Using Geographical Information Systems to map flood risk

Introduction

Accurate and current floodplain maps can be the most valuable tools for avoiding severe social and economic losses from floods. Early identification of flood-prone properties during emergencies allows public safety organisations to establish and implement warning and evacuation procedures.

Insurance companies using geographical information systems (GIS) can better assess the real flood risks involved and calculate appropriate premiums accordingly. When looking at flood risk, height and the distance from the nearest body of water are among the primary factors. A detailed map gives the insurers the opportunity to “see” the location of the property in detail and make a better informed decision as to the risk that particular property affords.

You are employed as a GIS officer at Worcester County Council. You have been asked to provide an accurate assessment of the properties and businesses which are at risk of flood within the city of Worcester. This information will be provided to insurance companies to enable more accurate flood risk assessment and will also be used to develop an early flood warning scheme.

You will need to use elevation data in combination with data provided by the Environment Agency in order to visualise which areas and properties will be affected.

Step One

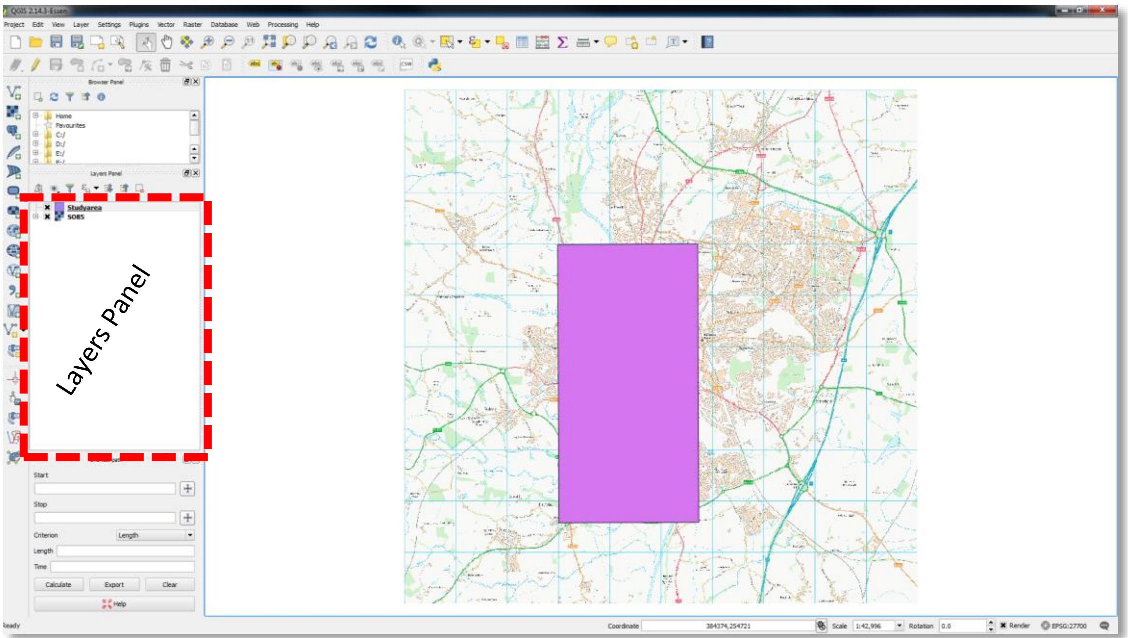
Add the backdrop mapping and study area boundary

