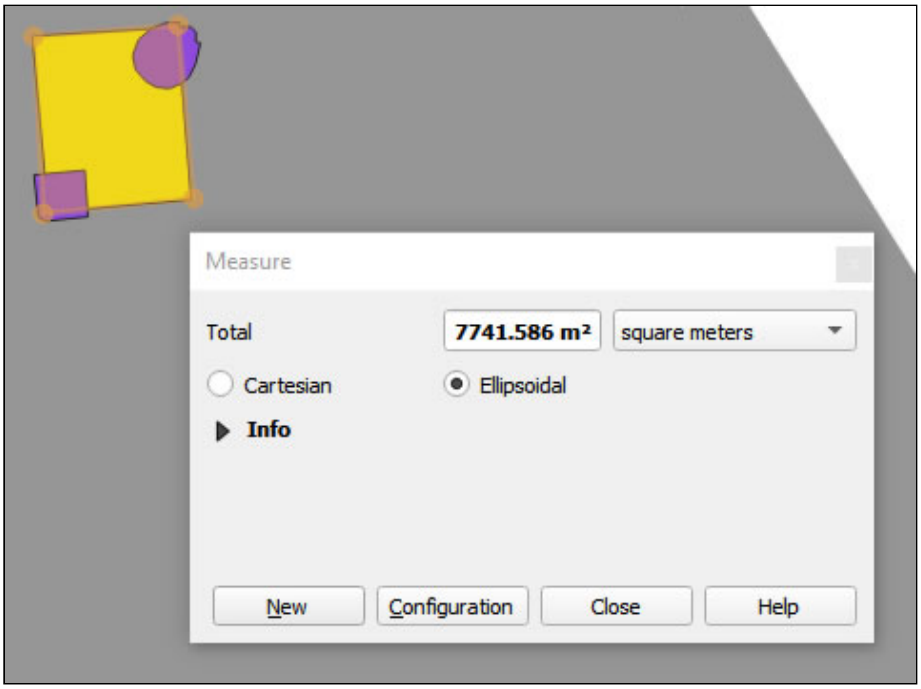
4. From the Map ribbon, select the Measure tool drop down 

- Click on the map screen

- From the drop down on the Measure tool, select the **Measure Features** option

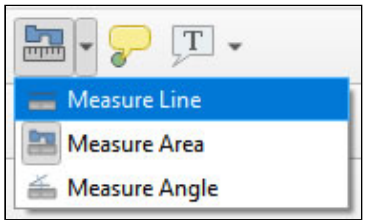


- Draw a box around the **Class C field**, left click when you are done to see the total area

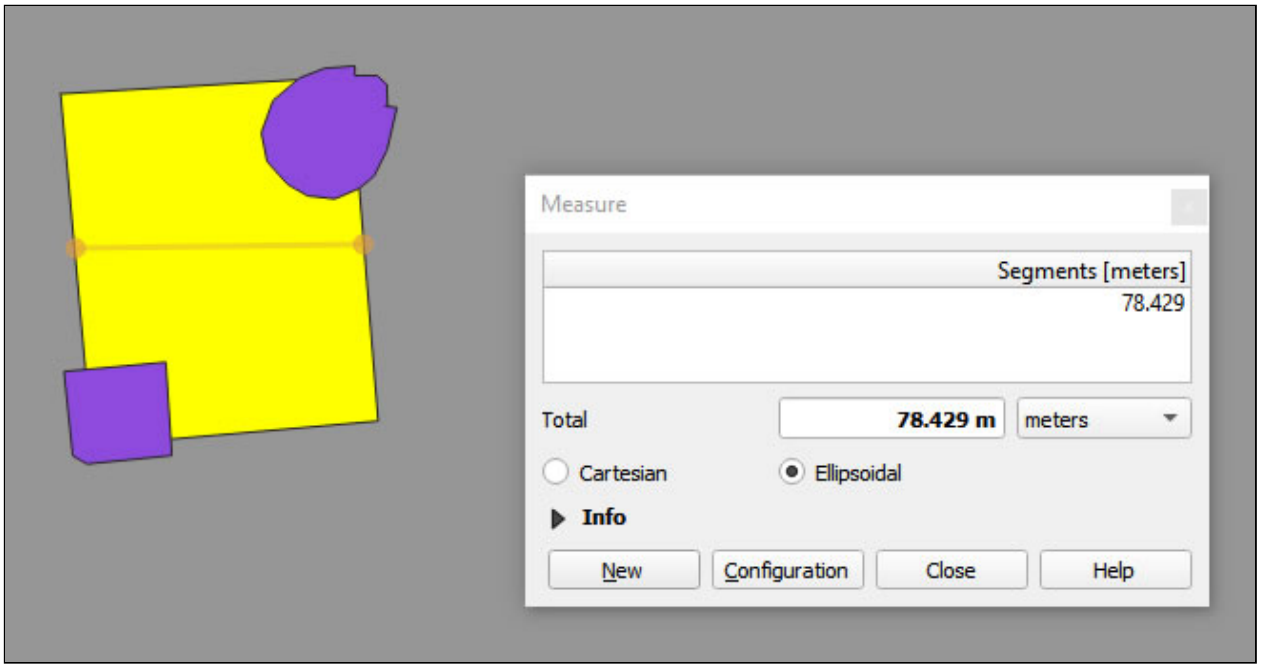


The field has an approximate square area of 7741.59m^2

5. If you would like to measure the diameter of the field from west to east select the **Measure Distance** option on the **Measure** tool.



6. Click on one side of the field to the other.



Raster data

Now that you have the fundamental understanding of Vector data, you will focus on learning the spatial properties of Raster data.

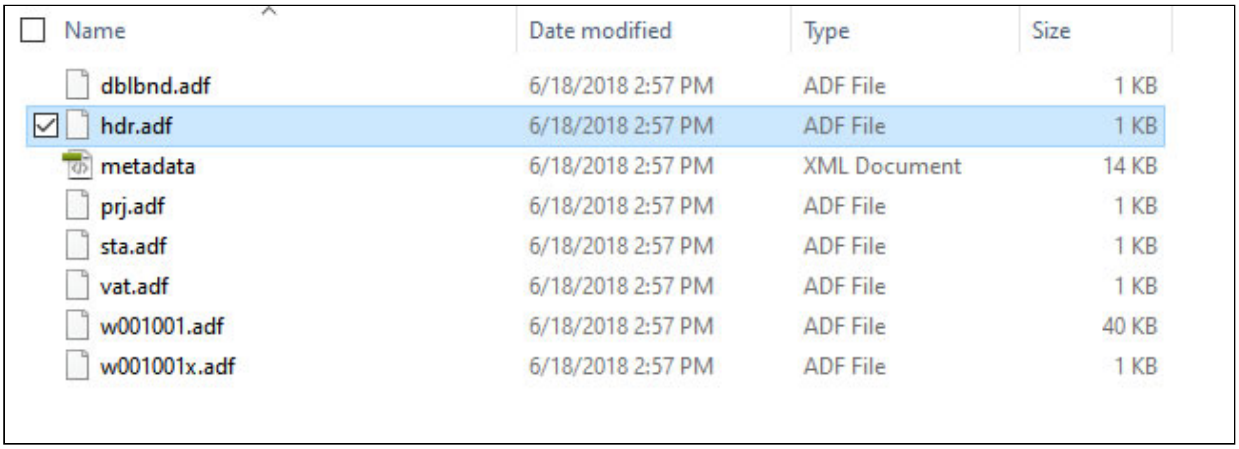
1. Use this link to save a Digital Elevation Model (DEM) which covers the extent of Victoria.

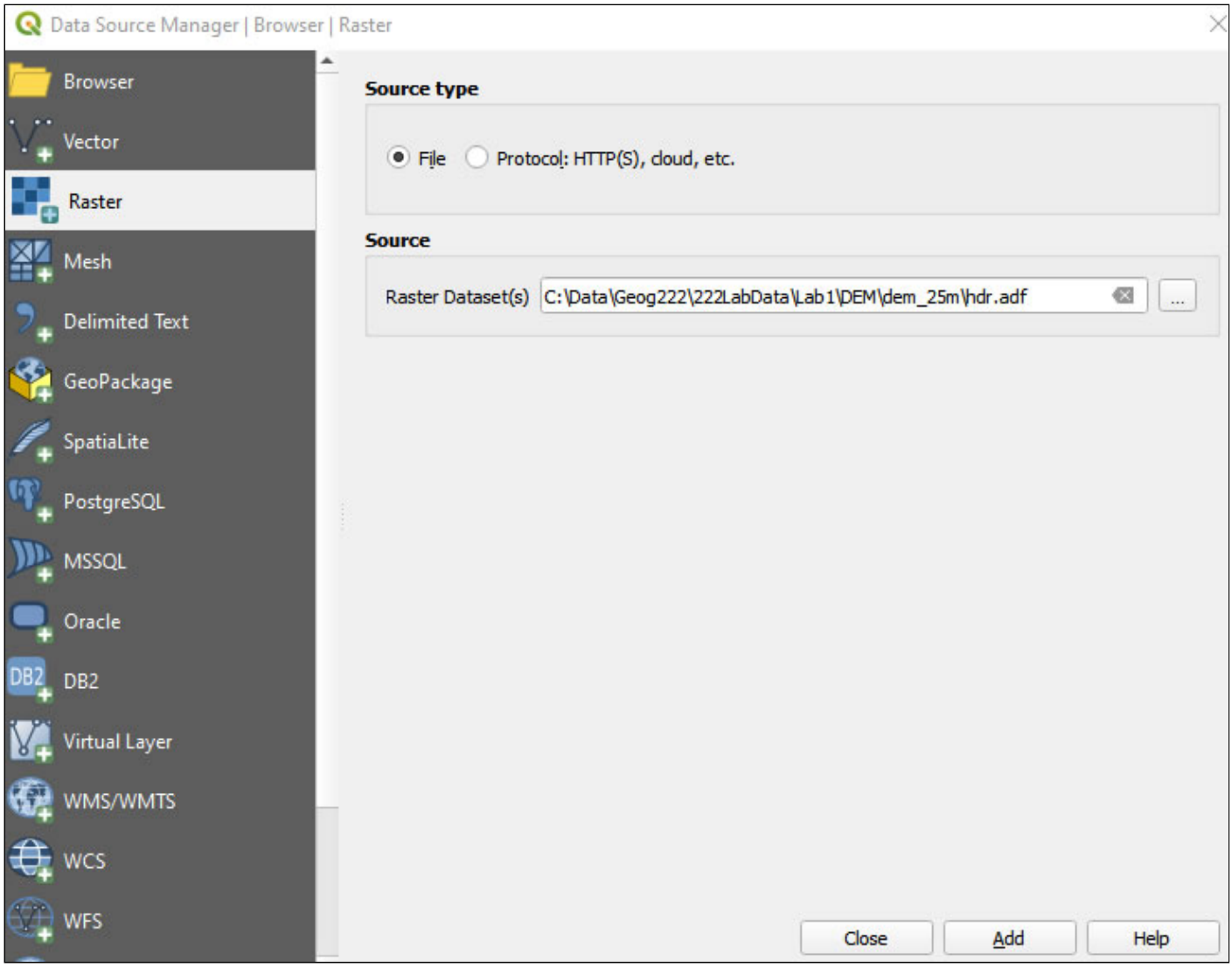
- Save the zipped folder to your downloads folder
- In your **Downloads** folder, double click on the file and paste the data to your **Lab1** folder

2. Use the **Add Data** button in QGIS Pro to open the grid

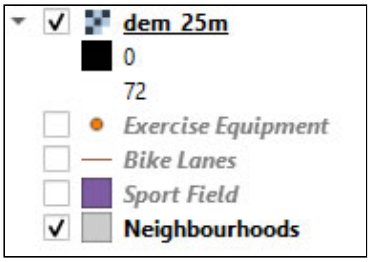
- Choose the raster tab → Browse to the **Lab1** folder

- Open the **dem_25m** folder → choose the **hdr.adf** file → press **Open** → press **Add** → **Close**

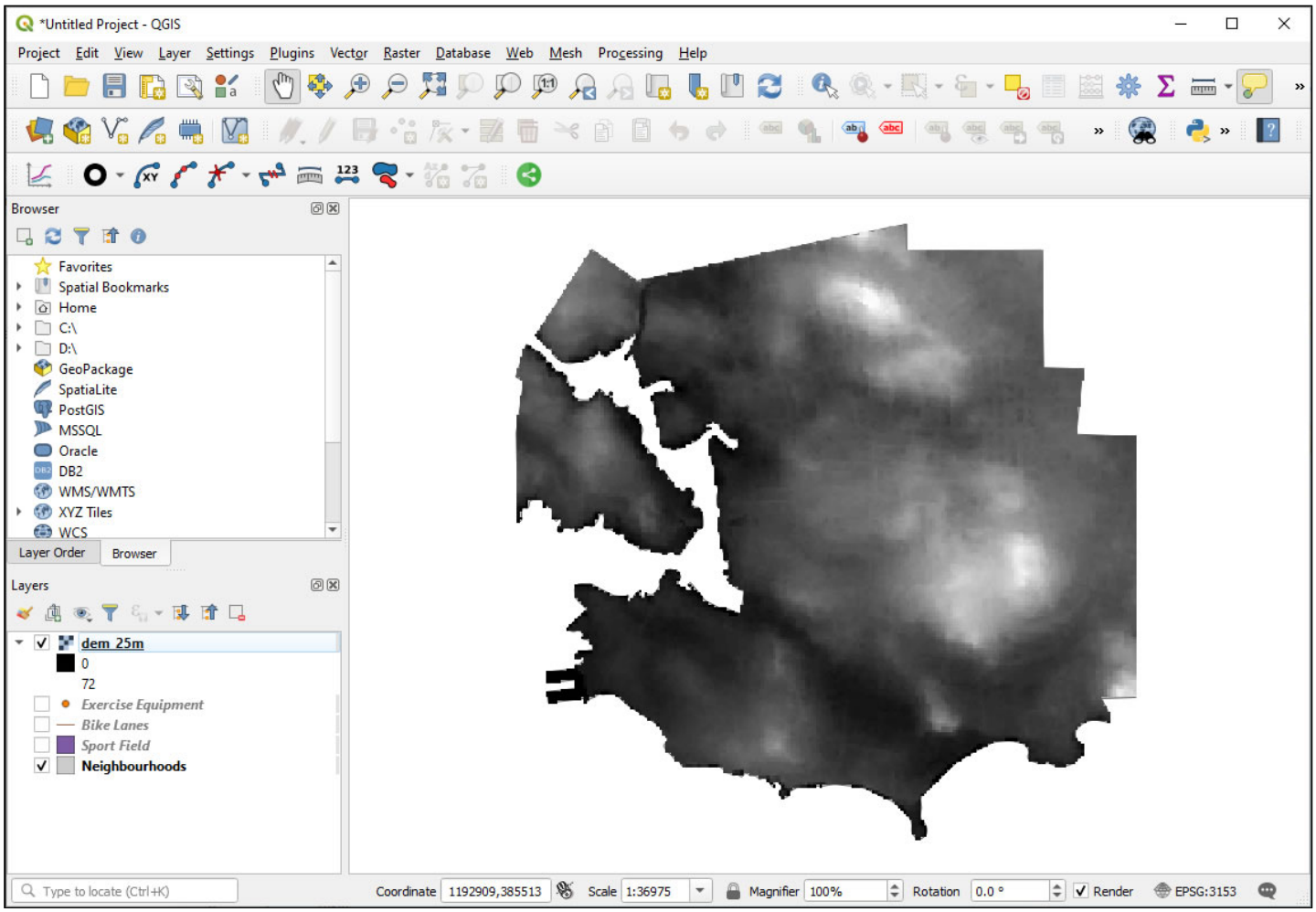




3. To view the DEM, ensure that it is at the top of your Contents pane



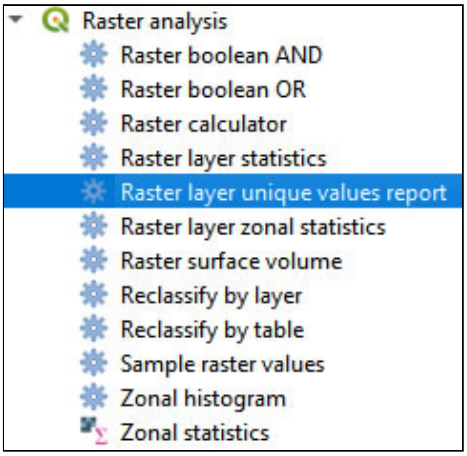
4. Select and hold the **dem_25m** in the Content panes, and drag it above the other layers

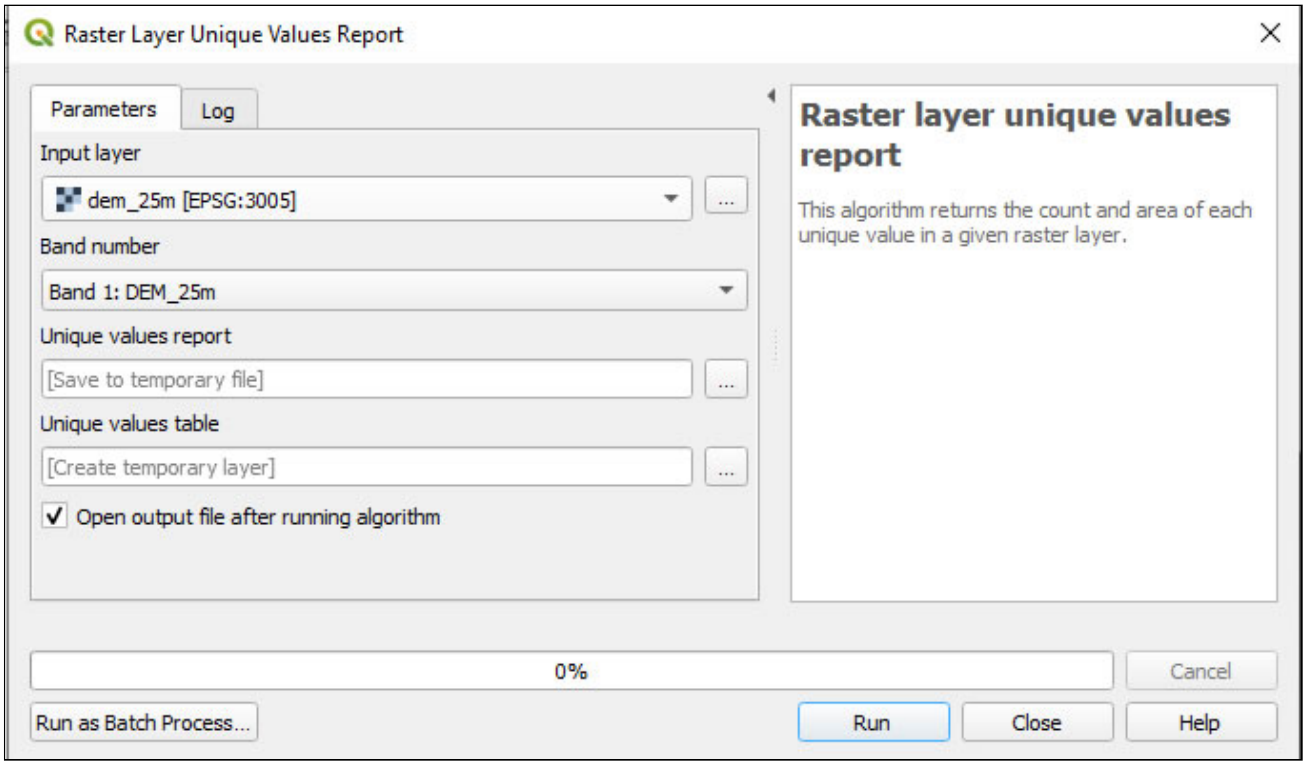


Note that the raster values range from 0m to 72m. This means that the elevation above sea level ranges from 0m (ocean) to 72m across Victoria.

