Spatial Data Visualisation: Advanced Techniques In QGIS

Session 1

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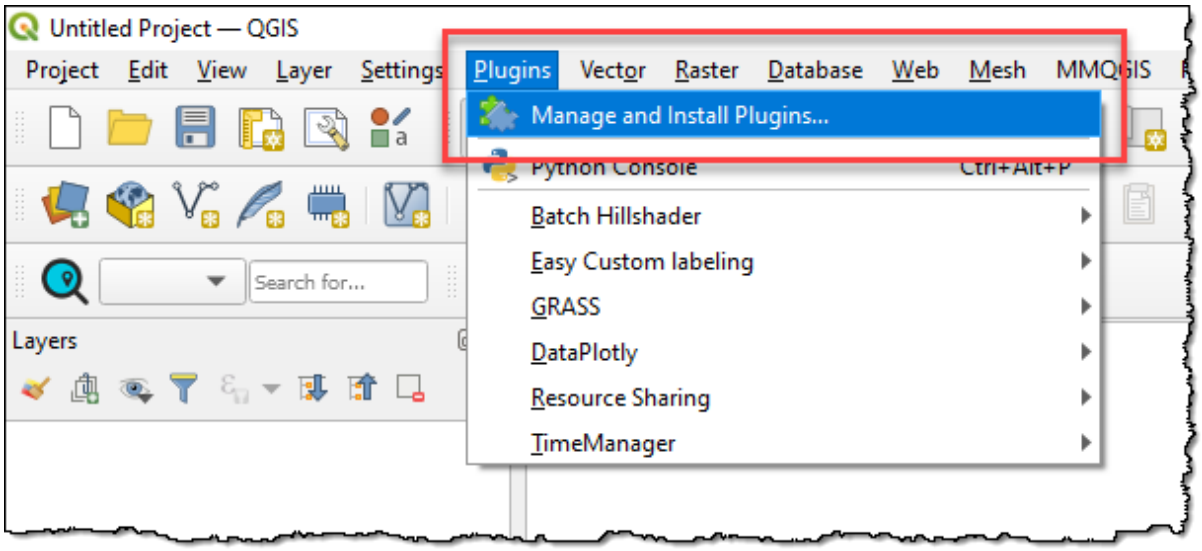
Setting up QGIS for the Workshop

For the workshop today we need to add a few plugins and you should set the projection we will be working in. You will only ever need to add plugins to QGIS the first time you use it. Equally you can set a default map projection to match your most commonly used data.

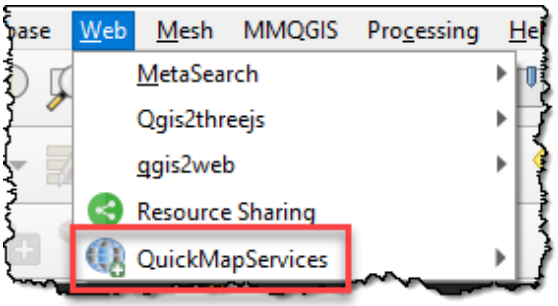
Plugins:



Click on the Plugins list at the top of the screen and go to Manage and Install Plugins. The ones we need today are **MMQGIS, QGIS2threeJS, QuickMapServices** and **Cartogram3.**

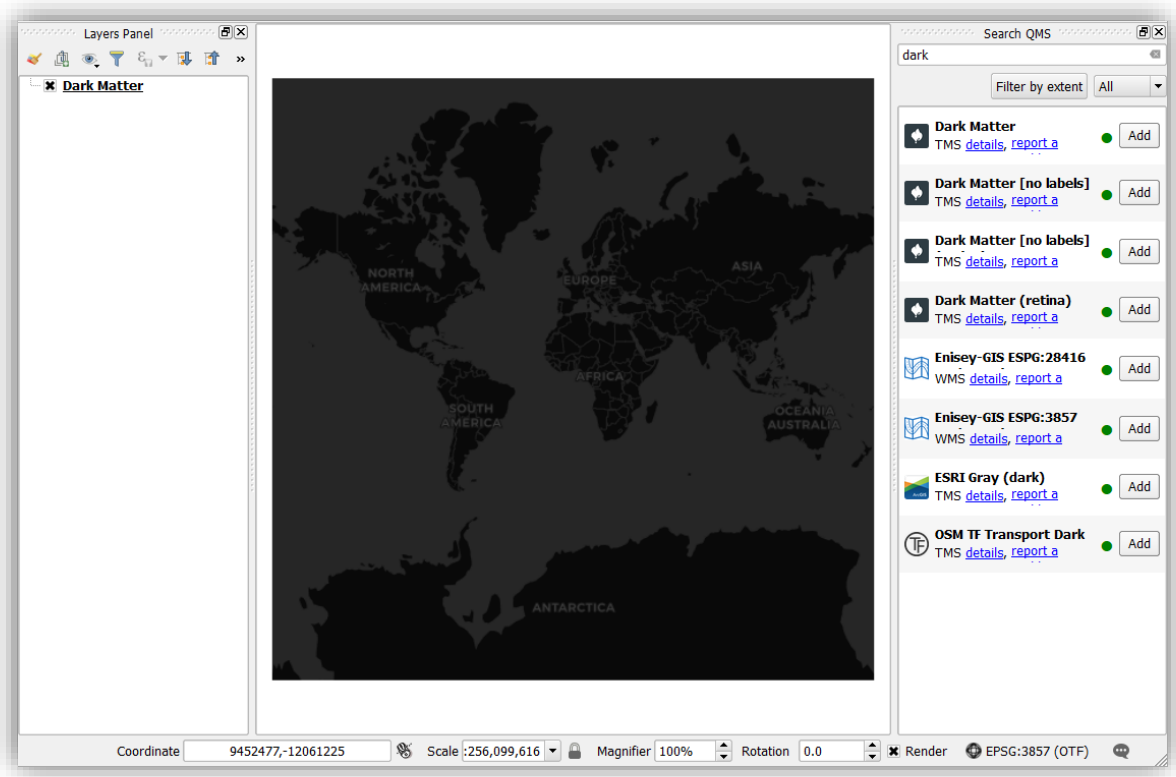
Adding a Web Basemap

The first dataset we are going to use is a global dataset so we need a global basemap to display it on. The **QuickMapServices** plugin will allow us to pipe one straight from the internet into the GIS.



- Click **Web** at the top of the screen.
- Select the **Search QMS** from **QuickMapServices**
- Type **"Dark"** in the search box of the **Search QMS** that has opened on the left of the map.
- Double Click on the **Dark Matter** option
- The map should appear in the main window.

You will now have a dark world map, just right for adding highlighted data:


Layers Panel
Dark Matter
NORTH AMERICA
EUROPE
ASIA
AFRICA
SOUTH AMERICA
OCEANIA AUSTRALIA
ANTARCTICA
Search QMS
dark
Filter by extent
All
Dark Matter
TMS details, report a
Add
Dark Matter [no labels]
TMS details, report a
Add
Dark Matter [no labels]
TMS details, report a
Add
Dark Matter (retina)
TMS details, report a
Add
Enisey-GIS ESPG:28416
WMS details, report a
Add
Enisey-GIS ESPG:3857
WMS details, report a
Add
ESRI Gray (dark)
TMS details, report a
Add
OSM TF Transport Dark
TMS details, report a
Add
Coordinate
9452477,-12061225
Scale
:256,099,616
Magnifier
100%
Rotation
0.0
Render
EPSG:3857 (OTF)

Creating a Proportional Symbol Map

Creating proportional symbol maps in QGIS is made very easy in QGIS with two main methods for making them. You can use basic Single Symbol style with the **Size Assistant** in the **Data Defined Override,** or you can use the **Graduated style** and choose **Size** as the **method** of gradation. Below is a set of instructions on how to use both methods to create proportional point symbols for your map.

Method 1: Graduated Symbols

This method works best when you want to use all the points in your dataset. QGIS allows you to vary the size of the data point based on the values in attributes of the data.

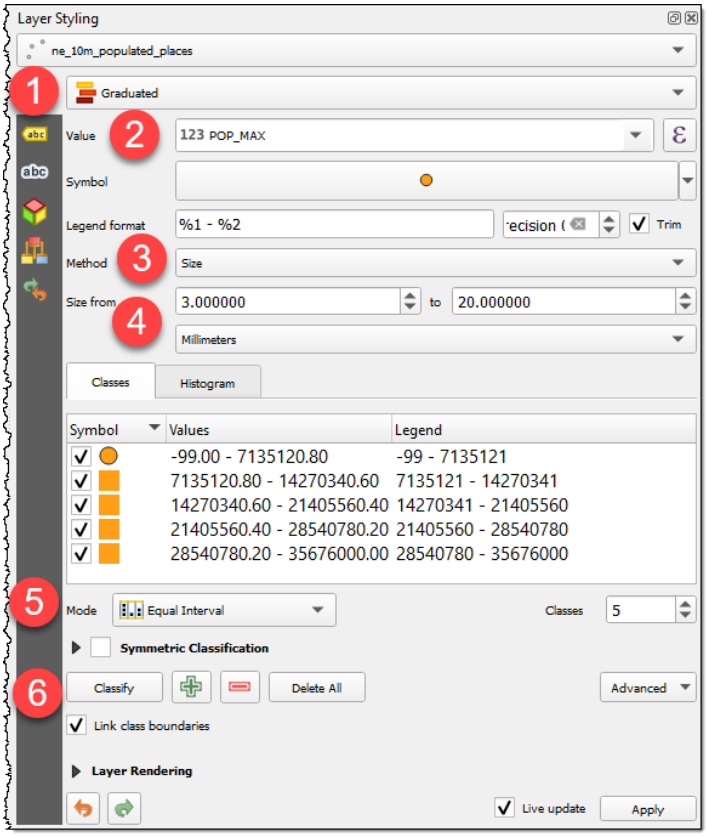
- Add the **ne_10m_populated_places.gpkg** data to your map.
- **Press F7** to open the **Layer Styling Panel** on the right-hand side of the map.