First, click add raster layer 

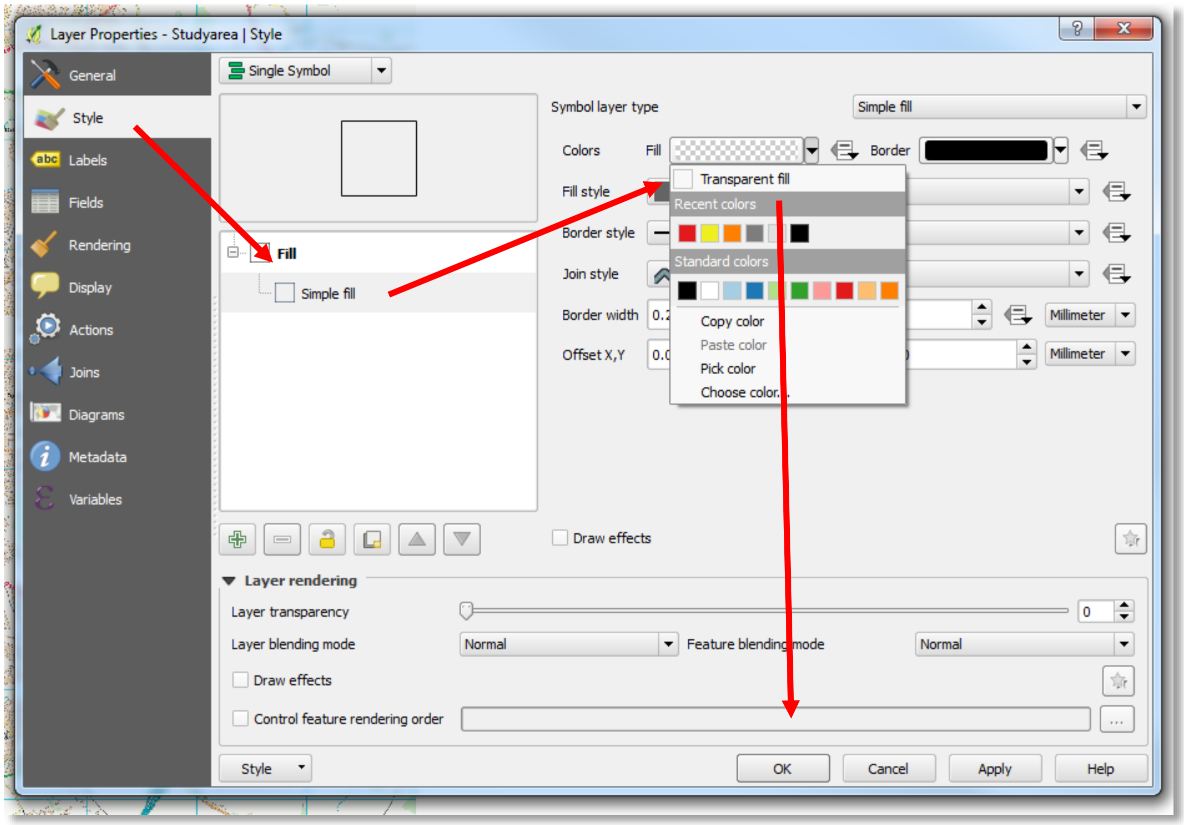
Then navigate to the project folder **Flood Practical Data (unaltered)**, and open the **Backdrop Mapping** folder. From this folder, select **SO85** (TIF file) and click Open. An Ordnance Survey district map at 1:25000 scale will appear, centred on Worcester.

Next, click add vector layer 

In the next window, click *Browse*, and navigate again to the project folder, this time opening the **Study Area** folder. Select the file **Studyarea.shp**, click OK then Open. Your map should now look something like this:



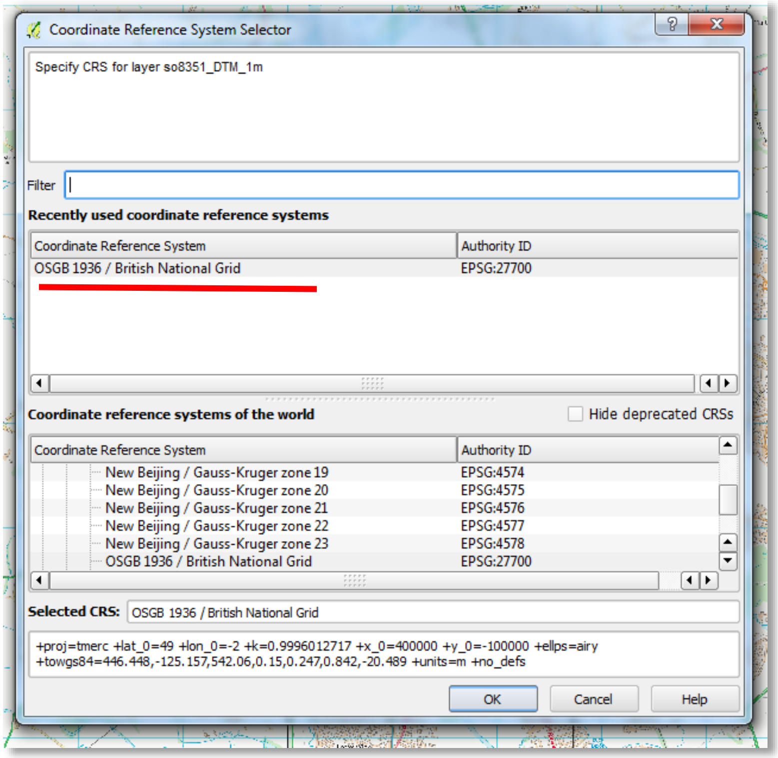
To change the colour of the box, double-click on **Studyarea** in the Layers Panel, shown above in the red box. Open the *Style* tab (see below), then click *Simple fill > colour > Transparent fill > OK*. You will then be able to see that the study area is the stretch of the River Severn that passes through the middle of Worcester.