5. To view the attribute information for the **dem_25m** you will have to build a unique values layer. To do so, you need to open the **Processing** menu → select **Toolbox**

- From the Toolbox locate **Raster analysis** → then choose "**Raster Layer Unique Values Report**"





- Set the Input Layer as: **dem_25m**
- Save the **Unique values report**
- Unique values report: **[Save to a temporary file]**
- Unique values table: **[Create Temporary Layer]**
- Press **Run**

6. Open the algorithm results file:

The output file will show the projection information of the file, the width and height of the file, the cell size resolution (units per pixel 25), and three columns including the **Value** (elevation at each pixel), the **Pixel count**, and the **Area**.

Analyzed file: C:/Data/Geog222/222LabData/Lab1/DEM/dem_25m (band 1)

Extent: 1193090.9322596970014274,379869.0643445411697030 : 1198665.9322596970014274,385394.0643445411697030

Projection: EPSG:3005 - NAD83 / BC Albers

Width in pixels: 223 (units per pixel 25)

Height in pixels: 221 (units per pixel 25)

Total pixel count: 49283

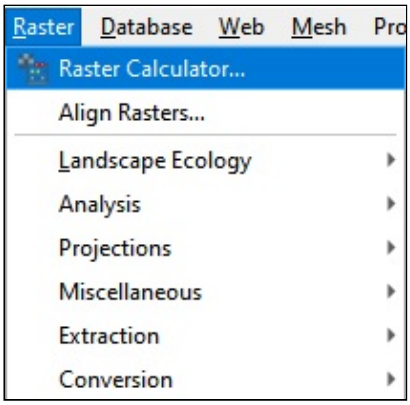
NODATA pixel count: 18137

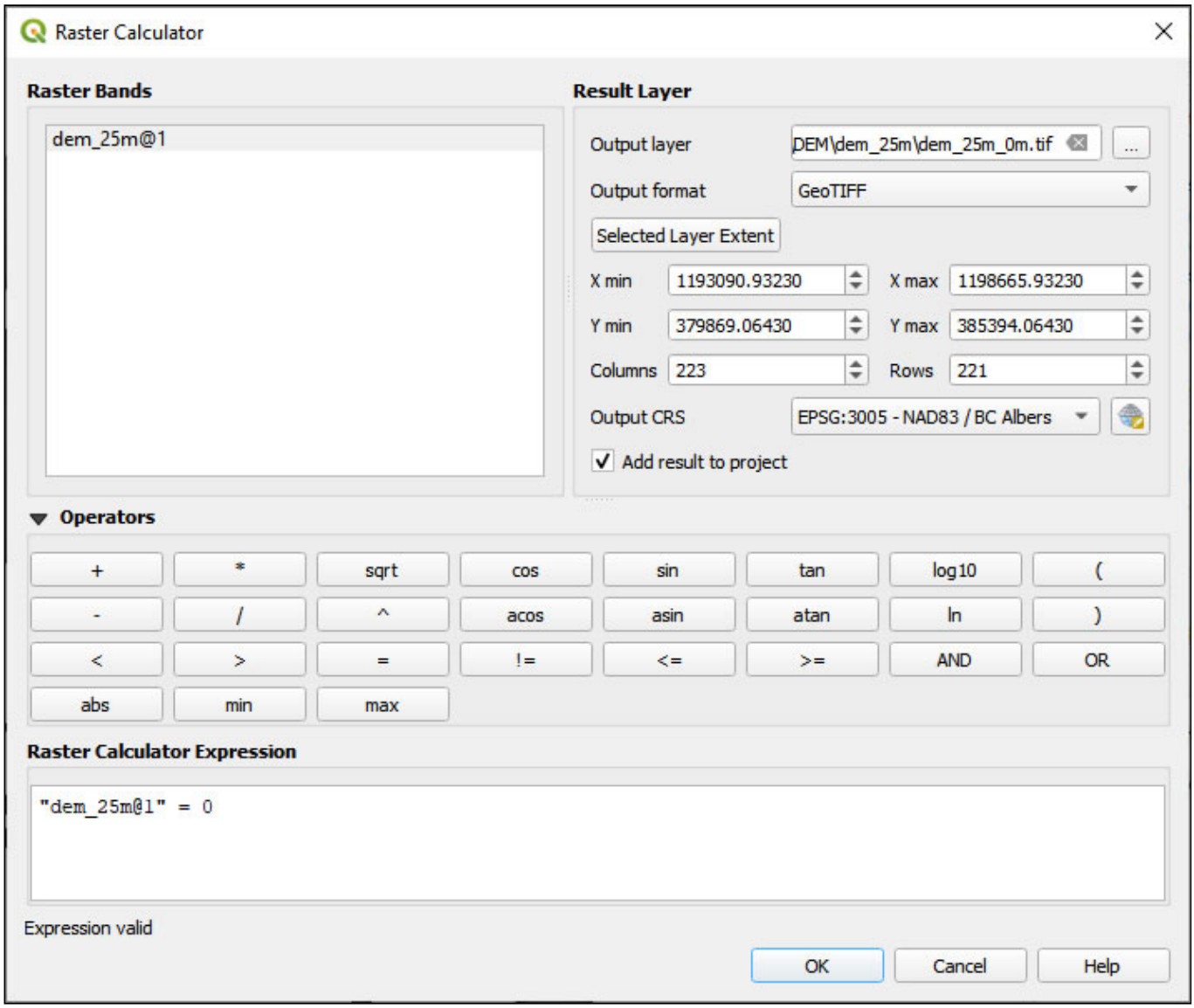
Value	Pixel count	Area (m²)
0	228	142500
1	61	38125
2	61	38125
3	80	50000
4	114	71250
5	187	116875
6	474	296250
7	762	476250
8	738	461250
9	857	535625
10	975	609375
11	896	560000
12	828	517500
13	944	590000
14	911	569375
15	948	592500
16	1068	667500
17	951	594375
18	994	621250
19	976	610000
20	943	589375
21	1034	646250

Observe from the attribute table, that 228 cells/pixels have a value of 0m elevation (the coastline) that makes up 142500m^2. You can calculate the area manually by multiplying the count of 0m pixels (228) by the pixel resolution (25m x 25m) your result will provide the square area of Victoria at 0m elevation (ocean). 142,500m^2

To understand where 0m values are within the Victoria area you will use the raster calculator to query the grid.

6. Navigate to the **Raster** menu → select the "**Raster Calculator**"

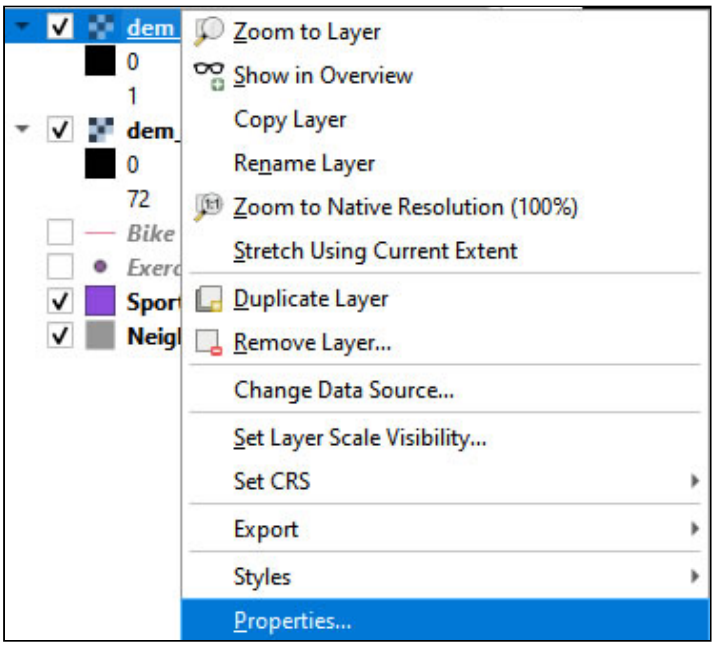




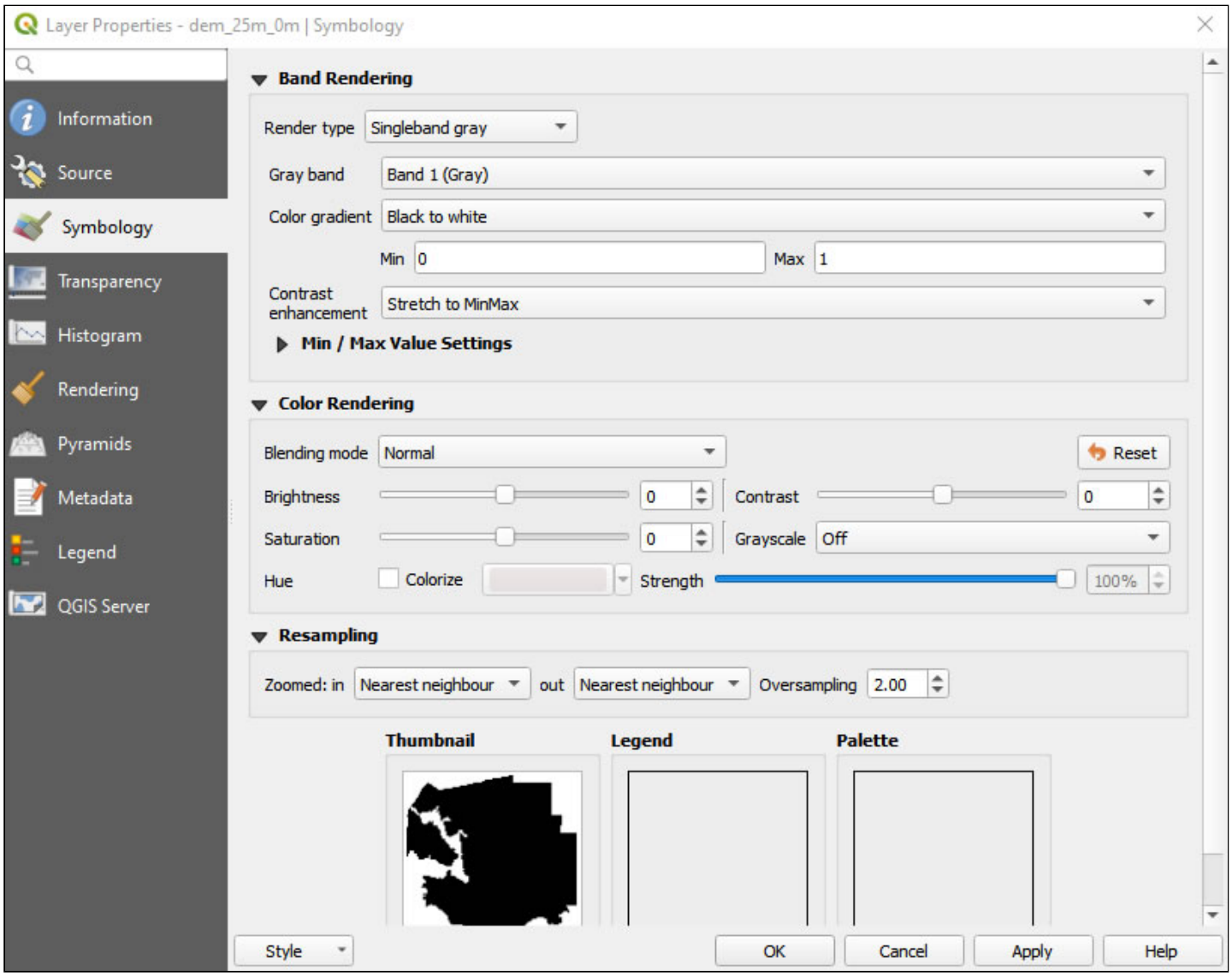
- Set the **Raster Calculator Expression** as "dem25m@1" = 0 **(add the expression with the buttons do not type it in except for the 0)**
- Save the Output layer as **dem_25m_0m** in your lab1 output folder **(you must browse to your Lab 1 folder. Do not include the .tif file extension in the filename)**
- Press **OK**

The output raster will provide a result with two values. A 1 and a 0 boolean output. The cells with a value of 1 meet the query (have a value of 0m elevation), and the cells with a value of 0 have elevations higher than 0m. The output grid will have a black and white colour pallet.

To change the symbology of the grid to see the 0m elevation cells verses the higher elevation cells, right click on the **dem_25m_0m** file, and choose **Properties**.