Make sure the top menu of the layer styling tab is set to the Natural Earth Point data, then:

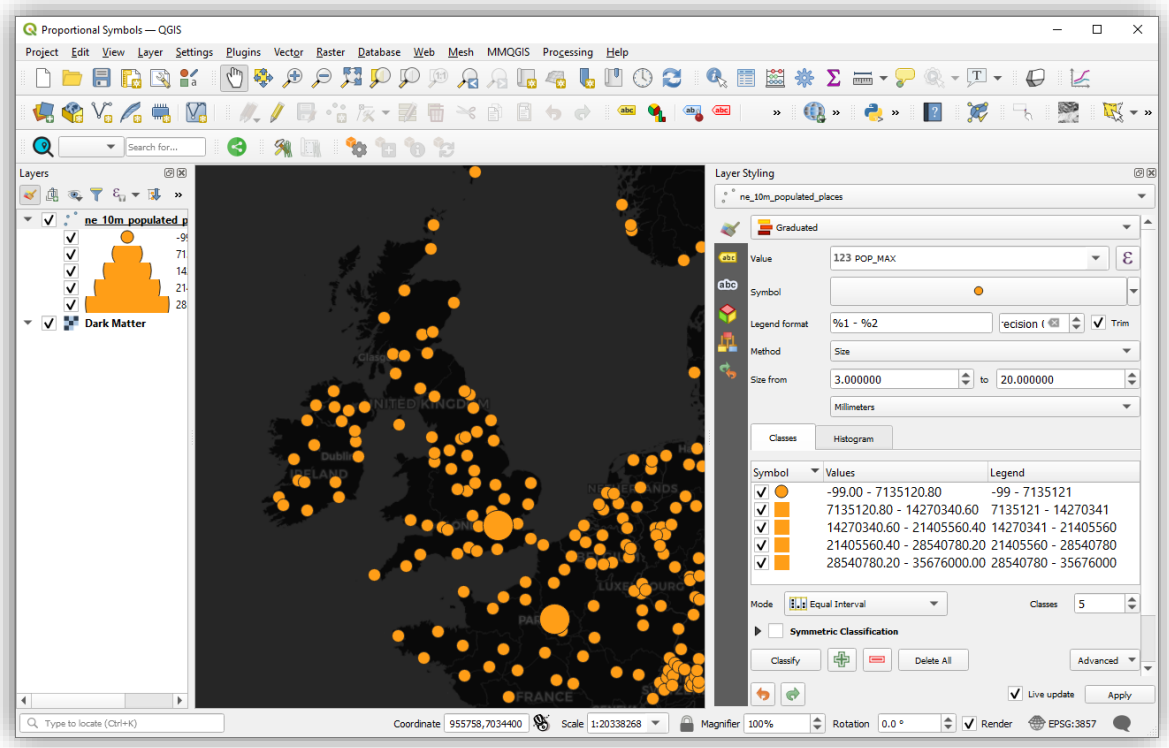
- Change **Single symbol** to be **Graduated**.

There are now a few new options to play with:

- Change **Column** to be **pop_max**
- Change **Method** to **Size**
- Change "**Size from**" to **3** and "**to**" to **20 Millimeters**
- Change the **Mode** to be **Equal Interval.**
- Click the **Classify** button to see how this looks.



The map will automatically update to look like the map show below, zoomed in to the UK and Northwest France:



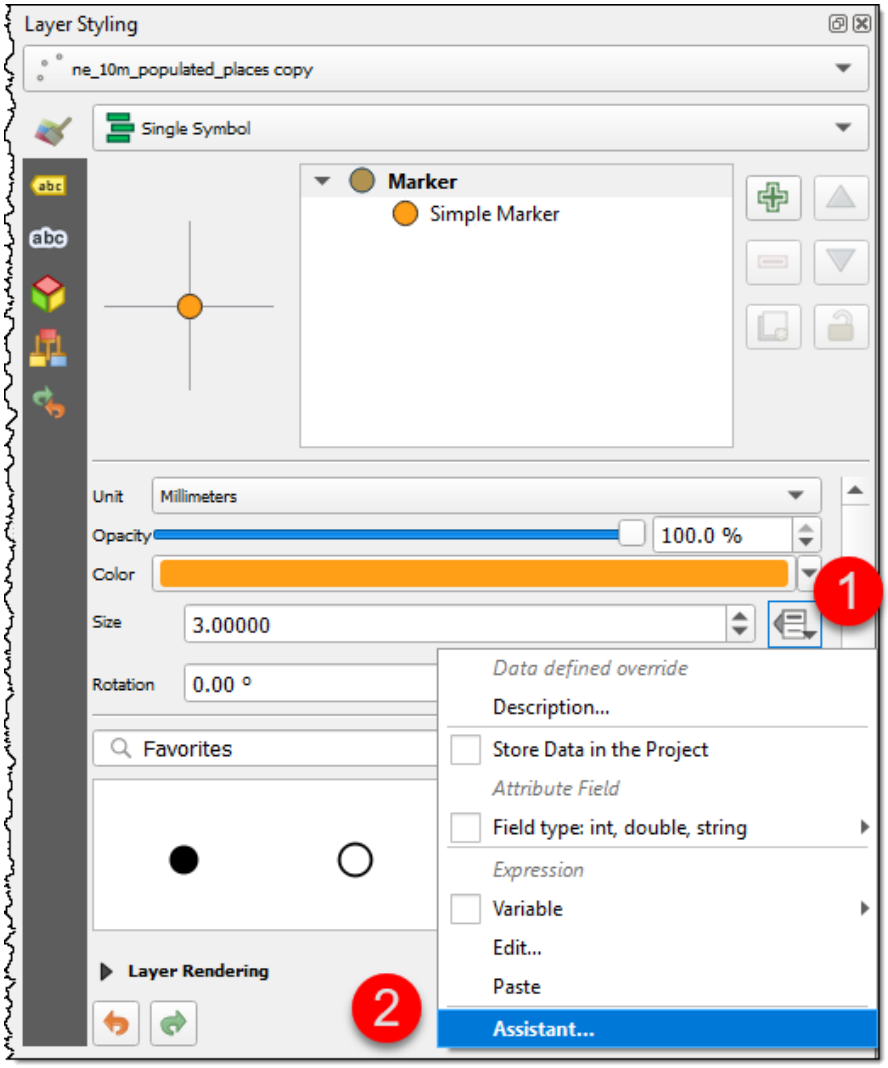
You have flexibility to change the number of classes and how you divide the classes, Equal Interval, Quantiles, Natural Breaks etc. You can also manually edit the classes by double click in the values column in the table.

Save your map as Proportional Symbols and we can move on to the second method.

Method 2: Data Defined Override

If you want a little more control over how the data is displayed this method allows you to quickly change maximum and minimum values to use in the data without having to set each level in between.

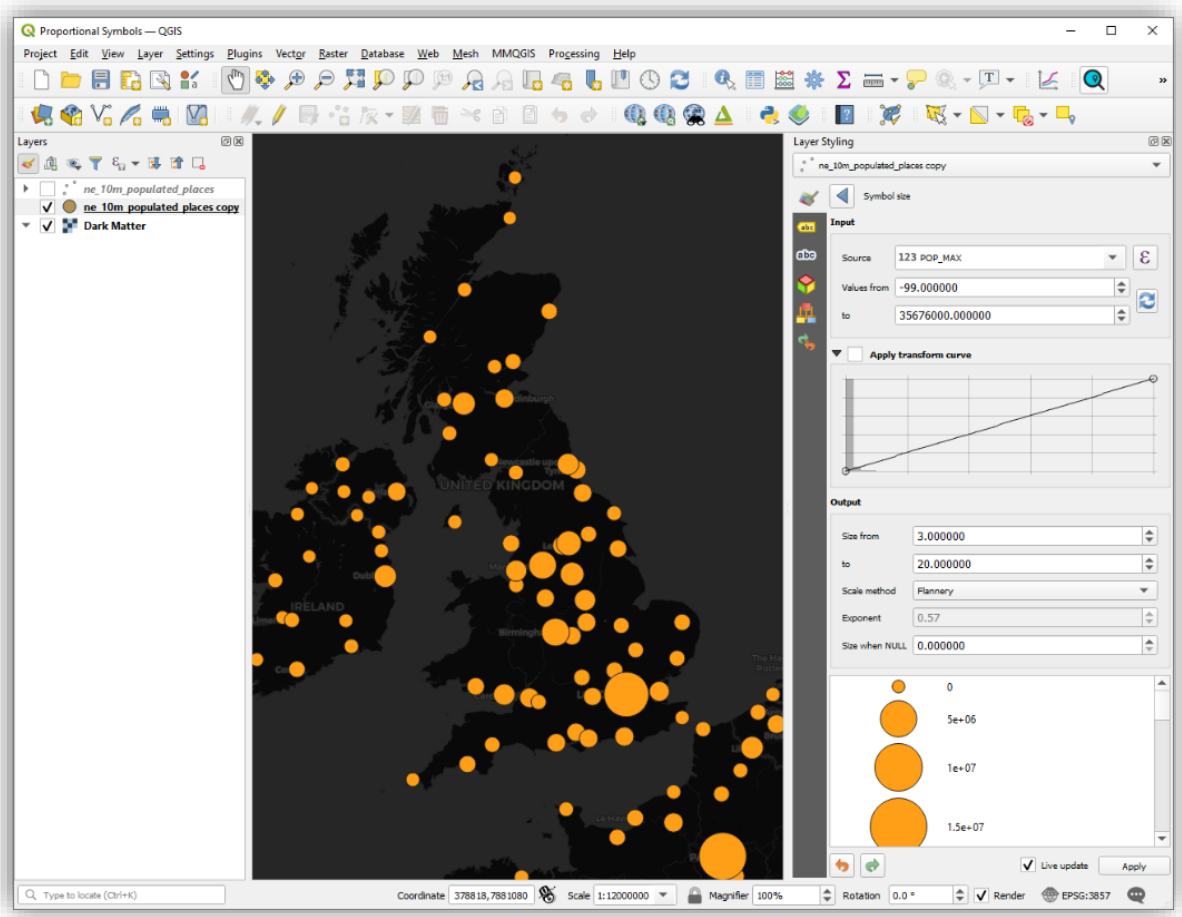
- Right click on the **ne_10m_polpulated_places** in the **Layers Panel** and click **Duplicate.**
- Uncheck the **ne_10m_populated_places** in the Layers panel and check the new **ne_10m_populated_places_copy** so this is the only one visible.
- Make sure the top menu is set to …copy.
- Set the symbology back to **single symbol.**
- Click on the **Data Defined Override** button  on **Size.**



- Click on the **Assistant** option at the bottom of the box.