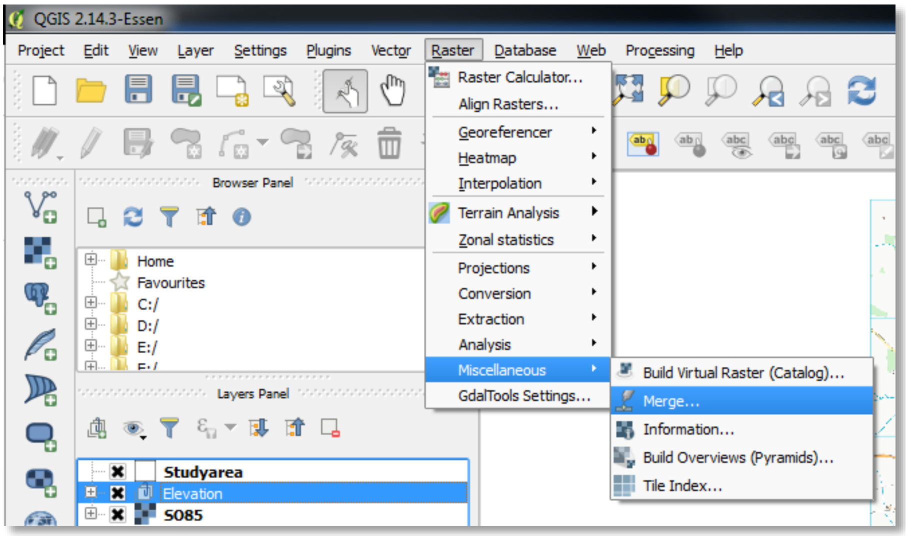
Step 2

Add and merge the elevation data

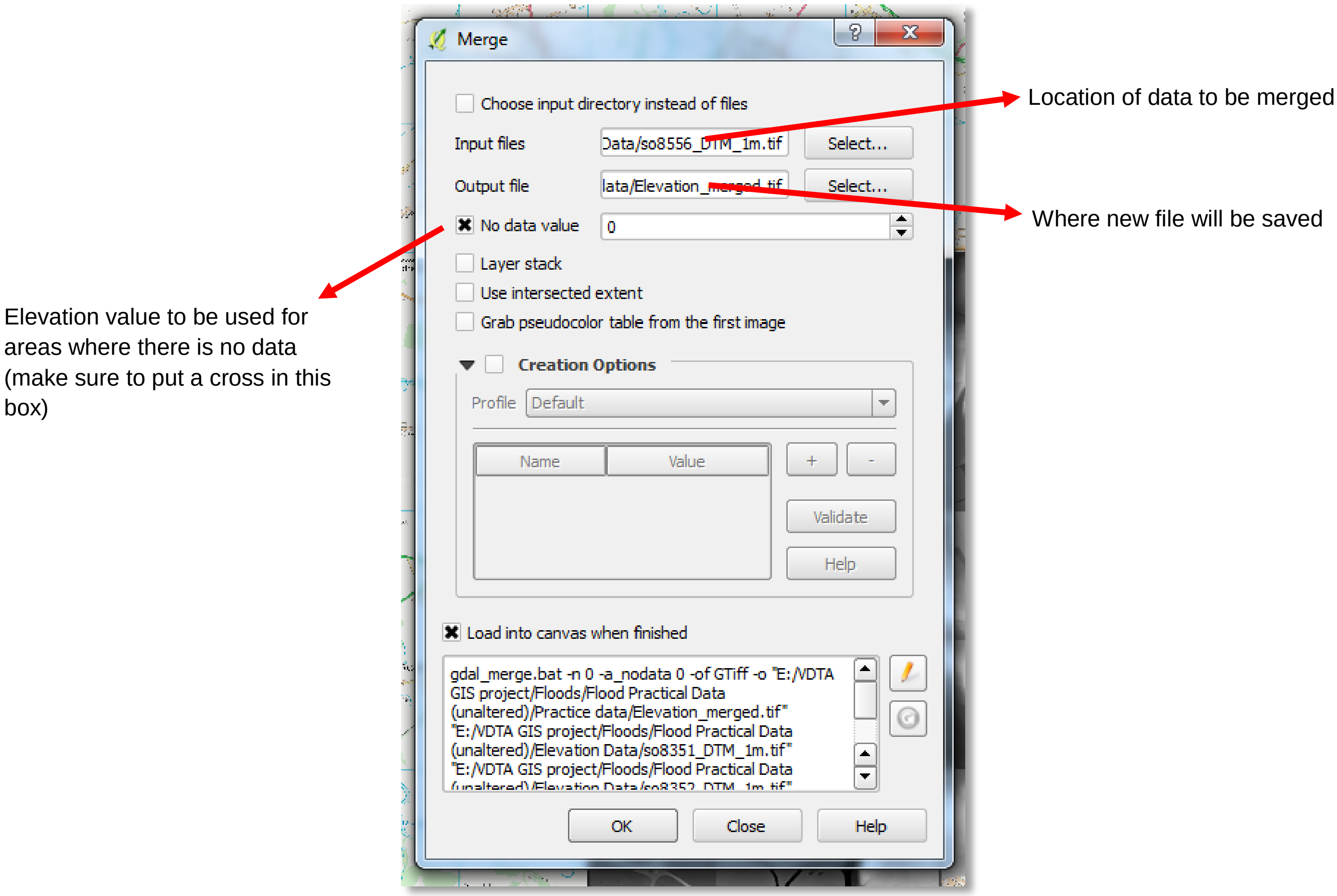
Click on add raster layer again. Find the folder named **Elevation Data**, and select all of the files there. Click Open, and a dialogue box will appear titled *Coordinate Reference System Selector*. The British National Grid should already be applied to all of the data for the practical, so you don't need to do anything now. Click OK, then repeat for all of the files that are opening. As you do so they will appear on the map.



Once all of the elevation data tiles are visible, they can be merged into one layer to avoid having to apply the same tools over and over again. Find the *Merge* tool under the *Raster* > *Miscellaneous* tab.

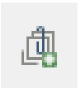


This will open a new window, in which you will need to specify the data to be merged and where the new layer will be saved. It should look like this:



Click OK and wait for the tool to run. Once complete, there will be several dialogue boxes which can be OK'd, and a new smooth version of the elevation data will be on the map.

****If an error message appears saying that the function crashed, click OK and close the tool. Click add raster layer and open folder where output was saved, and open the output file anyway****

Now is a good time to tidy and organise the layers panel by clicking the *New Group* button  located just above the layers panel. Name the new group *Elevation Data*, then click and drag all of the original tiles over the name of the group to add them (this can be done all at once by clicking the first tile, holding shift then clicking the last tile, or by holding Ctrl and clicking them one by one).

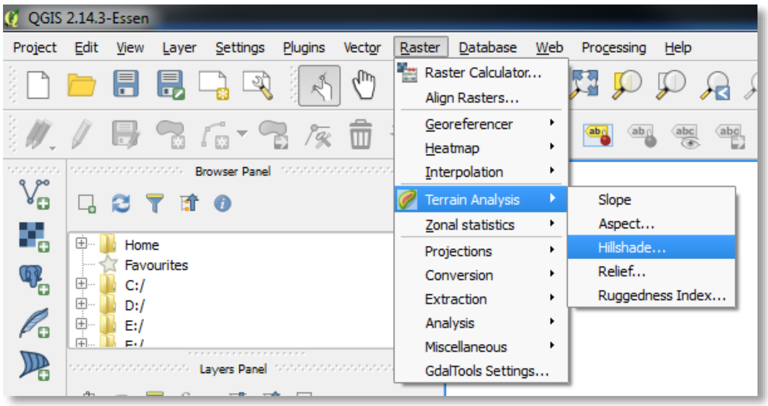
Step 3

Create a hillshade map

At the moment, the elevation data are displayed in black and white, and you should be able to pick out features like the river, and maybe the railway bridge.