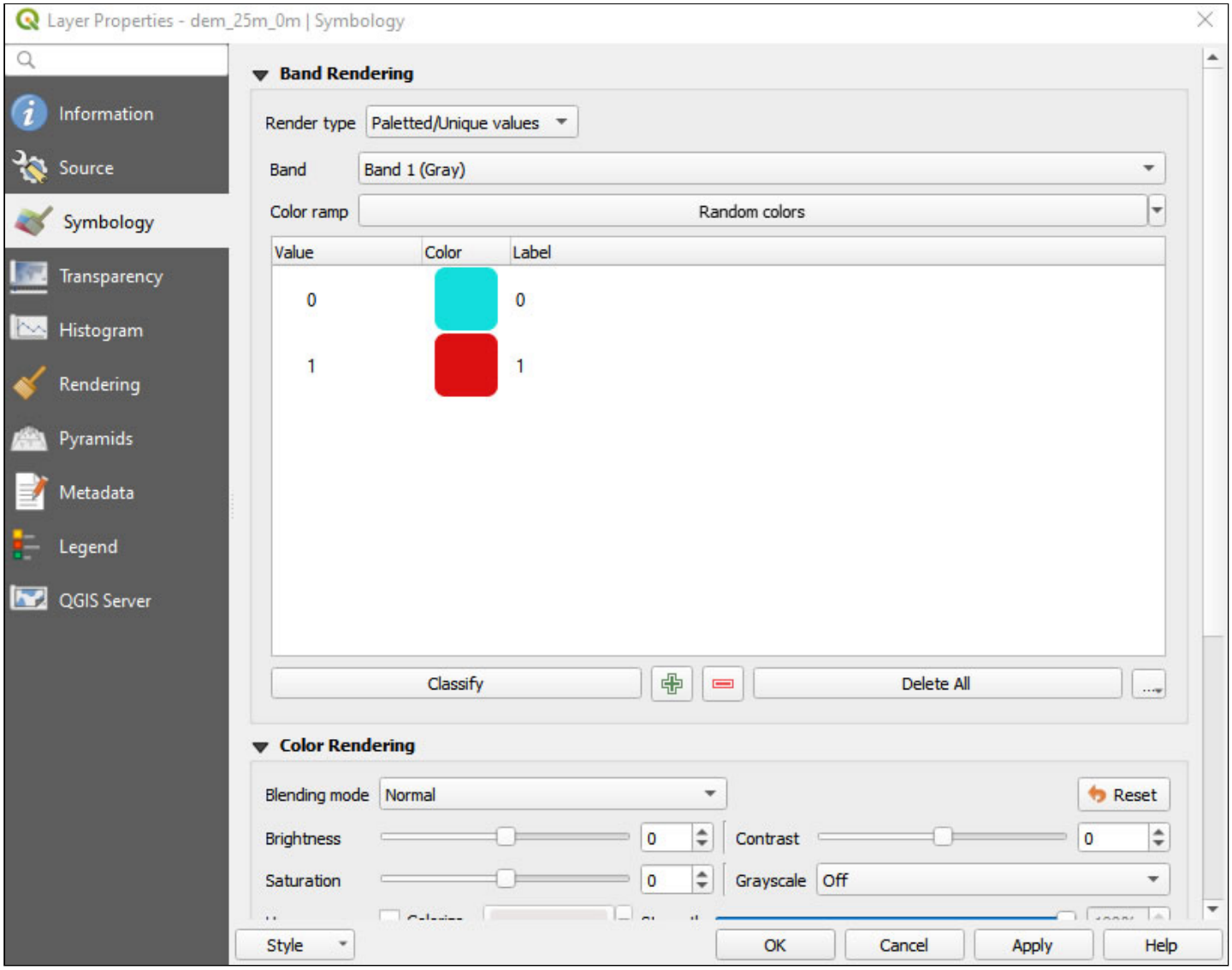


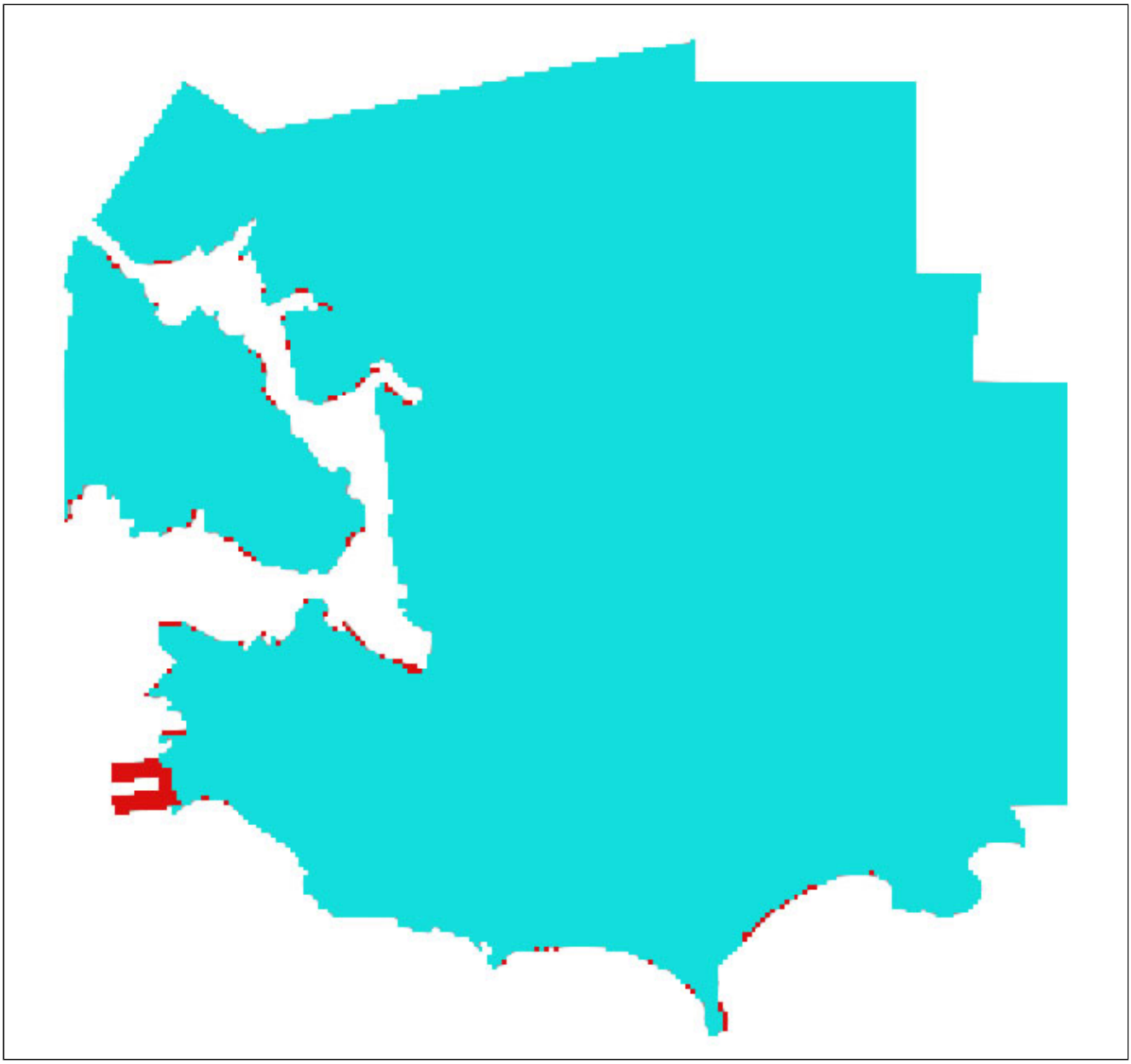
- Select the **Symbology** tab



- In the **Render Type** drop down select: **Paletted/Unique values**

- Press **Classify**
- Press **Apply → OK**





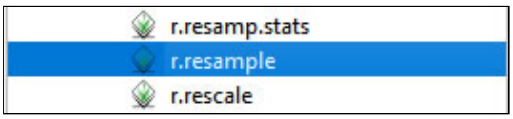
Now you will see the 0m elevation cells around the coastline of the DEM as these cells are in the ocean.

Resampling raster data

You can change the spatial resolution of raster data by resampling the pixel resolution. Understand that you cannot increase resolution from the source pixel size. If the dataset came with a resolution of 25m you cannot resample it to 5m and get any more information from the data (i.e., the range and variance in dataset remains the same you just have more cells showing the same elevation information). However, if you lower the resolution (increase the pixel size) you can select different ways of aggregating (collapsing) the pixels into larger pixels with less detailed information (elevation in this case).

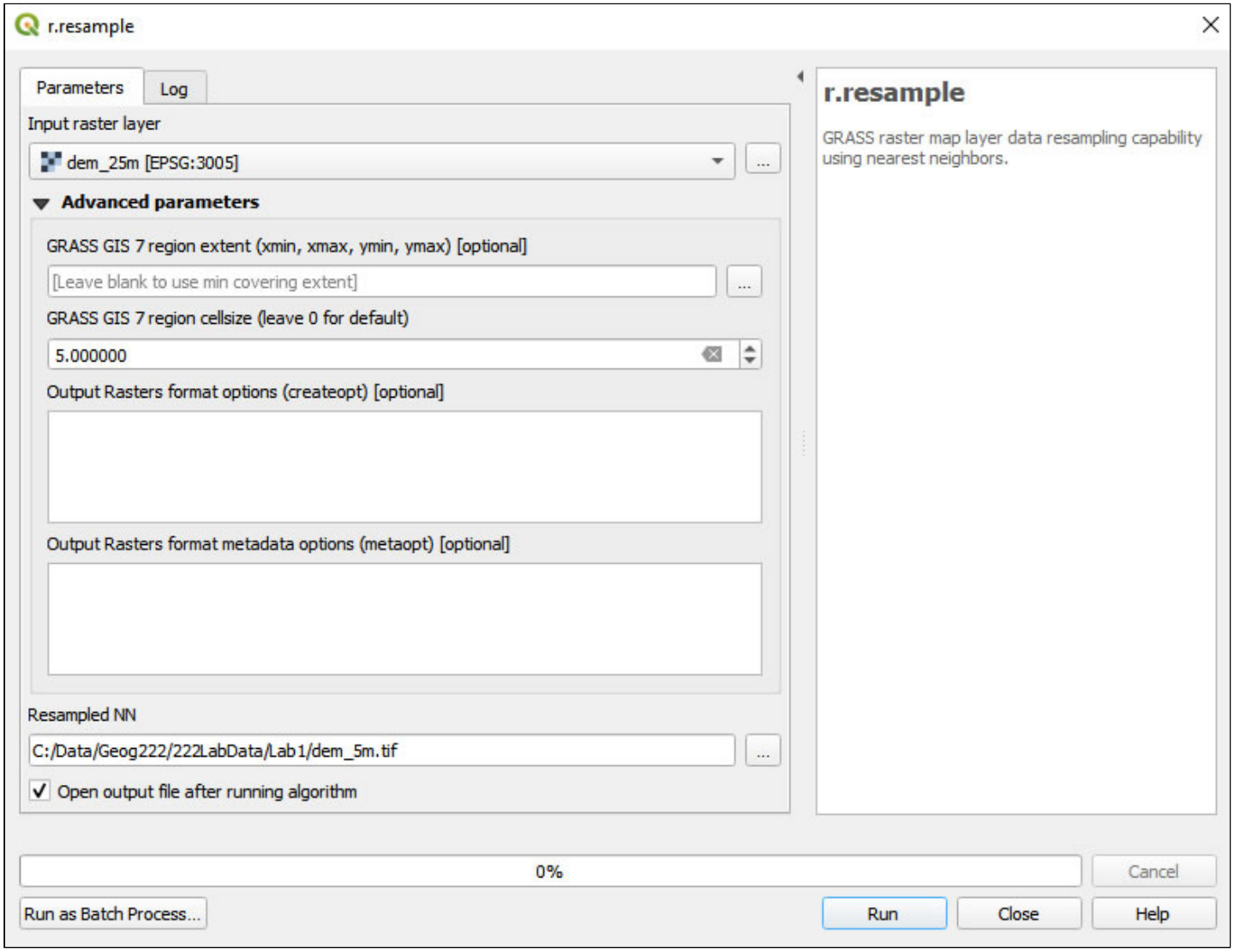
Let's test some resampling methods, to create new DEM files with variable resolutions, to demonstrate.

1. From the **Processing Toolbox**, navigate to the **GRASS** options → expand the **Raster** options → select **r.resample**



2. In the **r.sample** tool select the parameters as follows:

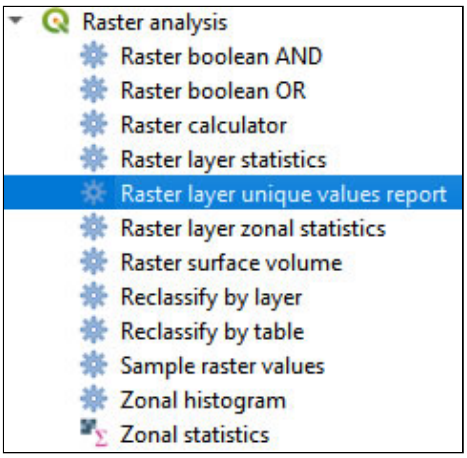
- Input raster layer: **dem_25m**
- GRASS GIS 7 region cellsize: **5**
- Resampled NN: save as **dem_5m** **(ensure you browse to your Lab 1 folder and save the file there)**



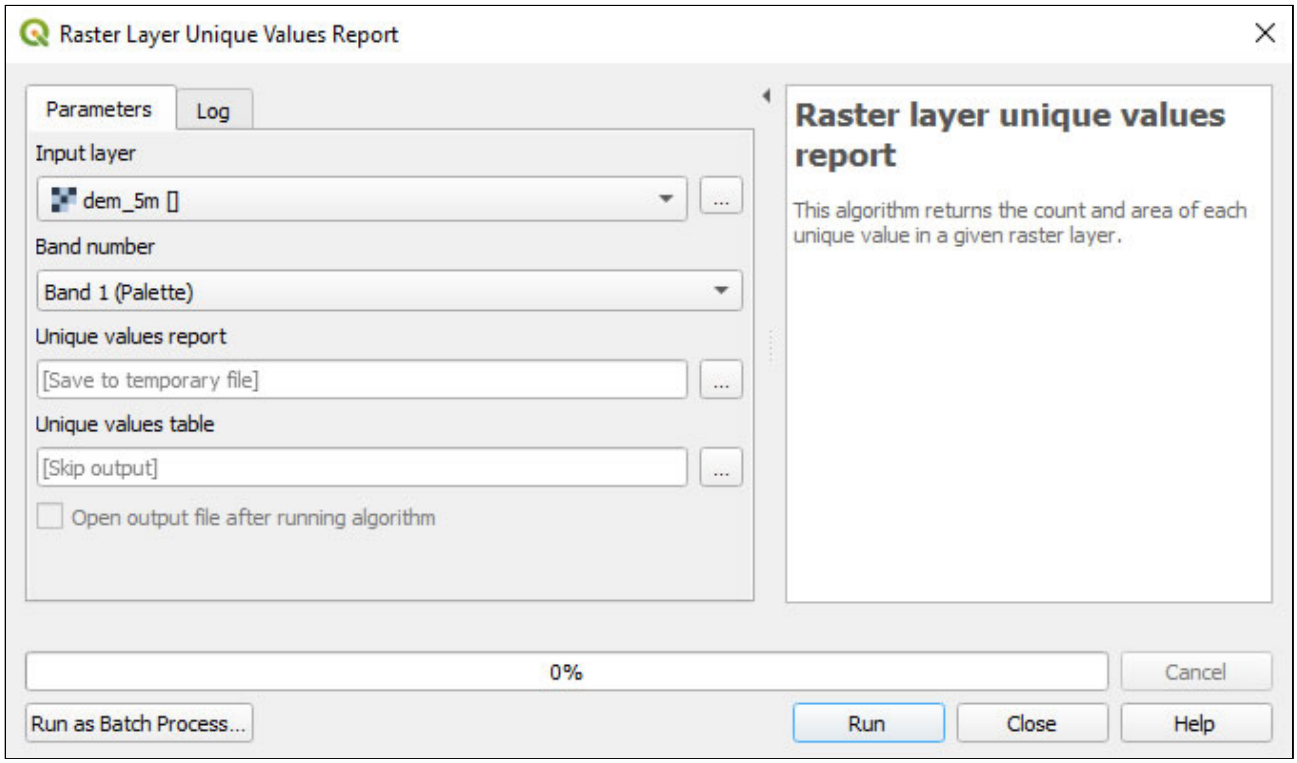
The new 5m DEM will have more rows and columns (count of pixels) compared to the 25m DEM.

4. To view the attribute information for the new **dem_5m** you will have to build a unique values layer. To do so, you need to open the **Processing** menu → select the Toolbox, in the

toolbox select the **Raster Analysis** tools → then choose "**Raster Layer Unique Values Report**".



- Set the Input Layer as: **dem_5m**
- Save the **Unique values report**
- Unique values report: **[Save to a temporary file]**
- Unique values table:**[Skip Output]**
- Press **Run**



Open the algorithm results file:

Algorithm: Unique values report
File path: C:\Users\JFITTE~1\AppData\Local\Temp\processing_de23aaf8f360436b9675aae859e307aa\ab92e58e09354f27b48e39707a2f4f3e\OUTPUT_HTML_FILE.html

Analyzed file: C:/Data/Geog222/222LabData/Lab1/dem_5m.tif (band 1)

Extent: 1193090.9322597000282258,379869.0643445400055498 : 1198665.9322597000282258,385394.0643445400055498

Projection: Unknown CRS: BOUNDCRS[SOURCECRS[PROJCRS["unknown",BASEGEOGCRS["

Width in pixels: 1115 (units per pixel 5)

Height in pixels: 1105 (units per pixel 5)

Total pixel count: 1232075

NODATA pixel count: 453425

Value	Pixel count	Area (m²)
0	5700	142500
1	1525	38125
2	1525	38125
3	2000	50000
4	2850	71250
5	4675	116875
6	11850	296250
7	19050	476250
8	18450	461250
9	21425	535625
10	24375	609375
11	22400	560000
12	20700	517500
13	23600	590000
14	22775	569375
15	23700	592500
16	26700	667500
17	23775	594375
18	24850	621250
19	24400	610000
20	23575	589375
21	25850	646250
22	26325	658125

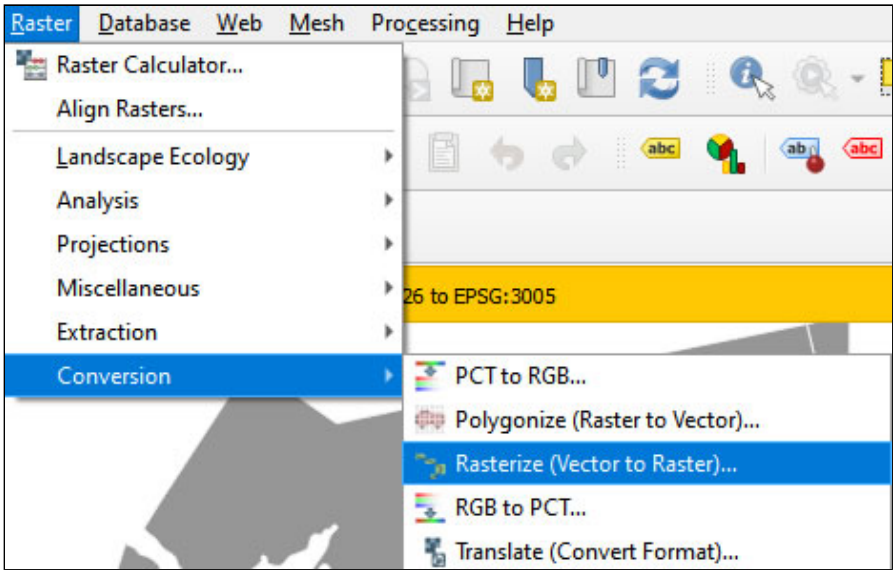
Scroll through the elevation values and see that the range remained the same (0 to 72m) after resampling the dataset to 5m resolution. What has changed in the dataset is the pixel resolution (units per pixel is 5m), and the amount of columns and rows (1115 columns, 1105 rows). The 0m elevation data has increased from 228 pixels to 5700 pixels in the new raster, though the total area remains the same at: 142,000m^2.

Data Conversions

For many GIS projects, analysts have to convert data between vector and raster data models. Similar to resampling, the resolution impacts the quality of the output datasets.

In the next steps you will convert the **Neighbourhoods** file into a raster format with two different sized resolutions, and compare the results.