You will now be looking at the Size Assistant dialog. The options here are very similar to using the method described above, allowing you to select the field to base the size on and having control over size of the points.

- Set the **Field** to be **POP_MAX.**
- Click on the refresh button to pull in the **Values from** and **to.**
- Change the "**Size from**" to be **3** and "**to**" to be **20.**
- Set the **Scale method** to be **Flannery.**

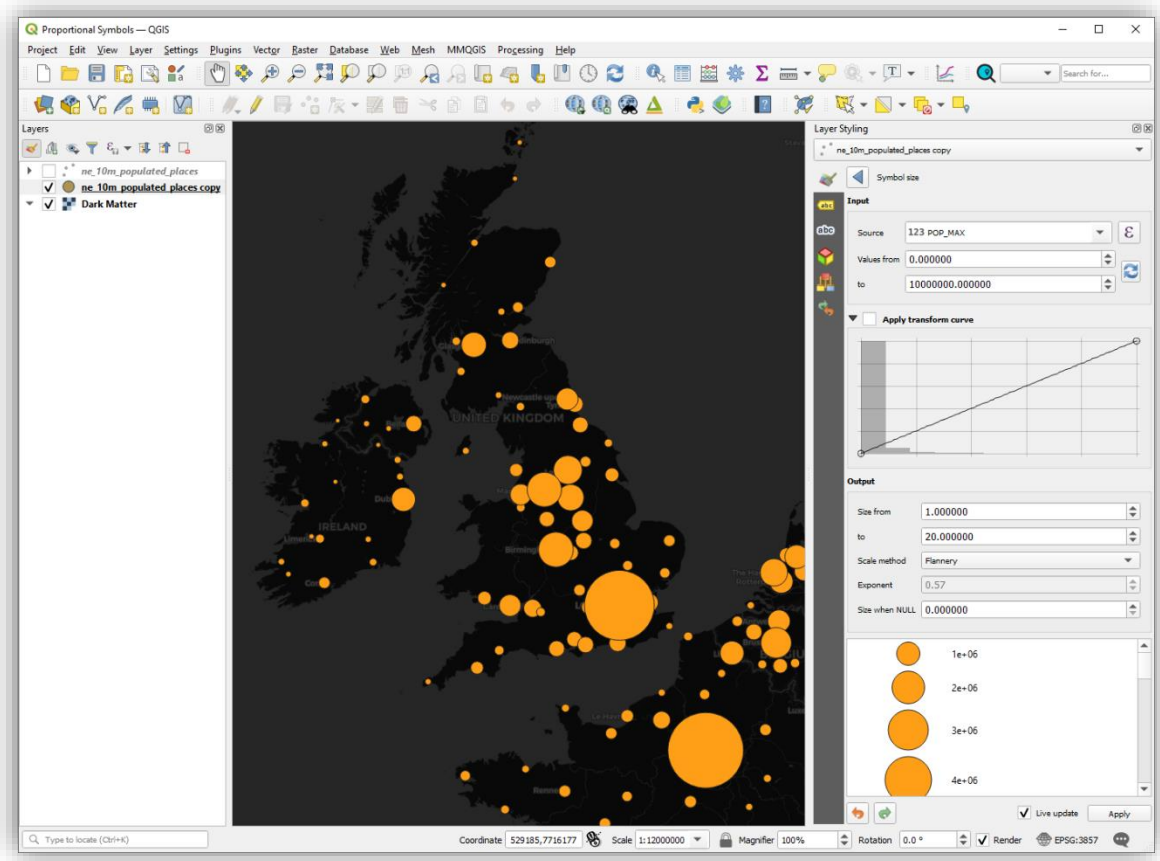


As you can see in the example above the symbols automatically scale from the smallest to the largest values in the field selected. However, where this method has a big advantage over the previous one you can set the upper limit to be different. The points will now automatically scale to this value without you having to manually update each range. This can be very useful if you are viewing only a portion of the data.

In the area we zoomed to in the previous method the largest cities are London and Paris, both having a population of below 10,000,000.

- Change the "**Values from**" to be **0** and "**to**" **10,000,000.**
- Change the "**Size from**" to be **1** and "**to**" to be **20.**

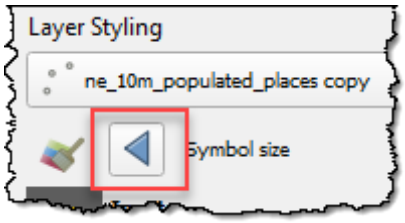
You can now see in the map below there is a bigger range of point sizes than the previous method for the area of the map.



Blend Modes

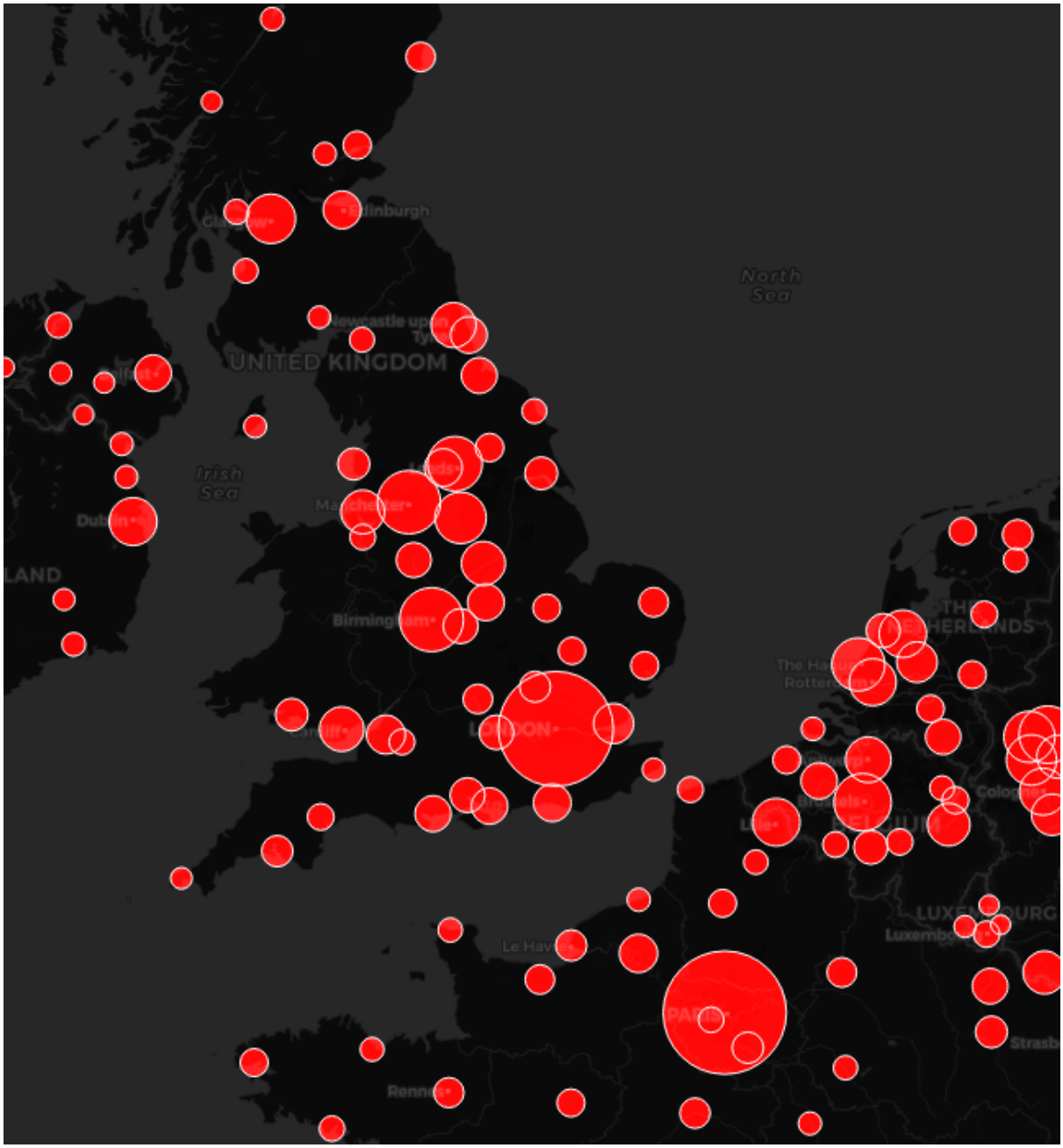
A little added tip is to use the blend modes on your symbology, so you can see the basemap through the shapes and reveal the detail on any overlapping symbols:

- First, go back to the styling on the left side panel by clicking the back arrow:



- Now we need a visible boundary on the points.
- Click on **Simple Marker** under the word **Marker.**
- Change the **Fill color** to be **Red**.
- Change the **Stroke color** to be **White**.
- In the **Layer Rendering** section of the style tab change the **Layer blending mode** to be **Screen**. This will allow you to see the basemap through the points.
- Change the **Feature blending mode** to be **Screen**. This will allow you to see overlapping points within the point dataset.

THE RESULT:



Save your QGIS Document as Proportional Symbols and we will move on to the next section.