Adding a hillshade can bring out the details and make the overall appearance more interesting.

Click the *Ratser* tab again, this time choose *Terrain Analysis > Hillshade*



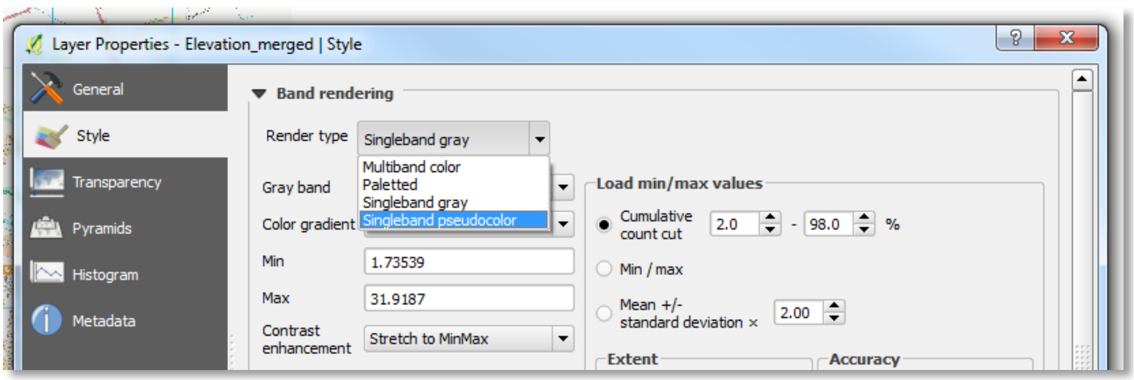
In the window that opens, choose the layer that was just created as an input file, then choose where to save the hillshade and what its name will be, just like with the Merge tool. You can leave the other options unaltered for now.

(FYI – the azimuth is the compass angle from which the data are illuminated, and the vertical angle is how near to the horizon the illumination source is – essentially, these two options let you chose the location of the sun in the sky).

Click OK and the hillshade will appear on the map. Arrange the layers panel so that the hillshade is just below the elevation data. Doing this then adjusting the transparency of the elevation layer will give the map a three-dimensional feel.