1. Navigate to the **Raster** menu, select **Conversion**, then **Rasterize**.



2. Set the geoprocessing parameters as follows:

Input layer: Neighbourhoods

Field to use for a burn-in-value [optional]: OBJECTID

A fixed value to burn [optional]: 0.00000

Output raster size units: Georeferenced units **(meters in this case because the data are projected in a NAD83 UTM Zone 10 projection)**

Width: 25

Height: 25

Output extent: use the **...** button, to select the **Neighbourhoods** layer as the extent

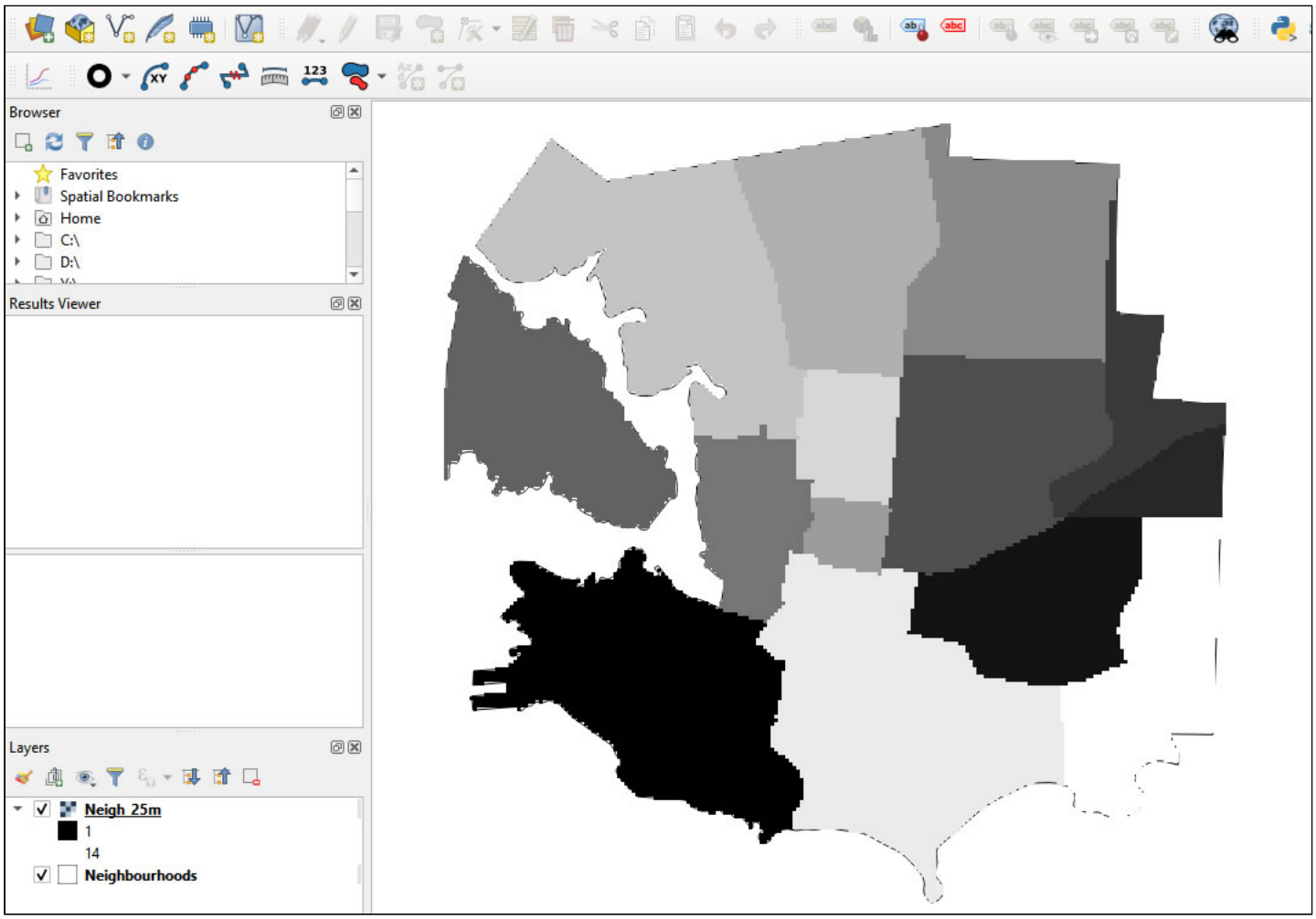
Output data type: Int32

Rasterized: Neigh_25m **(Use the ... button to save in your Lab 1 folder)**

Leave all other options blank and press **Run**

Note that the Field indicates which attribute will be converted to the OBJECTID field in the raster data. Since raster data can only represent one attribute at a time you only get the choice of one field. In this case, the field is the object ID.

2. Click and drag the output raster to the top of the drawing order in the Contents pane.



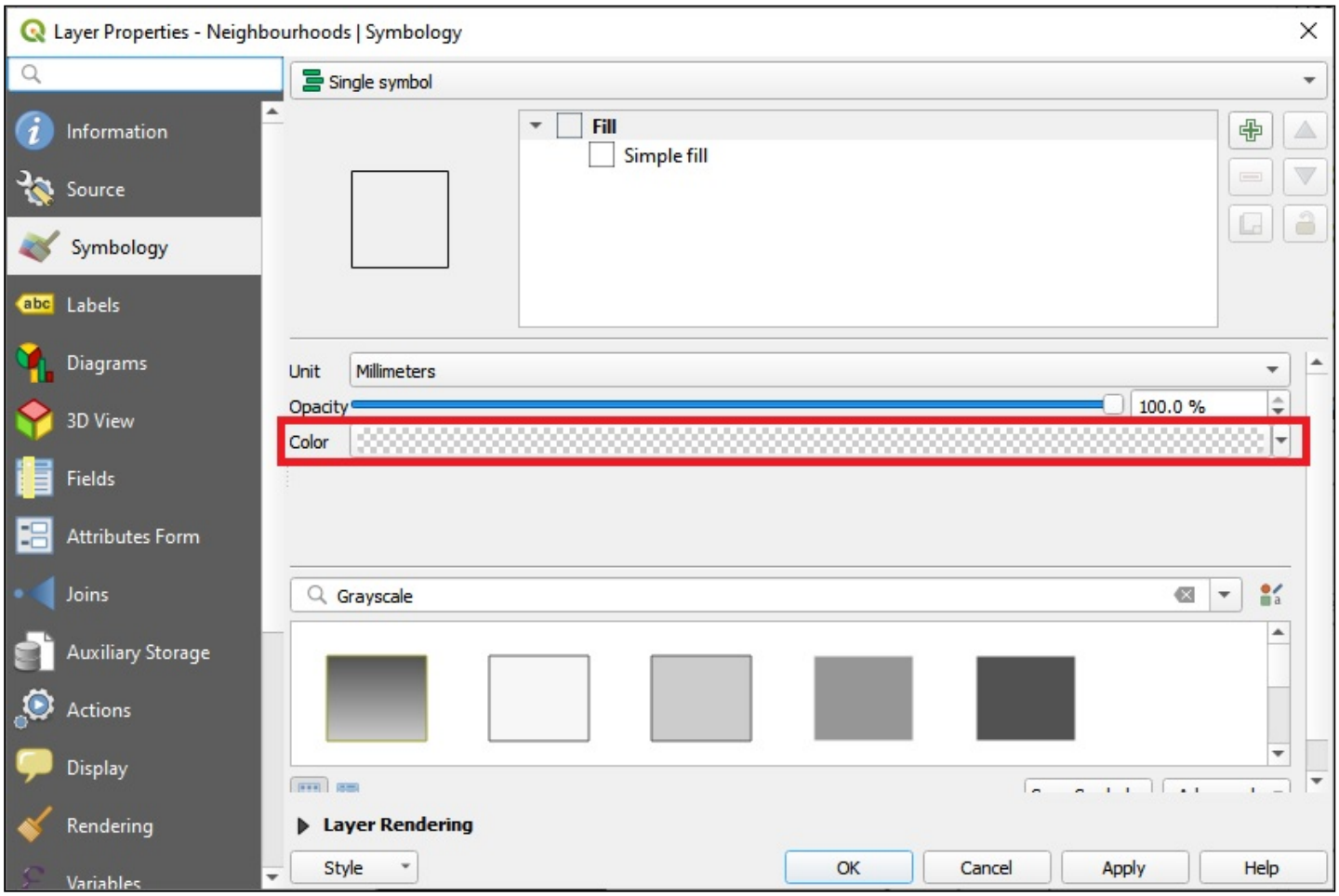
3. To compare the raster regional borders to the Vector data, hold and drag the **Neighbourhoods** layer above the **Neigh_25m** layer.

At this point you cannot see through the **Neighbourhoods** layer, so you will have to modify the symbology.

4. Double click the box symbol next to the **Neighbourhood** layer in the **Contents** pane.

A Symbol pane will pop-up on the right hand side of the software display.

5. Set the colour to no colour (the checkered pattern)

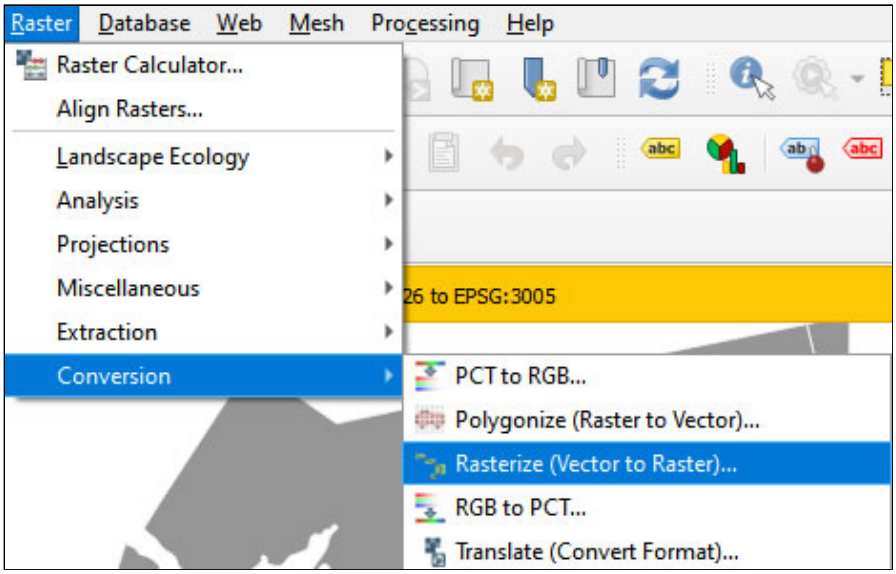


6. Use the zoom tool  to closely look at the boundaries of the shapefile

Hold the shift key and zoom into a border to see the conversion results.

Notice that the 25m pixel resolution is limited in its ability to represent the detail of the neighbourhood boundaries. Let's repeat the feature to raster conversion with a 2m pixel resolution.

7. Navigate to the **Raster** menu, select **Conversion**, then **Rasterize**.



8. Set the geoprocessing parameters as follows:

Input layer: Neighbourhoods

Field to use for a burn-in-value [optional]: OBJECTID

A fixed value to burn [optional]: 0.00000

Output raster size units: Georeferenced units **(meters in this case because the data are projected in a NAD83 UTM Zone 10 projection)**

Width: 2

Height: 2

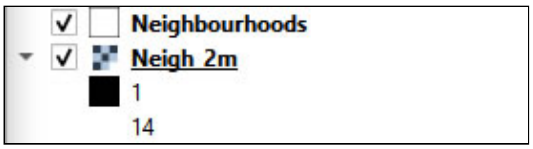
Output extent: use the **...** button, to select **Use Layer Extent...** and choose the **Neighbourhoods** layer

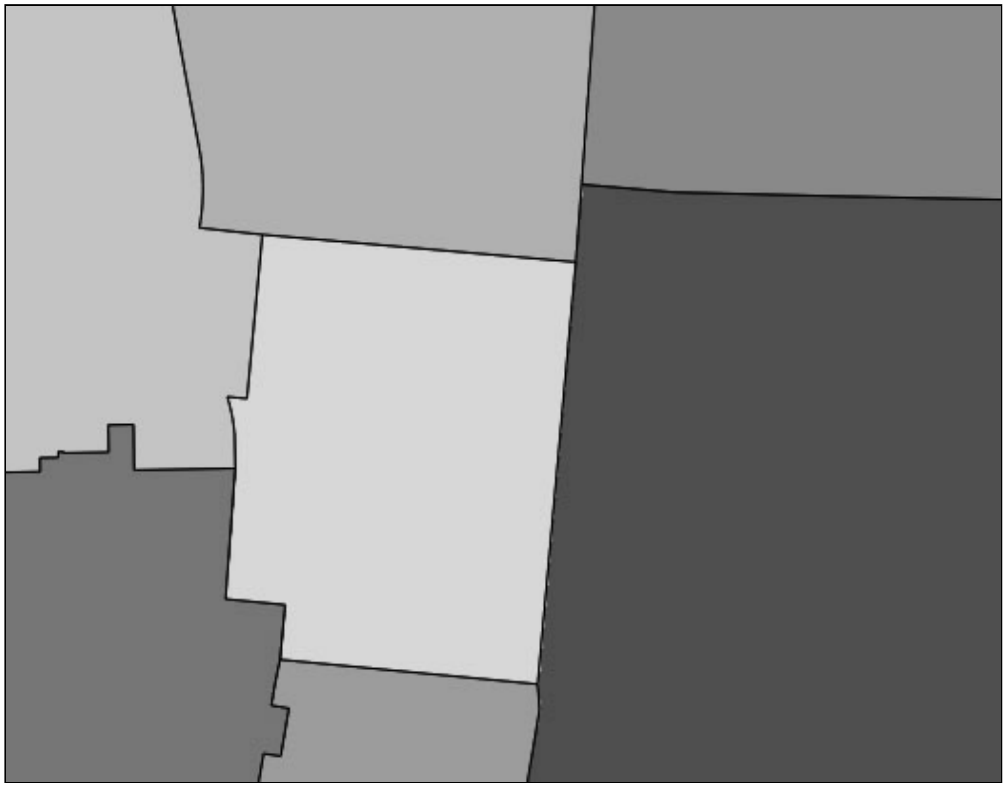
Output data type: Int32

Rasterized: Neigh_2m.tif

Leave all other options blank and press **Run**

To compare the raster regional borders to the Vector data, hold and drag the **Neighbourhoods** layer above the **Neigh_2m** layer.





8. Compare the results

- The 2m resolution is able to approximate the detail of the **Neighbourhood_Boundaries** layer.

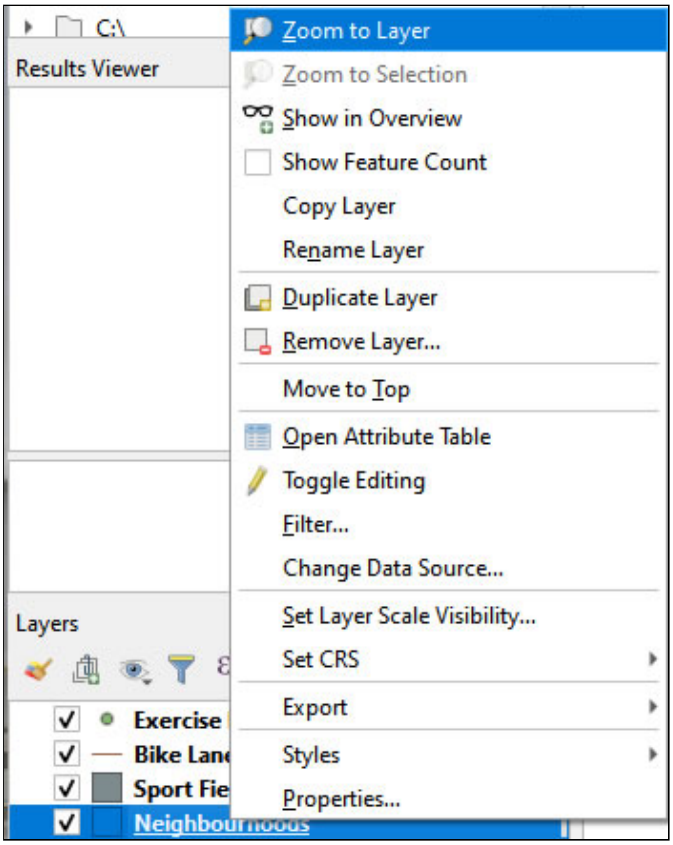
The resolution of raster data is limited by instrumentation or sampling design used to collect the raw data. For example, satellites that collect information on landscape characteristics are limited by spatial resolution. Some have a resolution of 25m (landsat), while others have a pixel resolution of 1km (MODIS). It is best to work with the smallest resolution as possible when conducting GIS projects, but there is a trade-off between detail and computer storage space.

Map making (Symbology, Labels, and Layout)

Now it is time to produce your first map.