NOTE: We will need this Map Document in the next session so make sure you save it in a sensible place!

CREATING HEATMAPS

Heatmaps are a great way to visualise point data as a surface, this can help reveal clusters and concentrations and give an overall impression of what a phenomenon is like over a wide area without which can be hidden in tightly clustered point data.

We are going to use some different data this time so create a new map document called **Heatmaps**.

COORDINATE REFERENCE SYSTEM:

In this exercise we will be using data in British National grid so we need to prepare QGIS for this.

- Click on the bit at the bottom right of the map, where it says  EPSG: xxxx .
- In the filter at the top of the dialog box that opens, type 27700.
- In the predefined Coordinate Reference Systems box below select British National Grid.

QUICK HEATMAPS FOR VISUALISATION

- Add the **listed buildings.shp** dataset.
- Add the **NT_buildings.shp** dataset.
- Style the **all buildings.shp** to have **50% grey** outlines and fill,
    - **50% "V"** for the **outlines**
    - **75% "V"** for the **fill**

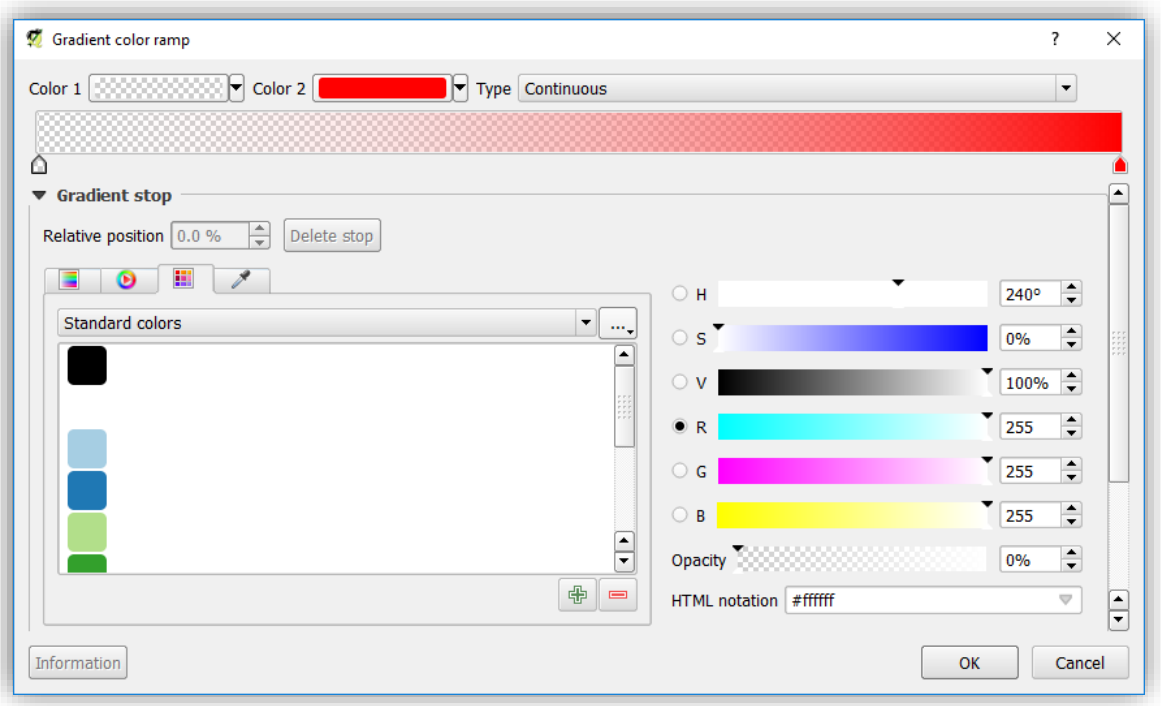
Now we can start styling the listed buildings:

- On the Layer Styling panel, make sure the earthquakes dataset is the one highlighted.
- Change the top drop down from **Single Symbol** to **Heatmap**
- Change the **Color ramp** by clicking on the drop-down arrow at the end and clicking on **Edit color ramp**
- In the **Select color ramp** window set **Color 1** to be transparent and set **Color 2** to be red.
    - Use the drop-down arrow next to the colour swatch

Make sure that the transparent colour is white, or you have a faded black halo around the heatmap points. If it isn't then make the following changes:

- Click on the transparent (checkerboard pattern) swatch next to **Color 1**.
- In the **Select ramp color** change the **HTML notation** value to **#ffffff**.
- Once you have selected a white colour click **OK**

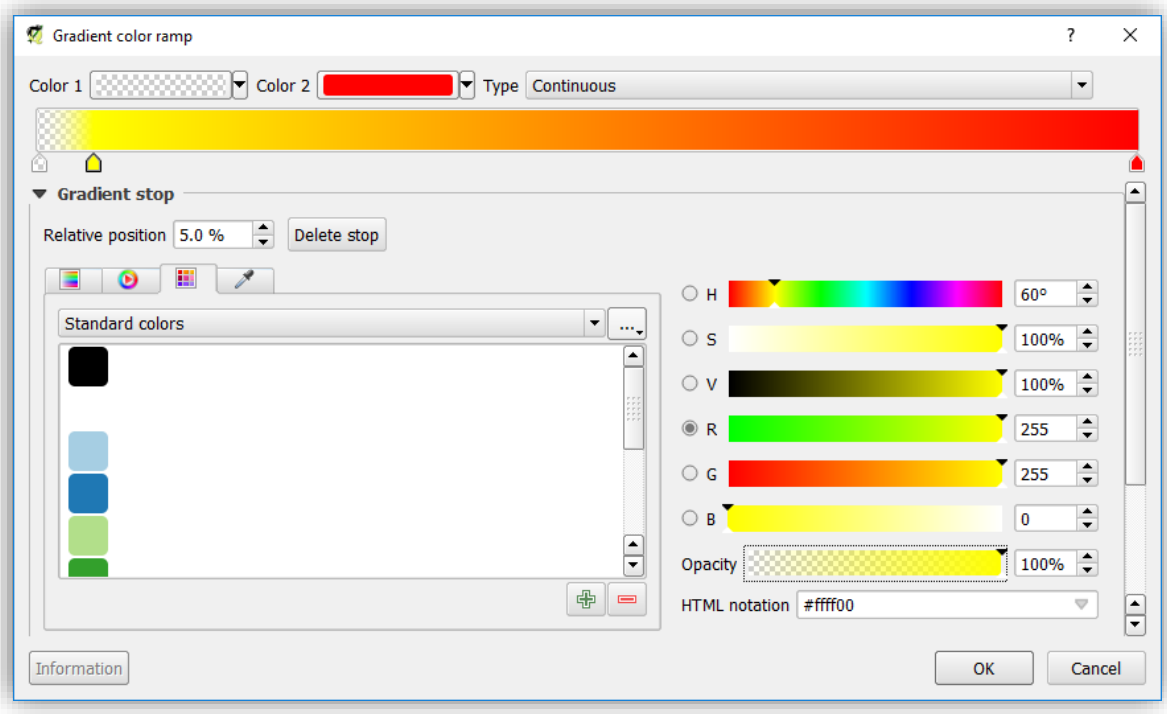
With the zero values being completely transparent we won't be colouring the entire map, just the areas around where there are listed buildings.



We are now going to add in a second colour to the colour ramp to give a more heat like impression.

- **Double-Click** under the gradient just to the right of the arrow at the transparent end to add a stop at around 5%.

A new arrow will appear, click on it to edit the colour and position.



- Change the **relative position** to be **5%**
- Change the color to be **Yellow**
- Change the **Opacity** to **100%**
- Click **OK**

Before we do anything else, we will need this colour ramp again later:

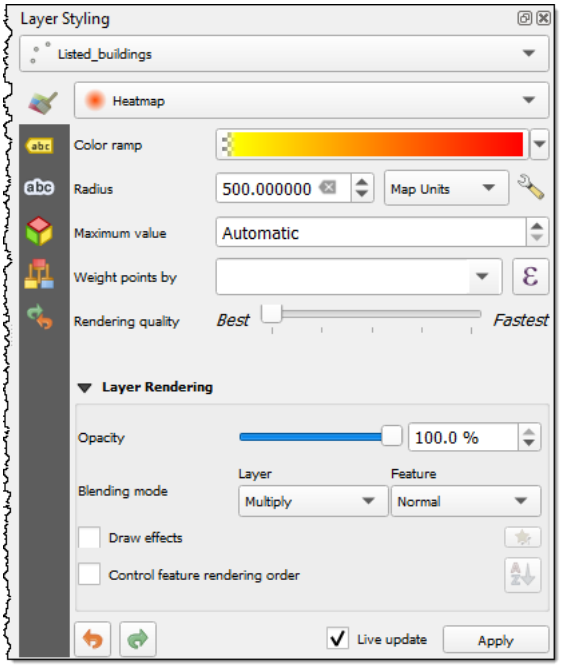
Click on the dropdown arrow at the end of the colour ramp row and select **Save color ramp…**

- Give it the name **Heat.**
- Tag it as **Colorful.**
- Tick the box for **Add to favourites.**

Back in the Heatmap Settings:

- Set the **Radius** to be **500 Map Units.**

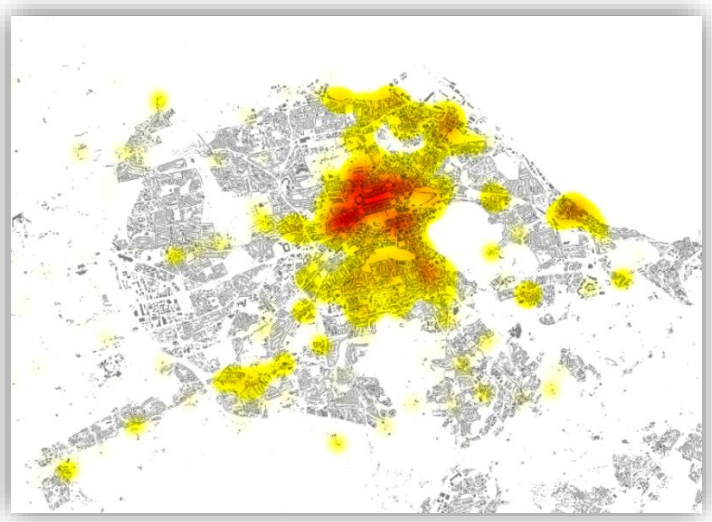
This is saying that the effect of the Listed building has is a 500 metre radius around it. Also, by using map units the heat map doesn't change when you zoom in and out.