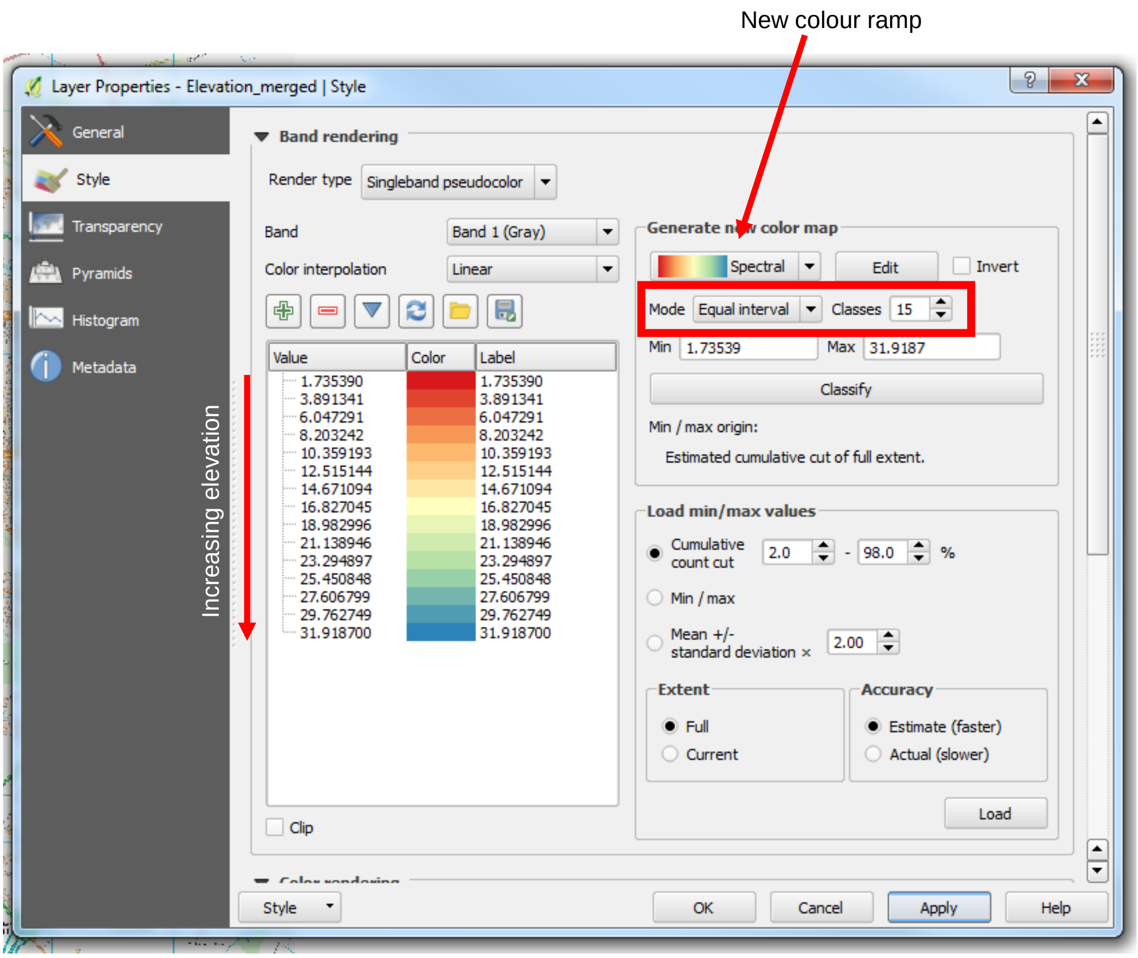
Double click on the elevation layer in the layers panel (or right click on it and select *Properties*).

The transparency can be changed by going to the Transparency tab and moving the slider (around 40% works well). The display can be customised further by opening the *Style* tab. Select *Singleband Pseudocolour* from the *Render type* drop down menu (see below).



Change the *Mode* to *Equal interval* and change the number of classes (15 shows the right amount of detail). Click *Classify*. The value column shows the maximum elevation which will be displayed in a particular colour – *i.e.* all data between the given value and the value beneath it will be of one colour.

The colours can be changed by choosing a new colour ramp, or by individually clicking each one.



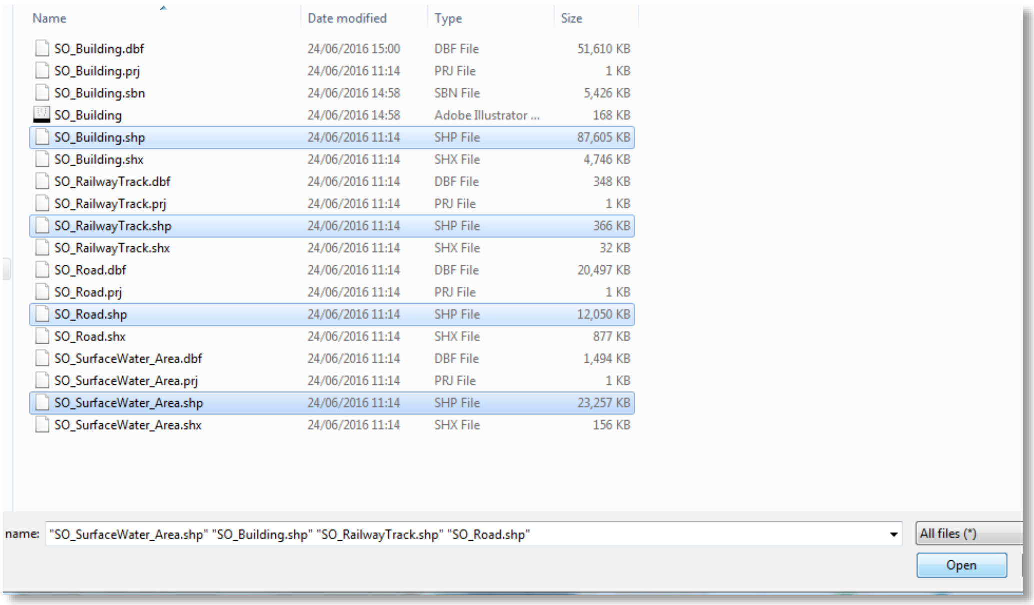
Features on the map should now be much easier to identify, such as the racecourse, the railway, and some roads and roundabouts (try zooming in a little if the map appears blurred).