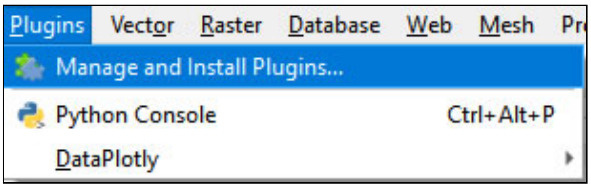
1. Remove the **DEM_25m, neigh_2m** and **neigh_25m** from your map (right click on the layers in the Contents pane → and select **Remove**)

3. To centre your Map, right click on the **Neigbourhoods** and Zoom To Layer

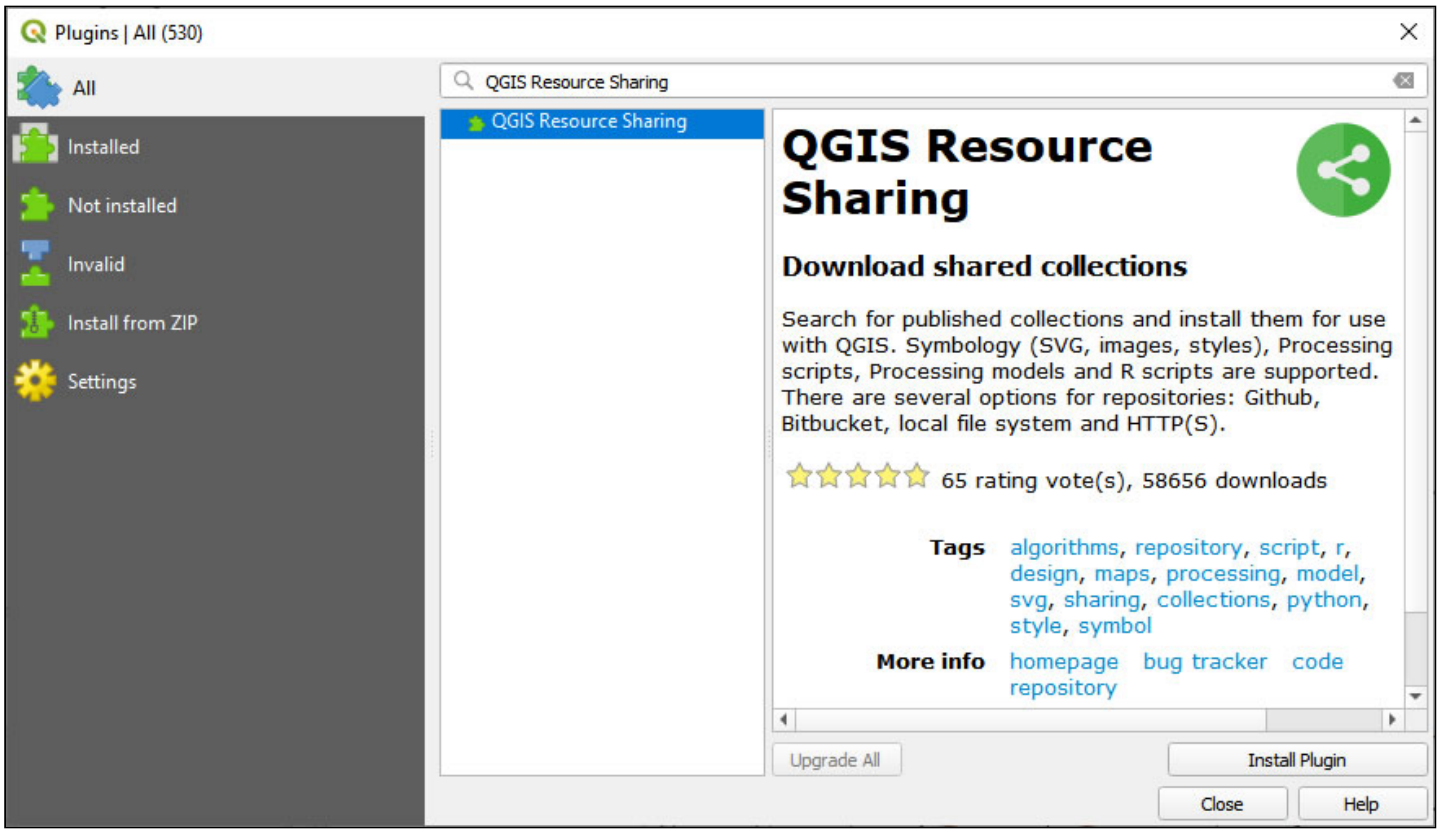


Now you will download a pluggin to install SVG symbols into QGIS.

1. From the **Plugins** menu, select **Manage and Install Plugins**...

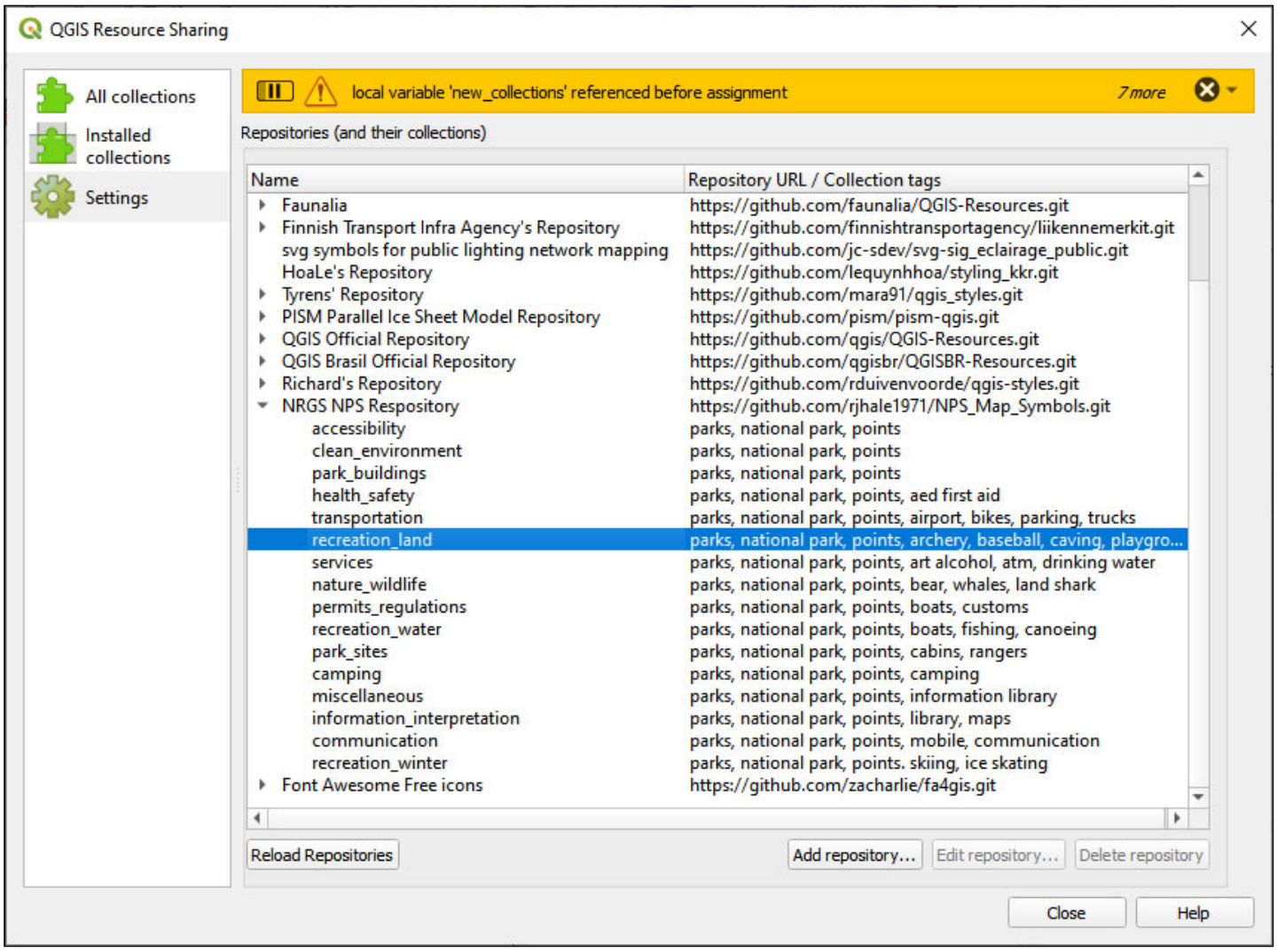


2. Search for: **QGIS Resource Sharing**

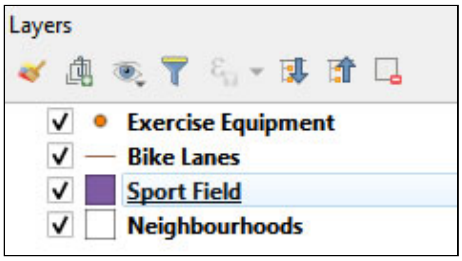


3. Press "**Install Plugin**"

4. Once the plugin is installed you will see a **Resource Sharing** button in your menu  , look for the **recreation_land** option, then press **Close**.

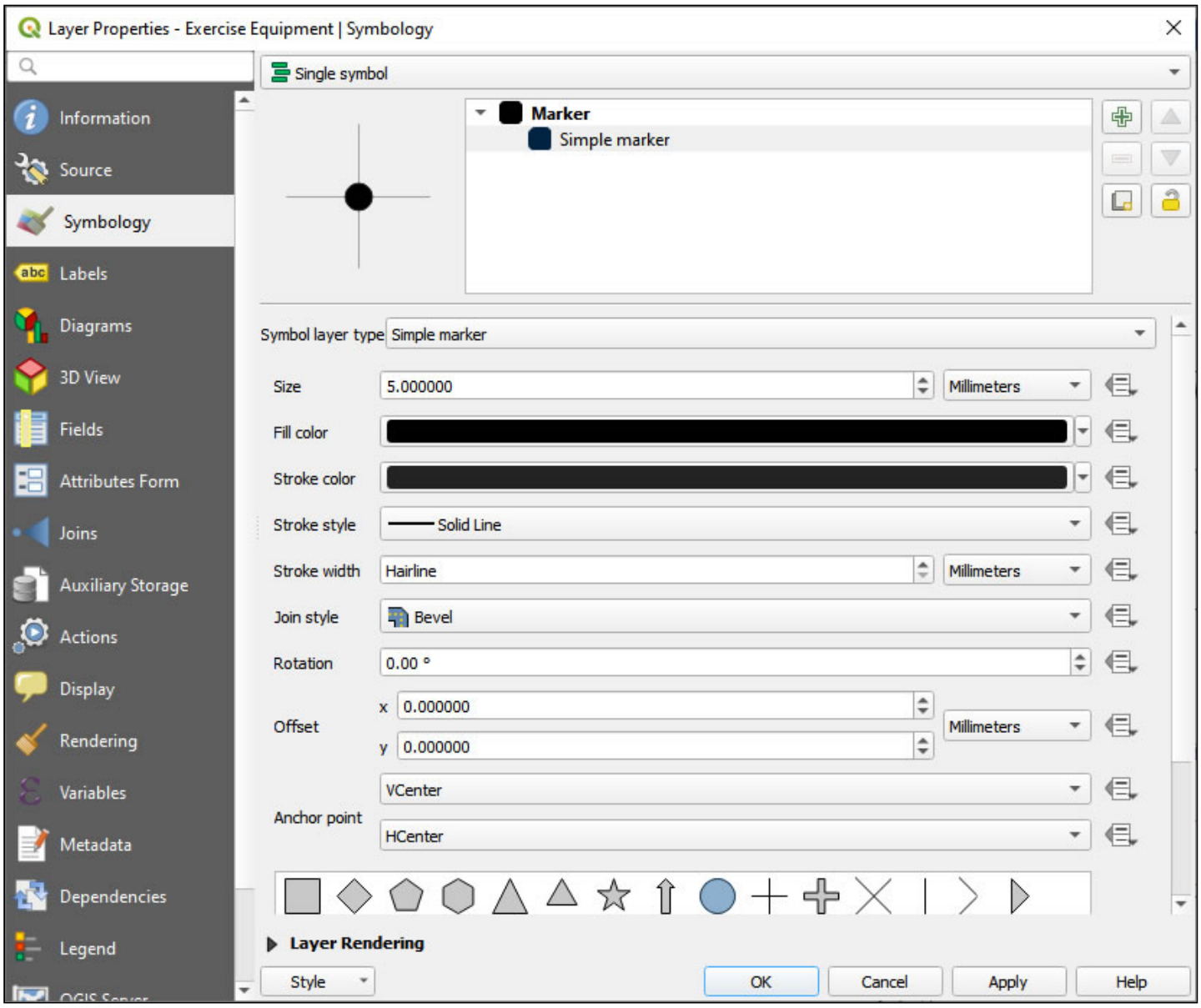


5. By clicking and dragging the layers in the Contents pane, arrange the drawing order as follows:



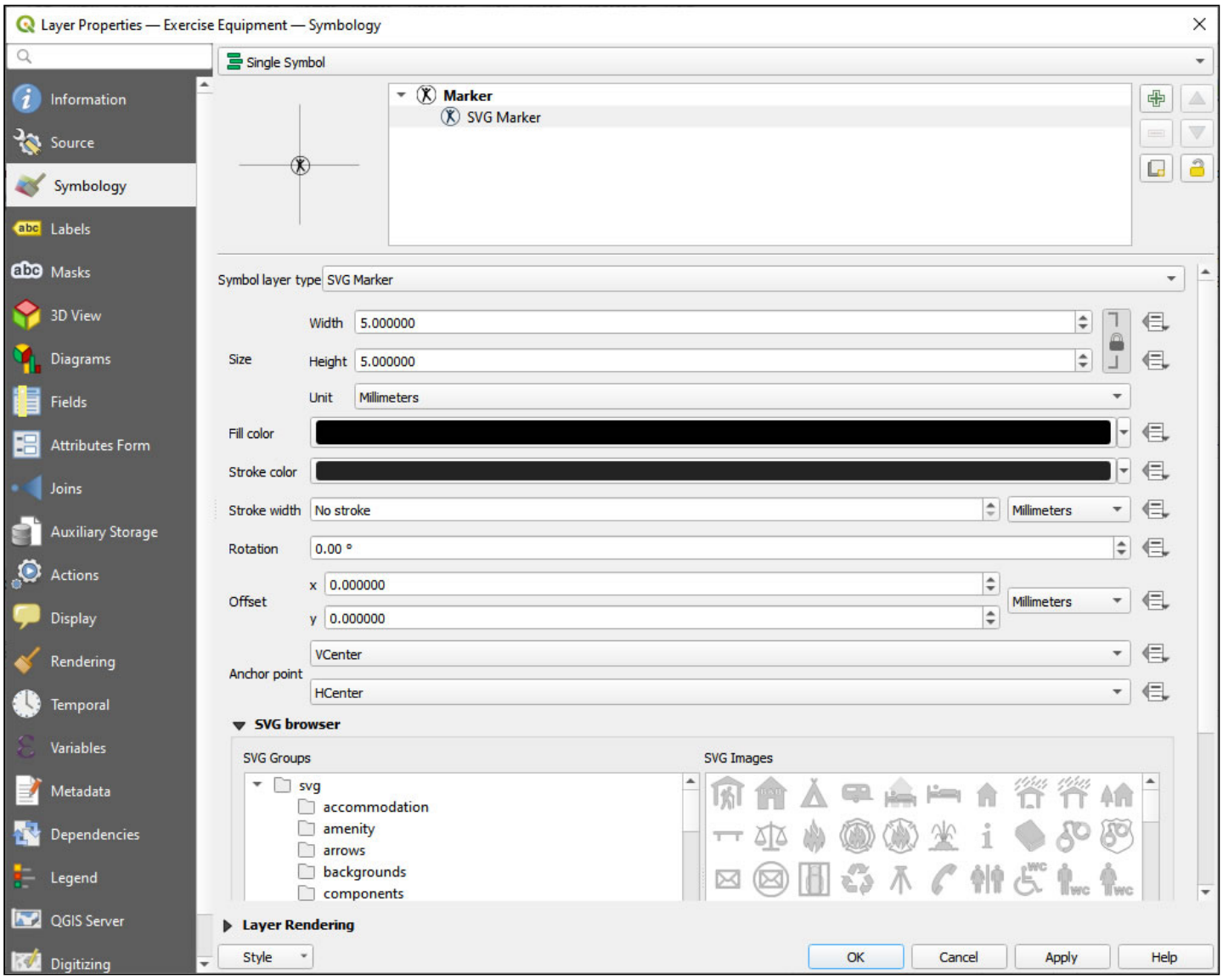
6. In the Contents pane, click on the **Exercise Equipment** symbol

With the **Simple Marker** chosen, set the size to **5.000000** and the Fill color to **black**



Now you will set the SVG symbol

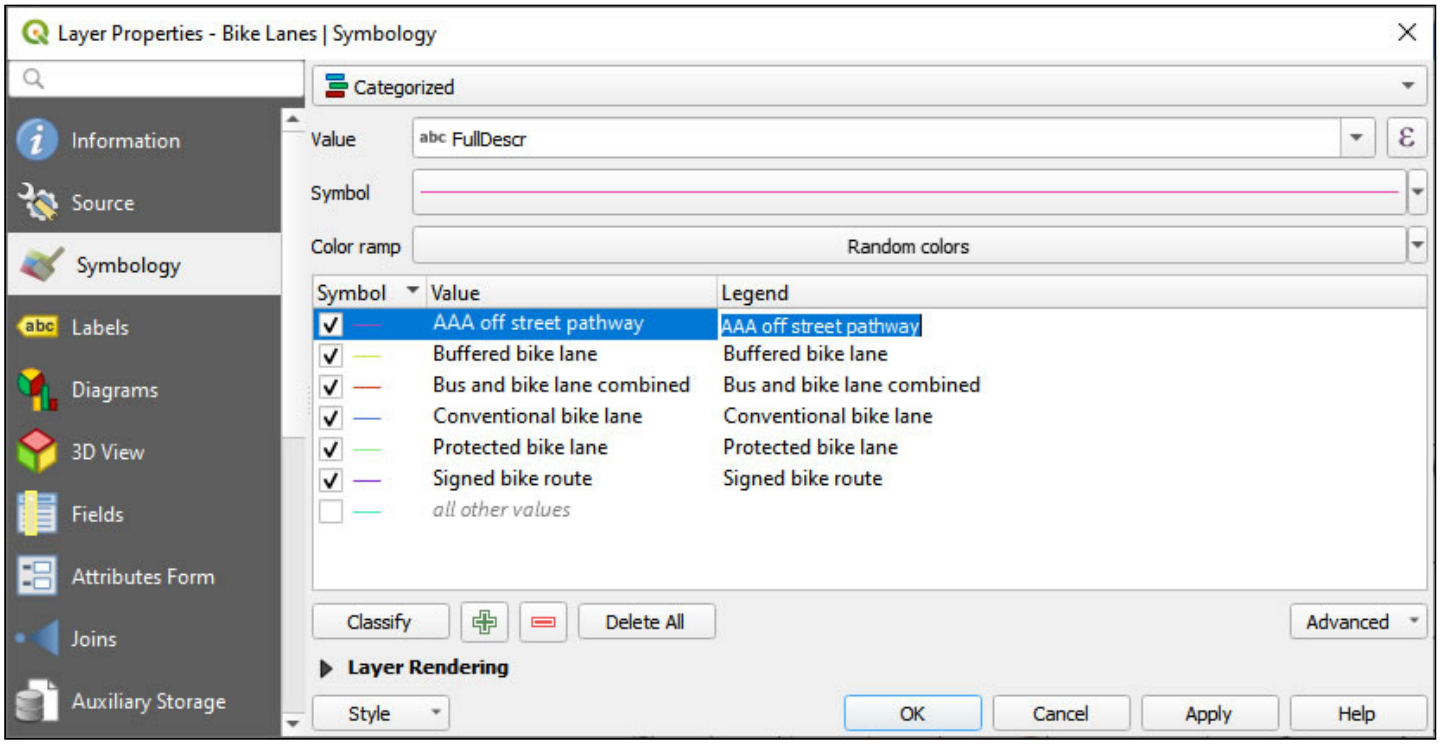
7. Under the **Symbol layer type**, select **SVG marker**, and scroll to the **SVG Groups** → select **sport** → choose the: **sport_liesure_centre**