- Set the **Rendering quality** to **Best** by dragging the slider to the left.
- Set the **Layer rendering → Layer blending mode** to **Multiply.**

The "Multiply" blend mode allows us to see the basemap through the heatmap.

The results show the areas where listed buildings are at their highest density:



Save your map in a sensible place, call it **Heatmap**. We will be revisiting this map in Session 2!

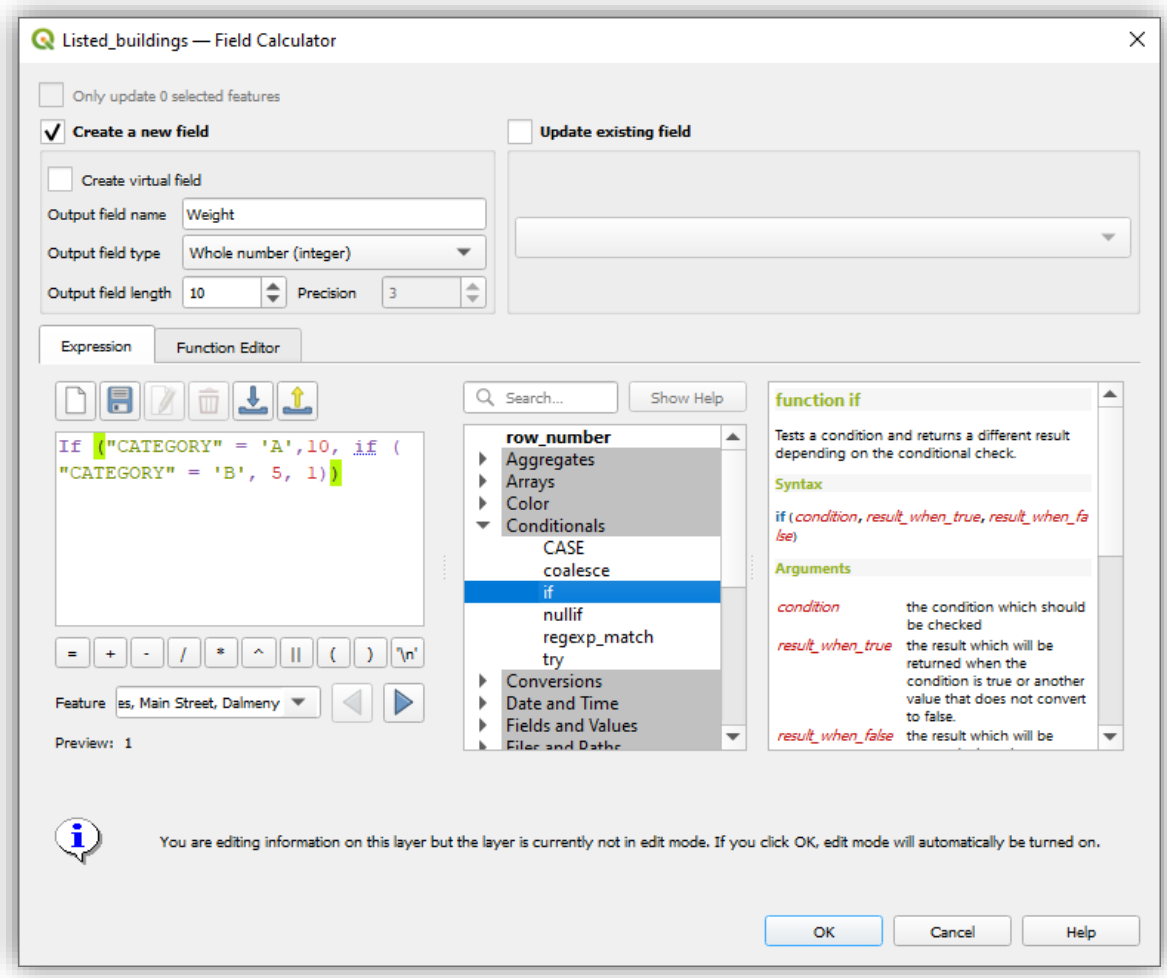
CREATING HEATMAPS AS NEW DATASETS FOR FURTHER ANALYSIS

If you need the heatmap visualization to be saved as a permanent raster layer or want to customize the heatmap with advanced options such as different kernels or dynamic radius, you can use the **Heatmap (Kernel Density Estimation)** from the Processing Toolbox. We will now use this algorithm.

Before we start, we can add a weighting to the data to give more influence to Grade A listed buildings over Grades B and C. The following instructions show you how to do this.

- Open the attribute table for the listed buildings data (right click on it in the **Layers panel** and select **Open attribute table**)
- At the top of the table click on the Open Field Calculator button: 
- Make sure **Create a new field** is selected.
- Enter the **Output field name** as **Weight**.
- Put the following in the Expression tab:

```
If ("CATEGORY" = 'A',10, if ("CATEGORY" = 'B', 5, 1))
```

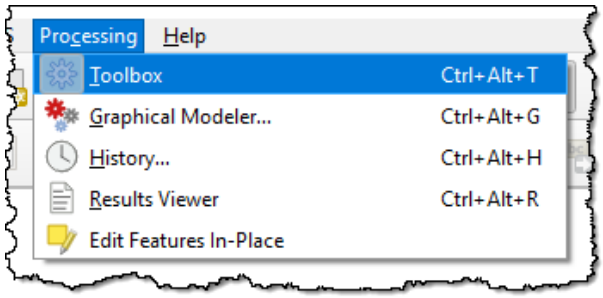


This code creates a new column in the attribute table called Weight, the entries in the table are numerical values 10, 5 or 1 depending on whether the building is in category A, B or any other value.

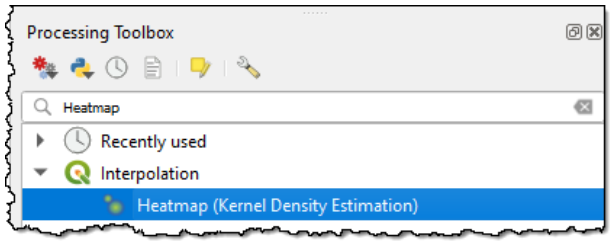
- Click OK and the column will be added to the data.
- Click on the **Save Edits** button and then the **Toggle Editing** button to turn off editing mode.

Now there is a weighting column we can create a permanent heatmap layer.

- Click on **Processing** in the top menu and select **Toolbox**.

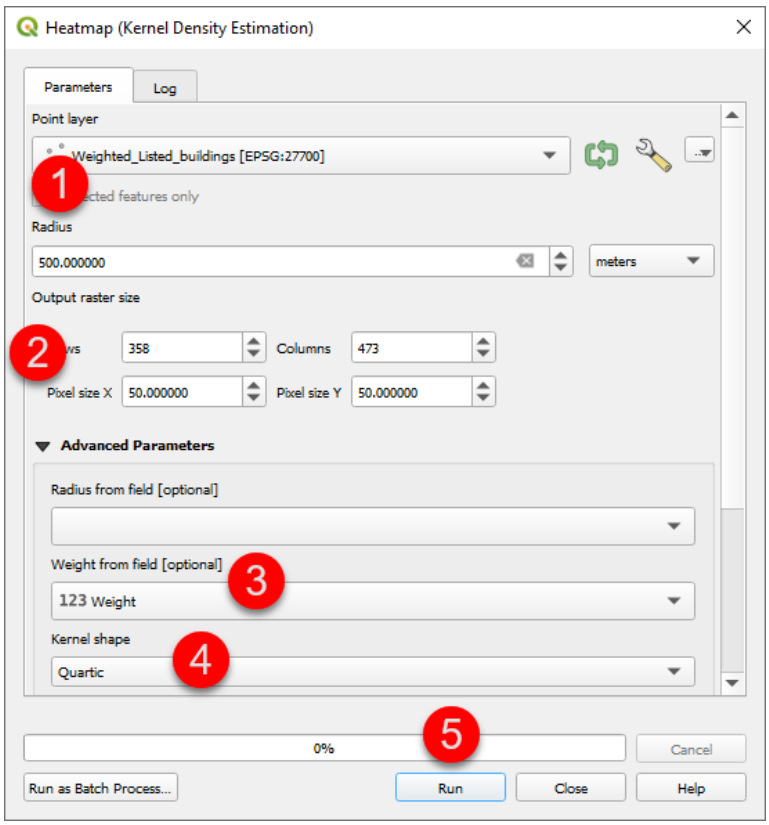


- Search and find the **Interpolation ▸ Heatmap (Kernel Density Estimation)** algorithm.



In the Heatmap (Kernel Density Estimation) dialog, we will use the same parameters as earlier.

- Select **Radius** as **500 meters**
- Set the **Pixel size X and Pixel size Y** to **50** meters.
- **Weight from field** to be **Weight**.
- Let the **Kernel shape** to the default value of **Quartic**.
- Click **Run**.