Step 4

Adding map details (vector data)

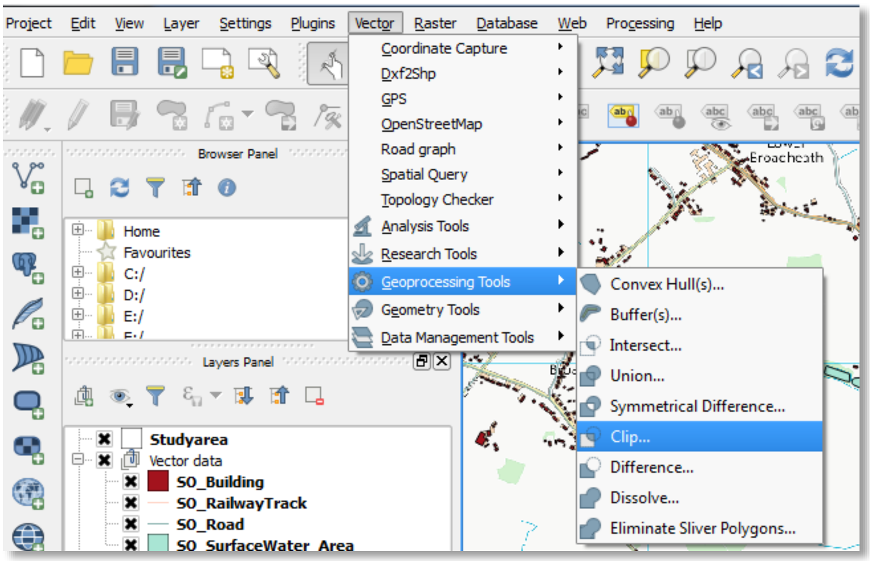
Already it should be clear that the areas with a colour similar to the river will be more likely to flood. We can see which roads and buildings might be affected by adding them to the map.

Use the *Add vector layer* button again, and this time open the **OS Vector Data** folder, then the subfolder. Within this folder, use Ctrl+click to select **SO_building.shp, SO_RailwayTrack.shp, SO_Road.shp, SO_SurfaceWater_Area.shp.**

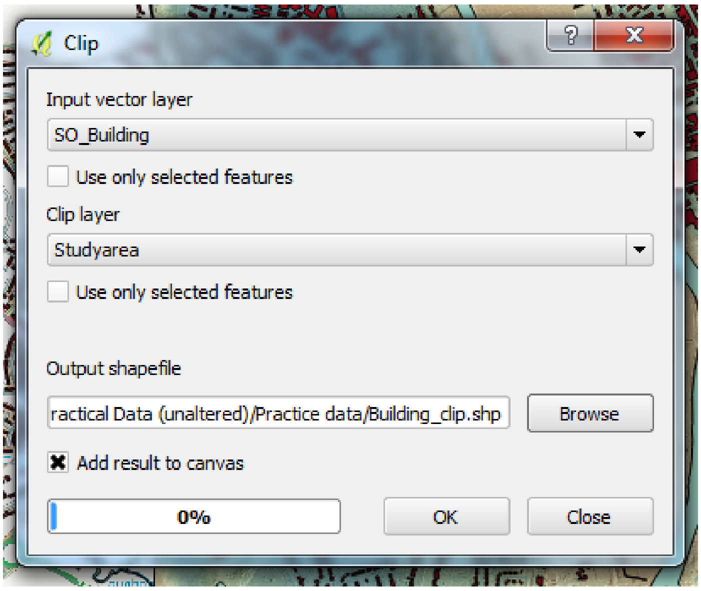


Open these files. You will see that the data cover more than just the study area – they contain information for the entire Ordnance Survey SO map square, but we are only interested in what is inside the study area. Using the Clip tool allows only the data with a certain area to be shown and extraneous data to be removed.