8. Press **Apply** → **OK**

9. In the Contents pane, click once on the **Bike Lanes** symbol.

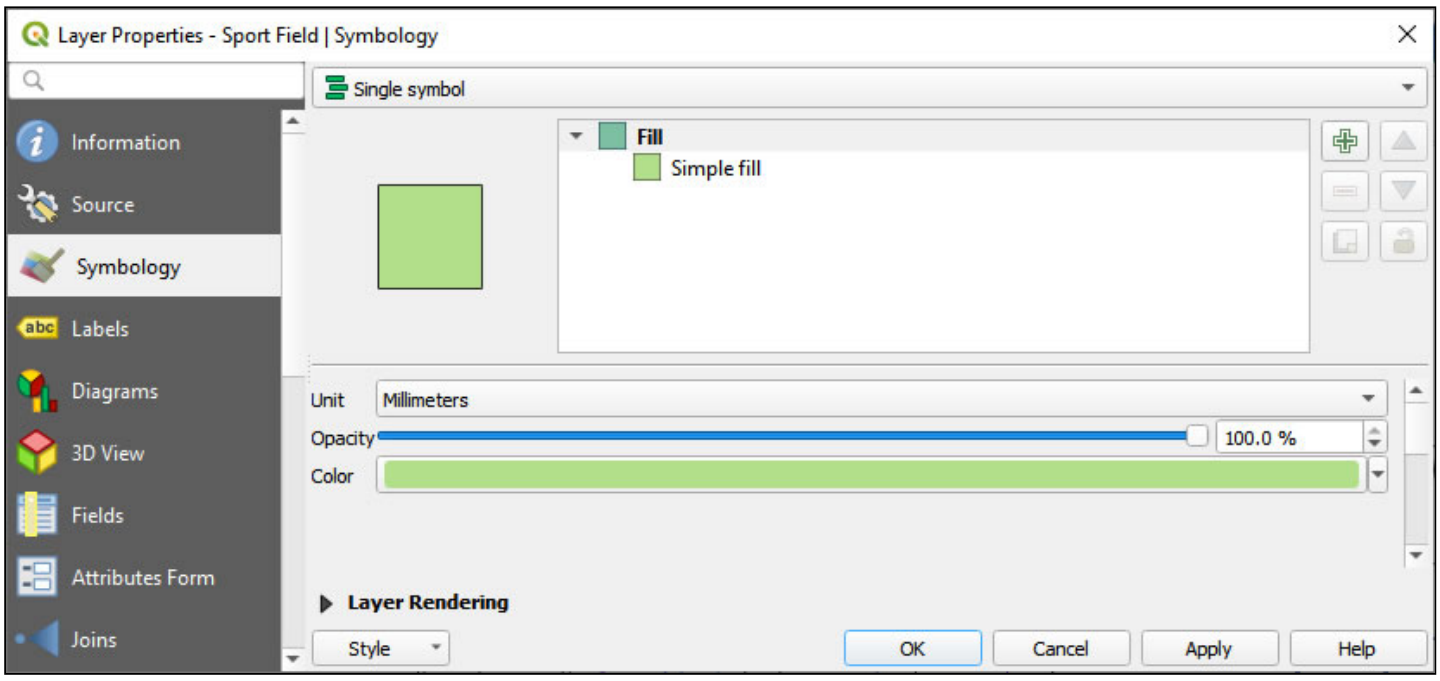
- When the Symbology window pops up change the type to: **Categorized**
- Press **Classify**
- Set the **Value** as: **FullDescr**
- To ensure the map does not include the category **"all other values"**, uncheck the option



- Press **Apply** → **OK**

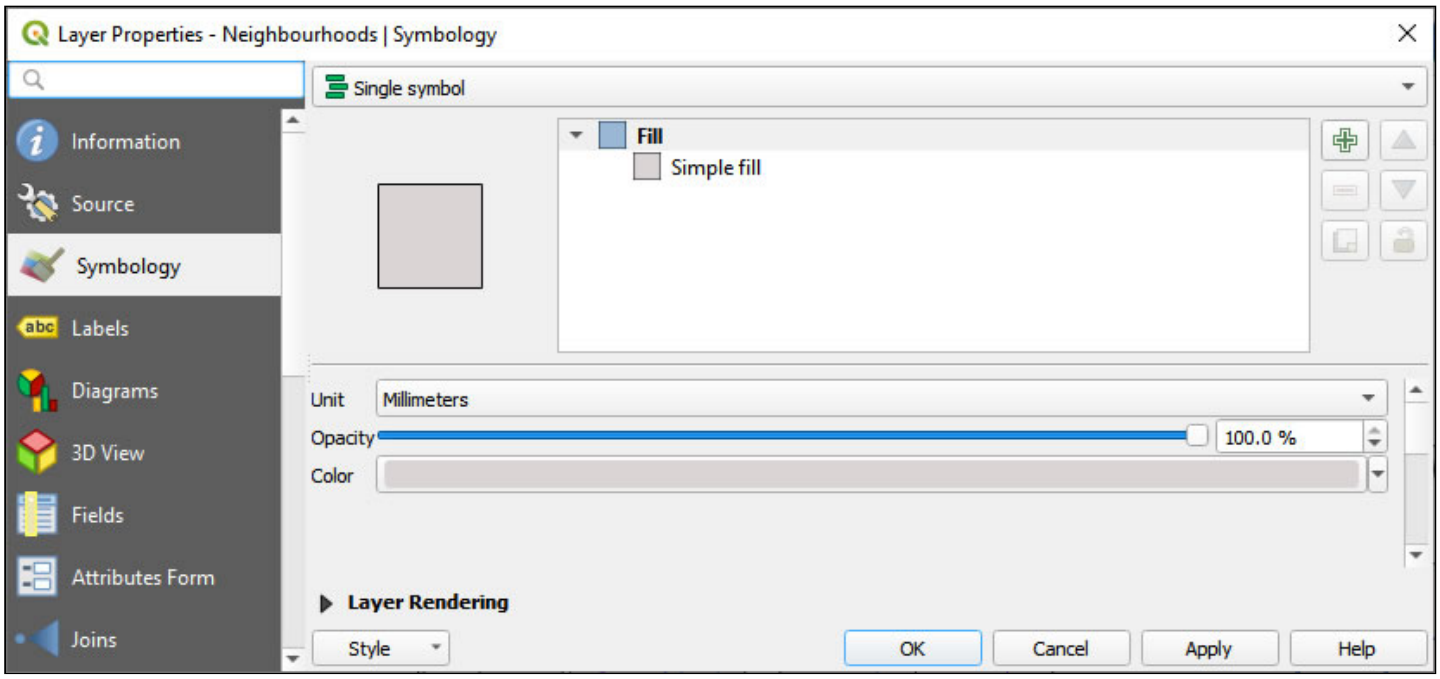
10. In the Contents pane, click once on the **Sport Field** symbol

- Leave as a **Single symbol**
- Click on the symbol icon to move to the symbol gallery



- Press **Apply** → **OK**

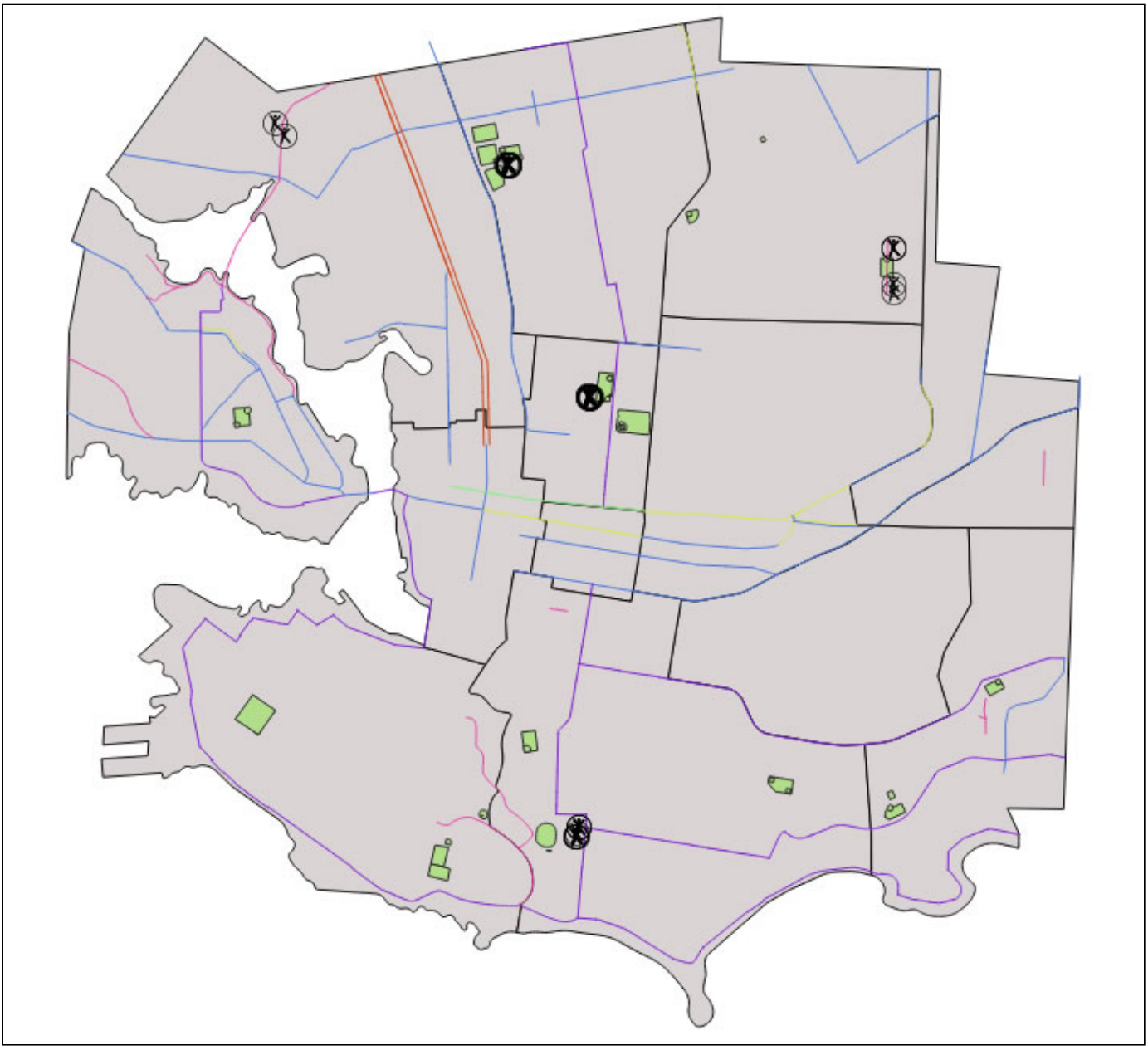
11. In the Contents pane, click on the **Neighbourhoods** symbol and choose a grey fill



- Press **Apply** → **OK**

12. In the Contents pane, drag the **Neighbourhood_Boundaries** to the top of the drawing order, so the boundary can be seen on top of all the other symbols.

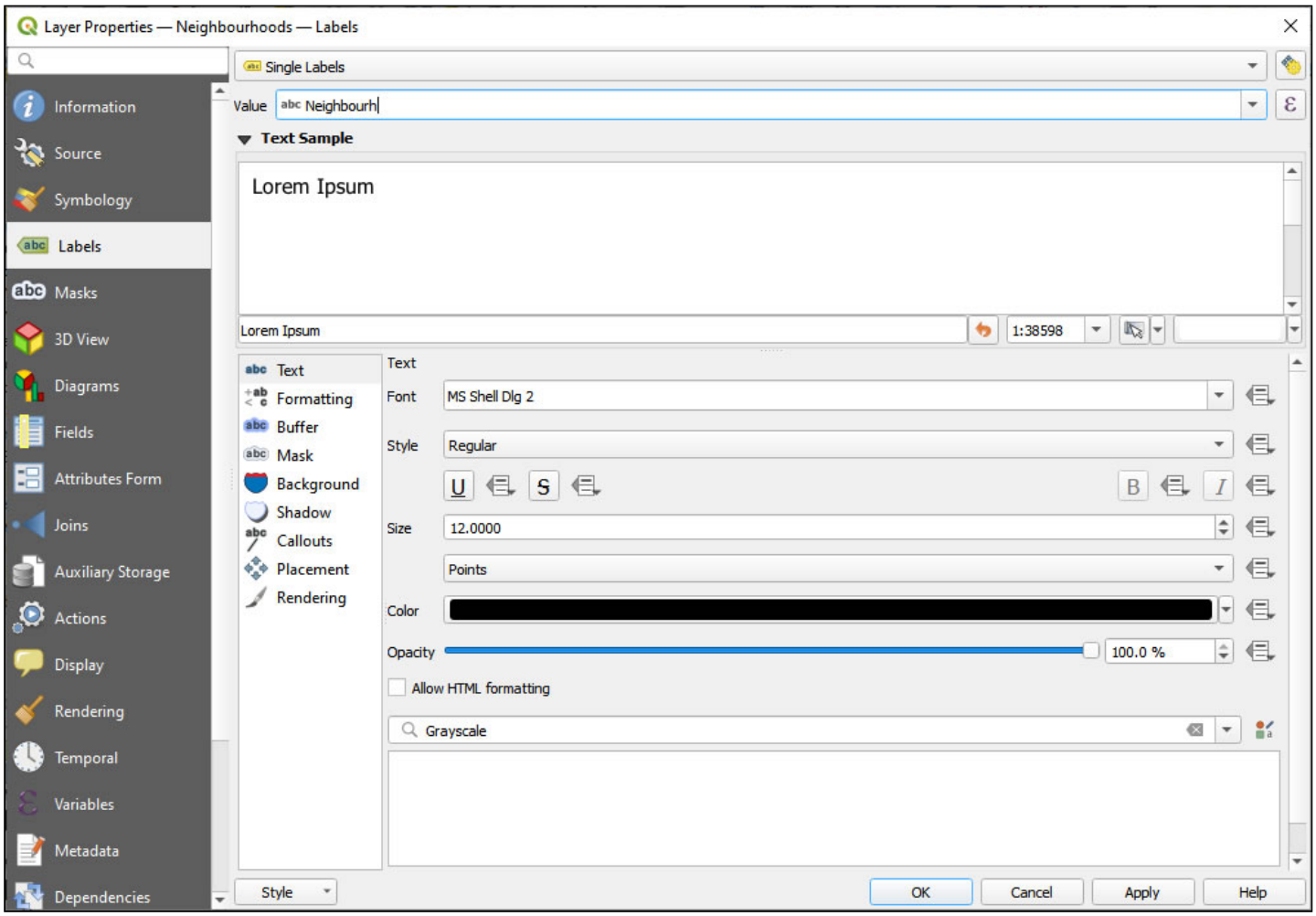
Your map symbology is complete.