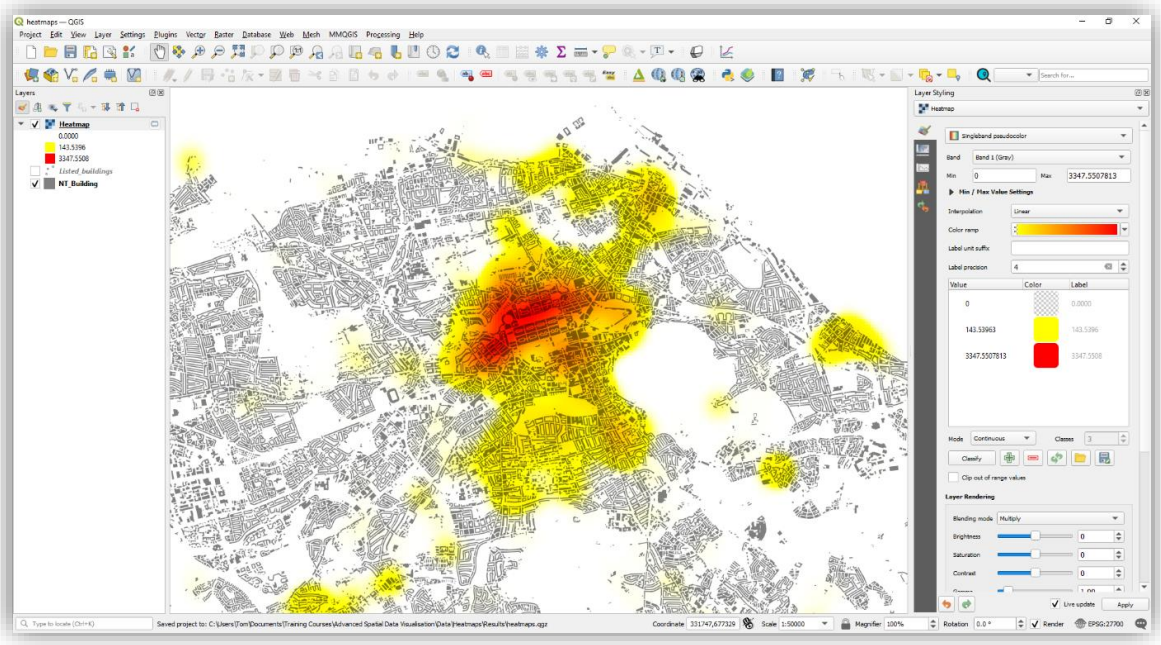


Note

The Radius from field parameter allows you to specify a dynamic search radius for each point. This can be used along with Weight from field to have fine grainer control on how each point's influence is spread.

- Once the processing finishes, a new raster layer named **Heatmap** will be loaded.
- The default visualization is uses a **Singleband gray** renderer so needs to be changed to be the same as the one we used before.
- Select the **Heatmap** layer in the **Layer Styling** panel.
- Change the render to **Singleband Pseudocolor.**
- Select the **Heat** color ramp that we saved earlier**.**

The layer now looks like the heatmap visualization that we had created earlier.



One problem with using a heatmap layer created with the Heatmap renderer is that there is no legend. If you want a legend for printing for example, then creating a Heatmap with the processing algorithm method makes this possible.

Don’t forget to save your work before we move on to the next section.

Making Choropleth Maps from Points

Sometimes in order to summarise or anonymise your data it is necessary to aggregate point data into polygons. The polygons have a count of the number of points within them that then let you visualise the data.

Start a new map and change the CRS to British National Grid again:

- Click on the bit at the bottom right of the map, where it says EPSG: xxxx
- In the filter at the top of the dialog box that opens, type 27700
- In the predefined Coordinate Reference Systems box below select British National Grid

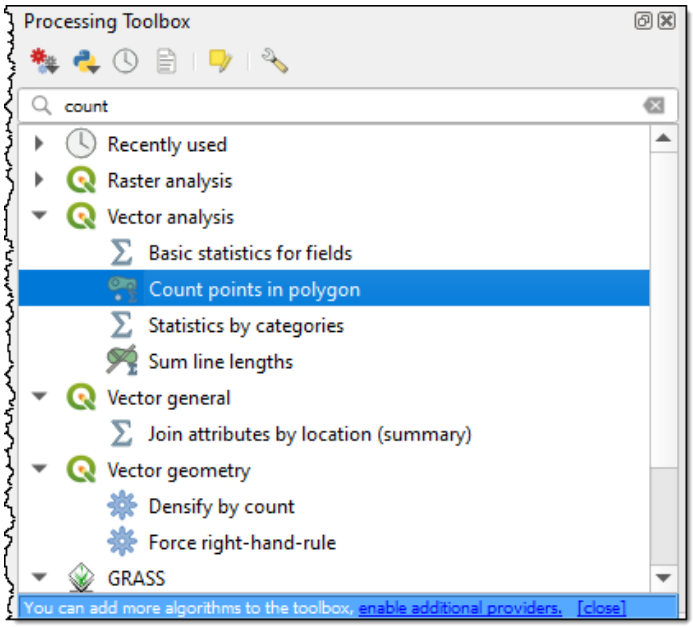
Creating a District Choropleth:

In this exercise we are going to use the GIS to count the number of listed buildings in each natural neighbourhood of Edinburgh and then style them based on the new data. Both data sets come from Edinburgh Council:

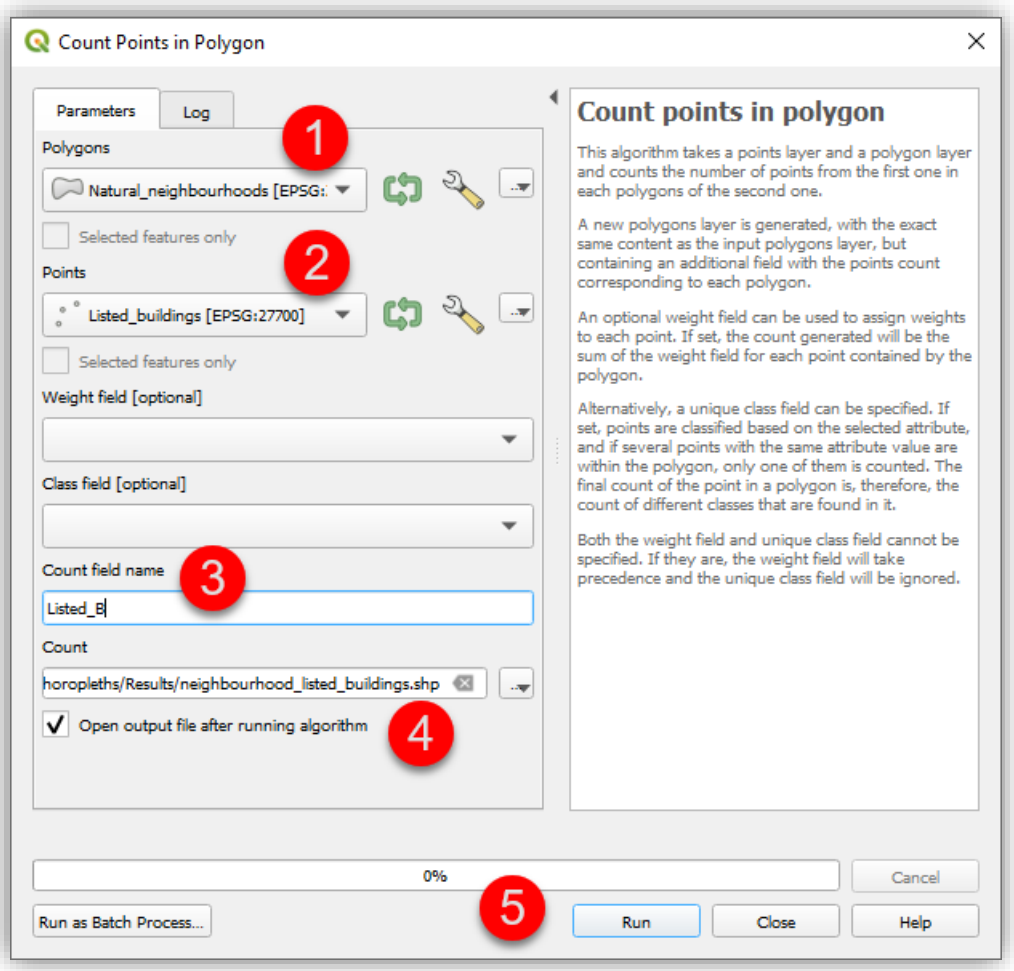
https://data.edinburghcouncilmaps.info/search

- Add the **listed_buildings.shp** dataset.
- Add the **natural_neighbourhoods.shp** dataset.

In the **Processing Toolbox**, search for **count** and select the **Count points in polygon option** from the **Vector analysis** section.



Use the following settings in the dialogue box that opens:

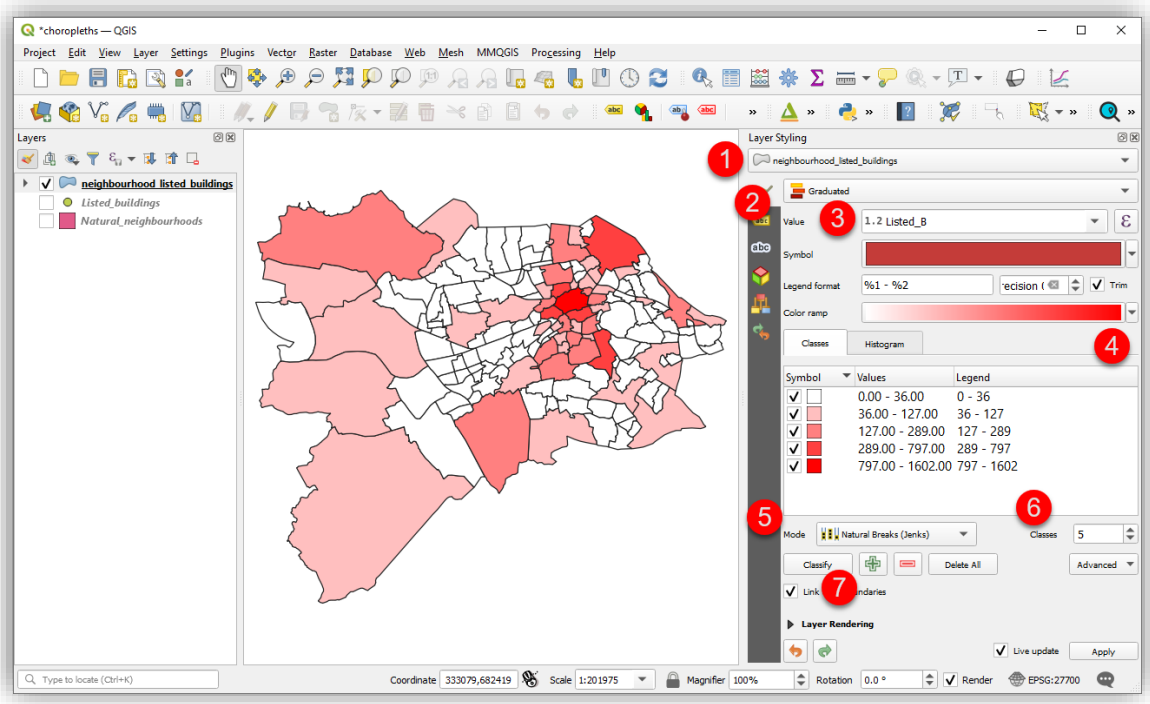


1. Set the **Polygons** to be the **natural_neighbourhoods**
2. Set the **Points** to be **listed_buildings**
3. Set the **Count field name** to be **Listed_B**
4. Save the resulting file as a shapefile called **neighbourhood_listed_buildings**
5. Click **Run**
6. Click **Close**

When you open the attribute table of this new data set you will see that the Listed_B column has been added to the table.