Under the *Vector* tab, select *Geoprocessing tools* > *Clip*.



In the new window (see below), set the *Input vector layer* to one of the layers that was just imported, such as **SO_Building**. The *Clip layer* is the layer to which the data will be clipped, so select the **Studyarea**. Under *Output shapefile* set the location and name of the clipped file, then click OK.



Wait for the tool to finish. The window will stay open, so you can just select the next layer to clip from the *Input vector layer* drop-down list. Make sure that **Studyarea** is still in the *Clip layer* box, set the new file name and location and click OK again.

Repeat this for the remaining two layers.

You should then be able to turn off the original vector data in the layers panel, and still see the new shapefiles on the map in the study area. You can then alter the colours of each feature to something more resembling the original OS map, or whatever else you choose.

This is another good opportunity to organise the layers panel into groups.

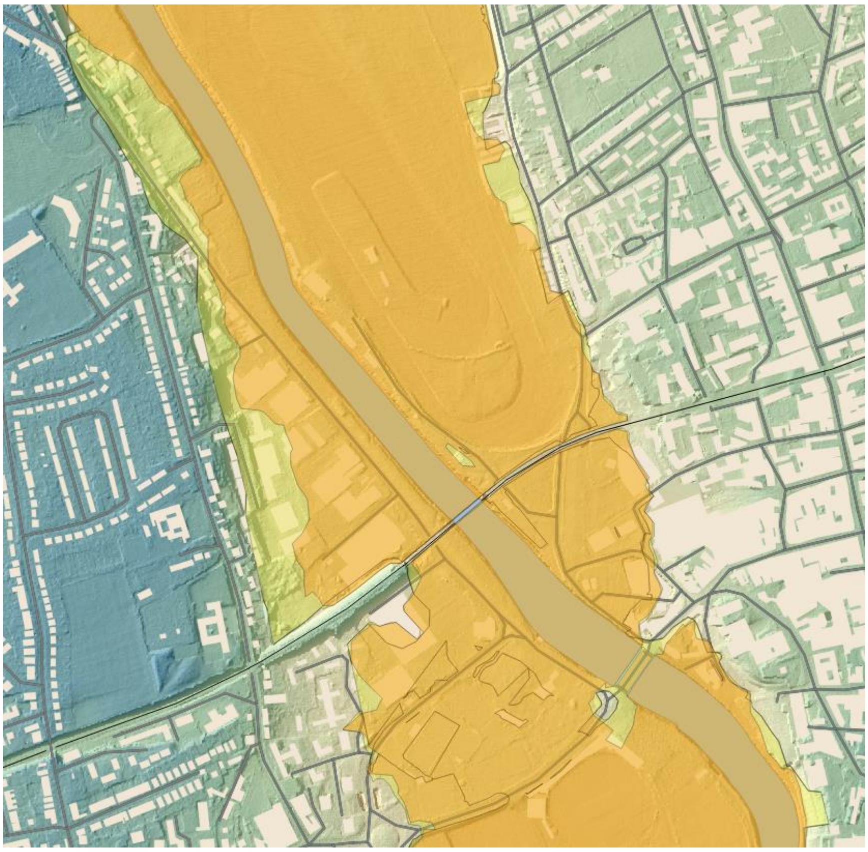
Look again at the areas around the river, and you will be able to see which buildings you think are likely to be prone to flooding.

Step 5

Comparing your inspections with Environment Agency flood risk data

Follow the previous steps taken to add the vector data, however this time open the data from the **Flood Risk Zone** folder, selecting **nat_floodzone2_v201602.shp** and **nat_floodzone3_v201602.shp**.

Use the same process to clip these new layers to the study area as well, and then alter their transparency so you can see the buildings beneath them (around 50%).



You will now be able to see if the areas that have a 1 in 100 (zone 3) or 1 in 1000 (zone 2) chance of flooding each year match with your predictions.

The final layer that is added is the **Flood defences** file **nat_defences_v201602.shp**. This layer shows the location of various kinds of flood defence. Add it to the map and change the colour so it can be seen easily.

Think about which areas are not defended, and why this might be.