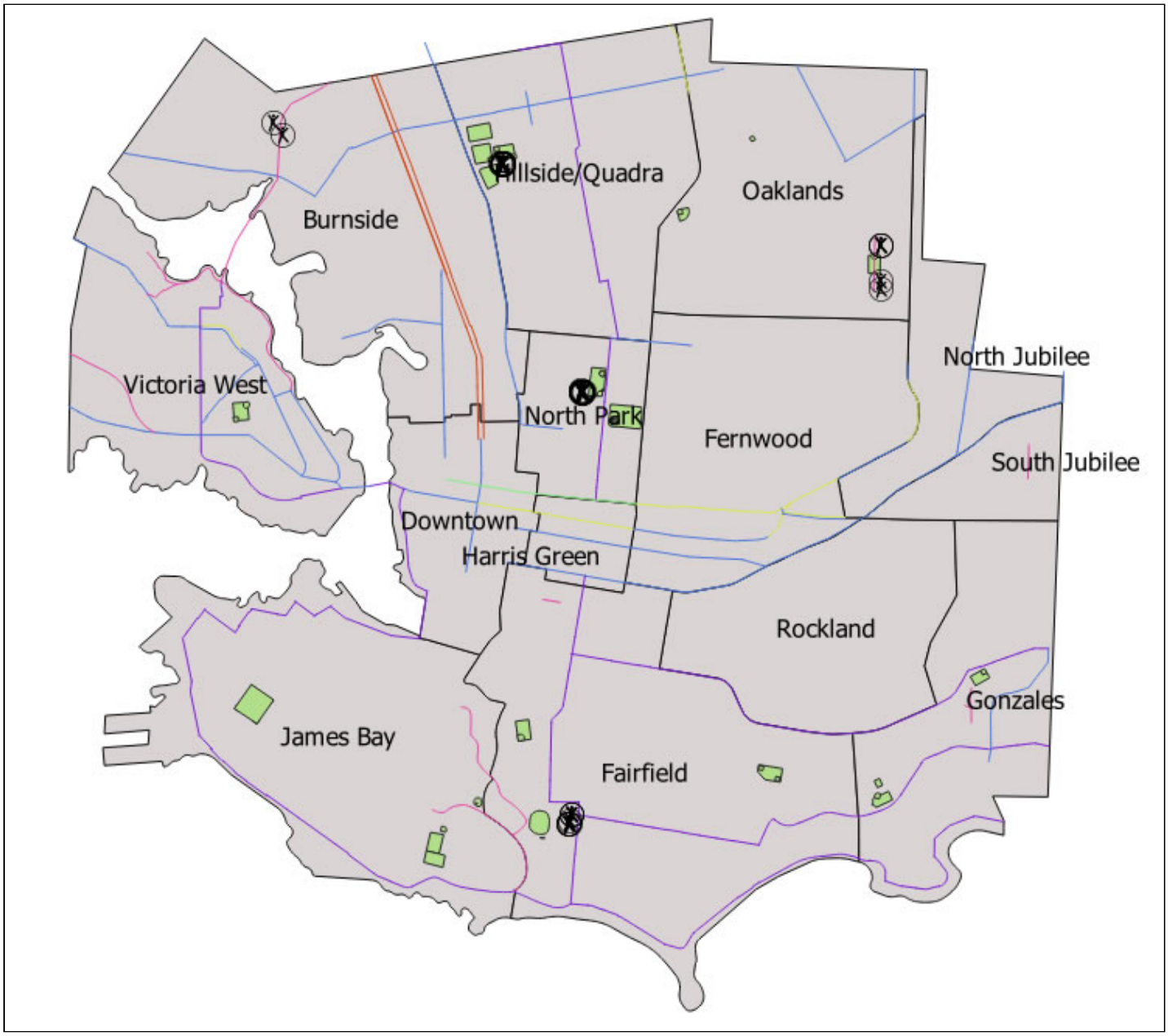


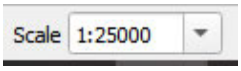
Now it is time to label the neighbourhoods.

1. Choose the **Neighbourhoods** layer in the **Contents** pane → choose **Properties** → select **Labels**

- Set type to: **Single labels**
- Value: **Neighbourh**
- Set size: **12**
- Press **Apply** → **OK**


Layer Properties — Neighbourhoods — Labels
Information
Source
Symbology
Labels
Masks
3D View
Diagrams
Fields
Attributes Form
Joins
Auxiliary Storage
Actions
Display
Rendering
Temporal
Variables
Metadata
Dependencies
Single Labels
Value
Neighbourh
Text Sample
Lorem Ipsum
Lorem Ipsum
1:38598
Text
Formatting
Buffer
Mask
Background
Shadow
Callouts
Placement
Rendering
Text
Font
MS Shell Dlg 2
Style
Regular
Size
12.0000
Points
Color
Opacity
100.0 %
Allow HTML formatting
Grayscale
Style
OK
Cancel
Apply
Help

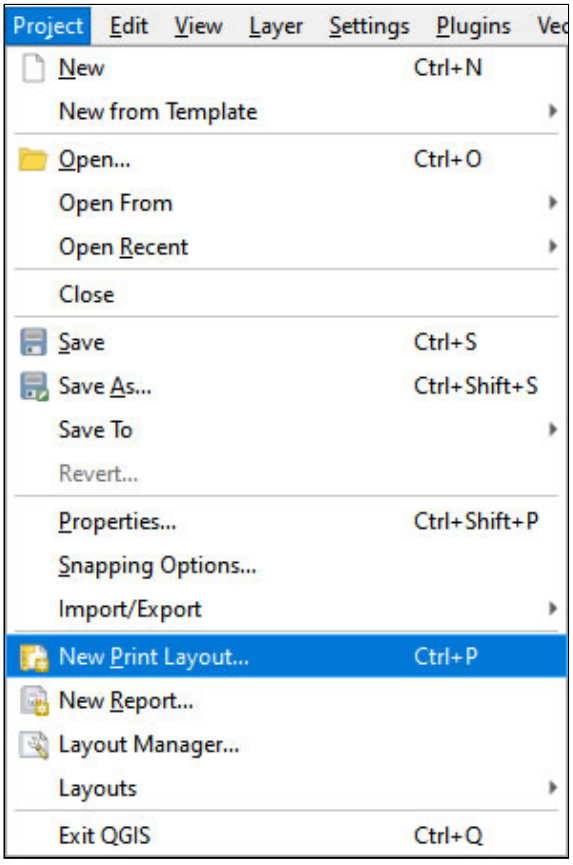


2. Set your map scale to 1:25,000 

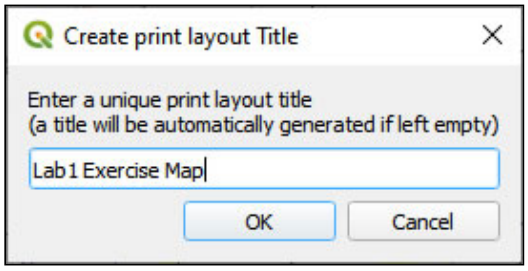
You are now ready to create a **Map Layout** where you can insert cartographic elements on your map, including a:

- Title
- North Arrow
- Scale
- Legend
- Attribution
- Projection
- Neatline (border)

1. Navigate to the **Project** menu, and select **New Print Layout...**

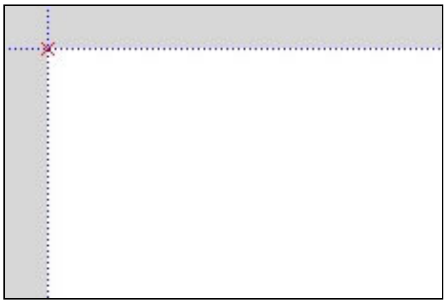


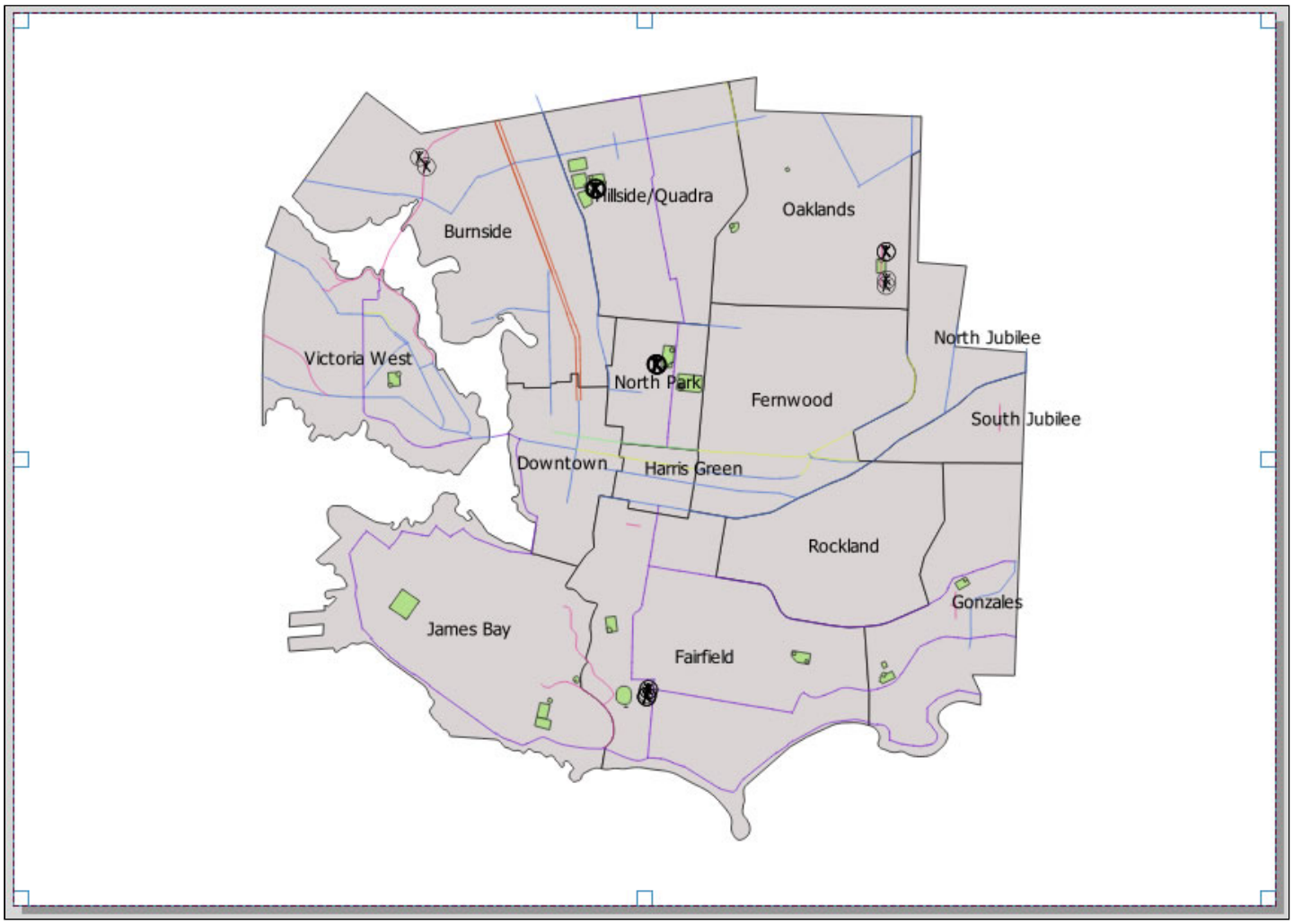
2. Save the map as: Lab1 Exercise Map



3. To add a new item to your map select the **"Add Map"** button 

4. Then, with the **Add Map** button selected (cross hairs showing) use the guidelines to draw a rectangle from corner to corner around the white page in the layout view. Click and hold to draw the rectangle.

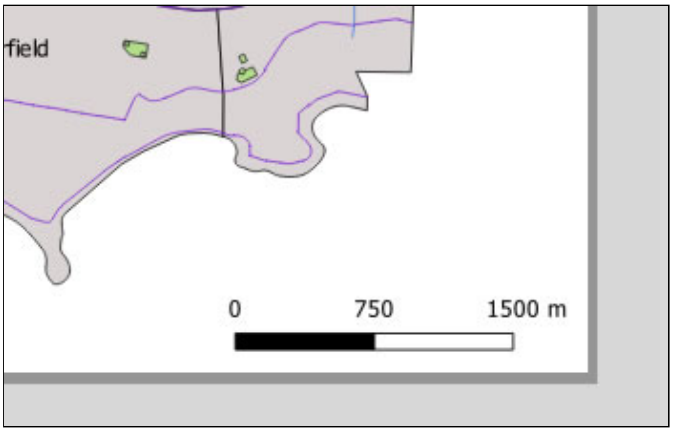




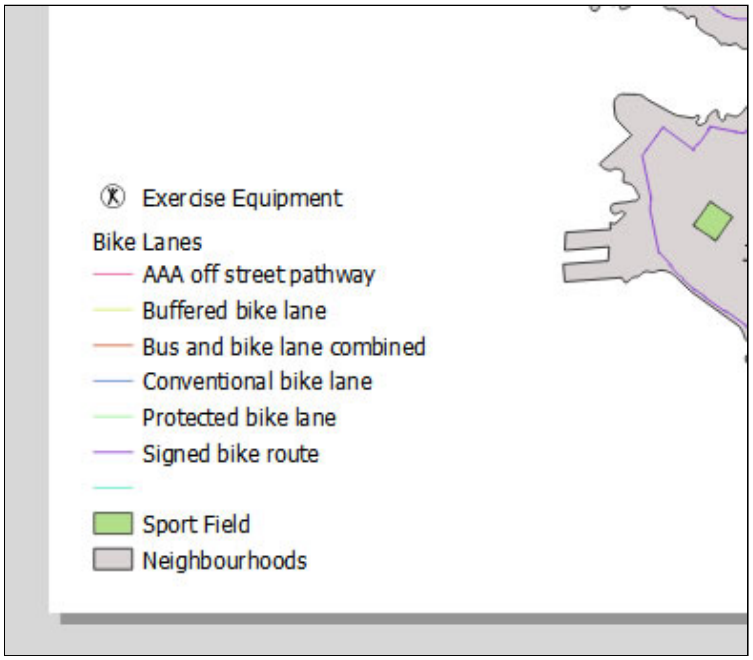
2. With the map item still selected, use the **Move Item** button to shift the map data slightly to the right hand side of the page (click on the page to move the map data)

Now you will add a scale to the bottom right hand corner of the map.

4. Use the **Add Scale** button  to insert a scalebar.



5. Next, select the **Legend** button  and insert a **Legend** item in the bottom left hand side of the map.

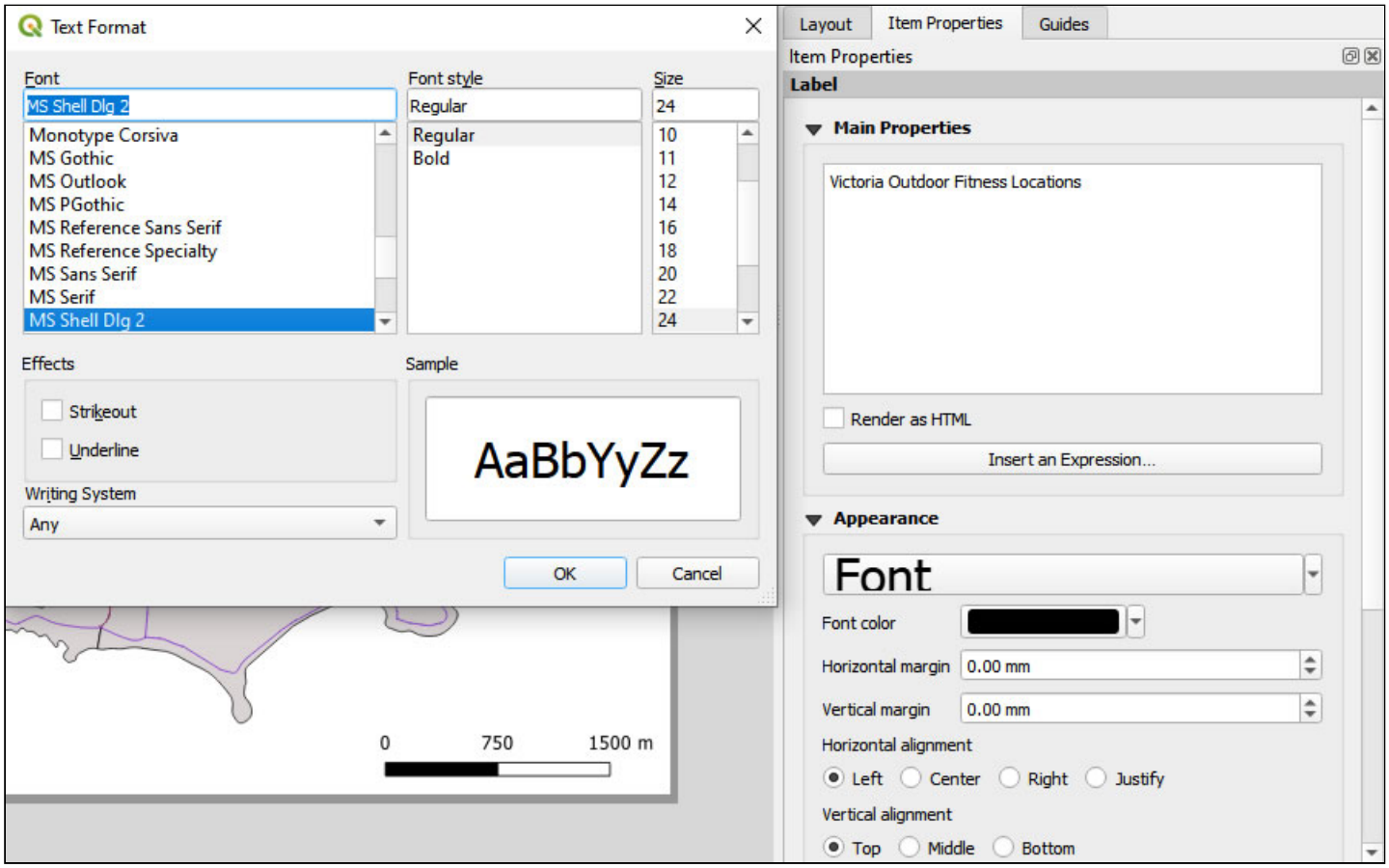


6. Now you will insert a title using the text button  .

7. Select the **text** item in the **Items** tab on the right hand side of the Layout view.

8. Under the **Item Properties** tab, and the **Appearance** options select **Font** → configure font → set the font size to **24pts**