You can now use this column to style the data:

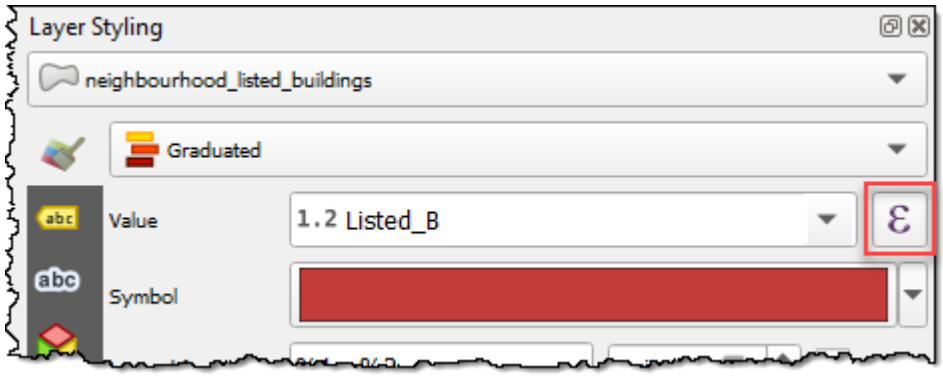
- Select the **neighbourhood_listed_buildings** layer in the **Layer Styling** panel on the right of the screen
- Change **Single symbol** to **Graduated**
- Change the **value** to be **Listed_B**
- Choose a **colour Ramp**
- Change the **Mode** to be **Natural Breaks**
- Set the number of classes to be **5**
- Click **Classify**



This map looks good, but there is something we have forgotten to do. Currently the colours represent the number of listed buildings in each neighbourhood, but it doesn't take into account the size of the neighbourhood. Is the number high because there are a lot of buildings or because the area is large?

We can easily normalise this dataset by area but you could also use the total number of buildings if you had this data to hand. To normalise the data by area we need to click on the E button next to where we set the value and set up a formula:

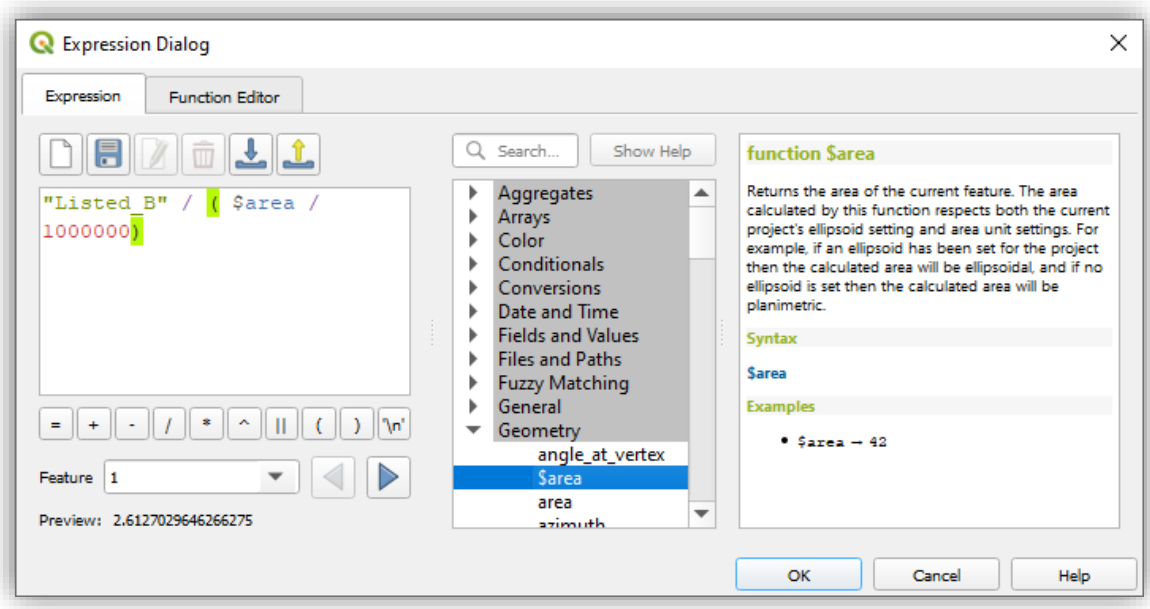
- Click on the button at the end of the Value:



- Enter this formula in the Expression dialog:

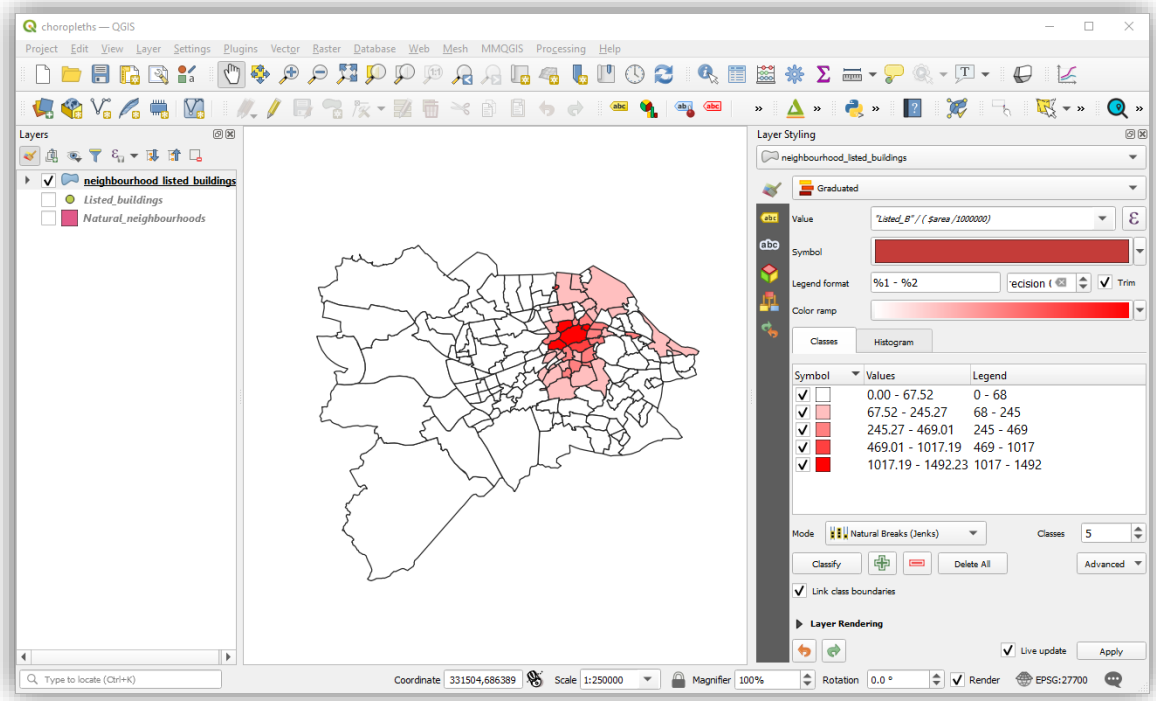
```
"Listed_B" / ($area / 1000000)
```

This converts the area into square kilometres before dividing the number of listed buildings by it. The resulting field is the number of Listed buildings per square kilometre.



- Click **Classify** again to use the new calculated value.