- Press **OK**
- Select the Horizontal alignment as **Left**



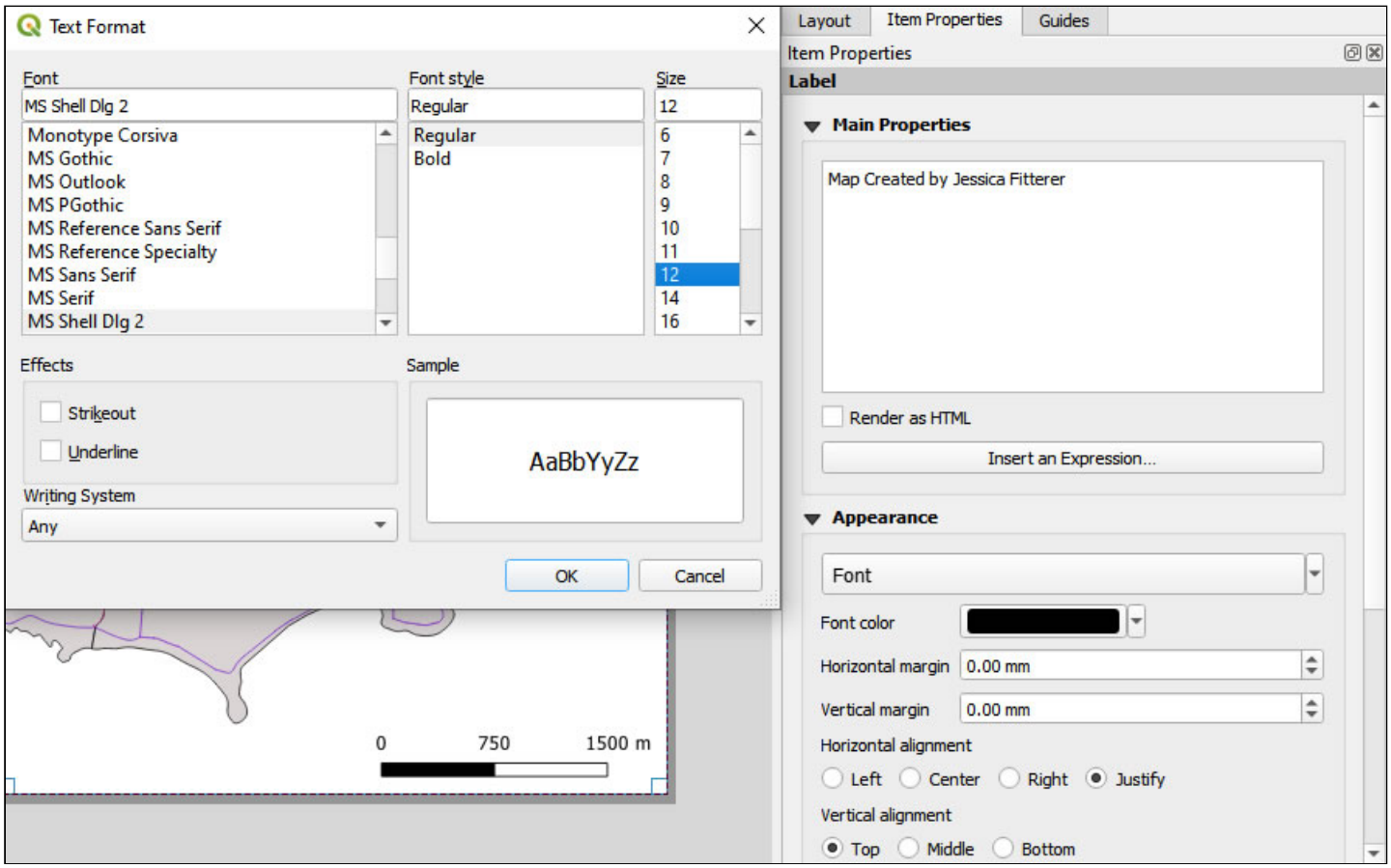
- Press OK

9. Next you will insert a "**Map Created by**" text option

Select the **text** item in the **Items** tab on the right hand side of the Layout view.

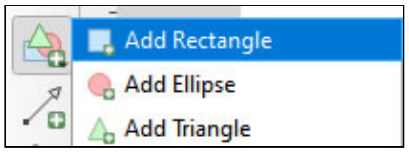
10. Under the **Item Properties** tab, and the **Appearance** options select **Font** → configure font → set the font size to **12pts**

- Press **OK**
- Select the Horizontal alignment as **Left**



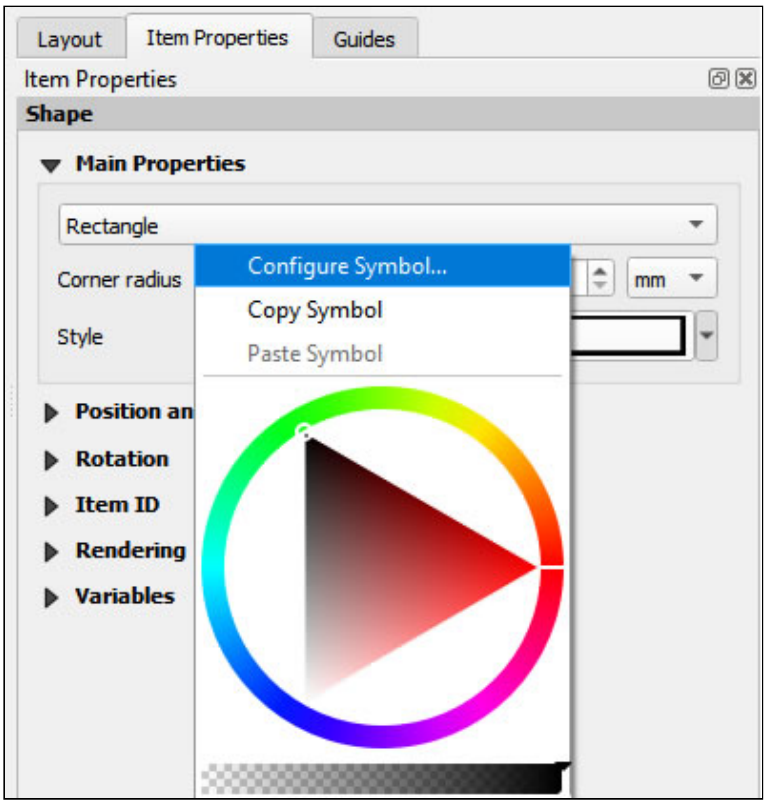
To finalize your map you will add a border

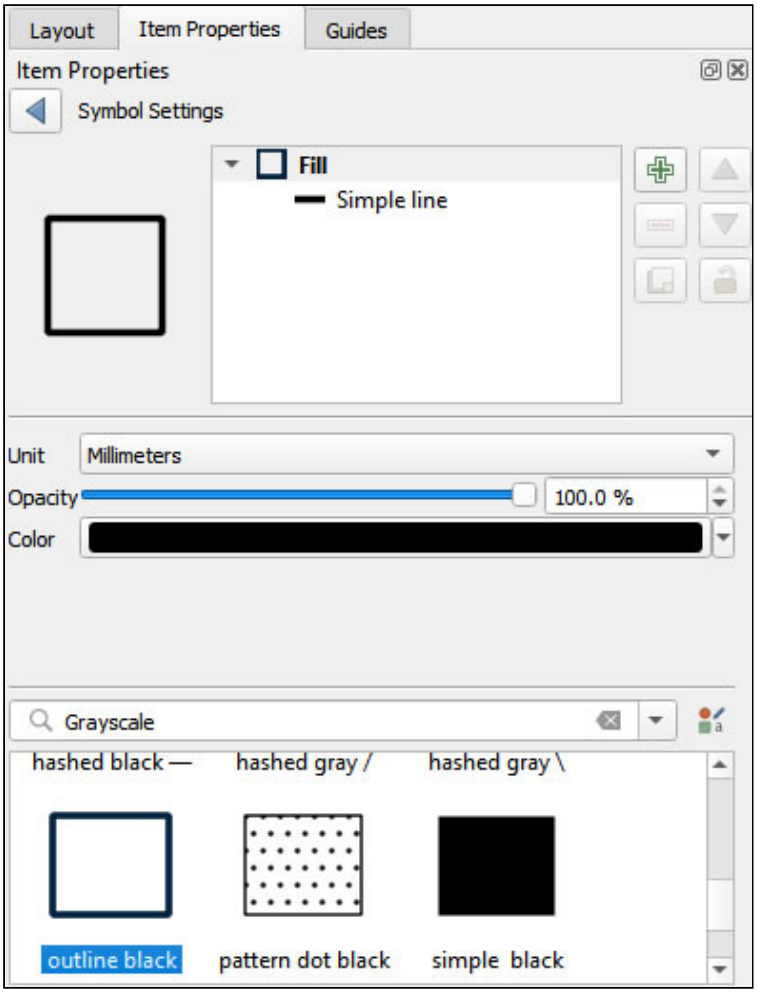
11. Select the **Add Shapes** button, and choose a rectangle



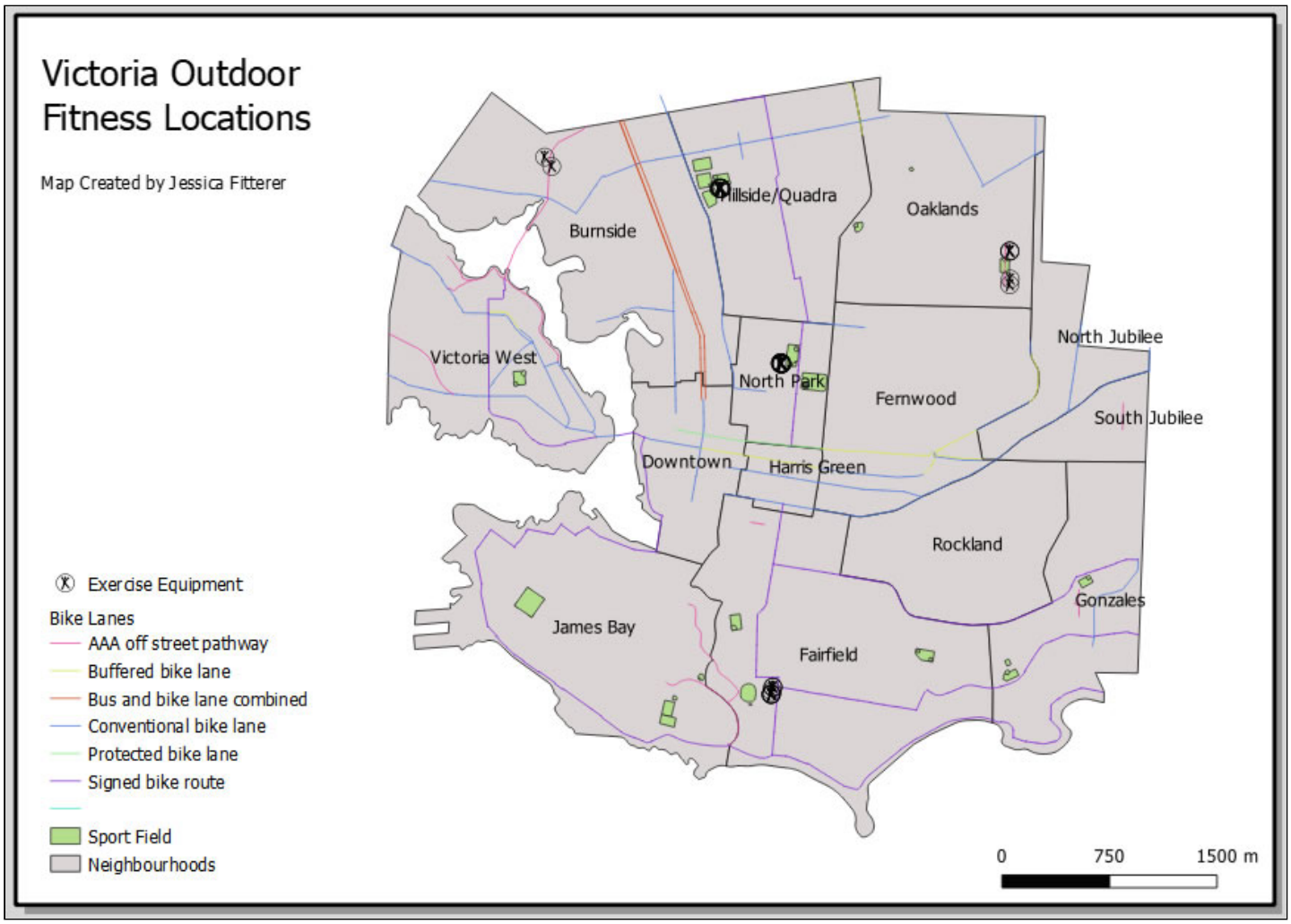
12. Draw a rectangle around the map (the map will disappear under the rectangle)

In the Item Properties set the fill to **outline black** by choosing **Configure Symbol...**

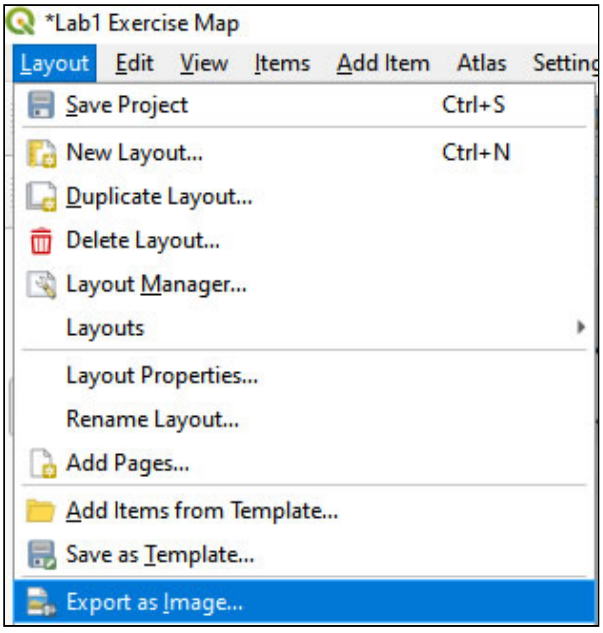




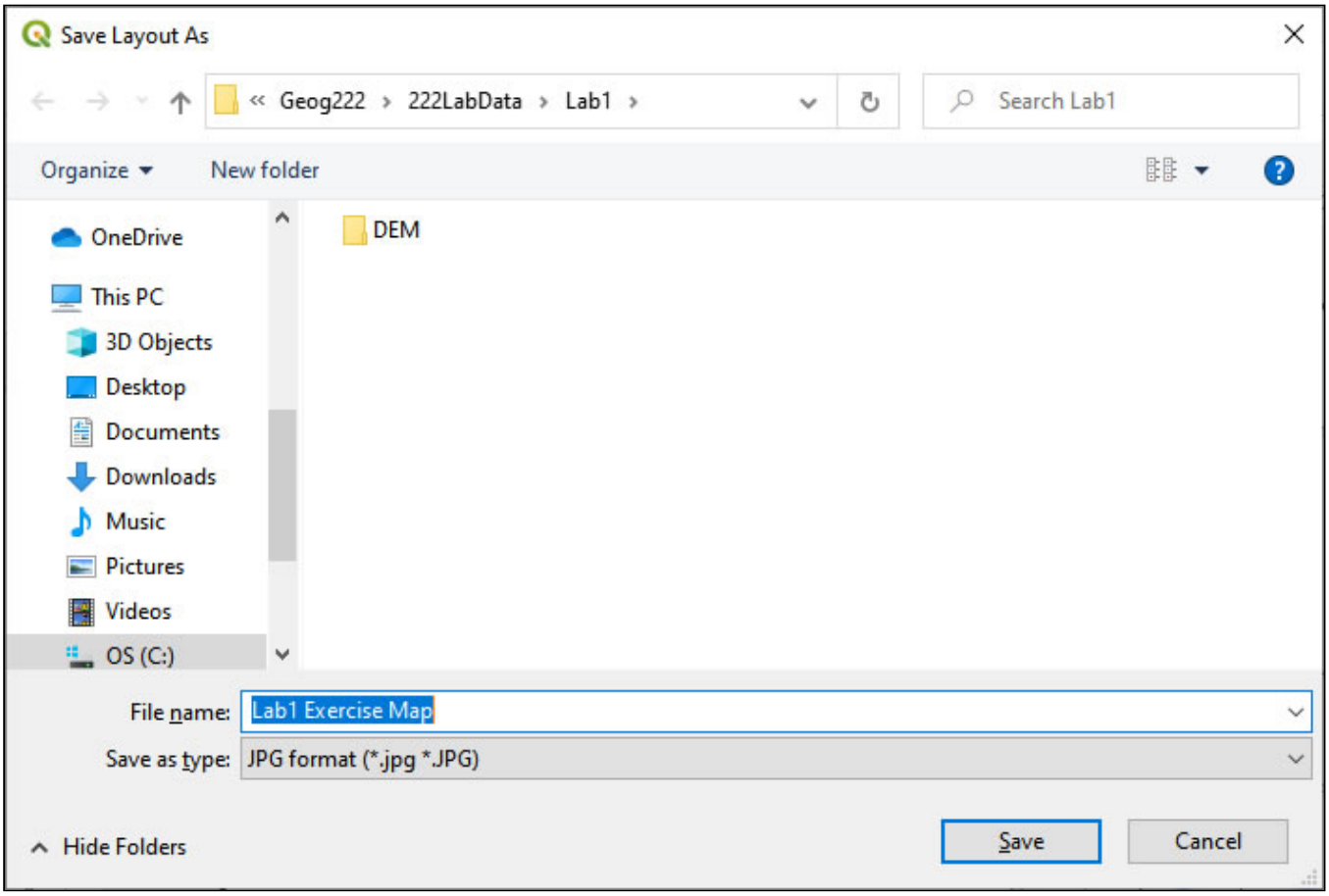
Now you have a functional map



13. To export your map choose Layout → **Export as Image...**



14. **Save As...**



- Press **Save**

Assignment