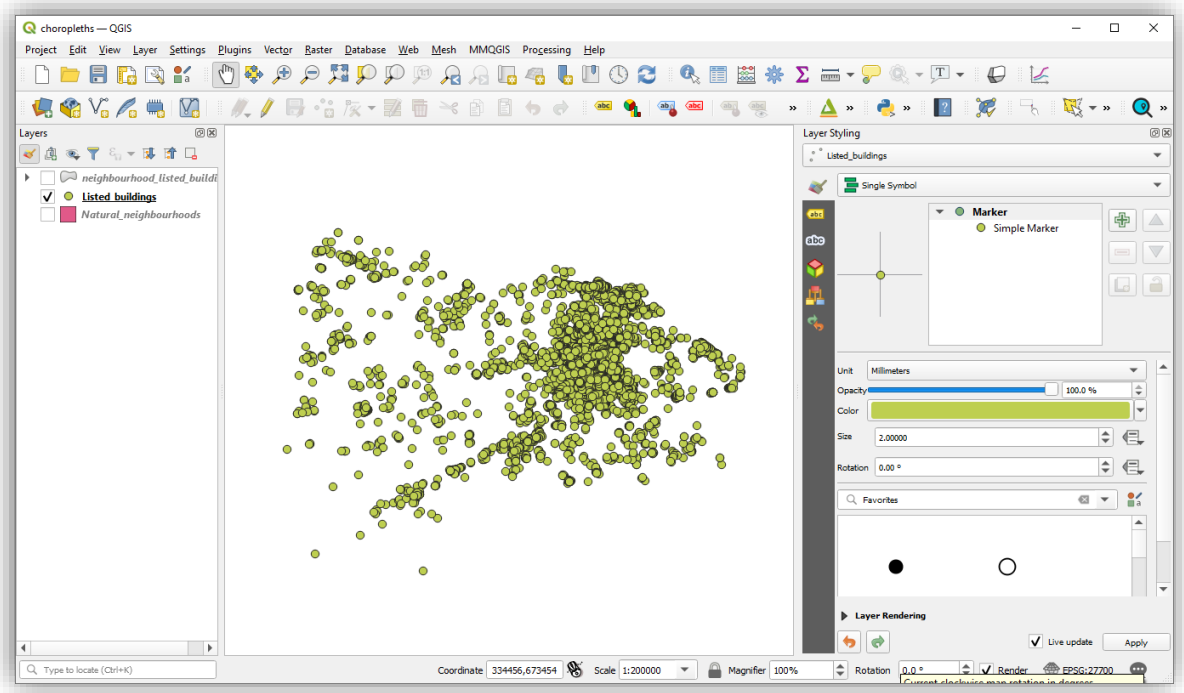
The resulting map shows an increased concentration in the centre of Edinburgh:



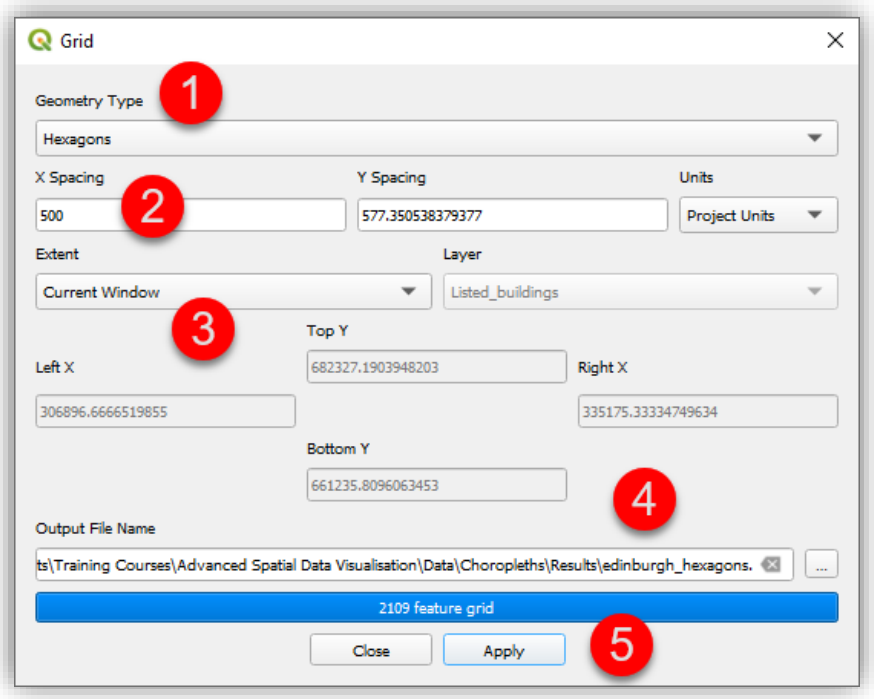
Creating a Grid Choropleth:

Similar to before we are going to count the number of points in polygons but this time rather than using the natural neighbourhoods we are going to use a regular grid we have created ourselves.

- First save the map as choropleths.qgz
- Next switch off the polygon layers just leaving the points switched on
- Right click on the Listed Buildings points layer and choose the top option of **Zoom to layer**
- The points will now all be shown on the map.
- You can zoom out just a little further by rounding up the scale at the bottom of the map



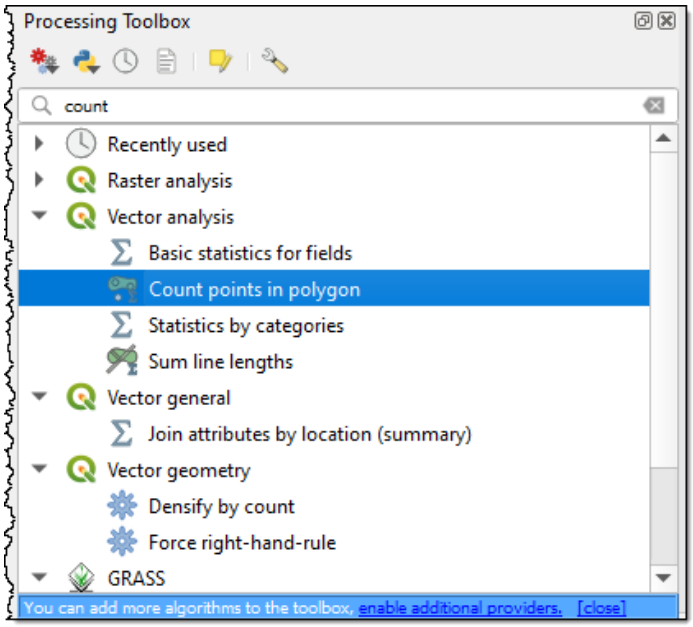
- In the top bar click on the MMQGIS button then Create → Create Grid Layer



- Change the **Geometry Type** to **Hexagons**
- Set the **X spacing** to be **500 metres** (the **Project Units**)
- Set **Output File Name** to be **Edinburgh_hexagons** and save it in a local folder
- Click **Apply**

You should now have a hexagon surface covering the map window, which we can now use like the natural neighbourhoods. As before we are going to use the gis to count the number of points in each hexagon:

In the **Processing Toolbox**, search for **count** and select the **Count points in polygon option** from the **Vector analysis** section.



Use the following settings in the dialogue box that opens:

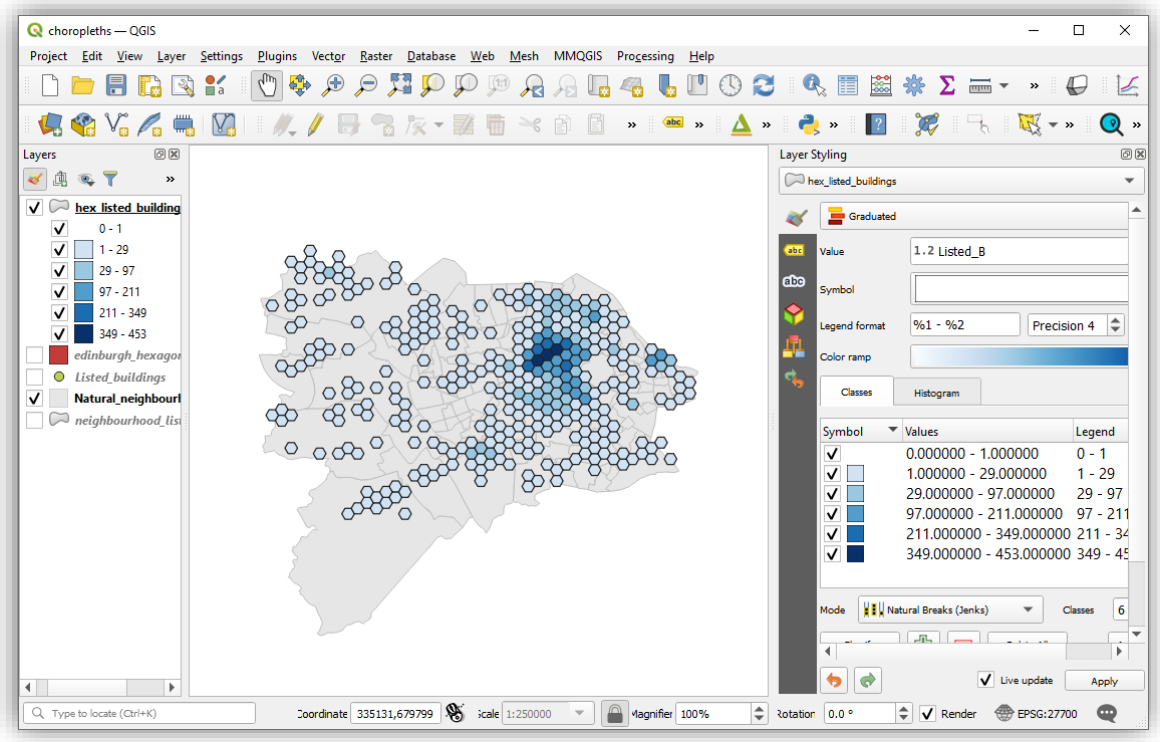
1. Set the **Polygons** to be the **edinburgh_hexagons**
2. Set the **Points** to be **listed_buildings**
3. Set the **Count field name** to be **Listed_B**
4. Use dropdown at the end of the Count row to select **Save to File.**
5. Save the resulting file as a shapefile called **hex_listed_buildings**
6. Click **Run**
7. Click **Close**

This time we can go ahead and just style the hexagons without any need to normalise by area as we have accounted for this with each hexagon being the same size.

- Select the **hex_listed_buildings** layer in the **Layer Styling** panel on the right of the screen
- Change **Single symbol** to **Graduated**

Time for you to experiment as it is the last exercise:

1. Have a look at how you can change the classifications manually.
2. See how you can make the hexagons that have no listed buildings invisible.



Thank you very much for working through this first session, we look forward to seeing you back in the second session.

Data Sources:

Natural Earth Land outlines and Populated Places:

http://www.naturalearthdata.com/downloads/

Edinburgh Listed Buildings:

https://data.edinburghcouncilmaps.info/search

Edinburgh Natural Neighbourhoods

https://data.edinburghcouncilmaps.info/search

VectorMap District Buildings

https://osdatahub.os.uk/downloads/open/VectorMapDistrict?